MORBID ANATOMY OF SHIPS.

A NOT inconsiderable proportion of the cases which come under the consideration of the Wreck Commissioner's Court consists of total losses of ships which disappear mysteriously, so that no particulars regarding the cause of loss are ever determined. Casualties of this description admit of as many explanations as those accounting for the losses at sea which occur under the observation of men who survive to describe them. Collisions, in which both vessels are lost with all hands, are doubtless a frequent cause of unexplained maritime disasters; and so are fires, capsizings, strandings, explosions of cargo, and sudden leakages. Each and all of these are known to be casualties of frequent occurrence, and evidence regarding them is tendered every week at Courts of Inquiry. That similar accidents should occur at times under circumstances precluding such evidence seems, therefore, to be a melancholy certainty.

Now, of these possible causes of mysterious disappearance, there are some which appear to be inevitably associated with traffic upon the seas, so that no manner of human forethought and prudence can prevail against them. Storms are ever contingencies of this kind, and however strongly a ship be built and equipped, it yet seems impossible to provide against all the dangers involved in a violent storm at sea. For, although ships commonly do weather the most furious gale when they have plenty of sea room, yet now and again a combination of circumstances occurs such as will prove fatal to the best work of men's hands. Fogs and snow-storms are prolific sources of disaster by collision, and it is difficult to see how such risks can be wholly removed from the long list of those to which a ship is exposed. Scientifically calculated proportions and judicious stowage will doubtless minimise the danger of capsizing; careful selection of coal and keeping it dry will go far to avert explosions at sea; fires may be prevented by taking prudent precautions, and strandings avoided by watchful navigation. But, when all has been done which is humanly possible, casualties at sea will still continue to occur, and some of these will be of the class usually described as "totally lost and never heard of."

It is not our purpose to discuss the many causes of loss at sea to which reference has been made; but rather to consider another source of casualty which it is to be feared has not hitherto received the attention which is demanded by the frequency of its occurrence. Everyone knows that ships built of wood are very liable to "spring a leak;" and many suppose that, because this is the case, a similar misfortune might as reasonably befall an iron or steel ship. That vessels built of iron and steel do occasionally spring a leak is only too true, but the circumstances which lead to such a defect are totally distinct from those which lead to leakage in a wood ship. The leakage in the latter might be due to decay in the caulking, or to starting a butt by straining; but neither of these causes should be looked to in order to explain leakage in an iron or steel ship. The caulking of the latter should rather be improved by the corrosion which increases with the vessel's age; while if she is strained at all so as to admit water, then something more serious than a leak might be expected to result. So rigidly are the parts of an iron or steel ship united to each other that no water can be admitted into her by straining without rivets being sheared or plates torn, and if either of these events occurred the foundering of the vessel would soon follow. It is not alleged that casualties of this kind have never occurred, for unfortunately the contrary is the case; but such a disaster can in no wise be attributed to the effects of age, wear and tear, such as will sometimes account for the destruction of a wood ship's fastenings. When an iron or steel ship founders through straining the loss is due either to weak construction or bad workmanship. As a general rule, then, whenever such a ship is reported to be leaky, it may be averred that straining is not the cause; for when straining produces a leak it produces a fracture also, and a fracture will in most cases result in total loss. In saying this it is not implied that an iron or steel ship is never submitted to undue stresses, or as to be, technically, strained. Butts of plating do, no doubt, at times show indications of movement when examined in a graving dock, and such movement may occasionally be due to undue tensile stresses; although in most cases they result simply from local flexibility. But to suppose that water has ever passed through such butts into the vessel without the cement on the inside of the plating being disturbed is, of course, wholly out of the question.

Despite these common-sense necessities of the case, it is not unusual to come across reports of iron and steel vessels—especially steamers—having suddenly sprung a leak and been therefore abandoned by their crews. In such cases it has been often assumed that the loss was due to straining, whereby a butt or other joint was opened in the bottom plating, and this, too, under circumstances such as the lost vessel and others similar to her had previously encountered successfully. Now, whatever may be the real causes of these disasters, there can be no doubt that they are at the root of a large proportion of those casualties regarding which no evidence is attainable in consequence of the loss of all on board. No better means can be afforded for the solution of this problem than the frequent examination of iron and steel vessels when in graving dock. Some of the phenomena witnessed upon such occasions are painfully suggestive of the causes of many losses at sea which are never heard of. The particulars of two or three of these, without mentioning the name of ship, locality or date of incident, will perhaps be of interest and profit in the consideration of this important subject. The first case is that of a new iron ship which arrived in a home port, after a voyage of about three or four months' duration, in a very leaky condition, so that she had to be kept afloat with steam pumps, while her cargo of raw sugar was being discharged. Subsequent examination showed that inferior cement, largely adultered with ashes, had been cut up by rivets, bolts, and pieces of wood rolling about in the limbers on the outward passage of the vessel, and that on her homeward passage the fermented drainage of the "green sugar" had dissolved her plating throughout its entire thickness in many places, while the thickness was considerably reduced elsewhere. Had the homeward passage of this vessel been of much longer duration, it would have been impossible to keep her afloat, and had the sea in that case been too stormy for the crew to escape in boats, it is very doubtful if the real cause of the disaster would have been suspected by anybody, while it is equally probable that an inquiry in the wreck courts would have resulted in the decision that she was overladen or unstable. The case just quoted is, of course, an unusual one, although it is worth remarking that a sister ship by the same builder, and engaged in the same trade, was, within an interval of a few weeks, found to be in a similar condition. From this it may be inferred that, given inferior cement, hard substances rolling between the frames, and a sugar cargo containing molasses, the durability of the bottom plating of an iron or steel ship may be measured in weeks and days. Indeed, it is doubtful whether even the hard substances lying loosely between the frames are essential conditions for bringing about maritime disasters in this way, for inferior cement will ultimately wear away by the mere motion of the bilge water, and this inevitable wear is only hastened by hard substances rolling upon it. If ship masters made a rule of always carefully lifting ceiling hatches of iron and steel ships, and examining the condition of the cement before loading a sugar, or indeed any cargo in a foreign port, the risk due to this species of casualty would be much reduced. In this country an annual examination of the cement is generally insisted upon by Lloyds' Surveyors; but during the time that an iron or steel sailing ship is usually absent from the United Kingdom or a European port, a great deal of mischief may take place below the close ceiling without the same being suspected by those on board. Cases sometimes occur in which a rivet, nut, or small bolt continually rolling from side to side in a frame space has been found to have not only cut through the cement but also to have scored a deep groove in the garboards; while instances in which the rivet heads in butt straps and plate laps have been wholly or nearly worn away are not at all uncommon. When one comes across a phenomenon of this kind the importance of punching plates from their meeting surfaces becomes clearly apparent, for only the slightly increased diameter of the rivet on the inside of the ship prevents it from falling out when the head is worn away.

But sugar is not the only corroding cargo carried in iron and steel ships, and loose rivets and nuts are not the only foreign substances which are known to cut up the cement between the frames. This will be seen by considering a second illustrative case, which is that of an iron steamer employed for many years in the coasting coal trade, with only one voyage to Spain for copper pyrites, made rather less than a year previous to the date of the examination, to which reference will now be made. The steamer in question suddenly "sprung a leak," so her master said, and was placed in graving dock in order to discover the nature of the damage which it was alleged had been sustained by straining at sea. When the dock was dry it was found that water was flowing out of a small hole in the bottom plating, and upon lifting the ceiling in way of the same the cause of the leakage was at once revealed. The ceiling had been allowed to decay in places, so that portions of the copper pyrites, which once formed her cargo, had fallen through upon the cement. The rolling motion of the steamer had caused the pyrites to wear away the cement until sulphide of copper, immersed in bilge water, rested upon the vessel's iron plating. Under such conditions as these it inevitably happened that the sulphur left the copper and attacked the iron, forming a red pasty substance, which was quickly washed aside by the rolling bilge water, leaving a clean surface of iron for further attack. In this way the bottom plating of the steamer, in both cargo holds, was worn in deep pits, of which happily only one extended through the plate. If this vessel had, however, been making a somewhat longer voyage, so as to admit of many holes being corroded through the plating, then abandonment would have been necessary, and in that case the survivors would doubtless have persisted in asserting that she really "sprang a leak by straining." If the crew had taken to the boats, and the latter had been swamped, so that no one survived, this would have been another of the missing ship mysteries, which are explained in the Wreck Courts as being due to well decks, overlading, or an inflammable coal cargo.

In the case just considered the leakage was clearly traceable to two acts of neglect, viz., that of the ceiling, in the first instance, by not keeping it in proper repair; and that of the cement, in the second place, by not submitting it to as frequent an examination as is possible. But are not both these very common subjects of negligence? Do not shipowners often grumble at being called upon to repair and renew ceiling, urging that no structural strength is contributed by it, and forgetting how essential is perfectly close ceiling, from bilge to bilge, to the safety of a ship? Do not shipmasters often place stiffening under the main hatchway, when a part of the cargo is out, without allowing themselves time to look at the cement, and urge as an excuse that "the cement was looked to out of the country?"

Portland cement has often been described as the very life of an iron or steel ship, and considering that, as a rule, the tendency to wear and tear from corrosion is much greater on the inside than on the outside of their plating, the substance in question is fairly deserving of the confidence reposed in it. If the cement is good and well looked after, the inside surface of the plating from bilge to bilge can suffer no injury whatever from the usual acid water lying in the limbers. Ships have been known to "float upon their cement," one case in particular being that of an old passenger steamer, which when examined in graving dock by striking the bottom with a hammer, yielded so dead a sound at one place, that a closer inspection was made, revealing the unlooked for fact that cement and not iron was being struck. The bottom plating was, indeed, wholly wasted by corrosion at the place which was struck, but so hard was the cement that only by many and vigorous blows was it broken. But cement was cement in those days, and not the adulterated mixture one sometimes comes across in this degenerate age. Moreover, sharp, fresh-water sand was used in mixing such cement as that, and not the dirty saline substitute now too commonly employed.

A careful and frequent study of what Mr. W. Denny, of Dumbarton, has very aptly styled "the morbid anatomy of naval architecture," will reveal some very important truths in connection with the construction and upkeep of ships. The necessity of using good and properly mixed cement is one of these, and the importance of keeping the ceiling in good condition is another. Both of these have been illustrated by what has already been said. But it is equally important to preserve perfect and easy accessibility to all the parts of an iron or steel ship, so as to make it not only possible to examine them, but also to render it probable that they will be examined throughout. It is to be feared that the disagreeable task of crawling through the slimy deposit in the bottom of a cellular ballast tank space is calculated to lessen the probability of a frequent and careful examination of such parts being made; but as there are two bottoms to such ships, and as part of the cargo can get into the cellular bottom, the risk is not a great one. The wear and tear by corrosion in the machinery space of steamers would be much greater than is usually the case, were it not for the quantity of grease which is always present and found adhering to floors, reverse frames, engine seatings, &c. Below the boilers, especially when the latter are leaky, corrosion goes on at a very rapid rate, but it rarely extends beyond the boiler bearers, keelsons, reverse frames, and floors. This is, however, wholly due to the presence of cement, and the rapidity with which the other parts in the vicinity are wasted affords an additional reason for making frequent examinations beneath the boilers and stoke-hold floor plates, especially in the neighbourhood of copper pipes. The average durability of a marine boiler is fully as great as that of the bearers and frame beneath it, so that whenever a steamer's boilers are renewed it invariably happens that heavy repairs are required to that part of the hull which is inaccessible when the boilers are in place.

From the foregoing it will appear that among the losses at sea which are not distinctly accounted for, many are, doubtless, due to other causes than those which are commonly assigned. It will further appear that in many such cases the casualties could have been avoided by using good cement in the first instance, and by making frequent examinations of the cement afterwards.

THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

By W. H. Wheeler, M. Inst. C.E.

No. IV.

Cost of Pumping Stations.

The cost of erecting a pumping station depends upon so many circumstances peculiar to the locality that no definite figures can be given. Generally the cost may be taken for buildings and machinery at from £70 to £80 per horse-power of water lifted. Allowing for an annual average rainfall of from 25in. to 30in., 1-horse power would drain about 150 acres with a lift of 5ft., making the cost per acre about 10s. The main elements to be taken into consideration are the quantity of water to be lifted—depending principally on the rainfall and the area drained, the height the water has to be lifted, and the nature of the foundations required. Frequently a much greater quantity of water has to be lifted than that due to rainfall from the soakage from other districts through badly constructed banks. If the district is small the proportionate cost would be greater, but an increase in lift would be less in proportion, as adding little to the cost of buildings and general arrangements. The cost of erecting the Lade Bank engines in Lincolnshire, in 1868, was £17,000; the area of land drained, 35,000 acres. The pumps were calculated to raise 700 tons of water 5ft. high per minute, equal to £71·75 per horse-power of water lifted. The cost of the two stations at the Wexford Harbour Reclamation Works was £91·10 for buildings and machinery at the north station, where the pump was erected—being £37 for machinery and £54 10s. for buildings; and £40 per horse-power for the scoop wheel and engine—the cost of the buildings not being given in this station. The cost of an iron scoop wheel with curved blades and horizontal engine, erected by Messrs. Appleby, for the drainage of the Upwell district, in Norfolk, was £2400—equal to £65·38 per horse-power of water lifted for the machinery, and £27 for the buildings—together, £92·38. Centrifugal pumps, driven by semi-portable engines, housed in wooden buildings, have been erected in the Fen districts at from £70 to £80 per horse-power of water lifted. In Holland the cost of erecting pumping machinery for horse-powers varying from 14 up to 500 during recent years has averaged £92 per effective horse-power[2] for scoop wheels, the amounts varying from £58 for the largest machines to £106 for the smallest. The buildings have cost £46·1 per horse-power, and the machines £46·3. For centrifugal pumps the cost has been £36·8 for machinery, and £34·2 for building—together, £71. The variation in cost for pumps has not been so great between the larger and smaller machines as that for wheels. The cost of erecting screw-pumps is given at from £76 to £100 for buildings and machinery—the average being about £94 per effective horse-power, the power varying from 120 to 130-horse power.

The annual cost of maintaining a pumping station varies with the accessibility of the locality as affecting the

[2] Abstract of report of M. G. Cuppari, "On Pumping Engines in Holland." Trans. : Instit. Civil Engineers, Vol. lxxv.

price of coals, the efficiency of the machinery, and the skill and care of the engine-man. From statistics prepared by the author as to the cost of maintaining pumping stations in the Fen land, the average cost for the three years 1881-2-3, which were very wet, and during which several floods occurred, was 16·25d. per acre throughout the level, or 1·86d. per acre per foot of lift, of which 1·47d. was for coals only. Taking the larger districts, in which from the engines being of a better character the proportionate consumption is less, the cost for coals only was found to be about 1d. per acre per foot of lift. These amounts were obtained as the result of the figures given by eleven different stations, draining about 120,000 acres of land, with lifts varying from 6ft. to 14ft., the cost of coals being about 16s. per ton delivered.[3] During the same period, the cost of working the large engines and scoop wheels at Podehole for draining Deeping Fen was 10·58d. per acre, of which 7·56d. was for coals. Taking the average lift of the water at 5ft., this gives 1·51d. per acre per foot of lift for coals.

The average working charges of the engines and centrifugal pumps at Lade Bank for draining the East Fen for the same period—1881-83—was £1089, equal to 7·46d. per acre. The average rainfall was 30·27in. a year. Taking the average lift at 4ft., this is equal to 1·86d. per acre per foot of lift. The cost of coals at this station would probably be about 14s. per ton. For the years 1871-72, in which the average rainfall was 28·25in., but was not so continuous nor the floods so high, the cost was only £532, equal to 3·63d. per acre; the average lift being taken for that season at 3ft. 9in.; this gives rather under 1d. per acre per foot of lift.

At the Wexford Harbour reclamation pumping station for the years 1881-83 the average rainfall was 40·34in., the average lift 5ft. 6in., coals 18s. per ton, the cost was 26·3d. per acre for coals for the scoop wheel, and 18·65d. for the centrifugal pump, respectively 4·76d. and 3·38d. per acre per foot of lift.

ENGINE DRAINS.

In designing pumping machinery for draining land, care must be taken that the power supplied is adequate to the work to be done. This will depend on the amount of rainfall in the particular district, and the proportion of it that has to be lifted in wet seasons. As every ton of water lifted represents the money value of the coals consumed in effecting this, it is obviously desirable that all high land water that can drain off by gravitation should be excluded from the drainage district by catchwater drains and banks. The pumping machinery should be adequate to the maximum rainfall of wet years, as it is at such times, when the outfall stream is full, that the benefit will be most felt. In winter the loss by evaporation and absorption by vegetation in wet weather amounts to scarcely any perceptible quantity; there remains then only the natural soakage into the ground, and when the outfall streams are perhaps nearly bank-full and nearly all the surrounding land saturated, there can be very little reduction to be made from the rainfall from this cause.

In the fen districts of Lincolnshire the average rainfall of recent wet years has been 32·39in., of which 17·52in. was due to the six winter months, September to February, which, spread over this period, gives an average daily rainfall of ·091. Taking the periods of excessive rain which occurred during the same time, extending over periods of from six to thirty successive days, the greatest average fall per day has been 0·40in. for fourteen days on one occasion only, the next highest being 0·29 for six days, both of which occurred in the same year, 1883. The average fall was 0·23in., each extending over sixteen days.

The quantity which was allowed for by the old fen engineers was the water arising from a continuous rainfall of a quarter of an inch of rain in twenty-four hours, making no deductions for soakage or evaporation. This calculation was also adopted by Sir John Hawkshaw for the engines erected for the drainage of the East Fen, and by Sir John Coode as the maximum quantity to be lifted by the engines proposed to be erected for the drainage of the North Level. A large fall of rain at any particular period does not necessarily produce a flood in flat districts. When rainfall succeeds a season of dry weather, it takes some time to saturate the land; and owing to the large capacity of the arterial drains, their small declivity, and the level character of the land, it occupies some time before these become fully charged. On the other hand, if rain falls after a continuance of wet weather, the land, together with the drains and already charged, and any exceptionally heavy rain, although even for a short duration, is at once succeeded by a flood, as the drains cannot carry off the excess in their surcharged state. Moreover, a much larger percentage of the rain flows off the land when it is in a saturated condition.

Taking the rainfall in the Fen district as a guide, it may be estimated that provision should be made for a daily rainfall equal to about three-quarter per cent.—0·76—of the average annual rainfall of a wet season. A quarter of an inch of rain represents 25¼ tons per acre, which, multiplied by the number of acres and the height to be lifted, gives the work to be done from which the actual horse-power of the engine required can be calculated. Thus, for example, taking a district of 1000 acres with a lift of 5ft. and daily rainfall of ¼in., which is equal to 393,860 lb. lifted 5ft. every minute, equal to 1,965,300 foot-pounds, which, divided by 33,000, the unit of 1-horse power, equal to 6-horse power. Adding to this 50 per cent. for the work to be done in overcoming the friction of the machinery, and leakage of the pumps, gives 12-horse power. This is on the supposition that the engine during extreme floods is running night and day, which in cases of emergency is generally done. If the work is required to be done in less time the power required will be proportionately larger. It is, however, safer to calculate on not running more than sixteen hours a-day. While it is desirable to provide adequate power, any unnecessary excess of expenditure should be avoided as adding to the dead weight of capital on which interest must be paid. On the other hand, it is never desirable to put too much strain on an engine, and a machine that is well master of the work will run more economically than one that is much pressed.

In calculating the work to be done, the height which the water is lifted is taken as the vertical distance between the surface of the water in the drain bringing the water to the pump, and that in the main drain or river into which it is discharged. If the water is discharged through horizontal pipes—as in one form of the centrifugal pump—an allowance has to be made for the friction.

Consideration must be given to the fact that this height may vary considerably in the course of the day, owing to the outfall being a tidal stream, or from the water having levelled itself up on the drain during the night, when pumping was not in operation.

If the pump used is of the turbine form its position in the pump well should be sufficiently below the lowest surface to which the water is to be pumped to prevent its drawing air, as within reasonable limits the depth of the pump below the surface does not add appreciably to the work to be done. It is desirable to keep the pump low enough, and the covering over the pump should not be less than 2ft. If the main interior drains are of sufficient capacity the inclination in the surface of the water should not exceed 3in. per mile, and even 2in. is sufficient to bring the water to the pump. The surface of the water in the drains for effectual drainage should be at a sufficient distance below the land to allow the drain pipes to discharge freely from the lands situated at the greatest distance from the pumps. In alluvial soils this will be from 3ft. to 3ft. 6in., and this, plus the amount to be allowed for the surface inclination from the lowest point, will regulate the level at which the water should be kept in the main drain.

The main drains leading to the engine, and especially the main engine drain, act not only as conveyers of water to the pump, but also as reservoirs to collect the water when the engine is not running, and should therefore be larger than the calculation would warrant if merely founded on their discharging capacity. When steam is once up it is bad management to allow the engines to stand still for a time for the water to gather, because the drains are not of sufficient capacity to keep it supplied. The pumping station should be placed as near the centre of the district as practicable. The main engine drain will then be of shorter length, and the minor drains arranged in a more effectual way as feeders than if the pumping station be fixed at one end of the district; the drains falling into it from both directions will require less fall than if they had traversed the whole length. The depth of water running in a drain should bear a fair proportion to the width of the drain, otherwise the progress of the water is impeded by an undue amount of friction from the contact of the water with the sides and bottom. In the smaller drains, say 3ft. wide at the bottom, it should never be less than 2ft. in depth, and increasing as the drain widens.

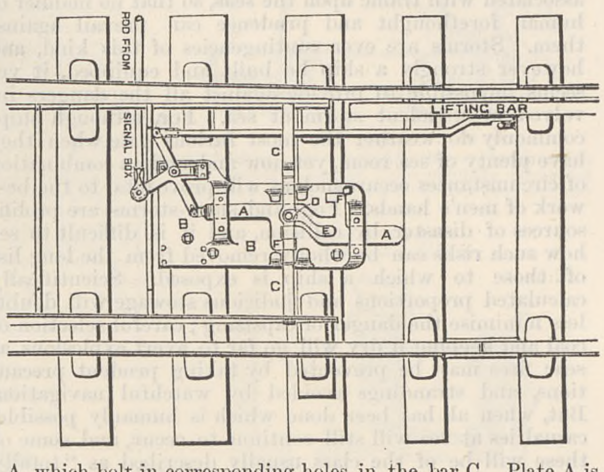
The power which causes water to move in a river or drain is that due to gravity or the difference in the level of the surface of the water. The velocity is governed by the rate of inclination of the surface and not of the bottom of the drain. The velocity of the water due to gravity is checked and retarded by the friction of the water against the rubbing surface with which it comes in contact, this rubbing surface, consisting of the sides and bottom of the drain, weeds, sides of bridges, or other impediments. The greater the body of water as compared to the area of rubbing surface, the greater effect the surface inclination has. The proportion of rubbing surface to area is termed the "hydraulic mean depth" of the stream, and is found by dividing the area by the contour of the stream or length of the sides and bottom in actual contact with the water. A deep stream therefore has a greater velocity for the same inclination than a shallow one. The most effective form is when the depth is about half the mean width of the channel and the discharge will then be at the maximum. This proportion, however, is never attainable in Fen drains, the width generally being from four to six times the depth. Every particle of water in a flowing stream being free to move, the whole body of water from the surface to the bottom is in motion; but owing to the retarding influence of the bottom and sides, the velocity is greatest in the centre of the stream, and at a small distance below the surface, and its least along the bottom of the channel. The mean velocity of a stream is generally taken as four-fifths of the surface velocity in the centre. A channel with numerous bends, and full of hills and holes at the bottom, presents a large area for friction. If the same quantity of water that enters a stream leaves it at the lower end, it is evident that the same body of water must pass throughout its whole length, whatever the difference in the area of the section at different parts; the water increasing in velocity when the area is small, and decreasing when it is large, the surface inclination varying in proportion.

The object to be sought in laying out a drain is to provide such a channel that the water shall be moved along its intended course with such ease that as small an inclination and area shall be used as possible. Every increase beyond what is absolutely necessary is a waste of land and expense in excavation. The method of calculating the velocity of a stream is by a formula deduced from the effect due to the action of gravity, reduced by the amount of friction encountered. The theoretical velocity, V, is found by multiplying the square root of the product of the hydraulic mean depth, R, by the slope of the water line, S, by 100. The result, ($V = 100\sqrt{R.S.}$) must be reduced by a coefficient varying with the nature of the stream, and determined originally by experiment checked by practice. Or putting the formula in the simplest form, $V = (\sqrt{R \times 2F})\,C$, where V equals mean velocity in feet per second; R, equals hydraulic mean depth in feet; F, fall of surface in one mile in feet; C, a constant, varying from 0·91 in rivers and large streams with considerable depth of water to 0·60 for small drains in good order. If the drains are encumbered by weeds, the contour of the hydraulic mean depth should be multiplied by 1·7. The surface velocity in the centre of the stream, as found by floats or by a current meter, must be multiplied by 0·80 to find the mean velocity of ordinary streams.

[3] "Report on the Improvement of the River Ouse," by W. H. Wheeler, M.I.C.E. 1884.

BARR AND LANGLEY'S RAILWAY POINTS.

THE accompanying engraving illustrates a view of a new mode of working points, and locking them in both directions by one lever. The cost is less than that of the usual mode of having two levers for this, and the man in the box has not so much to do. The cost of manufacture is less, and it is easily maintained. There are several fixed and working well on the Midland Railway. In the engraving A is a plate, supported and sliding on the bed B; C is a bar connecting the switches; D is a stud or roller fixed in bar C, and working in slot E; F, F, are projections on plate



A, which bolt in corresponding holes in the bar C. Plate A is moved by means of the hand-lever in the signal box, first withdrawing one of the projections F from a hole in bar C, then moving the switches over; the other projection, F, enters the other hole in bar C, and securely locks switches in their new position. The switches are thus unlocked, then moved into their new position and again locked, all by the one movement of the lever.

THE INTERNATIONAL MARITIME EXHIBITION AT HAVRE.

Le Genie Civil publishes an account of the Exhibition which is to be opened at Havre in the course of some few weeks. The principal object is to further the efforts that are being made to extend and facilitate the commercial and maritime relations of the country, especial prominence being given to the imports and exports of the colonies. The latest inventions relating to construction, to the fitting out and propulsion of ships, will be extensively represented, as will be seen by the succinct list given further on. The Exhibition will be international in regard to all industries relating to the marine, to fishing and electricity, and national in exhibiting only such products as are imported and exported by the French colonies. Nearly every type of vessel, from the small pleasure yacht to ships of war, will be afloat in the basin, which will be surrounded by covered galleries and a promenade, which will afford the visitors full and pleasant opportunity of observing the movements of the vessels. The two sides of the basin are connected by a foot-bridge. The main building, on the Place du Théâtre, is completed; it is light and elegant in appearance while being solid of structure, and its decoration, as yet incomplete, is in oriental style, harmonising well with that of the building. The general arrangements are under the direction of M. Bénard. The space allotted to exhibitors in the covered galleries already amounts to 15,000 square metres, although the opening is not to take place for two months, and many of those who intend to take part in the Exhibition have not yet had their full demands.

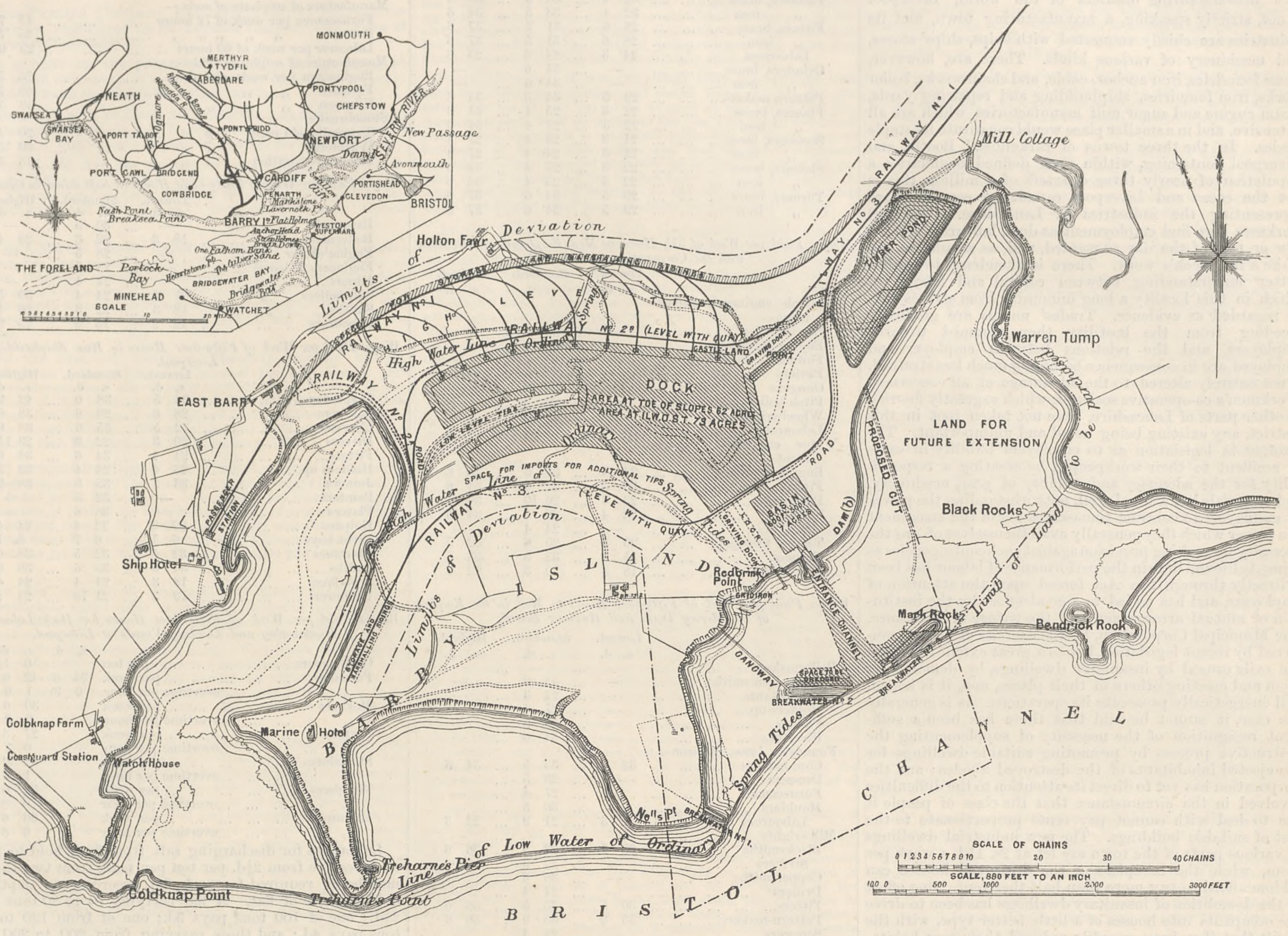
Among the exhibits likely to attract the greatest interest may be mentioned the following:—The sloop Favorite, on board which will be a complete naval hygienic exhibition. The best work of the professional schools, and an important group of products from the colonies and the protectorate countries, exhibited by the town of Havre. The Chamber of Commerce will exhibit powerful and ingenious salvage apparatus, models of port machinery, and a plan of Havre and its factories. The Department of Roads and Bridges will contribute models of hydraulic appliances for the working of the bridges and gates of locks, showing the newest systems. The Bureau Veritas will show a very large collection of models of ships. The General Transatlantic Company a cabin, such as is fitted into their new steamers. The Chargeurs Réunis, models and plans of the steamers of their fleet. The Forges et Chantiers de la Méditerranée, a torpedo-boat engine, an electric boat, artillery, &c. The Atéliers et Chantiers de la Loire, an engine for a despatch boat, marine boilers, &c. The other large shipbuilders of Havre will exhibit windlasses, hoists, steering machinery, and other appliances connected with vessels. The general exhibits will comprise everything connected with the commercial and naval marine; all direct appliances, as well as the products of the outside industries which have any relation to the subject. Power to 400 horses will be at the disposal of the exhibitors, also a gas engine of 30-horse power. Electricity will be very largely represented, and the *façade*, gardens, and principal galleries will be lighted by it.

The new works in the port, which are nearly finished, will be found interesting to the visitor, and will show, as will the Exhibition, the immense progress which has been made at this, the first French port on the Channel, both as regards its importance and the perfection of its machinery. To relieve the severity of an exhibition devoted to special subjects, a varied and attractive programme has been prepared which offers to the public a succession of fêtes, concerts, and regattas to be continued throughout the season.

IT is said that an important discovery of stream tin has been made at Stukey Gap, a distance of twelve miles from the head of the Annan river. The prospects, it is reported, go up to 12 lb. of tin to the dish.

THE BARRY DOCK AND RAILWAYS, NEAR CARDIFF.

MR. J. WOLFE BARRY, MR. T. FORSTER BROWN, AND MR. H. M. BRUNEL, MM. INST. C.E. ENGINEERS.



THE BARRY DOCK AND RAILWAYS.

THE Barry Dock now in course of construction is situated in the Bristol Channel, about seven miles from Cardiff, and within its port, the name being derived from that of Barry Island, on the land side of which the dock is being constructed. The enterprise is the outcome of a long-felt want for further dock and railway accommodation for the coal district to the north of Pontypridd, comprising the Rhondda, Merthyr, and Aberdare Valleys. This feeling, which had been growing for some years, at last culminated in a scheme promoted by the principal colliery owners and traders of the district, assisted by landowners who were interested. The work which is being carried out consists of a dock at Barry Island, Glamorganshire, and a railway connecting it with the coalfield, making with its branch lines a total length of about twenty-seven miles.

A Bill seeking the necessary powers for carrying out this scheme was introduced into Parliament in the session 1883, but was rejected in the second House, though powers were obtained the next session, 1884, and work forthwith commenced. The first contract was for the dock, a part of the railway being let in October, 1884, three months after the royal assent had been given. Since that date rapid progress has been made, the work being carried on by night as well as by day. And it is expected that the dock and railway will be opened for traffic in the latter part of the year 1888.

Barry inlet offers a most favourable site for the dock. Hitherto, it has been little used as a harbour, except by small coasters and pilot boats the great drawback being that the channel was dry at low water, although there was a considerable depth at high tide. The range of tide at springs is about 36ft.

The dock itself, as will be seen on referring to the plan, is in the channel between the island and the mainland, where the ground being naturally of a low level, renders a considerably smaller amount of excavation necessary, which, in a work of this description, is a large item.

Then again the shelter afforded by the island to the shipping in the dock is very great, the land, especially at the eastern end, being of a good height above sea level, while the south-eastern portion of Nell's Point gives complete shelter to the entrance from winds in a westerly and south-westerly direction, the prevailing quarter in this part of England, and the only direction in which there is a long fetch of open sea. The anchorage also outside Barry is good, and ships can come straight into dock from deep water, in which matter Barry compares favourably with its neighbours, Cardiff and Penarth, where ships entering or leaving are obliged to thread a narrow gateway, the navigation of which is somewhat risky.

Although the tide runs very strongly in the Bristol Channel, Nell's Point, to the west of the entrance, has the effect of deflecting the current and causing slackwater off the mouth of the breakwater, and will make the entrance into the dock perfectly safe. The distance between the heads of these breakwaters is 35ft. clear, and a deep channel will be dredged leading up to the basin entrance. The entrance into the basin is 80ft. in width, with a depth of water over the side of 37¾ft. at springs and 29¼ft. at neaps. This will allow of the largest class of ships being docked. The scheme, as authorised by Parliament, consisted of a 40 acre dock, a basin of 7 acres, a lock leading from the basin into the dock of 500ft. in length, and a timber pond of 15 acres. But it was found that for a comparatively trifling increase on the original estimate a much larger dock, viz., of 62 acres, could be made, by widening and extending the dock to the southward, leaving only a short passage between the basin and dock, at the same time placing the lock on the west side of the basin. This arrangement has been adopted and is shown on the accompanying sketch plan, with the addition of a mole running down the centre of the western portion of the dock, which will add considerably to the quay space.

The basin is 600ft. long by 500ft. wide, with an area of about 7 acres. It is proposed not to construct the lock at present, but to use the basin as a large lock when necessary. The passage leading from the basin to dock is of the same width as the entrance, viz., 80ft., and with the same level of site. The dock, with 62 acres of deep water area, the bottom being 2ft. lower than that of the side, will be for the shipment of coal, though every facility will be given for an import trade. In those portions of the dock devoted to the coal trade, viz., the Mole and the north-west side, the sides will be constructed of pitched slopes, the jetty carrying the coal staithes being made to project as far as the toe of the slopes. These staithes will be placed at various distances apart, varying from 174ft. to 300ft., with the object of suiting all classes of ships.

On the southern side, the greater portion of which it is proposed to devote to the import trade, an upright wall will be built to enable a vessel to discharge its cargo at any point alongside. The eastern side of the dock and the basin quays will be set apart for the timber trade, and is in close proximity with the timber pond, which will be twenty-four acres in area. The number of tips in the dock will be twenty; those on the north side being at a high level, and worked on the gravitation principle, the loaded trucks running down by their own weight from the main line of railway to the tip. The remainder of the tips will be fed by sidings on the quay level.

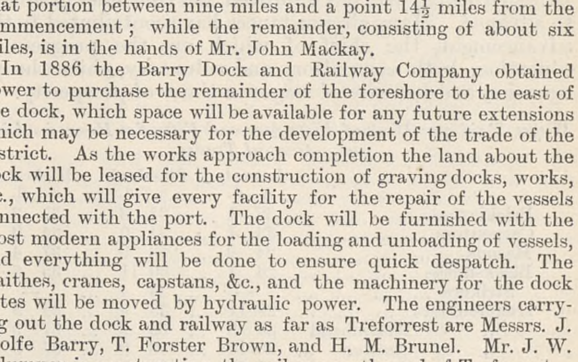
The total length of quayage in the dock is 3400 yards—nearly two miles—and in the basin 680 yards. The lock, when constructed, will be 680ft. between sills, with a width of 65ft., the depth of water over sill being the same as in the case of the entrance.

The railway portion of the scheme consists of a main line 18¾ miles in length, commencing at East Barry and terminating by a junction with the Taff Vale Railway at Hafod. There are also other junctions, another with the Taff Vale at Treforrest, south of Pontypridd, and two with the Great Western at Peterston and St. Fagans. In 1885 a short line was authorised connecting Barry with Penarth, and consequently with Cardiff. This line was very necessary, as the trade of these places will be intimately connected with that of Barry. Amongst other works connected with the railway there will be one tunnel of 1540 yards in length, commencing about five miles from Barry, while a shorter one of 1327 yards in length will be constructed about two miles from the termination. The main line will be carried across the river Ely on a stone viaduct consisting of nine spans each of 45ft., the height from water level to rail level being 65ft. Another viaduct 1½ miles from the termination will be 92 yards in length. The whole of the contracts for the dock and railway have been let, Mr. Thomas Walker, of Westminster, having obtained that of the dock works and the main line of railway up to a point nine miles from the commencement, with its branches. Messrs. Lovatt and Shaw, of Wolverhampton, that portion between nine miles and a point 14½ miles from the commencement; while the remainder, consisting of about six miles, is in the hands of Mr. John Mackay.

In 1886 the Barry Dock and Railway Company obtained power to purchase the remainder of the foreshore to the east of the dock, which space will be available for any future extensions which may be necessary for the development of the trade of the district. As the works approach completion the land about the dock will be leased for the construction of graving docks, works, &c., which will give every facility for the repair of the vessels connected with the port. The dock will be furnished with the most modern appliances for the loading and unloading of vessels, and everything will be done to ensure quick despatch. The staithes, cranes, capstans, &c., and the machinery for the dock gates will be moved by hydraulic power. The engineers carrying out the dock and railway as far as Treforrest are Messrs. J. Wolfe Barry, T. Forster Brown, and H. M. Brunel. Mr. J. W. Szlumper is constructing the railway northward of Treforrest.

ADAMSON'S SPRING BOLLARDS.

THESE bollards—illustrated by the accompanying engraving—have been constructed for working wire and other hawsers and stream cables, for warping or mooring purposes, or for towing, and have been found to effect a great saving in the tear and wear when compared with the old system. The bollard consists



of a base plate B on which is cast a strong centre bridge C, and heavy ears E at either end, through which are passed longitudinally two strong wrought iron bars D secured by screwed nuts. Between the end snugs, and held in position by the longitudinal bars and bevelled bottom flanges, is placed the bollard proper having a free fore-and-aft motion, and controlled by strong springs resting against the centre bridge of base plate. The springs are of Timmis's section, and are very strong.

WAGES IN GREAT BRITAIN.

No. VII.

Liverpool.—Though situated in one of the most extensive manufacturing districts of the world, Liverpool is not, strictly speaking, a manufacturing town, and its industries are chiefly connected with ships, ships' stores, and machinery of various kinds. There are, however, brass foundries, iron anchor, cable, and chain works, boiler works, iron foundries, shipbuilding and repairing yards, steam engine and sugar mill manufactories, which are all extensive, and in a smaller place would constitute its staple trades. In the three towns of Birkenhead, Bootle, and Liverpool containing, within their defined boundaries a population of nearly three quarters of a million, this is not the case; and Liverpool cannot be considered as representing the industries of Lancashire. Unskilled workmen here find employment as dock labourers by the day or part of the day as wanted, and, as a rule, do not make a full week's work. There is a tendency towards a better understanding between capital and labour, of which in this locality a long immunity from strikes may be regarded as evidence. Trades' unions are gradually receding from the hostility they assumed towards employers, and the relations between employer and employed are in consequence becoming much less strained, if not entirely altered, to the advantage of all concerned. Workmen's co-operative societies, which so greatly flourish in other parts of Lancashire, have not taken root in this district, any existing being small and unimportant. The changes in legislation as to employers' liability in cases of accident to their workpeople, by creating a responsibility for the adequacy and stability of gear, machinery, and materials has worked well, notwithstanding the power of employers to contract themselves out of the enactment—a power which they generally avail themselves of—as the necessity for making provision against such contingencies as injury to life and limb in the performance of labour has been indirectly through the Act forced upon the attention of employers, and has so led to a good effect by the institution of mutual arrangements in the nature of insurance. The Municipal Corporation, by the exercise of powers conferred by recent legislation, has to a great extent remedied the evils caused by insanitary dwellings, by demolishing them and erecting others in their places, and, it is hoped, will energetically prosecute its operations. As is generally the case, it cannot be said that there has been a sufficient recognition of the necessity of supplementing the destructive process by promoting suitable dwellings for the ejected inhabitants of the destroyed abodes; and the Corporation has yet to direct its attention to the difficulties involved in the circumstance that the class of people it has to deal with cannot pay rents proportionate to the cost of suitable buildings. The new industrial dwellings in various parts of the town are let at 2s. 11d. a week per room, while the occupiers of the destroyed houses can seldom afford to pay more than half that rent. One effect of the demolition of insanitary dwellings has been to drive the occupants into houses of a little better type, with the result that they have speedily reduced their new habitations into a condition as bad, or nearly so, as those from which they have been removed. The condition of the British working man has improved, and continues gradually to advance. Many circumstances have contributed to this advancement, the chief of which are the progress of education, both compulsory and voluntary, philanthropic agencies, and increase of wages in times of prosperity.

Wages Paid per Week of Fifty-four and Fifty-five Hours in Liverpool.—General Trades.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	32 1	34 3	37 3
Carpenters	33 1	34 0	34 0
Masons	24 0	33 9	37 4
Blacksmiths	26 4	30 11	35 6
Strikers	—	24 4	—
Ironmoulders	29 11	35 9	39 9
,, Birkenhead	35 9	35 9	37 9
,, Chester	23 10	33 9	35 9
,, Crewe	27 11	31 9	37 9
,, Lancaster	29 11	31 9	35 9
,, Preston	31 9	33 9	37 9
,, St. Helens	—	35 9	—
,, Widnes	35 9	35 9	37 9
,, Wigan	35 9	35 9	37 9
Tinsmiths	26 4	34 6	36 6
Labourers	21 3	24 4	27 4

Wages Paid in Liverpool and District to Members of Trades Unions.

			s. d.	s. d.
Bricklayers, Liverpool	per hour			8
Carpenters ,,	,,			7½
,, Chester	,,			7½
,, Preston	,,			7½
,, Runcorn	,,			7¼
,, Southport	,,			7½
,, Wigan	,,			7½
Stonemasons, Blackpool	,,			8
Amalgamated Engineers	per week			33 9
,, Preston	,,			28 0
,, Widnes	,,			30 0
Boilermakers and Iron Shipbuilders, Liverpool	per week	—	28 0	34 0
Ironfounders,	,,	—	—	36 0
,, Birkenhead	,,	—	—	34 0
,, Chester	,,	—	—	34 0

Wages Paid per Week of Fifty-four Hours in Foundries, Ironworks, and Machine Shops in Liverpool.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Boiler Shop:—			
Angle-iron Smiths	37 6	39 6	40 7
Holders up	—	28 6	—
Platers	37 6	39 6	40 7
Rivetters	—	34 6	—
Smiths	30 4	33 5	39 6
Strikers	19 3	22 3	23 3
Labourers	19 3	20 3	21 3
Foundry:—			
Brassmoulders	—	45 7	—
Dressers	26 4	26 4	27 4
Ironmoulders	34 6	38 6	40 7
Labourers	20 3	22 3	23 3
Machine Shops:—			
Drillers, brass	21 3	22 3	30 5
,, iron	21 3	22 3	30 5
Finisher, brass	32 4	33 5	39 6
,, iron	32 4	33 5	34 6
Fitters, brass	28 6	31 5	37 6
,, iron	28 6	31 5	37 6
Labourers	24 3	24 3	25 3
Grinders, brass	—	34 6	—
,, iron	—	34 6	—
Pattern makers	29 5	34 3	34 6
Planers, brass	22 3	25 4	34 6
,, iron	22 3	25 4	34 6
Screwers, brass	21 3	24 4	27 4
,, iron	21 3	24 4	27 4
Slotters, brass	22 3	25 4	34 6
,, iron	22 3	25 4	34 6
Turners, brass	29 5	34 6	37 6
,, iron	29 5	34 6	37 6

Wages Paid per Week of 51½ Hours to Men Employed in connection with the Corporation of Liverpool.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Borough engineer's department—			
Blacksmiths	—	33 6	—
Engine-drivers	—	30 6	—
Foremen- district	—	40 7	—
Paviors	—	32 6	—
Gaugers	—	35 6	—
Pitch-boiler	—	26 3	—
Wheelwrights	—	32 6	—
Labourers	20 3	21 3	24 3
Water engineer's department—			
Engine repairers	23 3	29 5	35 6
Fitters	30 5	32 4	34 6
Pipelayers	23 3	26 10	30 5
Smiths	26 4	30 5	34 6
Strikers	—	24 4	—
Testing fittings	20 3	25 6	32 5
Turners	31 5	32 5	33 5
Labourers	18 3	20 3	22 3

Wages Paid per Week of Fifty-four Hours to Men in the Employ of the Mersey Docks and Harbour Board.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Boilermakers	—	—	—
Angle-iron smiths	—	38 6	—
Assistants	—	22 3	—
Holders-up	—	27 4	—
Platers	—	38 6	—
Rivetters	—	34 6	—
Foundries, brass and iron—			
Core-makers	32 5	33 5	34 6
Dressers	—	29 5	—
Furnacemen	—	27 4	—
Moulders	—	36 6	—
Labourers	21 3	21 9	22 3
Millwrights	—	—	—
Blacksmiths	30 5	33 5	36 6
Strikers	—	22 3	—
Coppersmiths	—	36 6	—
Drillers	—	24 4	—
Fitters	30 5	33 5	36 6
Pattern-makers	35 0	35 9	36 6
Screwers	—	24 4	—
Tinsmiths	33 5	34 2	35 0
Turners	30 5	33 5	36 6
Enginemen at stationary engines	29 5	30 8	31 11
Navvies	21 3	22 0	22 9
Paviors	—	24 0	—
Quarrymen	24 4	25 1	25 8
Rock-getters	24 4	25 1	25 8
Sawyers	—	35 0	—
Wagon fillers	21 3	22 0	22 9
Wheelwrights	—	35 0	—

Wages Paid per Week of Fifty-four Hours to Men Employed in Locomotive, Permanent Way, and Wagon Departments of Railways in Liverpool.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Brakesmen	23 3	28 1	32 11
Carriage examiners	26 3	26 9	27 3
Fitters	21 3	27 11	34 6
Foremen	40 7	41 10	43 3
Paviors	24 3	24 9	25 3
Gaugers	18 3	22 9	27 3
Platelayers	23 3	25 3	27 3
Smiths	26 4	27 11	29 5
Strikers	—	19 3	—
Shunters	23 3	25 7	27 10
Telegraph linemen	21 3	27 1	32 11
Turners	30 5	32 5	34 6
Wagon repairers	21 3	24 10	28 5
Labourers	18 3	21 4	24 4

Wages Paid per Week of Fifty-four Hours by Mr. George Heaton Daglish, M.I.C.E., in the engineering trades at St. Helens.

	s. d.
Foreman boilermakers	100 0
,, foundries	45 0
,, ironworks	45 0
,, machine shops	70 0
Apprentices	8 0
Boilermakers	25 5
Boilersmiths	33 3
Casters	35 0
Drillers	24 0
Engineers	34 0
Founders	24 9
Locksmiths	34 0
Machinists	24 0
Millwrights	32 0
Model makers	34 0
Moulders	35 0
Patternmakers	34 0
Planers	24 0
Platers	36 0
Rivetters	32 0
Smiths	32 0
Strikers	20 0
Turners	34 0
Welders	32 0
Labourers	19 2

Wages Paid per Day to Coal Miners in South Lancashire and Cheshire.

	s. d.
per day	4 9

Wages Paid per Week in Chemical Works at Saint Helens.

		s. d.	s. d.
Manufacture of carbonate of soda and caustic—			
Average earnings of men per week of 72 hours		25 5	30 5
Manufacture of sulphate of soda—			
Furnacemen per week of 72 hours			45 7
Potmen ,, ,, ,, ,,			45 7
Labourer per week of 60 hours			25 0
Manufacture of sulphuric acid—			
Enginemen per week of 7 days			26 5
Foremen ,, ,, ,, ,,			49 7
Kilnmen ,, ,, ,, ,,			30 5
Stonebreaker—			
(generally old men)	6 ,,		20 4
Wheelers	7 ,,		30 5
Labourers (youths)	7 ,,		18 3

Wages Paid per Week of Forty-eight Hours in Salt mines in Cheshire.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bargemen	—	30 5	—
Boilermakers	18 3	22 3	26 4
Engine driver	—	28 5	—
Engineers of barge	—	28 5	—
Miners	—	24 4	—
Salt boilers	21 3	24 4	30 5
Smiths	18 3	22 3	26 4
Labourers	12 2	13 8	15 3

Wages Paid per Week of Fifty-four Hours in Iron Shipbuilding in Liverpool.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Carpenters	33 5	38 0	42 9
Caulkers	28 6	28 6	38 6
Clippers	32 5	35 6	38 6
Drivers	20 3	22 9	29 11
Fitters	24 4	34 6	34 6
Holders up	26 4	26 4	32 5
Joiners	33 5	35 9	38 0
Painters	—	32 5	—
Platers	—	38 6	—
Helpers	20 3	22 4	24 4
Rivet boys	6 1	6 7	8 1
Rivetters	32 5	32 5	38 6
Smiths	34 6	35 6	36 6
Strikers	18 3	24 4	24 4
Labourers	19 3	21 10	24 4

Wages Paid per Week of Fifty-three Hours for Dock Labour in Discharging and Loading Vessels at Liverpool.

		s. d.	s. d.
Coalheavers	per ton		0 1¼*
Foremen	per week	33 6—	42 6
,,	overtime per hour	0 9—	1 0
Markers	per week		30 6
,,	overtime per hour		0 8
Porters	per week		27 3
,,	overtime per hour		0 7
Stevedores	per week		42 6
,,	overtime per hour		1 0
Weighers	per week		30 6
,,	overtime per hour		0 8
Labourers	per week		30 6
,,	overtime per hour		0 8

Labourers for discharging salt from flat's hold to flat's deck receive from 2¼d. per ton per man, from two to four men being required for each flat, according to depth of hold and size of flat. A flat carrying 70 to 80 tons pays 2½d.; one of 100 tons pays 3d.; one of from 120 to 150 tons pays 4d.; and those carrying from 200 to 300 tons pay from 5¼d. to 6d. per ton per man. After the salt is raised from the hold to the deck, the ship pays for putting on shore and storing.

Wages Paid per Month to Engineers of Steamers in Liverpool.

	Atlantic. £ s.	East Indies. £ s.	Mediterranean. £ s.	West Indies. £ s.
Chief engineer	18 5	20 6	15 4	15 4
Second ,,	15 4	15 4	13 4	12 3
Third ,,	12 2	10 3	10 13	9 3

The dwellings of the working classes in Liverpool are of two kinds. Though so much has been done in improving insanitary property, there are still remaining in the older parts of the town 2500 courts containing over 14,000 houses and accommodating over 70,000 inhabitants. These courts differ mainly in the number of houses, the bulk of them being very similar in appearance. The general type of court contains ten houses, five on each side, built back to back, with no through ventilation, the doors and windows facing the court, which is from 10ft. to 12ft. in width. The end of the court is usually closed by high buildings, and the entrance from the street is in many cases by a tunnel passage through a house or warehouse. Each house, as a rule, contains a cellar, two rooms, and an attic, and is let at from 2s. 6d. to 3s. a week. Many of these houses are sublet at from 1s. to 1s. 3d. a room, and in consequence great overcrowding prevails. Although new houses are built according to modern sanitary regulations, these courts are a favourite abode with a considerable proportion of the population. The dwellings occupied by the better class of working people consist of streets of four and six-roomed houses, the four-roomed houses letting at from 4s. 6d. to 5s. 3d., and the six-roomed at from 7s. to 9s. a week. Coal is from 14s. 8d. to 16s. 9d. per ton, and gas 2s. 9d. per 1000 cubic feet.

Examples of Cost of Living per Annum in Liverpool.

	Number in family. 4	5	5	6
	£ s.	£ s.	£ s.	£ s.
Bread and flour	13 14	15 19	13 5	18 5
Butter, cheese, coffee, milk, sugar, tea, &c.	37 13	17 0	26 6	21 8
Meats	9 6	3 8	11 7	9 3
Vegetables	—	2 13	—	6 9
Fuel and light	3 12	3 11	3 17	—
Clothing	8 19	4 11	8 5	8 6
Rent	†6 10	‡5 4	§11 1	‖6 10
Incidentals	4 7	—	6 1	4 18
Total	84 1	52 6	80 2	74 19
Income	84 11	53 7	80 2	80 5

* Each coalheaver has additional for a night's work 5s. 1d., and sometimes they earn as much as £3 1s. a week.

† Two rooms looking into court. ‡ Two small rooms in tenement house.

§ Small cottage of four rooms. ‖ Two rooms in third floor of a large lodging-house.

RAILWAY MATTERS.

TENDERS for the construction of the Bunbury Railway, Australia, and the erection of a post-office at Perth, are to be invited.

THE Panama Company has bought thirty locomotives in Belgium, eighteen of the St. Leonard Company and twelve of the Cockerill Company.

A REPORT on the progress of the Tay Bridge has just been issued, from which it appears that the contractors expect to be able to finish the work within three months.

AN effort is to be made to construct a railway between Kimberley and Pretoria, and English investors should see that, if called upon, they support the English and not the Boer Company.

THE South African railway revenue for 1886 exceeds that for 1885 by over £11,000, but is short of estimate by £54,000. The *Colonies and India* says, "there is a heavy falling off on the Eastern line," and asks, "Why?" Most people answer, "Give it up."

THE Channel Tunnel Railway Company voluntarily and others per force enable a select few to continue the new boring at Dover, the depth of which is now 500ft., and the operations, which "are made with a view to ascertain whether the geological strata conform with those of the French coast," are being continued. The discovery of coal is mentioned as one of the objects of the boring.

ON the 21st ult. the new Hooghly railway bridge, which forms a connecting link between the East Indian and Eastern Bengal lines, was formally opened by the Viceroy, in the presence of the Lieutenant-Governor, and they have called that too the "Jubilee Bridge." Sir Bradford Leslie has been the engineer of the Hooghly Bridge, illustrated in THE ENGINEER of the 23rd January, 13th February, and 20th February, 1885.

AT a recent meeting of the Paris Academy of Sciences, a paper was read on "The Inauguration of Railways in France: its true Date," by M. Léon Aucoc. It is pointed out that the proposed celebration in 1887 of the fiftieth anniversary of this event rests on an historical error. The first line actually completed was that between Saint-Etienne and Andrezieux, 23 kilometres long, opened on October 1st, 1828; that is, nine years before the assumed date, 1837.

IN his report on the accident which occurred at Corbett's-lane signal cabin on the 21st December on the South-Eastern Railway, Major-General Hutchinson, the Board of Trade inspector, says:—"The present collision, like the recent one between Farringdon-street and King's Cross, again demonstrated the superiority of an automatic over a non-automatic brake; in both cases the vacuum pipes being broken on collision, the brakes became inoperative, and the progress of the train ceased to be arrested; with an automatic brake the fracture of a pipe would have been of no consequence."

THE *Birmingham Gazette* publishes a letter which has been addressed by Mr. Ruskin to a Cumberland gentleman who had communicated with him respecting the Ambleside railway project, in which he says:—"I do not write now further concerning railroads here or elsewhere. They are to me the loathsomest form of devilry now extant, animated and deliberate earthquakes, destructive of all wise social habit or possible natural beauty, carriages of damned souls on the ridges of their own graves." In this Mr. Ruskin's remarks are consistent with his previous notoriety-securing passages concerning this "machine and devil-driven England."

THREE miles of the Penang tramways were opened for traffic last month. An additional six miles—which will complete the entire undertaking—will be opened soon, the latter running into the best and most populous portion of the country districts which surround Penang. The line has been constructed and equipped by Messrs. Kerr, Stuart, and Co., of London. It is regarded as one of the most needed and useful means yet accomplished for developing the trade and industries of the Straits Settlements. It is, we understand, a well finished and well equipped railway. The cars are divided into four classes, and are run by locomotives specially constructed for the purpose. The plant and rolling stock are of English manufacture.

THE Americans are again waking up to the notion that heating cars by steam is a possibility, but in this matter their aversion to improvement would do credit to the most obdurate of old Eastern nations. Heating cars by steam from locomotives has been done over and over again, but America is now discussing the possibility of the thing. Some say the draught of steam is too much from the locomotive; some who have tried it say the firemen do not notice the difference. Some now object that the locomotive might become disabled from being fixed in the snow, and so deprive the train of heat; and so it is proposed to place a small emergency boiler permanently connected with the steam-heating system in the baggage car, and kept shut off, though full of water in winter and fuel in the fire-box ready to light.

IN a recent number of the *Fortnightly Review*, Professor Arminius Vambery gives an interesting account of the Transcaspian Railway. After describing the use of naphtha as a fuel for working the line, he refers to a system which might be adopted with advantage on some of our colonial railways. He says:—"In a country where there are no roads, where no fences, no gates and no watch-boxes are required, it was quite sufficient to place a watchman's hut every twelve and a-half versts. Such a hut is built in the form of a barrack, and serves as the dwelling-place of several workmen and watchmen. By its side is erected a small tower, from which the road can be surveyed for some distance right and left. But in order to inspect more minutely the state of the permanent way, to try the rails, and to remove obstacles, two men start daily from the barracks, going six versts in each direction up and down the line. For this purpose each barrack is provided with two horses. On their journey out one rides and the other walks; on their return journey the one who rode walks, yielding the horse to his comrade, who now in his turn rides. By this clever arrangement the inspection of the vast line of railway does not require more than 110 or 120 such guard-houses—and a by no means contemptible economy is effected."

THE shares in the Bengal-Nagpur Railway were eagerly taken up by the public, the £3,000,000, in 150,000 shares of £20 each, being subscribed within two or three hours, and, it is said, five or six times over. The company has been formed under the supervision and with the support of the Secretary of State for India, for the purpose of carrying out a contract with him by which the company takes over the existing Nagpur-Chattisgarh Railway from Nagpur to Nandgaon—149 miles—converts it to broad gauge, and constructs other lines, embracing in all a system of railways 784 miles in length. The interest upon the share capital is payable in sterling at the rate of 4 per cent. per annum, and is guaranteed under contract by the Secretary of State for India in Council, with the addition of one-fourth of surplus profits. These railways will be on the Indian standard gauge of 5ft. 6in., and will extend from near Seetarampore on the East Indian Railway, about 138 miles from Calcutta, to Nagpur, the north-eastern terminus of the Great Indian Peninsula Railway, 520 miles from Bombay, with a branch—161 miles—northwards from Bilaspur to the Umaria coal mines, where it joins the existing line between Umaria and Kutni, a station on the Jubbulpoor branch of the East Indian Railway. The contract contemplates the Umaria and Kutni line being also taken over by the company.

NOTES AND MEMORANDA.

THE University of Bologna has decided to celebrate its eight hundredth anniversary in the spring of 1888. The exact date of its foundation is not known, but of course that does not matter, the Octenary can be held all the same. Authorities on the subject agree that an important school was established at Bologna in the eleventh century. Afterwards the University took a great place as the chief centre for the study of judisprudence, and there also anatomy was for the first time scientifically studied.

SOME time ago it was reported that oil springs had been discovered in Trinidad. It seems, however, that the discovery has not turned out to be so good as was expected. Mr. Newsam reports that on going to the place he found two small pools, about the size of a washhand basin, full of liquid, several bottlesful of which were taken and sent to the Government analyst, who has reported that the liquid contains about 75 per cent. of oily matter, similar to that found at the Pitch Lake. A large pond of it is said to exist in the neighbourhood of Mon Effort and several other places, notably the Oropouche Lagoon.

IN the Report of the U.S. Geological Survey on the mineral resources of the United States for 1885, it is stated that the total mineral product is valued at 428,521,356 dols., an increase of 15,306,608 dols. over 1884. Among seventy mineral substances cited, coal is the most important, showing a total value of 159,019,596 dols. An increase is shown in the production of coke, natural gas, gold, silver, copper, zinc, quicksilver, nickel, aluminium, lime, salt, cement, phosphate rock, manganese, and cobalt oxide, while the production of coal, petroleum, pig iron, lead, precious stones, and mineral waters decreased. According to the Report, it is probable that the total output of 1886 was much greater than that of 1885, and even larger than that of 1882.

A PAPER in the *American Journal of Science*, on "The Muir Glacier," by G. Frederick Wright, contains an exhaustive study of this interesting glacier, which lies in the Alpine region of Alaska at the head of Muir Inlet, Glacier Bay, in 58 deg. 50 min. N. lat., 136 deg. 40 min. W. long. It forms a frozen stream some 5000ft. wide by 700ft. deep, entering the inlet at a mean rate of 40ft., or 140,000,000 cubic feet, per day, during the month of August. The vertical front at the water's edge is from 250ft. to 300ft., and from this front icebergs are continually breaking away, some many hundred feet long, with a volume of 40,000,000 cubic feet. The glacier appears to be rapidly retreating, there being indications that even since the beginning of this century it has receded several miles up the inlet, and fallen 1000ft. or 1500ft.

ACCORDING to the report of the British Iron Trade Association, the production of pig iron in the United Kingdom during 1886 amounted to 6,870,665 tons, as compared with 7,250,657 tons in the previous year, thus showing a decrease of 379,992 tons. The decrease in 1885 on 1884 amounted to 278,309 tons; so that the decrement of make for the two years has been 658,231 tons. The make of 1886 has been the smallest of any year since 1879, when the production amounted to 6,009,434 tons, and is only 129,000 tons above the output of 1872. The United Kingdom is not, however, singular in showing a reduced output of pig iron in 1886. There has been an even greater reduction of make in Germany, and Belgium and France both show a decreased production as compared with 1885. In the United States, on the other hand, the make of 1886 has been 1,640,017 tons above that of the previous year.

AT the last meeting of the Meteorological Society, a paper was read on "The Influence of Weather on the Proportion of Carbonic Acid in the Air of Plains and Mountains," by Dr. W. Marcet, F.R.S., and M. A. Landriset. The authors give an account of some experiments which they have made on the proportion of carbonic acid in the air at Geneva and on the summit of the "Dole," the highest point in the Jura chain, the difference in altitude being 4193ft. The results of these experiments show: (1) that in fine clear weather on a mountain chain of moderate Alpine altitude, and in the adjoining valley or plain, the atmosphere holds the same mean proportion of carbonic acid at both places; and (2) that when the summit of a mountain chain is in a fog, a circumstance which frequently happens in an Alpine district, the air in the fog contains a smaller proportion of carbonic acid than it would hold in fine, clear weather.

AT a recent meeting of the Berlin Physical Society, Dr. Richarz, speaking on the formation of peroxide of hydrogen by electrolysis, said if a current were conducted through diluted sulphuric acid, then there was formed at the positive electrode a strongly oxidising substance, formerly taken for peroxide of hydrogen, but demonstrated by M. Berthelot to be per-sulphuric acid, S_2O_7. In experiments on the electrolysis of concentrated solutions of sulphuric acid with wire-shaped platinum electrodes, the speaker had obtained in the solution, beside per-sulphuric acid, ozone and peroxide of hydrogen, and assumed that all three bodies made their appearance at the positive electrode. The following experiment served as a proof:—A 40 per cent. sulphuric acid solution was subjected to electrolysis, and thereby, on account of too great attenuation, no peroxide of hydrogen, but only per-sulphuric acid, came to view. If, now, into the 40 per cent. sulphuric acid 60 per cent. acid were poured, after the electrolysis was finished, then did peroxide of hydrogen show itself in the fluid.

AT the last meeting of the Physical Society, Professor Reinold read an abstract of a paper on "The Continuous Transition from the Liquid to the Gaseous State of Matter at all Temperatures," by Professor W. Ramsey and Dr. Sydney Young. The authors find the relation between pressure and temperature of gases and liquids at constant volume expressible by $p = b\,t - a$, where b and a are constants, and therefore conclude that the isochers—*i.e.*, curves connecting p and t for constant volume—are straight lines. At temperatures below the critical point the isotherm during passage from the gaseous to the liquid state is a serpentine curve intersected by the horizontal line of vapour pressure corresponding with that temperature, the two areas between the curve and straight line being equal. By experiment and extrapolation, the authors find that the loci of the apices of the serpentine curves, corresponding with different temperatures, intersect at the critical point. The above results are proved for ether and carbonic dioxide, and the authors believe them to be true for all stable substances.

AT a recent meeting of the Berlin Physical Society, Dr. Weinstein reported on his deductions from observations of the earth's current in the telegraph lines of the German Empire. He said the earth's current showed an intimate relation to the earth's magnetism, and especially to the declination. He failed to discover a relation in the earth's current to the period of the sun's rotation, although such a relation was asserted for the earth's magnetism. The latter, too, was a point which the speaker doubted, and that because he had been unable to confirm the relation, which was likewise affirmed, between the aurora and the sun's rotation. It was true he obtained an average period of about twenty-five days, but the minima amounted to twelve and the maxima to thirty-seven days, and between such extremes a mean was not allowable. For the earth's current likewise he found minima of twelve days and maxima of thirty-seven days, and this result appeared to him to conflict with the assumption of a connection between the earth's current and the sun's rotation. He conjectured that in the case of the earth's magnetism single values deviating too strongly from one another had been united into a mean. Be it further related that the intensity of the earth-current proved itself to be nearly proportional to the length of the lines. In the discussion following this address, Dr. Brix spoke of the earth plates which had been introduced in the lines used for measurements of the earth-currents, and which had hitherto proved so little disturbing that for the present the introduction of unpolarisable plates had been stopped.

MISCELLANEA.

IT is proposed to construct a dock at Deal for commercial purposes, and as a refuge for vessels in distress on the Goodwin Sands.

SUBSCRIPTIONS are invited for the Hotchkiss Ordnance Company, which has been formed to acquire and carry on the business of the late Mr. B. B. Hotchkiss. The proposed capital is £800,000, in shares of £10 each.

TENDERS are being invited by the borough of Kingston-on-Thames, for the sewage disposal works, and contractors willing to tender for the erection of sewage disposal works, or for providing engines, machinery, &c., are requested to send their names to the borough surveyor by to-morrow.

WE have received from the publishers of the *Timber Trades Journal* a new tape which is made specially for measuring round timber or other commodities, the speciality of this tape being that the contents of 1ft. are marked on the back, thereby showing the cubical contents without calculation.

AT Northwich, last week, a startling subsidence occurred in Castle Stone, one of the main thoroughfares. The foundation of a coachbuilder's shop, together with about ten yards of the adjoining footpath, sank into a deep pit, which soon became filled with water. Shortly afterwards a pit four yards in diameter and five yards deep was suddenly formed in the Hartford Volunteer drill-shed.

THE Aldershot Gas and Waterworks Company is about to increase its water supply, and Messrs. Le Grand and Sutcliff, of London, have commenced boring another artesian bored tube well, which will be 7¼ in. in diameter, and from 250ft. to 300ft. deep. This will make the fourth of a series of artesian tube wells which this company has had sunk, the entire supply now being obtained by the tube well system.

THE *Stevens Indicator*, which is the name of the journal published by the Stevens Institute of Technology, has appeared in a new form as a quarterly, and the first number gives an article on the general prosperity and work of the Institute, followed by articles on the Institute's electrical and steam engine testing facilities, and on several subjects of engineering interest relating to matters outside the Institute.

THE Winchester House Company, of Old Broad-street, City, has just started a hydraulic passenger lift of exceptional size. It has a total travel of 90ft. and a solid steel ram measuring 5⅜in. in diameter by about 95ft. in length. Two other lifts in the building have a travel of 80ft. each, and all work at a speed of 250ft. per minute. They are on Stevens and Major's hydraulic balance system, and are made by Messrs. Archibald Smith and Stevens.

IN connection with the water supply of Sydney the aqueducts at Simpson's Creek and Elladale Creek, half a mile from the cataract, have been completed, and the water admitted. The aqueducts are 8ft. in diameter, and capable of conveying 150,000,000 gallons of water per day. Two other aqueducts on the line of the canal at Mullaly Creek and Ousedale Creek are now ready for the reception of water. The last contract was recently let for laying five miles of 6ft. wrought iron pipes from the Sydney side of Prospect to Potts Hill.

As papers are sometimes read before the Royal Society that are interesting to engineers, it may be mentioned that the Council of the Society have decided that the publication of the "Philosophical Transactions" shall henceforth be in two independent series, one (*a*) containing those papers which are of a mathematical or physical character, the other (*b*) those of a biological character; that the papers in each series form a yearly volume, and that each paper shall be also published separately in paper covers as soon as it is ready for publication.

THE Dover Harbour Bill was read a second time in the House of Lords on the 28th ult., by a majority of five. This is a private Bill, promoted by the Dover Corporation; and it proposes to transfer to the Corporation the property which was vested by a public Act in a Board created for the purpose. No precedent could be found for such a measure. By the new Bill, the property of the Board is to be transferred to the Corporation, who will be able to apply any surplus arising from the harbour to the ordinary expenses of the town. The direct profits arising from a harbour ought not to be expended on anything except the harbour itself.

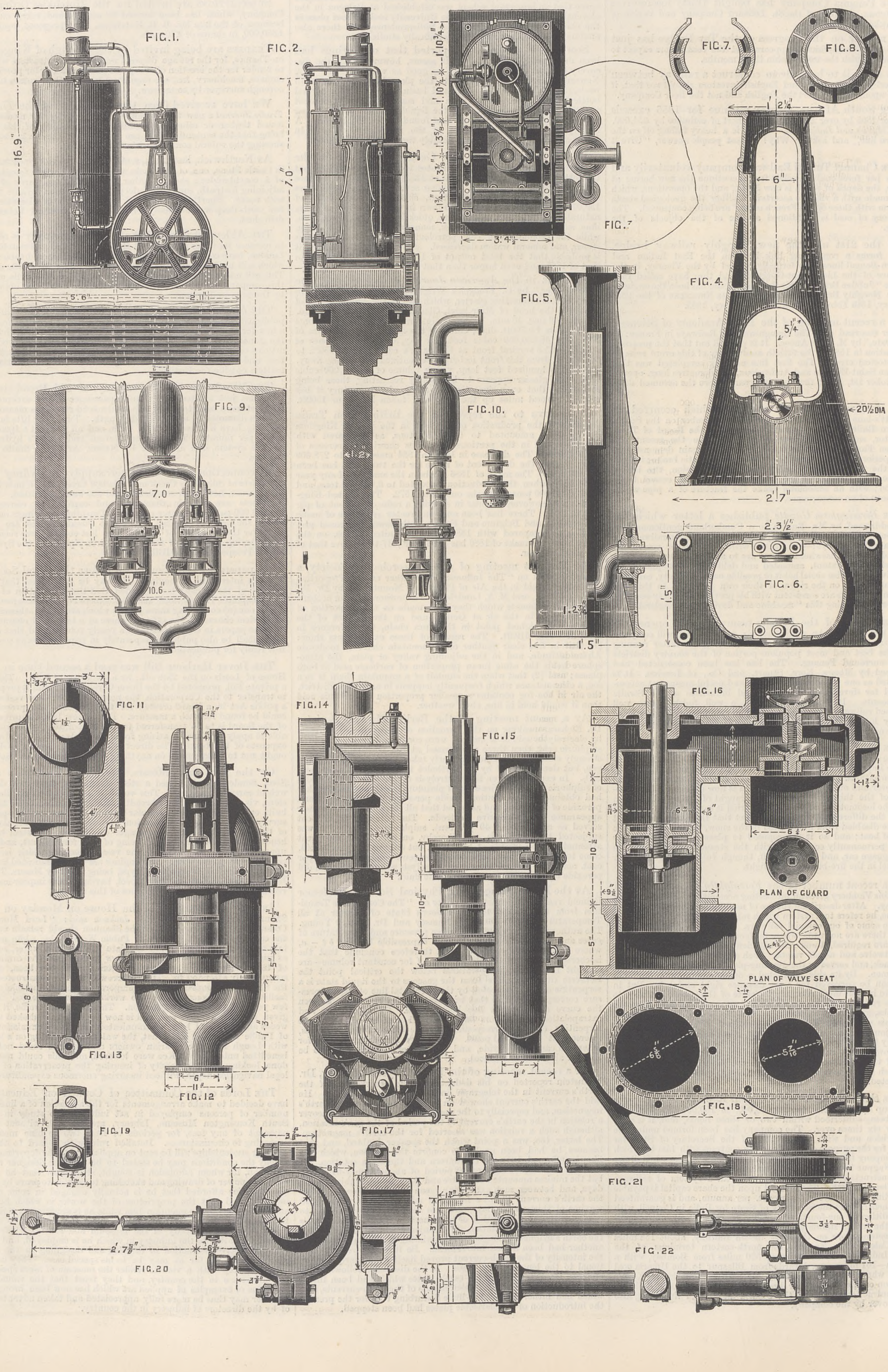
ON the 23rd inst., Messrs. Joseph L. Thompson and Sons, Sunderland, launched a steel steamer of 3800 tons deadweight carrying capacity. This vessel is of the following dimensions, viz.:—Length, 312ft.; breadth, 40ft.; depth of hold, 25ft.; built on the longitudinal cellular bottom system, under special survey for the highest classification, and also under the regulation of the Board of Trade for passenger certificate. Six steel bulkheads are fitted, the main deck being of steel fore and aft, and the upper deck of steel for half the vessel's length, which is also covered with yellow pine. The engines are of 1400 indicated horse-power, of the triple expansion type, being built by Messrs. Thos. Richardson and Sons, of Hartlepool, having all the improvements recently applied by them to engines of this type.

IN reply to a question in the House on Monday on the Shannon Drainage Works, Mr. Jackson said: "Lord Monck's Commission recommended that the Shannon should remain under the care of the Commissioners of Public Works, who, while maintaining the navigation, should regulate the depth of water, so far as might be in their power, with a view primarily to the drainage of the country. This recommendation is, and has been, most scrupulously attended to. The Lecarrow Canal was constructed by the Shannon Commissioners as a temporary measure, and solely for facilitating the execution of the works, but was treated for a few years as part of the navigation. There being no traffic, it was given up fifteen years ago, and is now in great part choked with weeds and silted. I have communicated with the Commissioners of Public Works and learn that, the water surface being on a level with Lough Kee, the riparian owners and tenants could not be benefitted unless Lough Kee were lowered, and this could not be done, looking to the necessity of insuring the preservation of the legal navigation depth, without incurring enormous expenditure."

THE Lords of the Committee of Council on Education have decided to make arrangements for the admission of a limited number of persons employed in art industries to study in the South Kensington Museum, Library, and Schools, without the payment of any fees, for periods of from two to nine months according to circumstances. Detailed rules with regard to these working studentships will be sent on application to the department. Briefly the conditions may be stated to be that the designer and workman, for whom admission is sought, shall show that he has sufficient power of drawing and sketching to be able to prove by the opportunities afforded that he is actually engaged in some art, industry, and that the proprietors of the works in which he is engaged undertake to maintain him while he is studying at South Kensington. When admitted the working student will be set, under direction, to study in the museum and art library from examples relating to the industry in which he is employed, and he will also receive instruction in drawing and designing in the art school, suited as far as may be to his special case. They have taken this step with a view to render the museum of more special and direct use to the country, and they trust that the valuable collection of examples of applied art which has now been brought together may thus be more fully appreciated and taken advantage of by the directors of industry in the country.

SIX-HORSE ENGINES AND PUMPS FOR THE INDIAN STATE RAILWAYS.

(*For description see page 170.*)



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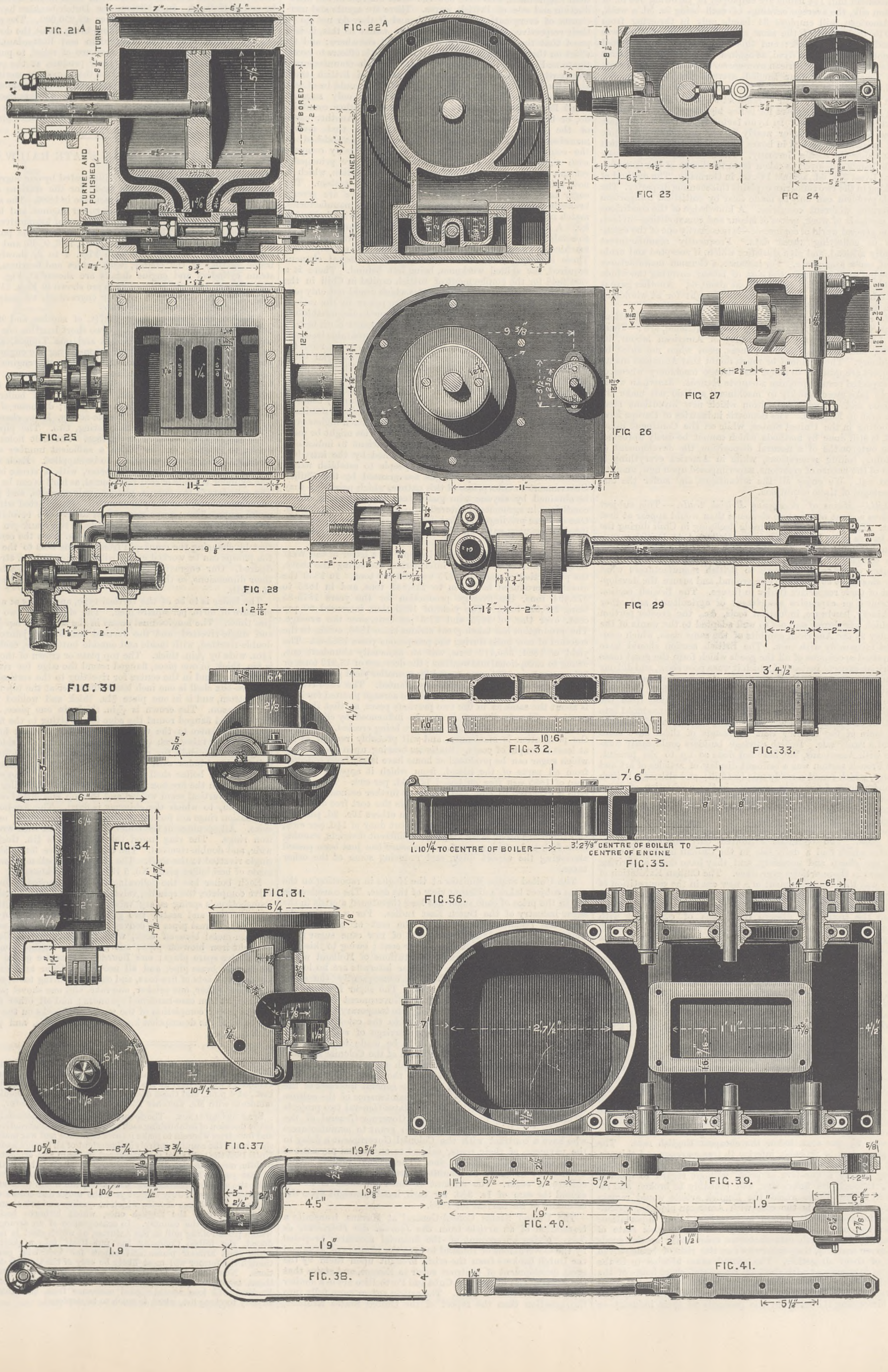


ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Cost of production in Europe and America. — The United States Consul at Tunstall reports that while in a certain Macclesfield mill 144 hands are employed in throwing 500 lb. of Canton silk, the average earnings of each being 9s. 5d. a week, an American mill employs 84 hands only in throwing from 1050 lb. to 1200 lb. of the same silk. Half of this product was turned into sewing silk; and this half had to be subjected to another process and dyed, as against the Macclesfield amount of throwing alone. American average earnings of 22s. 11d. a week give cheaper result than English average earnings of 9s. 5d. Nothing is said in the report of the quality of the work.

At a shoe factory near Frankfort-on-the-Maine the price paid for making the uppers for ladies high-top button gaiters is given at 10½d. per pair. In Lynn factories the cost of the same labour is 5½d. per pair, or nearly 54 per cent. less. A whole boot finished and packed in boxes costs in Lynn 1s. 4½d., which is far below the cost in Germany. The actual earnings per week of the hands employed as taken from the books of the factories, are at Lynn 37s. 6d., against 14s. 6d. in Germany. The method of working in the two countries explains this seeming disparity. The whole problem can only be made clear by statistical comparison concerning different countries. A knowledge of the conditions and methods of work, prices of labour and commodities—in fact, of the general world of commerce—is necessarily one of the essentials in collecting these data. Frequently manufacturers wilfully mislead, and give statistics which, if accepted and made use of, cause annoyance. For instance, a German manufacturer of sewing machines gives the cost of labour covering the whole machine, including the woodwork, at about 6s. Another gave it at higher than the machine can be bought for at wholesale. Both intended to mislead, but for different objects.

The results of inquiry, always bearing in mind the limitations of space and time by which they were controlled, are :—There can be no doubt of the superiority of American labour, its greater efficiency and productiveness, even when not aided by machinery. There cannot be much doubt that American manufacturers are quicker to adopt and change machinery whenever the expected results promise adequate returns. American workpeople take more quickly to machinery, and do not make the factious and obstinate opposition which new inventions meet with even in England. The domestic industries of Europe have no footing in the United States, while on the Continent much work is still done by methods which cannot be easily uprooted, being outgrowths of a natural disposition, the development of plodding, toiling generations, while in America everything is more of the nature of creations, superimposed upon new, uncultivated soil. We enjoy all the advantages, and suffer the disadvantages of these conditions.

Chili.— Means of developing British trade. — This subject involves a great many more elements than would appear at first sight. The cause of British trade declining in Chili during the last twelve years is, perhaps, to be attributed to British manufacturers themselves. The Exhibition of 1875, which brought into competition the manufacturing product of nearly every country, ought to have shown to British manufacturers what they should do so as not to lose ground, and secure the development of their respective trades in future. The British section contained an expensive assortment of agricultural and other machinery, hardware, industrial tools, &c., the greater portion of which was dearer and not so well adapted to the wants of the country as the American exhibits of the same class, which compared favourably with ours. The British section should have comprised specimens of all the goods which form the great mass of British exports, instead of which it was a poor show, and did our manufacturers very little if any good. American manufacturers exhibited a very good selection of almost everything they produce suitable for exportation, with little competition from the British section. American carriages were first introduced into Chili at this Exhibition, and they are so suitable to the climate and taste of the country that thousands of them have since found a ready sale. British carriage builders could easily compete with Americans, but have not done so up to the present. The French section was a brilliant display of articles of art and luxury, which found a ready sale in Chili; and although British manufacturers favourably compete in the production of these articles in Europe, and consequently might do so anywhere else, there was scarcely an article of the kind in the British section. The Belgians, Italians, and Swedes, favourably competed with British manufacturers in many things, from matches to earthenware and glass. The Germans exhibited only samples of those articles which find a daily sale in the Chilian markets because they are cheap and necessary, and they have done a thriving business in those articles ever since. The Chilian Exhibition of 1875 was the commencement of a new era in the competition of foreign manufacturers and merchants exporting goods to Chili. British manufacturers have not during the past eleven years taken the trouble to discern the means of competing with other countries in the importation and sale of articles which they could produce at the same price if they would adopt the same system, and not remain under the belief that nobody else can produce goods similar to theirs at the same price. Other nations have proved the contrary in the most practical manner. The root of the evil may be attributed to two prime causes, and also other important ones of a secondary nature. The fact is that British manufacturers as a rule refuse to produce articles in ordinary use of an inferior quality irrespective of markets. It is well known nearly everywhere that British goods are superior in quality to those of other countries, also more durable, but more expensive. The great mass of consumers being the poor and uneducated classes, ignore this fact, and only purchase what is cheapest. As an example, the Americans do a large trade in hardware in Chili. They can sell a porcelain lined saucepan at 2s. 4d. less than the price of an English one. The iron and porcelain of the former are thinner, and will break, crack, or wear out sooner; but the user overlooks the fact, and only sees the cheapness. Belgian and French earthenware and glass are in a somewhat similar position. Belgian glass is sold 2½ per cent. below the cheapest English rate. The Belgian glass is probably inferior in transparency and thinner, but it sells, and drives the British article out of the market, being simply a question of price, without regard to quality, and, through its inferiority, will probably be broken and replaced several times whilst the English article would remain whole. The same is the case with American ploughs, agricultural implements, hardware, and various other importations from various countries. The only remedy for this state of things is that British manufacturers must make special goods for given markets, they otherwise run the risk of being driven out of them altogether. The second cause alluded to in the report is concerned with the high wages and short hours of the British workman, and suggests that the only practical solution of the question is by the co-operation of employers and employed by interesting the latter in the proceeds of their industry—a system which works well in some countries. Among the other causes to which the decline of British trade may be attributed are the want of competent and energetic travelling agents, ignorance of the language of the various countries canvassed by those already abroad, and the consignment of goods to other than Englishmen, who have not the same interest in the introduction and sale of British wares. There are agents and merchants of every nationality in Chili, and if they do not go to their respective countries to supply the wants of this, it is a proof that they find more suitable articles elsewhere; and no effort on the part of our consular and diplomatic officers to investigate and remedy the causes to which British manufacturers apparently attribute the loss or stagnancy of British trade abroad, even if they could discern the truth, would be of any avail to help them, as these officers can only suggest. Until British manufacturers do as those of other countries do, or better even, this aid will be fruitless. Another cause of the decline of British trade in Chili is that several manufactories have, during late years, been established in the country, chiefly by foreigners, which profitably compete with similar foreign goods imported. These are principally refiners of cane sugar and beetroot sugar production, which is now being worked successfully on the German system. The sugar is of bad quality, but is all sold. There are several breweries, biscuit bakeries, cheese dairies, furniture manufactories, match manufactories, paper mills, rope yards, spirit distilleries, &c. A few attempts have been made by the Chilians themselves to establish native industries, in the belief that with first-class machinery alone the desired object could be accomplished. These attempts have failed through the principal element required, the skilled workmen, being left behind. There is a vast field for the employment of British capital in Chili in the establishment of numerous industries which would not only pay, but pay well. There is a natural motive power in the various rapid rivers which would have been a fortune to the inhabitants but for their indolence. There is but one woollen cloth factory in Chili, situate in Santingo, and doing a small profitable business. The cloth is much inferior to British made. There is room for half a dozen of these establishments, the raw material being plentiful in Chili and the Argentine Republic. There is not a cotton manufactory in the country, all the cotton is obtained from Central America and Peru, the larger quantity of which is sent to England and France, returning manufactured; commissions, freights of both voyages, insurances, &c., being a dead loss, the product has in consequence to be sold at a much higher price than its real value. Numerous other industries might be mentioned, but the foregoing instances are sufficient to indicate to British capitalists what may be accomplished by the introduction of capital, machinery, and workpeople to establish native manufactures. Special privileges are granted by the Chilian Government to enterprises of this nature, which privileges may be obtained by anyone who guarantees the fulfilment of the conditions in agreements entered into with the object desired. One of these privileges is that foreign artisans so introduced into the country enjoy all the advantages granted to ordinary emigrants.

Java: Cultivation of sugar.—In reply to a letter of the West India Committee, asking for information respecting the above, the production of sugar in 1875 was 195,590 tons, In 1880 the quantity produced had risen to 213,843 tons, and in 1885 to 372,494 tons, the average production for the years 1875-85 being 248,920 tons. The yield of 1885 thus increased 90 per cent. over that of 1875, and 37·5 per cent. over the average. The production has taken great strides since 1880, owing to the erection of new mills during the prosperous years 1881-83. The yield of 1884, 386,413 tons, was an unusually abundant one, owing to exceptional fine weather; the decrease of 13,919 tons, or 3·6 per cent., in 1885, was caused by a smaller yield per acre, and not to any reduction in the acreage planted. The 1886 crop is probably equal to that of 1885, and the acreage planted for 1887 is about the same as in the two previous years, so that the production will only differ as it may be influenced by climatic or unforeseen causes. Two new mills are being erected, at present the production is stationary, and will probably remain so for at least a couple of years. Statistics bearing upon the price at which sugar can be produced at home have lately been collected from all parts of the island, from which it appears that the crop of 1885 was free on board 11s. 6d. per cwt. The present crop is expected to cost less, owing to further economies in the manufacture. In some individual mills the cost free on board does not exceed 8s. 9d. per cwt., and in others 10s. 3d. per cwt. The cost of production includes an export duty of 1½d. per cwt., and there are other taxes varying in different districts, running from 8¼d. to 1s. 0⅜d. per cwt. A measure has just been passed abolishing the export duty, and reducing some of the other taxes.

The United States Minister at the Hague in reporting on the same subject takes a different view of the case. The considerable fall in the price of cane sugar has long threatened a crisis in the sugar industry of the Dutch East Indies. For some time the price has remained much below the cost of manufacture. Between 1874 and 1885 the imports of raw cane sugar from Java into Holland diminished 92 per cent.; owing to this condition of affairs many financial institutions of Holland which have made large advances to the sugar interests are no longer willing to continue their assistance, consequently the sugar industry is on the verge of ruin. The sugar interests for some time have been petitioning the Government for relief—usually for the reduction or the complete temporary abolition of the rents due from the manufacturers to the colonial Government; a reduction of the cost of carriage of sugar by the State railways in Java; advances to be made to the manufacturers by the State. In the opinion of the Colonial Minister the Government should neither abolish nor reduce the rents, nor decrease the cost of carriage by the State railways. The Government being convinced that the general interests of the State require as far as possible the maintenance of the culture of cane sugar, has submitted to the States-General two projects of law. According to the first the Governor-General of the Dutch East Indies will be allowed to grant to manufacturers who have a contract with the Colonial Government a delay in the payment of their rents, subject to an annual payment of 6 per cent. on the amount due. The second project allows advances to be made to manufacturers who freely follow the culture of sugar. The amount of these advances is not to exceed the sum of 1s. 3¼d. for each hundredweight upon the estimates of the harvest for 1886.

The United States Consul-General at Havana transmits a translation of an article from the *Journal des Fabricants de Sucre*, giving an account of the financial measures proposed by the Government of Holland to save the planters of Java and the Dutch bankers from the crisis brought upon them by the great development of beetroot sugar in Europe, and states that the bankers and planters of Cuba and Porto Rico are in a similar condition to those of Java. The article enters more fully into the question than the report of the United States Minister, states that the condition of the planters in Java is desperate, and that salutary measures must be adopted without delay. The stoppage of the sugar industry in Java would throw half a million of labourers out of employment, who would go to increase the large number of Malay pirates. In consequence of their close connection, a commercial crisis in Java would be followed by one in Holland. In addition, the Dutch bankers have lent the planters sums amounting to over £8,250,009. The ruin of the planters in Java would therefore bring about the downfall of the largest bankers of Amsterdam and Rotterdam. The Dutch Ministry has decided, as a measure of relief, to purchase from the planters five-eighths of their produce at the price of 13s. 1½d. per cwt. At present prices this imposes a sacrifice on the State of 1s. 8d. per cwt., or upon the total production of over £1,500,000. Advances are to be made to manufacturers on the security of their crops, and a colonial bank is to be established which will give special attention to loans to planters.

PUMPS FOR THE INDIAN STATE RAILWAYS.

The engines, boilers, and pumps illustrated by our engravings on pages 168 and 169, are those made for the stations of the Indian State Railways under contract late in 1886. The specification describes them as six-horse power engines and boilers, with pumps for supplying water for the use of locomotives from wells 100ft. deep. The engine and boiler and the pump in position in a well are shown at Figs. 1, 2, 3, 9, 35, and 36, on pages 168 and 169, together with Figs. 4 to 8, showing the frame casting of the engine, with guides and bearings. The steam cylinders and engine details are shown at Fig. 20 to Fig. 29, page 169, and pump details are shown in Figs. 11 to 19, page 168. In description of our engravings we may take particulars from the specification :—

"Each of the pumps is to have 27ft. of suction and 99ft. of delivery pipes, in 9ft. lengths, also two short lengths, one of 4ft. and one of 6ft., two quarter bends and one T-piece, and all necessary pump rods and guides for connecting the engines and pumps, the pumps being about 80ft. below the engine. The general dimensions of the engines, boilers, and pumps are as follows :—Diameter of steam cylinder, 8in.; length of stroke, 10in.; diameter of boiler, 3ft. 2in.; height of boiler, 7ft.; number of conical water tubes in ditto, two; diameter of pump barrel, 6in.; stroke of pumps, double-acting, 12in., changeable to 8in.; number of pumps, double-acting, two. The pipes are to be flanged and machined on the face. The bolt holes to be drilled to template, and for which a sufficient number of ¾in. bolts, with 10 per cent. extra, are to be supplied. Each engine has one steam cylinder 8in. diameter, with a stroke of 10in. The cylinder is made of cold-blast metal, as hard as can be bored. The cylinders of the pumps, pistons, valves, seats, and guards are of gun-metal, and the piston-rods of copper, fitted with gun-metal nuts. The pumps are geared to give one revolution to four of the engine. The large wheels have two crank-pin bosses in each, one at 4in. and the other at 6in. from the centre, so that by changing the crank-pin from the one boss to the other, the pumps can be worked either with an 8in. or 12in. stroke, as desired. Our engravings give the whole of the details, with their dimensions, so that it is unnecessary to describe the pumps at length.

The boiler is to be of the vertical type, and works at a steam pressure of 60 lb. per square inch. The shell is in two plates, ⅜in. thick. The longitudinal seams in the shells are lap-jointed and single-rivetted, and the vertical seams butt-jointed and double-rivetted, with inside and outside butt strips, each strip 7¼in. wide by $\frac{5}{16}$in. thick. The top plate or crown of the boiler is ½in. thick, in one piece, flanged round the edge for rivetting to the shell, and in the centre for rivetting to the vertical tube. The fire-box shell is one inch less in diameter at the top than at the bottom, and is in one plate ⅜in. thick and welded in the vertical seam. The crown is $\frac{7}{16}$in. thick, in one piece, dome-shaped, and flanged round the edge for rivetting to the fire-box and in the centre to the vertical tube. The fire-box has two conical water tubes each $\frac{5}{16}$in. thick, welded on the sides and flanged at the ends for rivetting to the shell of the fire-box; suitable hand-holes with wrought-iron doors and straps are fitted to the boiler shell for cleaning the tubes. The vertical tube between the fire-box crown and the top of the boiler is ½in. thick, the vertical seam welded and the top end fitted with an angle iron, to which the chimney is fixed. The fire-hole and foundation rings are formed of forged rings machined on both sides. All openings in the boiler shell are fitted with wrought-iron rings. The ring round the man-hole is ⅝in. thick, 4in. wide, and double-rivetted. The other rings are 3in. wide, and single rivetted to the shell. The chimney is bell-mouthed, and made of best boiler plate, No. 5 B.W.G. in thickness.

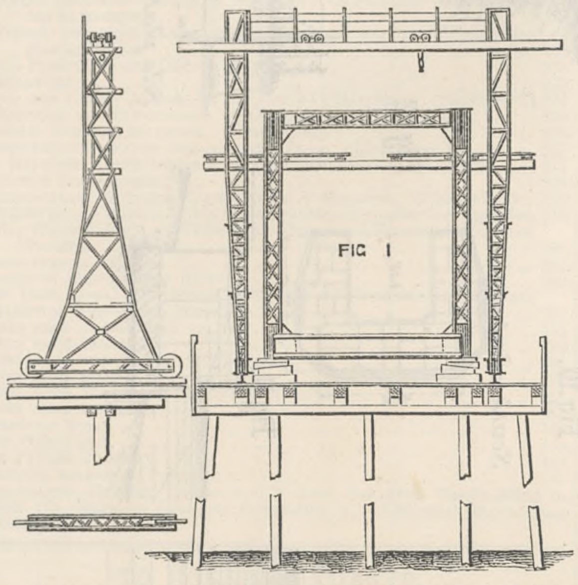
Each boiler has the following fittings attached. One stop valve complete, the spindle, valve, and seat of gun-metal; two Ramsbottom's spring safety valves, on one casting, with gun-metal valves and seats; two gauge glasses, with gun-metal fittings and brass pipes to convey the water into the ash-pit; one gun-metal blow-off cock, with wrought iron handle; one wrought iron blow-off pipe; one gun-metal fusible plug seat, and twelve spare plugs; one Bourdon's pressure gauge up to 80 lb. and brass pipe, and all necessary steam and exhaust-piping; two sets of fire-bars, and one set of firing tools, consisting of one poker, one pricker, one rake, and one shovel; one set of wrought iron case-hardened spanners; and all other fittings for the proper completion of the work. All cocks on the boiler are to be of the description known as Dewrance's, and packed with asbestos.

An Exhibitors' Club has been formed in connection with the Manchester Royal Jubilee Exhibition. A meeting of exhibitors will be held at the Victoria Hotel on Tuesday, the 8th inst., at 4 p.m., and those desirous of joining the club should communicate with Mr. Fletcher Tonge, Pendleton, Manchester.

Spanish Ordnance.—The Spanish Government has definitely come to the decision of establishing such steel works and constructive shops and foundries wherein to make its own ordnance and war material as shall make the country entirely independent of all foreign assistance. Until 1885 the only steel manufactured in Spain was cemented and puddle, mostly used up by the producers themselves, but in October of that year a Bessemer steel works was started at Bilbao. However, the cholera breaking out soon after, the works were stopped until 1886, when in July of that year the works had orders on the books for 18,000 tons of rails, which in quality and price came into competition with the English ones, which hitherto had been chiefly used in the country. In consequence of an arrangement with a plate-rolling mill in the Asturias, at which steel is not produced, the Bilbao Company has put itself into a position to make steel armour plates and others for industrial purposes, though the former will most likely be only of the thinner descriptions. Now that the Government works are to be established, these, together with the Bilbao one, will make it possible that England will lose another good customer from the unhappily already too long list, which is much to be deplored.

SWING BRIDGE OVER MASNEDSUND, BETWEEN THE ISLES OF FALSTER AND SEELAND, DENMARK.

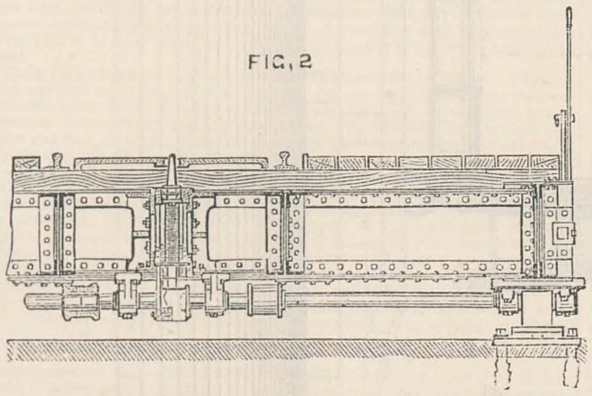
This bridge, like the railway of which it forms a part, has been constructed with a single line. The river over which it passes is 190 m. wide. On the south side the bottom slopes gently to an average depth of 7 m., near the quay of the station of Masnedsund, which stands on the border of the Sund on the north. The bed to the depth of 16 m. is composed of a firm clay, mixed with quantities of boulders; this has rendered the work of excavation very difficult. The piers are sunk into this bed, and good foundations obtained; their depth is 11 m. below the sea level. Below this bed is a second, formed of a less resistant clay, 25 m. deep; and under this, again, is a third stratum of hard limestone. The foundations are thus well calculated to resist the blows of the blocks of ice driven by the current, which at times is very strong in this place.



STAGING AND CRANE FOR ERECTING AND MOVING GIRDERS.

The currents being strong, the bridge has been made 187 m. long, so as not to encroach upon the free passage of the water more than is necessary. The swing span is in the middle, and is 55 m. long; the fixed portions are 66 m. long respectively. The ordinary form of quadruple lattice of 6·3 m. deep, forming an angle with the horizontal line of 45 deg., has been adopted for the fixed spans. The parabolic form has been given to the girders of the swing bridge; firstly, because it corresponds to the theoretic weight curve; and, above all, because it presents the smallest surface to the wind. This is all-important in order to facilitate the working, because if the direction of the wind made an acute angle with the bridge, one of the arms of the turning-bridge would be sheltered by the fixed part of the bridge, while the other would receive the full pressure.

FIG. 2



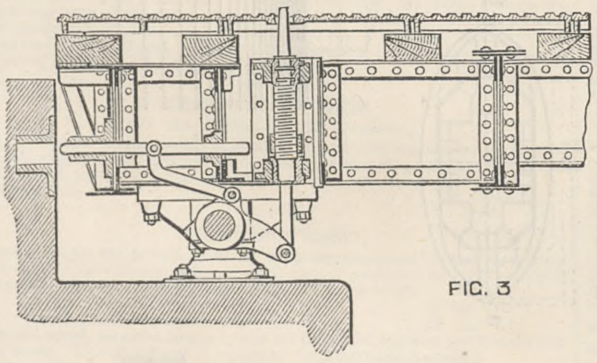


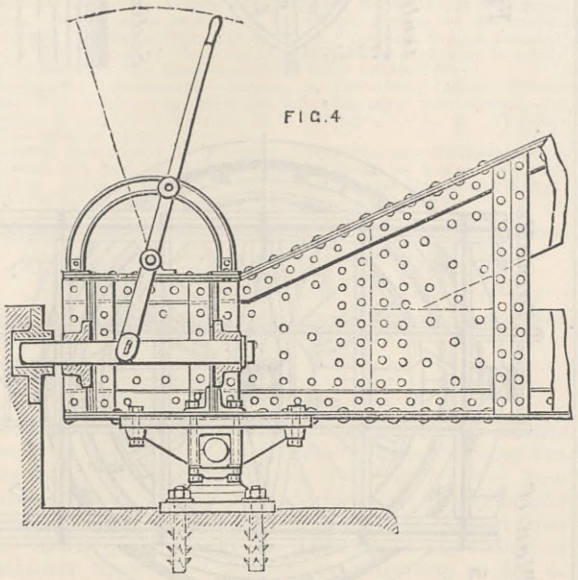
FIG. 3

MECHANISM FOR RAISING AND FIXING END OF SWING SPAN.

The swing span rests on sixteen rollers, which turn upon a circle having a central pin of 0·32 m. in diameter. A part of the weight of the bridge has been thrown upon this pin in order to relieve the rollers. The bridge is worked by means of two vertical windlasses, which set it in motion, by means of a pinion gearing with the large horizontal wheel, 17 m. in diameter, which rests on the surface of the centre pier.

From an architectural point of view the bridge is well designed. At its extremities are placed Gothic turrets, and on either side of the opening portion of the bridge also turrets have been erected to do away with an unsymmetrical effect produced by the difference in form of the girders. The north abutment is founded on a slope of 0·40 m. 60 piles, with an abutment of concrete 1·50 m. thick, crowned with blocks of dressed granite 0·30 m. thick. The south abutment is on a slope of 3·50 m. A depth of 1·50 m. of concrete has been sunk in a cradle of pine, and on the bed thus formed a block of hard brick masonry has been built, which, in its turn, is protected by a wall of granite.

The piers are oval and protected at the foot by starlings for breaking the ice. They are 13·50 m. long and 6·30 m. wide, the central pier being 8·50 m. in width. The composition of the concrete of which the piers are made is as follows:—Portland cement 1 part; sand, 3 parts; broken stones, 6 parts. The rest of the masonry is built of well-burned bricks cased with granite. The base of the piers is protected by a cylinder of plate iron about 5 mm. thick. The whole of the masonry is laid in cement. The foundations of the abutments were made in coffer dams. The foundations of the piers were built in the iron cylinders, which are loaded with a ring of masonry of 0·60 m. thick, which was supported on the inside of the cylinder by small iron brackets. As the cylinder descended the earth was removed from the inside. To dig up and extract the materials from the inside of the cylinder, a Priestmann's excavator was used, but not very successfully, in consequence of the compactness of the bed and the great quantity of boulder stones; often it was found necessary to loosen the earth first by means of dynamite. When once the desired depth was attained they proceeded to fill up the cylinder with the concrete; the designs given—Figs. 1 to 5, page 172—show clearly the construction of the girders and framework in all their details.

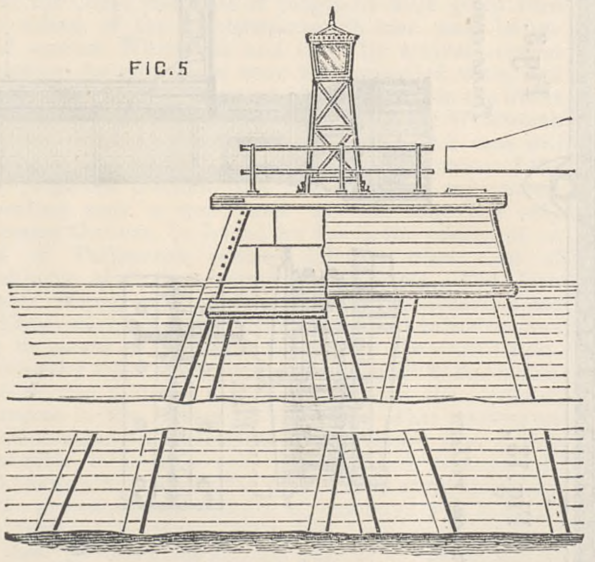


SUPPORT AND CATCH FOR END OF SWING SPAN.

The fixed girders are on either side of the swing bridge, rest on cast iron plates fixed to the masonry, while the ends on the abutments rest on cast iron expansion chairs and rollers of 0·28 m. diameter, the construction of which is shown on page 172. It will be seen, Fig. 13, that a partly circular form has been given to the rollers, that they might not exceed in length that of the supporting plate, while the same facility of expansion was given to the girders. It will be seen, also, that the mechanism employed to produce the rotary movement of the swing span is enclosed in the central pier, and protected by a wall of 0·75 m., which is protected in its turn by iron plates fixed on to the girders. This arrangement was adopted on account of the small depth which had to be dealt with. When the bridge is shut the two ends are lowered by means of excentrics worked by two screws, which prevent the bridge from turning, and drive the iron bolts into the sockets fixed on to the piers, as shown in Figs. 2 and 3 annexed. When there is no wind one man can work the machinery, but a very little wind increases the difficulty of the work.

The girders were temporarily connected upon a wooden staging, and mounted by means of a crane moved on rails.

FIG. 5



DOLPHIN—SIDE VIEW.

It would lift 3000 kilogs., as shown on Fig. 1 above. As soon as the bridge was finished it was tested by an ordinary locomotive with twelve trucks laden with rails being passed over it. The weight corresponded to 1 ton per 0·32 m. run. The result was satisfactory, the greatest deflection being 28 mm.; and on the bridge being opened the drop of the free extremities was found to be 12 mm.

When the bridge is open the movable girders are very liable to be hit by the passing ships. To prevent this two dolphins have been constructed above and below the bridge, as shown at Fig. 5 above, which serve to support the two ends of the bridge during the passage of ships. The dolphins are each supplied with a small lighthouse. The expenses of constructing this bridge have been as follows:—

	Francs.
Masonry of the piers and abutments	413,000
Iron framework	240,000
Dolphins	16,000
Administration and sundries	31,000
Total	700,000f.

These sums represent 47f. per 100 kilos. for the ironwork; 100f. the cubic metre for the masonry. The total weight of the framework is 508,000 kilogs., which may be divided thus:—

	Kilogs.
For the two fixed spans	370,000 of iron. 10,800 of cast iron. 1,500 of steel.
For the swing-bridge and the mechanism	101,300 of iron. 21,800 of cast iron. 2,600 of steel.

This bridge will much shorten the distance between the isles of Falster and Seeland, and do away with the inconvenience of transhipment. Our engravings and particulars are taken from *Le Genie Civil*.

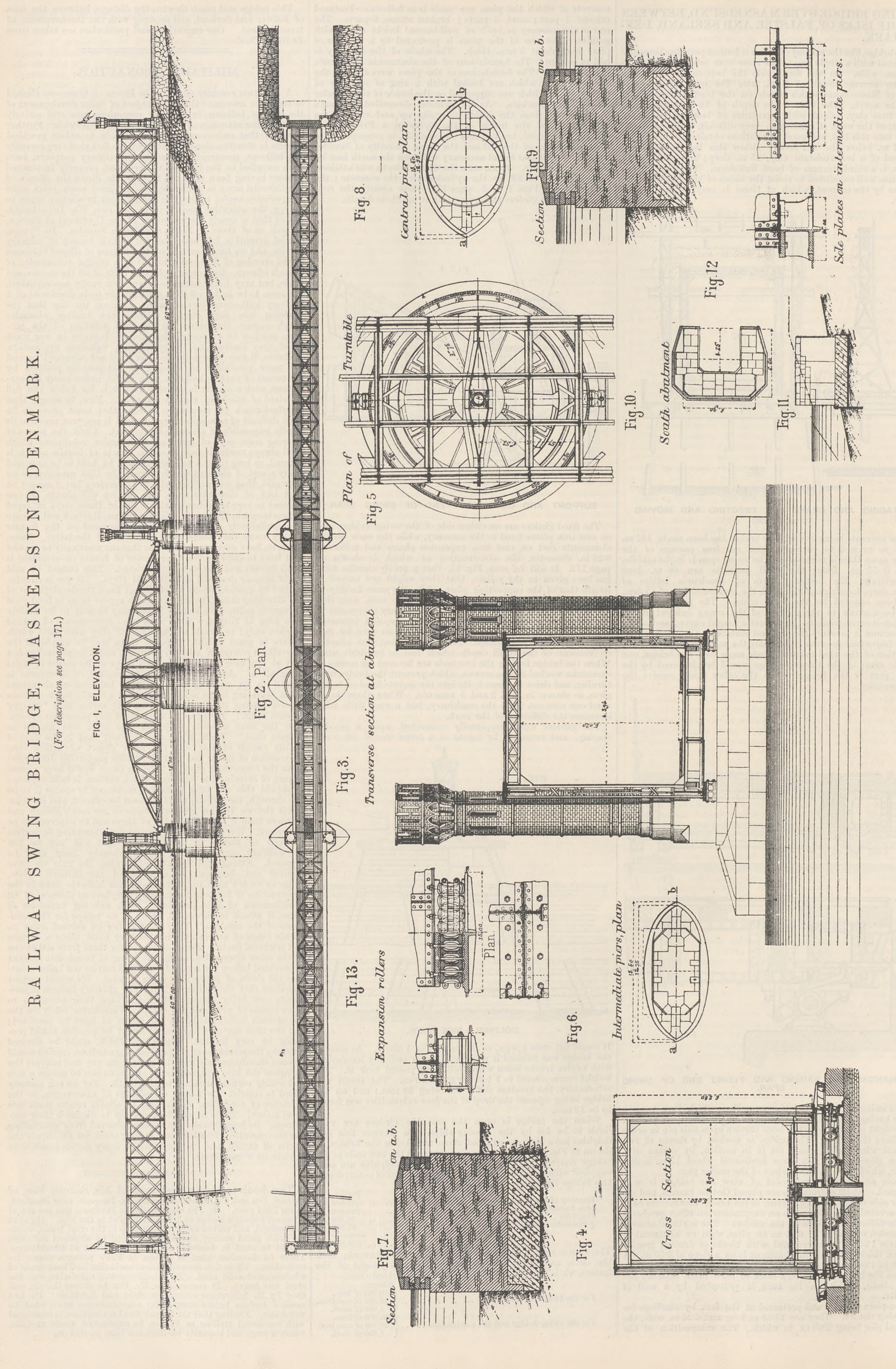
MILITARY ÆRONAUTICS.

A question recently asked in the House of Commons elicited in reply the assurance that the subject of fuller development of the use of balloons in military operations was still actively engaging the attention of the authorities at Woolwich. Further evidence that endeavours are being made to attain practical success in this direction is afforded by the fact that very recently two balloons, constructed specially for military purposes, have been supplied to the Chinese Government, properly instructed persons having been sent out to China to direct the officers of the Celestial army in their use. It is a good many years since the probable useful employment of balloons in warfare began to occupy the attention, not alone of our own War Department, but of that of nearly every country of the Continent of Europe, as well as of those of North and South America. In France, special attention has been directed to this branch of military service, and we have heard from time to time of alleged successes in the steering of balloons achieved by a special commission of French officers. But, nevertheless, in spite of all the endeavours made, but very little seems to have been really accomplished. We seem to be as far off from securing the main *desiderata* of a military ballooning service as we were on the day that the question was first started. Until the leading obstacles which oppose themselves to the full solution of the problem set can be overcome, the use of balloons in war must be of very limited and, comparatively, valueless application. Hitherto, it may be strictly said, we have not advanced beyond the mere possibility of viewing an antagonistic position by the means of captive balloons. No doubt, under many circumstances, such a facility is valuable, but it is far below the full standard of efficiency that is aimed at. Now, to secure that standard much yet remains to be done that must prove to be most difficult of accomplishment, even if it may not prove to be wholly impossible of ultimate attainment. Until the power of steering some sort of aerial machine under conditions which shall always render it safe from the effects of hostile attack is secured, so long must a military balloon be held to be only and solely a sort of elevated watch tower. In that capacity, as we have said, they will undoubtedly be of service; but it cannot be kept out of view that even that service will always be one exposed to very considerable risk. For in these days of rapid improvement in the arts of military and naval attack and defence it is sufficiently evident that the attainment of the former quality more than keeps pace with that of the latter. Guns, hitherto, have overcome all armour that can practically be applied—at least to ships—while their power of future development is to all intents and purposes unrestricted. This cannot be said of the armour designed to withstand them. Its use is circumscribed by considerations which do not limit the development of the attacking arm. The same relations appear to us to hold good as regards military balloons. These may be said to be mainly—so long as they are what they are—instruments of statical defence only; as much so indeed as if they were solid watch towers of great height. Against them may be employed the marvellous powers of modern artillery, and a single lucky shot may at any time deprive an army corps of its means of aerial observation. As long as power of control of movement is denied to us, so long must military balloons—at all events while operating in the neighbourhood of a hostile force—remain captive during their use. It is an old saying that "history repeats itself." In the naval warfare of our preceding generation the most efficient projectile was what was known as "chain shot." With it was accomplished what in the days of sailing vessels of war was the main object of attack—the destruction of masts and spars. Similar projectiles discharged from the long-range guns of modern times would have a great chance of severing the rope by which a balloon is held captive; or should this not offer sufficient resistance to enable it to be cut through, the balloon must at least be overset, and its occupants thrown to the ground. Balloons are costly things, and no more than a limited number of them can be expected to be in reserve. We may be sure that whilst attempting to perfect balloons as means of observation, sight will not be lost by military men of the means whereby they may be crippled. Attack will probably—following the rule we have pointed out—become the superior of the defence. Now, so far as we are able to judge, there has hitherto been in the construction of balloons for military purposes an absence of all consideration of this postulate. With existing examples of these, if attack is successful, there is no escape for the occupants of the machine. They must either be carried away to within range of an enemy's influence, or must incur a certain and frightful death. Means of escape for them from either one or the other alternative, unless the power of immediate descent is provided before the force of the wind carries the balloon outside the circle of protection, there is none. We would suggest therefore that those charged with our military balloon experiments now being carried out should turn their attention to some means of provision for escape. Parachutes ready for the use of each individual in the car might at least be provided; but the time during which escape might be possible would probably be very limited. Means, we think, could be devised whereby the severance of the rope holding a balloon captive would at once simultaneously free the globe from gas and convert the collapsed silk into a parachute of sufficient size to ensure a safe and nearly vertical descent to the earth. For we can scarcely afford to restrict the ascent of balloons of observation to the existence of conditions which must invariably render them safe from attack. To do so would be greatly to diminish their usefulness. So long therefore as we are debarred from controlling the movements of free balloons, so long must we anticipate the result of attack, and be prepared by every means possible to obviate its worst effects.

The death took place last week of Mr. Samuel Fox, of Samuel Fox and Co., Stockbridge Works, Deepcar, near Sheffield, in his 72nd year. Mr. Fox was a native of Bradwell, and the son of a weaver's shuttle maker in a remote hamlet in the hills. He went to Sheffield, and served an apprenticeship in the steel trade, working with great energy and industry until he acquired sufficient capital to start in business on his own account at Stockbridge. There he invented what is known as Fox's paragon frame for umbrellas. Up to this time the ribs of umbrellas had been made of whalebone or solid steel. The whalebone was unreliable, and the steel was heavy. It occurred to Mr. Fox to groove the rib, and thus by its hollowness secure elasticity and lightness. He had made a fortune before many other manufacturers knew what he was doing. Finding that the French fiscal arrangements interfered with successful trading in France, he established works at Lille, where a large and lucrative business has been carried on.

RAILWAY SWING BRIDGE, MASNED-SUND, DENMARK.

(For description see page 171.)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

CONTENTS.

THE ENGINEER, March 4th, 1887.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

J. S. BURTON (Newcastle-on-Tyne).—*A letter lies at our office for you.*

E. M. (Llanelly).—*The best non-condensing engines use about* 3 *lb. of coal per horse per hour; the best condensing engines, about* 2½ *lb.; the best compound condensing engines, about* 1½ *lb. A pound of coal will evaporate from* 6 *lb. to* 11 *lb. of water, according to the quality of the boiler and of the coal.*

W. McG. (Workington).—(1) *We do not understand your question. What do you mean by the "force" of a fly-wheel? Do you want to calculate the controlling power of the fly-wheel—that is to say, the range of variation in the speed of the engine during any revolution?* (2) *You will find the information you need about the pumping engine in the "Proceedings" of the Institution of Civil Engineers, vol. lxxxvi.*

W.—*The result you aim at could not be attained, because no hydraulic or other machine can be made to give a useful effect equal to* 100 *per cent. of the power expended on it. Theoretically, any body, be it water, a stone, a mass of earth, &c., in falling from a given height, does as much work as would suffice to raise it to the height from which it originally fell; but there is no surplus left to overcome friction and other sources of waste.*

R. T. C.—*You would not gain any advantage by forcing cold air under the grates of puddling furnaces. Many years ago hot air was so applied by Messrs. Fox, Head, and Co., Newport Mills, Middlesbrough, with a considerable saving of fuel. The load on your girder may be taken as distributed, and the stress in tons on the flanges will be* $\frac{W L}{8 D}$; *W being total weight in tons, including weight of girder, L = length, and D = depth, both in feet or both in inches. D must be taken as the depth between the centre of area of the flange sections, excluding rivet holes. Taking a factor of safety of four, you may put a stress of, say,* 4·5 *tons per square inch of section on the flanges. Your upper flange will have excess strength. Covers,* 2s. 6d.

CASTOR OIL PRESSES.

(To the Editor of The Engineer.)

SIR,—I shall be very much obliged to any of your readers who will give me information concerning the method of extracting oil from the castor bean which has been found to answer best in practice.

March 1st. H. ORCHARD.

SUBSCRIPTIONS.

ADVERTISEMENTS.

MEETINGS NEXT WEEK.

SOCIETY OF ENGINEERS.—Monday, March 7th, at the Westminster Town Hall: Ordinary meeting. Paper to be read:—"Bridge Floors; their Design, Weight, and Cost," by E. Olander, A.M. Inst. C.E., of which the following is a synopsis:—The great difference in bridge floors makes comparative analysis desirable—Old and new methods of estimating loads on railway bridge floors—Timber floors—Iron-plate floors—Comparison of weight, strength, and cost—Modern trough floors—Analysis of various sections—Questions of "distributive length"—Road bridge floors.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, March 7th, at 8 p.m.: Cantor Lectures. "Building Materials," by W. Y. Dent, F.C.S., F.I.C. Lecture IV.—Asphalt described Timber: causes which promote its decay—Methods adopted for its preservation—Description of the creosoting process—Painting. Wednesday, March 9th, at 8 p.m.: Ordinary meeting. "Railway Brakes," by William P. Marshall; Sir Frederick Bramwell, D.C.L., F.R.S., vice-president of the Society, will preside.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, March 10th, at 8 p.m. Paper to be read:—"Reversible Lead Batteries and their Use for Electric Lighting," by Desmond G. FitzGerald, Member.

SOCIETY OF ARCHITECTS.—Tuesday, March 8th, in the Freemasons' Tavern, Great Queen-street, W.C., at 7 o'clock p.m.: Ordinary meeting. Paper to be read:—"Registration," by R. Walker, A.M.I.C.E. (Cork).

SOCIETY OF CHEMICAL INDUSTRY.—Monday, March 7th, at Burlington House. Papers to be read:—"M. Hermite's System of Electrolytic Bleaching," by Messrs. Cross and Bevan. I. "Castner's Sodium Process;" II. "A New Method of Elevating Liquids specially applicable to Acids," by Jas. Mactear. The discussion will be taken on April 4th.

GEOLOGISTS' ASSOCIATION.—Meeting at University College, Gower-street, W.C., this evening, when the following paper will be read:—"A Revision of our Lower Eocenes," by G. F. Harris, F.G.S., &c. The chair will be taken at 8 p m.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—Saturday, 5th inst., at the Cannon-street Hotel, at 8 p.m.: Quarterly meeting. Paper to be read:—"The Modern Marine Engine and Boiler," by Walter Swanson, late chief engineer of the s.s. Inverleith.

THE ENGINEER.

MARCH 4, 1887.

THE RATING OF MACHINERY.

THE recent decision of the Superior Courts in the appeal of the Tyne Boiler Works Company against the Assessment Committee of the Tynemouth Poor Law Union, upon an assessment made by the overseers to rate machinery assumed by the appellants to be exempt from such liability, has placed the question of the rating of machinery upon so unsatisfactory a footing, so far as the interests of industrial and manufacturing enterprise are concerned, that it has become imperative some steps should be taken to alter the state of the law as it has been laid down by the Court of Appeal. No preceding judgment in the Upper Courts has been so searching and far-reaching in its consequences, in regard to the rating power of overseers, as it has conclusively established the fact that henceforth all machinery—light or heavy, whether movable or attached to the premises, or for whatever industrial purpose it may be used—must be taken into consideration as enhancing the rateable value of the premises on which such machinery is found. The judgment given by the Master of the Rolls has been made to decide, amongst other cases, the one known in the Manchester Court of Quarter Sessions as the "Whitworth Case," in which the firm of Sir Joseph Whitworth and Co. had appealed against the assessment made by the overseers upon some light machines hitherto held exempt from liability to be so assessed. Practically, as the Tyne Boiler Works case was under argument at the time, the Court said that if judgment were given then the ruling of the Bishopwearmouth case must be upheld against Whitworth and Co. By mutual consent therefore the arguments were not proceeded with, and eventually upon the judgment given recently in the Court of Appeal in the Tyne Boiler Works case, the Whitworth case was decided against the appellants. This case will not be carried to the higher Courts, as the terms of the last judgment preclude the possibility of any success attending such a step; and at this time the only easement that can be hoped for lies in the passing of an Act of Parliament strictly defining what class of machinery shall be exempt from rating. The Iron Trades Employers' Association, whose headquarters are in Manchester, has taken a prominent part in endeavouring to secure a legislative remedy for the existing unsatisfactory state of the law, and a Bill with this object in view was prepared for presentation to the House of Commons in the session of 1886; but other matters so much occupied the attention of the House that it was impossible to proceed with the proposed measure. A Bill has now been drawn for presentation at an early date in the present session which it is considered will meet all the required purposes. This Bill proposes to enact—(1) that "in estimating for the purpose of assessment to the poor rate, borough rate, or any other rate leviable upon property rateable to the relief of the poor, the rateable value of any tenement or premises occupied for any trade or manufacturing purposes, the annual value of the machinery in this section specified upon such tenement or premises shall be taken into consideration; that is to say (*a*) fixed motive powers, such as water-wheels and steam engines, and the steam boilers, donkey engines, and other fixed appurtenances of the said motive powers; (*b*) fixed power machinery, such as the shafts, wheels, drums, and other fixed appurtenances which transmit the action of the motive powers to the other machinery, fixed and loose; (*c*) pipes for steam, gas, and water. (2) Save as in the last section provided, no machinery or plant, whether attached to the tenement or premises or not, shall be taken into consideration in estimating such rateable value." This Bill has received a most hearty support in the different centres where the ironmasters have branch associations, and in these districts petitions have been signed in favour of the Bill, in which it is set forth that the petitioners, being engaged in industrial and manufacturing enterprises greatly affected by the present uncertainty as to the operation of the law in regard to rating, pray that the House will pass the above Bill, and will thus remove the existing uncertainty in the application of the law, and, subject to the exceptions named in the Bill, will ease the manufacturing enterprises of the kingdom of a very onerous burden which seriously affects the cost of production in the several trades in which the petitioners are engaged.

A PROFESSOR ON ENGINEERING LITERATURE.

THAT professors of physics have a very solid contempt for engineers is pretty generally understood. To this we need take no exception. The feeling is reciprocated. On both sides its expression is restrained at once by native courtesy, and the circumstance that facilities for expressing it are not plentiful. Now and then, however, the professor gets his chance, and he takes it. A notable example is afforded by *Nature* of last week. In it will be found a review of Mr. Anderson's treatise on the conversion of heat into work. The review is signed with the initials, "P. G. T.," which are sufficient to identify its author. It is indeed impossible to believe that any one other than a professor of physics could have written it. If the author had confined his attention to the work which he reviews we should have said nothing about the matter; but he uses the book simply as a peg on which to hang a diatribe on engineering literature. What, for example, do our readers think of the following? "From the purely scientific point of view, there are two prominent faults in the majority of such works as those before us. The first is the habitual use of a special 'vernacular,' not quite so outrageous, perhaps, as 'pidjin' English, but quite on a par with a 'wire,' a 'cable,' an 'aniline,' and such-like monstrosities of recent American origin. Were the words of this vernacular different from those of strict science, our only complaint against their use would be that we should have to learn what would be practically a new language; but they are, in the main, the same words, and yet each stands for other than the accepted meaning." We fancy that this will be news for engineers. The passage as it stands is not very clear. Lest the reader should be at a loss to understand what "P. G. T." means, he goes on to give examples. We find from these that engineers perpetrate the enormity of writing about pressures in terms of tons or pounds per square inch. "Thus," says the critic, "we constantly find pressure given as so many tons per square inch; sometimes the word 'square' is omitted." "What," the distracted engineer may ask, "am I to say?" "P. G. T." will not enlighten his ignorance. He only vouchsafes to tell us that "tons per square inch, or pounds per square foot, refer to matter and not to force. They measure, in fact, what is called surface density." At the outset of his review, "P. G. T." tells us that there are a few exceptional books on engineering, the majority written by the late Professor Rankine, which are free from such defects as those pointed out above. Yet Rankine has not hesitated to talk of pounds on the square inch or on the square foot. It is difficult, for example, to open his treatise on the "Steam Engine and other Prime Movers" without coming across the expression. However, to attempt to justify the use of words which are properly employed and perfectly understood would be mere waste of time.

Having so far explained what the first defect of engineering literature is, "P. G. T." goes on to define the second. It is yet more grave. "It consists in the fundamental misuse of well-settled scientific terms which the author of an engineering book usually perpetrates whenever for a moment he deserts his vernacular and passes from the applied to the pure part of his subject." Before giving examples of this grave defect, he incidentally attacks Mayer, and succeeds in introducing a very ingenious hyperbole. Here it is:—"This shows how deep a root has been taken by the extravagant laudations of Mayer, which were so common twenty years ago, but which have long since been thoroughly exploded." Laudations which can take root and then be thoroughly exploded are not things to be spoken of lightly, we take it. They may be relegated to the company of the birds of the air which, according to Sir Boyle Roach, lived from hand to mouth. Having fired his shot at Mayer, "P. G. T." once more takes Anderson in hand. It seems that this gentleman is so ignorant that he has actually written: "Dividing 3,942,400 foot-pounds per minute by 33,000 foot-pounds, we get 119·4-horse power." This expression strikes "P. G. T." as synonymous "with dividing £500 a year by £50, we get £10 a year, which contains essentially the same absurdity."

Reading this, we are in doubt as to whether "P. G. T." really has any idea what the expression means. As a matter of fact, Mr. Anderson is strictly correct when he says that 3,942,400 foot-pounds are to be divided by 33,000 foot-pounds to get the horse-power. What does 33,000 mean? Simply the number of foot-pounds of work done in one minute, which is equivalent to a horse-power; and Mr. Anderson is guilty of no inaccuracy or improper use of terms in stating what the figures 33,000 are intended to convey. This becomes much more apparent if instead of the mutilated sentences quoted by "P. G. T," we give the whole. "It is frequently more convenient to speak of the *rate* at which work is being done than of the total work performed. The unit rate of work for large quantities has been taken at 33,000 foot-pounds per minute, and is called a horse-power. The work of getting up the speed of the train occupied six minutes; hence the rate of work was $\frac{23{,}654{,}400 \text{ foot-pounds}}{6 \text{ minutes}}$, or dividing by 33,000 foot-pounds we get 119·4 horse-power, which the locomotive exerted in producing the accelerated motion of the train." Nothing can be more neatly put than this, "P. G. T." to the contrary notwithstanding. We cannot give all "P. G. T.'s" illustrations. Our readers must rest satisfied with one here and there, unless indeed they read the whole in the columns of our contemporary. Here is another:—"If bodies are elastic. . . The whole of the energy of the striking body is expended in producing motion in the body struck." This, in "P. G. T.'s" opinion, is so bad, that nothing which follows can surprise him; and yet the statement may be perfectly true. It is a fundamental truth that at every instant of the impact of two bodies the sum of their momentums ($M_1 v_1 + M_2 v_2$) of the two bodies is the same as before the impact took place. Let the conditions of collision be such that the striking body is brought to a state of rest, then the body struck must be put in motion, and will carry away with it the whole of the energy previously in the striking body. This, as Mr. Anderson shows, is proved by a well-known experiment. Two ivory balls are suspended from a frame, one of the balls is drawn to one side and permitted to strike the other ball. The first ball is brought to rest, the other is set in motion.

After all, it is at least pleasant to find that in "P. G. T.'s" opinion Mr. Anderson's work "may be made, even as a whole, thoroughly useful to those habituated to the persistent inaccuracies of the 'vernacular,' but to effect this it must be thoroughly purged of statements analogous to the three last-made quotations." Of the three we have given one. The other two are of still smaller moment.

Before taking leave of "P. G. T.," it may be as well to point out that to every profession belongs what may be termed its own vernacular. The lawyer and the physician, as well as the engineer, have their own language. To attack engineers, writing for engineers, because they use terms and methods of expression perfectly understood in the profession, is not hypercriticism; it is simply impertinence. The assertion that engineers in general write inaccurately comes with a very bad grace from the physicists, who are open at every turn to the charge of inaccuracy, because no two of them employ certain important words in the same sense or with the same meaning. We may cite two or three examples. Thus, some physicists use the phrase "potential energy," others will have none of it, and employ the phrase "energy of position." To one set of men there is nothing wrong or absurd in the word "attraction;" others, in common with Newton, hold that attraction has no existence; while a third set employ it, it is true, but with strict limitations. The word "force," again, is a well-known example of difference of opinion. Professor Tait has defined it in terms which are accepted as accurate by none but a limited number of his own pupils and admirers. Finally, we may be excused if we hint that, with all its defects, the literature produced by engineers has done more real good to the world than the literature of school men. Whatever a select few may think to the contrary, an investigation into the cause of the economy of the triple expansion engine is more likely to prove valuable to the world than Sir W. Thomson's demonstration that the sun cannot continue to warm and light the earth for much more than 6,000,000 of years. George Stephenson did more for the human race than all the professors of science the world has ever seen put together. The professor is useful in his sphere. He is honoured and honourable. The world is content for the most part to take him as being worth to it what he say she is, and it follows that the life of a professor is usually that of a man whose lot has fallen in pleasant places. But as a rule he does not understand engineers, their methods, or their language, and he never shows to worse advantage than when, as in the present case, he takes it upon him to criticise them. He will find pleasanter employment in carrying out investigations, and explaining, after the engineer has, Columbus-like, broken an egg and so made it stand, why it stands. His wisest course will be to let the engineer go his way in peace, and confine his attention to his own work. *Ne sutor ultra crepidam.* Let us not be misunderstood. There are engineers, in the fullest sense of the term, filling chairs in our colleges all over the kingdom; to those gentlemen what we have said does not apply. They were engineers before they were professors. Indeed, they must share with Mr. Anderson the contempt of "P. G. T." Are they not engineers using a vernacular?

FRENCH TELEGRAPH CABLES.

THE student of metaphysics who examines closely into the question of why England obtained her commercial supremacy will probably come to the conclusion that something besides iron and coalfields enters into the solution. Too little attention has been paid to the effect of the inherent gambling spirit which imbues the Anglo-Saxon race. Anything in the shape of speculation is sure to find friends, and the more hazardous the risk, with, of course, correspondingly great returns if successful, the more favour it meets with amongst certain portions of the speculating fraternity. Of olden days history tells us how argosies filled with merchandise were sent out to trade in known, and at the time of starting, unknown markets. They were to find new markets if unsuccessful in their bartering in the old markets. Spain sent her legions to despoil the natives and hold them in subjection. English merchants risked their capital to found new factories or centres of trade, from whence too they ultimately subjected the natives. The one commenced with military occupation, the other ended with it. The one ruined the countries over which it obtained sway, the other rendered those previously unknown countries of some account in the civilised world. The trait of the English character to which we have referred will perhaps account for the nation having in several directions taken the initiative in important work, and developed industries which have become the envy of other nations. This success has led other nations into a fierce competition with us—a competition to which there can be no objection in the abstract, if carried out on the ordinary commercial lines; but in many instances the competition is not a fair one, and is fostered and bolstered up by appeals to the taxpayer. One such case is in its inception, and will bear consideration.

The submarine cable industry has invested in it between thirty and forty millions sterling. It employs some thirty to forty of the finest ships ever built in the yards of Great Britain, equipped with apparatus evolved during thirty years' experience to a state of almost absolute perfection. This is hardly exaggerated language when it is stated that a thread of about 1in. in diameter is found and picked up from the bottom of the sea some two or three miles below the ship's keel, examined, mended, and replaced Why has this industry developed in English hands? The answer is simply that France and America in the fifties and sixties thought the risk too great, and refused to assist with a maravidi. After the experience has been bought, after the work is mostly done, France has lashed herself into jealous fury, and would at once jump into the shoes of the English companies. Therefore the Minister of Posts and Telegraphs, M. Granet, is supporting a Bill in the French Chamber, which has for its ostensible object the connection of France to her American colonies without the aid of an English line. The real object is to ruin the English companies, and to attempt to foster the manufacture of cables in France. No doubt such an industry might be fostered, but at what cost?

About 1845 the Brothers Brett, of Hanover-square, made overtures to the English Government to telegraphically connect England and Ireland; the negotiations were not successful. Subsequently, propositions were addressed to the French and Belgian Governments, with the result that lines from Dover to Calais, and from Dover to Ostend, were ultimately laid. Successful in these enterprises, which returned excellent dividends to the speculating investors, the Brothers Brett extended their operations. Working under the auspices of the Governments of France and Piedmont, they formed a company to connect Europe telegraphically with Africa, again being successful. The Brothers Brett were ably seconded in their work by English engineers and capitalists, but they got no aid from foreign investors. Hence cable factories arose in England, and have since flourished. Thirty years ago messages of twenty-five words cost 8s. to Calais, 12s. to Paris, 22s. to Berlin, 22s. to Vienna, and to other places in proportion. Coding was then unknown, and a message was in plain English. Now a message to New York costs 6d. a word, and one word is perhaps used instead of fifty; cases are known where it has been used instead of a hundred. The aim of these pioneers was to join places which would bring business to the company and a return to the shareholders. Colonial dependencies, mother countries, politics and politicians, were unthought of, except so far as they could aid in making a company prosperous, the promoters of the companies being far-sighted enough to see that such costly undertakings could not succeed unless they were virtual monopolies. The value of cable connections was acknowledged, and various Governments granted sole rights of landing to the pioneer companies. Hence up to the present time the Submarine Cable Company is practically the monopolist of telegraphic traffic between England and the Continent, as are other companies to other parts of the world.

Political considerations are being pushed forward at the present time to the extinction of commercial considerations, and companies which have, upon the faith of Government concessions, expended some millions of money, are threatened by State-aided competition. A certain Count d'Oksya has received the support of M. Granet for a project to lay cables from Pará, in Brazil, to the French colony of Cayenne, thence to Paramaribo, Martinique, Guadaloupe, Mona, Puerto-Plata, to New York, where the line joins the Brest Atlantic cable. Several of these colonies are already under agreements and paying subsidies to lines already existing—lines which can carry five hundred times the traffic they are now called upon to carry. Cayenne is almost the only place not connected with existing cables. That colony has been connected, but the cable failed, and the company is said to have lost £300,000 over the failure. The commercial value of cables direct from France to Guadaloupe and Martinique can be estimated by the fact that the number of messages the year before last averaged less than three per day; the returns of last year are not yet complete, but the average has not increased. The French nation is asked to pay £40,000 a year for twenty-five years to a company to be floated, as soon as the promise is obtained, with a capital of just over £1,000,000.

This company is to lay cables of French manufacture between the places mentioned; and the staff is to be wholly French. Suppose the cables laid. The first thing done would be to try and force business by lowering the rates; and of course a company practically formed by a Government would not hesitate to force its rivals from the field. Hence the project, if carried out, presents a bad outlook for the existing companies. It should be said that the promoter of this scheme is not a Frenchman at all, but is said by M. Granet to be a Pole; and how the French company was to be all French, yet controlled by a Pole, could not be understood by the French Chamber, which referred the project back to the Budget Committee.

The tale thus briefly told is only one indication among a large number that tends to show English capitalists how keenly this question of competition is to be fought out. Political unrest in France makes it convenient to push the cry, "Everything of this country and for this country," without considering whether the work under discussion is really possible in the country. In the case mentioned, we believe there is a saving clause, which will permit the company to go outside France if the work cannot be completed otherwise in a given time; and undoubtedly this would be done if a company alone were concerned. But when a Government really provides funds it will readily extend the time initially allowed, especially as the delay would arise from having to build factories, construct machines, teach men, build ships, and gain experience in handling them under special conditions. The principle involved is that to which attention is directed, as not one but many industries may find their prosperity waning under similar influences.

SHIPOWNERS AND THE TRIPLE-EXPANSION MARINE ENGINE.

THE triple-expansion marine engine may now fairly be said to have passed the experimental and entered on the practical stage; and this fact is very generally, although not universally, recognised by shipowners. A number of well-established instances are on record which prove beyond a doubt, that vessels fitted with machinery adapted for a working pressure of about 150 lb. are capable of performing long voyages with perfect ease and safety, and with a very considerable economy in the matter of coal. With this fact before them, and stimulated no doubt by the extreme difficulty of making anything out of their vessels, owing to the low rates of freight obtainable, shipowners are considering in what way they can obtain the benefits which are to be had from the adoption of the improved system. Many ships are almost new, and of the enormous number built within the last ten years, the greater part are still serviceable so far as the condition of their boilers goes. What will be done with such ships is not easy to foresee; but it is likely that the newest of them will be kept running for some time at least, even if they do no more than make ends meet. When the freight market feels the effect of the more economical working of the improved vessel, as it sooner or later must, then the position of the older ships will be worse than it is now. In fact, they will find themselves "out of the running" altogether.

A few shipowners still maintain that they can do as well with their old type compounds; but the number is rapidly diminishing, and the best commentary on such an opinion is the fact that the screw engines in course of construction throughout the country are almost, if not quite, exclusively of the triple-expansion type. This being the case, the course of an owner intending to build is tolerably clear. He has only to specify three-crank triples in order to have the best that modern engineering can give him, and the price he will have to pay should be very little, if any more, than he has been paying for similar powers. If, however, he has a fleet of ships which suit his trade, and which he cannot afford to sell at the prices obtainable just now, he must face the problem of how best to make them suitable for present circumstances. Two courses are open to him: (1) He may clear out the existing engines and boilers and replace them by an entirely new set of machinery; or (2) he may fit new boilers and alter the old engines so as to adapt them to the increased pressure. As this latter course appears to be the one most easily carried out, and is certainly the least costly, we will examine it somewhat carefully. Before doing so, however, it may be well to point out that as steam at 150 lb. pressure when used in properly designed triple-expansion engines has been found to be more efficient by about 25 per cent. than steam of 75 lb. used in ordinary compound engines, it is possible to reduce the size of the boilers proportionately, assuming, of course, that it is not intended to increase the indicated horse-power. For the same reason the coal bunkers may be reduced in capacity to a like extent without interfering with the distance to which the ship may steam without coaling. Any plan of alteration which is to give the best results to the owner must take into account the possible increase of carrying capacity which may and ought to be obtained in this way. In this connection, too, it is proper to remark that owing to the greater efficiency of the steam at the increased pressure the diameter of the low-pressure cylinder may be considerably reduced—for example, a triple-expansion engine having a low-pressure cylinder 53in. diameter will be found to develope as much power as an ordinary compound engine with a low-pressure cylinder 60in. diameter, the piston speed being the same in both cases.

Assuming that it is desired to convert a set of two-cylinder compound engines into the newer type, there are practically only three ways in which change can be effected. All of them, as a matter of course, contemplate the complete removal of the old boilers and the fitting on board of new boilers suitable for the increased pressure of, say, 150 lb. per square inch. The first and simplest is to place a new high-pressure over one of the existing cylinders, so that one of the engines of the pair becomes a tandem engine, and the former high-pressure cylinder becomes the intermediate cylinder. Secondly, a new high-pressure cylinder may be placed in advance of the existing cylinders, complete working parts being, of course, added with it, including crank-shaft, bed-plate, and valve gear; and thirdly, two new high-pressure cylinders may be arranged over the existing cylinders, each having an area equal to one-half of the total high-pressure cylinder area required, both taking steam direct from the boilers, and both exhausting to the old high-pressure cylinder, which now becomes the intermediate cylinder. The first-mentioned plan need hardly be discussed at length here, as it is open to the grave objection that the engine over which the new high-pressure cylinder is placed is subjected to strains considerably in excess of what the various parts were originally designed to bear, unless, indeed, the power be very much reduced under the new arrangements. For this reason alone, if not for others, this method of alteration is regarded with some doubt, although new engines properly designed and of this type have been made and are working satisfactorily. There are, however, many cases in which engines may be altered in this simple way, with perfect safety and to advantage.

The second mode of conversion mentioned above is not so easy to carry out, as it involves a considerable addition to the weight and number of working parts of the engine, as well as an extension of the foundation for the purpose of carrying the new engine. A considerable amount of valuable space is also taken up by the additional engine, and to make room for this addition bulkheads or bunkers must be taken down and refitted, platforms and floors must be altered, and many things done which cannot well be estimated for, but which are certain to add seriously to the cost of the work. It is worthy of note also that unless it is intended greatly to increase the power developed at sea, all the working parts will be much too heavy for the work they will be called on to perform. In explanation of this, suppose a pair of engines of the ordinary type which have developed regularly 900 I.H.P., and which have been recompounded by the addition of a third cylinder and crank in advance of the old set. As a two-cylinder engine, each crank and connecting rod had to transmit 450-I.H.P. or thereabouts, while as a three-cylinder engine, each set of working parts has to pass only 300 I.H.P. In other words, the entire engine is

33 per cent. too heavy for its work. These drawbacks, however, may not be equally serious in every case, and to shipowners who do not object to carrying the extra weight and losing the carrying and paying space, the three-crank method of conversion may be satisfactory.

The third mode of conversion appears to offer distinct advantages. The parts added are comparatively light and easily overhauled. No alteration is required to be made in engine-room bulkheads, or bunkers, although possibly in some cases it may be necessary to raise the engine-room skylight a little. As the bunkers may be considerably reduced, it will be possible in the great majority of cases to move the boilers nearer to the engines, and throw the whole of the space thus gained into the main hold, either by shifting the main bulkhead, or by making water-tight doors through it. In this way a most valuable addition is made to the carrying power, and consequently to the earning power of the vessel, a point by no means to be neglected in these days of keen competition. There are also minor points of advantage which may be touched on; for instance, the high-pressure pistons and gear generally may be made interchangeable, the least advantage of which is that one-half the ordinary weight of spare parts gives full protection against disablement. As the boiler pressure is admitted to both high-pressure cylinders, engines of this class are very "handy," a point which will be appreciated by owners who have had to repair damage caused by the refusal of engines to go ahead or astern when required. There is another way of altering existing engines which finds favour in some quarters, and which consists of four cylinders of different diameters arranged tandem-fashion over the cranks, the whole forming a quadruple expansion arrangement. This plan has a number of the merits possessed by the triple expansion two-crank arrangement; but it is not as yet proved that any further saving which it may effect will compensate for the greater weight of the boilers necessitated by the higher pressure proper to the quadruple system.

All these methods of recompounding have their advocates, and much discussion has taken place as to their relative merits. For instance, a decided superiority is claimed for the three-crank engine on account of its possible greater smoothness in running: but we have seen no satisfactory explanation given or attempted as to why there is reason to expect greater efficiency. Certainly a mental comparison between three-crank steamers such as the Umbria, America, City of Rome—which last vessel, by the way, has a perfectly balanced three-crank engine—with the Germania, City of Berlin, Furnessia, or John Elder, shows no obvious gain from the mere employment of three cranks, and we very much doubt if any of them run much below $2\frac{1}{4}$ lb. of coal per indicated horse-power per hour. Some people appear to suppose that crank shafts will last much longer in the threefold engines than they have hitherto done in the ordinary compound design; but it should be remembered that crank shafts do not usually fail because of the twisting moments, but because bending strains are produced by the bearings getting out of line, either through unequal wear in the bearings, or because, as an eminent shaft-maker once put it, the shaft was not strong enough to keep the hull in shape. We remember the case of a three-crank engine, carefully designed and constructed, in which, after a year of continuous work, the forward bearing was found to have worn down $\frac{3}{16}$in. Each of the remaining five was worn less and less, the farthest aft of the six showing little or no wear beyond what might have been expected. This case would seem to prove that engines with six main bearings are not more likely to keep in line than those with four.

There are many other points of interest in connection with the whole subject of the triple expansion system which may be profitably considered. In the present article, however, we have endeavoured to select those which more immediately concern the shipowner.

GAS PRODUCTION AND DISTRIBUTION.

A YEAR ago we noticed in THE ENGINEER the accounts of one of the gas companies in the heart of the Durham coalfield; and the publication of another year's balance-sheet enables us to supplement the remarks then made. The company is the Bishop Auckland Gas Company, and it is advantageously situated for the cheap purchase of coal. Its revenue is from the sale of gas, about £4812 yearly—the bulk of it being sold at 3s. 6d. per 1000 cubic feet, but a portion being sold for public lighting. In all there were carbonised by the company during last year 3619 tons of common and 33 tons of cannel coal. The coke yielded was 2438 tons; the tar, 198 tons; and the ammoniacal liquor was 291 tons. The gas sold, apart from that for public lighting, was 25,696,300 cubic feet. The company has a practically closed capital account, the expenditure on that account during the whole of the past year being only £31, whilst this was more than met by the sale of some surplus land. The dividends paid for the year are on the original capital at the rate of £$8\frac{1}{2}$ per cent., and on the additional capital, £5 per cent. These are very handsome dividends at a period of dulness such as the present, but they are based on a sale of gas at what must be considered a high price. The coal, including depositing at the works, cost, on the average, about 6s. 8d. per ton, a price which is less than that of some companies using more, and there are none of the other items of the cost of production which seem heavy. The coke was sold, after deducting the cost of cartage, at about the same price, but other residuals made about the low rates which have for some time been current. The high price of the gas must check its use, and must condemn the mains and pipes to idleness during a large part of the day. The gas companies have yet to learn, in a large number of instances, that a lower price for their production would so stimulate the sale that there would be better results to the shareholders than under the present system of a higher price and a limited sale. When in the metropolis there is the probability of handsome dividends out of the sale of gas at 2s. 6d. per thousand cubic feet, there should be the ability at least to sell it at that price just about the centre of the gas coalfield; and it should not be forgotten that the electric light increases in use, and the high price of gas fosters that increase. At no period in recent history has the price of gas coal been so low as it at present is; and at none has there been the probability of such cheap manufacture. The high prices for residuals have passed away, it is true, but in other respects the gas companies are better placed than ever they were, and if they are wise they will cultivate the trade by producing and selling cheaper than they have been doing, both in large and small areas.

LITERATURE.

On the Conversion of Heat into Work: a Practical Handbook on Heat Engines. By WILLIAM ANDERSON, M. Inst. C.E. London: Whittaker and Co.; and G. Bell and Co. 1887.

IN 1884 and 1885 Mr. Anderson delivered before the Society of Arts a series of lectures, intended to popularise the doctrine that in heat engines the work given out is due to the conversion of the molecular motion of heat into the visible motion which it is intended to produce. These lectures he has collated, corrected, and published in the form of an octavo volume of 252 pages, fully illustrated.

As the book is intended to be practical, in the sense that it shows how the laws of heat as defined by Carnot and others are applied in practice, its pages contain no recondite formulæ. Those who desire to read treatises on the mathematics of heat will find all they want in the treatises of Rankine, Clerk-Maxwell, or Clausius. In point of fact, the results of the investigations of the men we have just named admit of being put into very simple statements and propositions. It is only necessary that the student should have sufficient faith in his teacher to accept what he has to tell him without demanding a proof on every page. Mr. Anderson, however, does not make heavy demands on the faith of his readers, because whenever it is desirable he explains clearly why certain phenomena occur. He begins with a brief investigation of the laws of motion. Next he considers the principles involved in oscillations or vibrations. Then follows a chapter on the properties of gases. The fourth chapter deals with Carnot's laws, sources of heat, and the properties of fuels. The fifth chapter takes up the blast furnace, and contains an admirable investigation of the action of a gun as a heat engine. The sixth chapter deals with heat engines proper, while in the seventh and last he considers various forms of the steam engine and their characteristics. From beginning to end the book is written for engineers, and it is therefore likely to prove more useful to engineers than any work with a similar object produced by a non-practical man for students of physical science. It is not improbable that this proposition may be disputed by some of our readers; yet we think its truth admits of demonstration. In order to prove this, it is not necessary that we should digress far from our principal object to consider the nature of the training which an engineer should receive. It will be admitted that men who know nothing of the theory of heat have built very good steam engines. It cannot be shown that those who know the theory of heat as taught by Rankine or Clausius, let us say, have built better steam engines than those who know little about it. It seems clear, therefore, that for the purposes of the engineer it is quite unnecessary that he should waste time in acquiring information which can be of no use to him in his subsequent career. In other words, there is a certain amount of knowledge of heat which the engineer should possess, and this seems to be very satisfactorily supplied by the book before us.

It would serve no good purpose to consider the contents of the volume step by step. The space at our disposal will be best employed if we reserve it for the consideration of one or two propositions which may be taken as originating with Mr. Anderson, and the soundness of which may or may not be open to question. One of the most remarkable, and certainly the most generally interesting, is nothing more or less than a new theory of the steam engine. Mr. Anderson does not put it forward as a new theory, but that it is one there can be no doubt. This theory is that the whole of the work done during expansion in a steam engine with a metal cylinder is done by the heat surrendered by the metal. It has long been known that the curve of an indicator diagram very closely approximates to an isothermal. After pointing this out, our author goes on: "Since the pressures in expanding have varied as the ordinates of an isothermal curve, it follows that the temperature of the steam has not altered, and consequently none of its heat has been converted into work; but the heat which has been so converted must have been derived from an extra volume of steam which was condensed on the relatively cold surfaces it came in contact with, which surfaces again gave it out as the volume of the steam increased, and so compensated for the waste caused by the conversion of some of the heat into work. In other words, the surfaces of the cylinder acted as carriers of heat from the boiler to the expanding steam."

Now it has long been known that re-evaporation tends to raise the toe of a diagram. Indeed, the circumstance that an indicator traces an isothermal would be inexplicable on any other hypothesis; but this seems to us to be the first time that it has been plainly stated that the whole of the heat converted into work is derived from the walls of the cylinder, its lid, and the piston face. The total quantity of steam condensed in the performance of work is very small—very much less than that which is usually condensed in the cylinder of a steam engine during the full pressure part of the stroke; and there is, therefore, nothing improbable about Mr. Anderson's view. Let us consider for a moment what takes place in an engine cutting off at, say, one-fifth of the stroke. During the first fifth of the stroke it takes steam from the boiler, and of this, say, 20 per cent. is condensed by the cool metal. We have then at the moment when the cut-off valve closes a mixture of steam and water in the cylinder, all at the same temperature, and the water is only prevented from flashing into steam by the pressure. As, however, the piston proceeds on its way the pressure continues to fall, and the heated water then gives out steam. That which takes place in Lamm's hot water locomotive on a large scale here takes place on a small scale. The temperature, however, falls at the same time, because saturated steam cannot have a greater temperature than that due to its pressure. This fall in temperature, however, does not affect the water, which will go on giving off steam, its own temperature being higher than that of the steam in the cylinder. A certain proportion of the water will thus be re-evaporated. The amount admits of easy calculation once the conditions are known. Let us suppose, for example that the pressure at the moment the cut-off valve closed was, let us say, 100 lb. absolute. Now, a pound of water under this pressure will contain 328 units of heat. Let the pressure at the end of the stroke be 20 lb. absolute; 1 lb. of water under this pressure will contain 228 units. The difference is 100 units, and this must go somewhere. It is actually expended in converting a portion of the water into steam. The latent heat of 1 lb. of steam at 20 lb. pressure is the equivalent of 953 units, and as each pound of water can give up 100 units, it follows that about one-tenth of a pound will be evaporated without drawing on the cylinder at all. But the cylinder in its turn cannot help parting with its heat to the water, and thus a still larger quantity will be converted into steam. The exhaust port is now opened, and the temperature falls to that of the condenser; more of the water remaining in the cylinder instantly flashes into steam, and the metal also parts rapidly with its heat during the time the exhaust port is open. During the period of expansion and the period of exhaust the metal must lose all the heat represented by the quantity of steam condensed at the beginning of the next stroke. All the re-evaporation which takes place during the exhaust period is not wasted, and, as we have said, Mr. Anderson holds it to be sufficient to represent the whole of the heat converted into work. It would be quite worth while to discuss the bearings of this proposition, though to do this would, however, lead us far from Mr. Anderson's book. It must suffice to say, that if a cylinder gives back to the steam all the heat it has taken from it, no loss under certain conditions need be incurred by cylinder condensation. In a word, the metal of the cylinder will simply play the part of a fly-wheel. It will take up energy—heat—at one part of the stroke, and give it back at another; but it is tolerably clear that this condition can only be fulfilled if all the water thrown down at the beginning of the stroke is reconverted into steam before the end of the same stroke. This opens up the whole question of the value of jackets. It must suffice to mention the fact here.

Certainly not the least interesting portion of Mr. Anderson's book is his investigation of the behaviour of a heavy gun as a heat engine. The investigation has to all intents and purposes originated with him altogether. It has, as a matter of course, been understood for many years that the efficiency of a gun depends on the amount of the heat due to the combustion of the powder converted into work, but a thorough explanation of what takes place on the heat engine basis has not before been published in a book. The explosion of a pound of powder developes about 1300 units of heat, of which not more than 712 can be realised, or about 245·5 foot-tons per pound of powder. The work done by the discharge of a 10in. gun represents 27,035 foot-tons of external work, and 4011 tons of internal work. The available energy of the powder fired is 73,658 foot-tons; the difference is expended in heating the gun. Mr. Anderson mentions and explains the curious fact that a gun does not begin to recoil until after the shot has left the muzzle. On the whole subject he supplies a great deal of valuable information, and it will not be out of place to say here that long since he insisted on the necessity for carrying the strength of guns further forward than was the practice. Recent failures of guns have confirmed the accuracy of his opinions.

In reading Mr. Anderson's work we have detected in a few places small inaccuracies of statement. None of these, however, are of any consequence, or in the least detract from the value of the volume. There was no doubt felt at the time Mr. Anderson was lecturing that he was supplying a want; and this volume, being more generally available than his lectures, will serve even a better purpose. In nothing is the book more admirable, we think, than in the absence of superfluous matter. There is almost always a tendency manifested by lecturers to say too much—to spin out their teaching to a wearisome point. This fault Mr. Anderson has avoided, and we have no hesitation in saying there are young engineers—and a good many old engineers, too—who can read this book not only with profit but pleasure; and this is more than can be said of most works on heat.

Almanach für die K.K. Kriegs Marine, 1887.

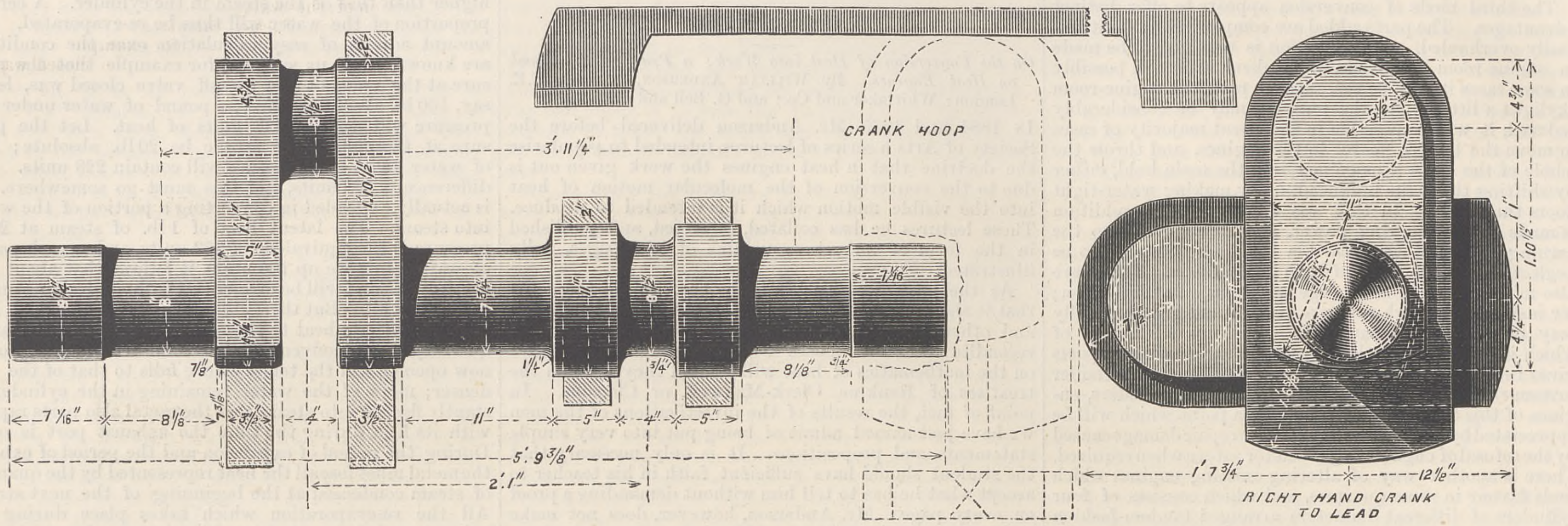
THE edition of the Austrian Marine Almanack for this year has certain important additions, which were necessary to bring this very useful little work up to date, chiefly the new guns of England and France. The work is well known for the value of its information on German matters, and the number for 1886 was well up to date in most respects. We happened, however, to feel the inconvenience of the newest French guns not being in it, as although they were shown in our own naval gunnery book, that work was confidential and could not be quoted. We are therefore pleased to find them in this year's Almanack, as well as the new British guns; and we are glad to commend this work to our readers as one that is now recognised as a valuable book of reference by the authorities in this country.

IRON AND STEEL SHIPBUILDING IN 1886.—The total amount of shipbuilding launched in 1886, as per returns received from the several ports of construction in the United Kingdom, was 481,233 tons, being a decrease of 59,138 tons on the tonnage launched in the previous year.

ENGINEER STUDENTS' ASSOCIATION.—The members of the Association of Birmingham Students of the Institution of Civil Engineers held their fortnightly meeting at the Colonnade Hotel on the 24th ult., the President, Mr. E. Pritchard, in the chair. A paper was read by Mr. Alfred Hill, West Bromwich, on "Waterworks and Water Supply," in which he described the ancient and modern methods of sinking wells and deep borings, also the construction of water towers.

CRANK AXLES, LONDON AND BRIGHTON RAILWAY.

MR. W. STROUDLEY, BRIGHTON, ENGINEER.



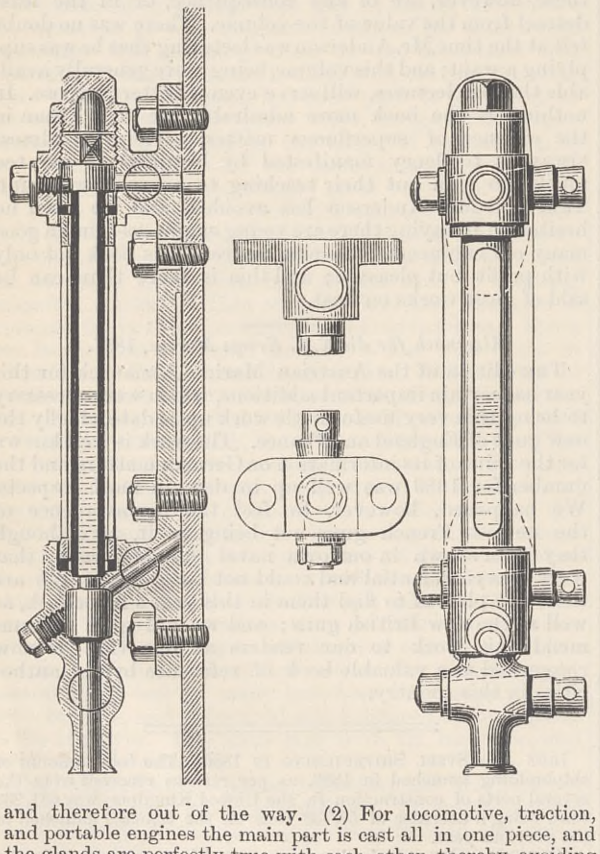
HOOPED CRANK AXLES, LONDON AND BRIGHTON RAILWAY.

It has been pretty clearly proved that the hooping of a crank strengthens it very materially at that part which, from the narrowness of the gauge, is made weaker than it ought to be. In addition to this, it provides, in nearly every case, for the safety of the crank should it break in the usual place through the web, as the engine runs home without causing any delay or damage. The ordinary plain heavy hoop, which Mr. Stroudley has used for the last seventeen years on some classes of engines, interfered with the balancing of other high-speed engines, which had not been fitted with the e hoops, and he has therefore devised the present balanced hoop which we illustrate to counteract this

The engraving shows the crank for B and C class—express passenger and goods engine—with its hoops in position, and also the manner in which the hoop itself is forged and smithed, by which it will be seen that it is an extremely easy hoop to make. The crank is turned on the outer ends of the webs to the mean centre; that end nearest the axle is left in this form, but the crank pin end of the web is slotted to a circle set somewhat excentric to the crank pin, so as to reduce the overhang as far as possible. These hoops are planed on both sides, and bored for the circular end, the other part of the inside being slotted. The hoops are made $\frac{1}{16}$in. shorter than the crank web, and are heated up to a dull red, and are shrunk upon the crank. It makes a very nice-looking piece of work and does not disturb the original balance of the engine, at the same time it is not more costly to make than the ordinary crank hoop, except the trifling extra piece of metal, whilst we are absolutely sure that the weld could not possibly affect the total strength of the hoop itself.

EDDINGTON AND STEVENSON'S WATER GAUGE.

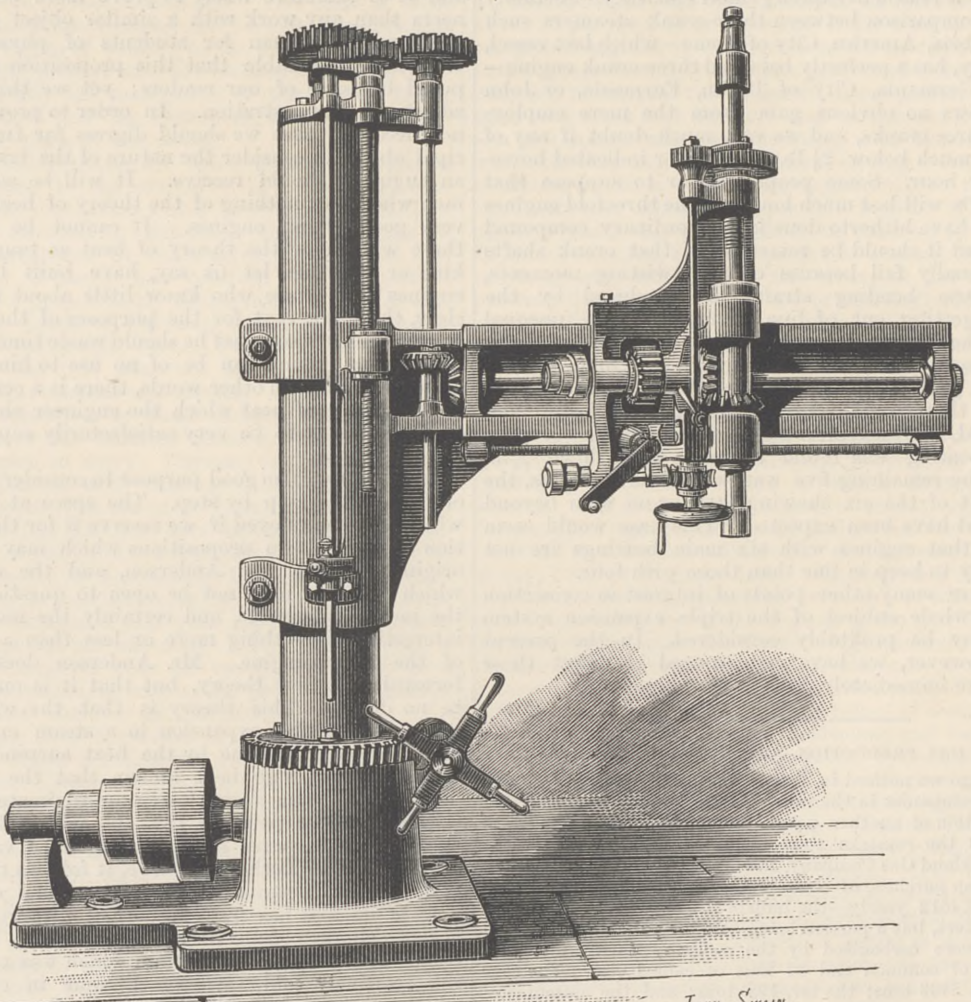
Messrs. Eddington and Stevenson, of Chelmsford, have introduced a new water gauge and cocks, which will be readily understood from the engraving, and for which several advantages are claimed. (1) They are without any reduced neck between the glass and the boiler, making them very strong and practically impossible to break—a very important point in portable engines. They also bring the glass much closer to the boiler,



and therefore out of the way. (2) For locomotive, traction, and portable engines the main part is cast all in one piece, and the glands are perfectly true with each other, thereby avoiding the principal cause of breaking the glass. (3) The glass is inserted in a very simple way, one screw makes the joint at both ends simultaneously. (4) They have much fewer parts than the ordinary gauge. (5) The absence of glands, and the bottom waterway being made on the bevel, the water can be seen in the glass until it gets below the opening to boiler, therefore the bottom hole is fixed somewhat above the top of the firebox, and at same time the usual working level is near the centre of the glass. This is not possible in the usual gauge. (6) The water passages being very short and of large diameter, are not liable to get stopped, and are easy to clear out. (7) All the nuts and screws are of large size and made of Whitworth's standard. (8) The whole gauge can be taken off and refixed in a few minutes, without even taking out the glass. The makers have used these water gauges and cocks on all their portable and traction engines for some time past with very satisfactory results. The arrangement will be clearly understood from the drawing.

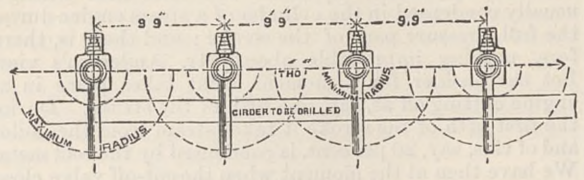
RADIAL DRILLING MACHINE.

MESSRS. G. BOOTH AND CO., HALIFAX, ENGINEERS.



RADIAL DRILLING MACHINE.

The accompanying illustrations show a very useful radial drilling machine, which has been recently designed to drill the rivet holes in girders, wagon framework, &c., constructed by Messrs. G. Booth and Co., Halifax. The machines have a radius



DRILLING GIRDERS.

of 6ft. from centre of pillar to extreme centre of spindle, and will admit an article 5ft. under the spindle, which will allow of a girder being built up and the rivet holes drilled while it is in position. The machine is single geared, driven by four-speed cone running in brackets at the base: it is on the column principle, the external column being turned, bored, and fitted, upon an internal column cast with the base. The radial arm is arranged to rise and fall upon the internal column by means of a screw driven by gearing placed on the top of the column and reversed by lever and shaft shown upon the radial arm. The saddle is moved along the radial arm by screw and bevel gear worked by a handle. The cast steel spindle is 2in. diameter running in a cast iron socket, with taper neck, and lock nuts for adjustment. Self-acting feed motion 10in. deep by screw gearing, and three-speed cone. The feed is stopped or started by the positive clutch on the handle shaft. The wear of the nut for the feed screw is compensated by a gun-metal wing nut fixed on the feed wheel, the nut being adjusted by set screws. When used for drilling girders the machines are placed preferably in sets of four, as shown by the small plan, each being 9ft. 9in. apart, a distance which is sufficient for one drill to work where the other left off, thus enabling the attendant to drill a hole anywhere on a girder 18in. wide and 41ft. long without moving the same. But when the girder exceeds this length it can be moved longitudinally, as it is carried upon bogies running on rails placed upon the floor of the shop. By using this class of machine the girder need not be moved transversely for every row of holes, as is required when using the multiple drill, thereby saving time and trouble in setting the girder under the drill spindle. The machines are strong and proportionately geared to withstand the heavy work of a bridge and girder yards. The shafts are of Siemens steel, and the principal bearings bushed with gun-metal, and the necessary gearing of cast steel.

On the 23rd ult. a fly-wheel at a rolling mill in Marchiennes, weighing about 90,000 kilogs., broke, and split a second fly-wheel, and the two wrecked the iron roof of the building, causing great havoc. Three workmen were killed and thirty-five severely hurt. Nine boilers were at work, and some fear arose that they might explode.

THE MANUFACTURE OF STEEL CHAINS WITHOUT WELDING.

A NEW process for the manufacture of chains without welding was invented some little time ago by M. Oury, chief of the Maintenance Department of the Marine at Cherbourg. After various trials in the arsenal, a factory has been built at Massaelière, near Terre-Noire. The inventor being dead, the French patent has been taken up by a company. The Oury system consists in cutting the chain links into a bar of metal cast and rolled in form of a cross with equal arms. The metal employed has 0·178 per cent. of carbon, and 0·452 per cent. of manganese; its tensile strength is 47 kilogs. per square millimetre, and its elongation is 10 per cent. to a length of 200 mm. The metal will not temper. The bars employed are about 7 m. long, and have a transverse section, the form and half-size of which, for a chain of 18 mm., are shown in the sketch, Fig. 1. This steel weighs about 15 kilogs. per metre run.

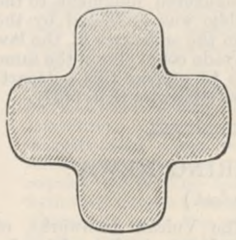


FIG. 1

The company is supplied with the bars ready rolled, from the forges of Terre-Noire. We have only, therefore, to consider the various transformations through which the bar passes. The first operation is performed hot, with a double cutter. The cutter is placed at the door, and operates on the bar as it is withdrawn from the furnace; it passes between two tools which act at the same time, the one descending, the other rising, and producing the notches A, Fig. 2.

The notches are 90 mm. from one another from centre to centre, and the distance between them is regulated with exactitude by the machine.

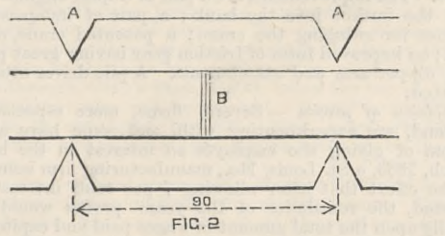


FIG. 2

When the notches are completed over the whole length of one arm of the cross, it is re-heated and passed under the cutter, which acts on the second arm, and produces the notches B exactly midway between the cavities A. The second operation is performed without heat. A workman marks the place where the oblique incisions are to be pierced; these incisions are 45 mm. apart. The boring is done by means

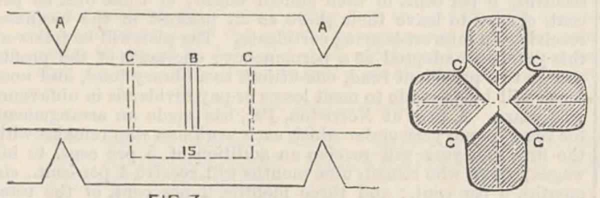


FIG. 3

of small vertical machines and American twist drills, worked by boys; the drills are 7 mm. in diameter and 35 mm. in length. The space between the incisions being 45 mm., a bar would contain $\frac{7000}{45} = 155$ links; the loss at the two ends, however, reduces them to 152 or 153. The third operation is done hot with a double mortice cutter, furnished with curved punches. Each branch of these curved punches has a section straight on the inside, and of a long-shaped demi-ellipsis on the outside. The punches produce the shaded cavities D in the bars; their length is the same as that of the spaces between the

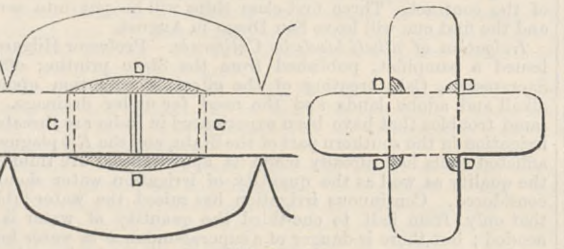


FIG. 4

oblique incisions C, Fig. 4. The distance between the two branches of each punch is a little less than the thickness of the arms of the cross; these tools raise by the fraction of a millimetre the arm placed vertically under the instrument before hollowing out the cavities D. Only a little less than a quarter of the depth of the bar is hollowed out by the first punching.

The fourth operation deepens and enlarges the cavities D, and gives an oval form to the links by wedging back the metal. This operation is similar to the preceding one, the punches only being replaced by larger ones. After the second punching only a line

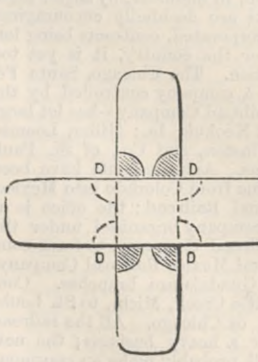


FIG. 5

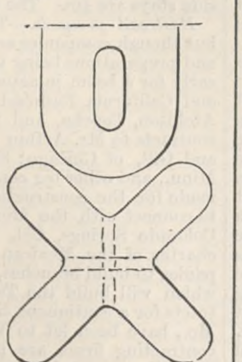


FIG. 6

of space remains between the two cavities—Fig. 5. The fifth operation is done not with a swage or die, its object is to give by stamping and transfer, form to the links. Every bar is heated and passed twice under the swage. The cavities D have now been deepened, and only a thin fin of metal remains. For the sixth operation no heat is required; it is done by two workmen, whose business it is to drive out the thin fin D with a hammer, to cut off the exterior and interior of the rings, then with a pointed chisel to break the adherent parts of the links by a blow. The rupture takes place at the part weakened by the nick C. The links thus detached, the chain is in form, Fig. 7.

The seventh operation is done hot. It consists of shaping the detached links by a stamp of 550 kilogs. The four last operations all relate to finishing and perfecting the work. A link of weldable steel is used for joining the ends of the chains

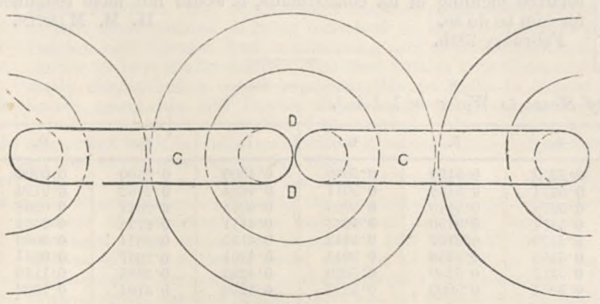


FIG. 7

to each bar. This weldable steel has a tensile strength of 50 kilogs. to 55 kilogs. per square millimetre, and its elongation is 20 per cent. to 24 per cent.

The following figures will show the results of experiments:—Four pieces of chain of three links of 18 mm., presenting a double section of 510 mm., have been submitted to a strain of 15,700, 22,300, 21,200, and 20,700 kilogs., being 30·8, 43·7, 41·6, and 40·5 kilogs. per square millimetre. The two first were broken, and the two last were found equal to the test.

LETTERS TO THE EDITOR.

We do not hold ourselves responsible for the opinions of our Correspondents.]

SLIDE VALVE FRICTION.

SIR,—In your issue of January 28th, on page 78, I observe an interesting description of some experiments which have been made lately on the Chicago, Burlington, and Quincy Railroad, in the United States, on the resistance of slide valves. The *Railroad Gazette*, dated New York, December 31st, 1886, says:—"The method by which the amount of friction was ascertained was simple and ingenious, and leaves little room for error."

I am glad to see that the apparatus which I suggested and sketched, and which is illustrated and described in a letter of mine published in THE ENGINEER of April 24th, 1885, page 316, has so soon borne fruit.

In the apparatus as sketched by me provision was made for taking diagrams simultaneously from each side of the piston in the hydrostatic cylinder, and in order that no error from different areas might arise, I showed the slide valve rod—acting as piston rod in the hydrostatic cylinder—passing through both levers. In the sketch shown by you on page 78, it would seem that the resistance when moving in one direction only is measured, but it appears to me far preferable to take diagrams from both ends of the cylinder, and to find from these diagrams the variations of resistance which occur, and the precise points in the travel at which they occur.

In the results given nothing is said as to the size of the valve, but merely that the greatest resistance of an ordinary unbalanced valve was 990 lb. This, with a travel of 6in., and on an engine making five revolutions per second, gives a speed of 300ft. per minute, or 297,000 foot-pounds, or 9-horse power. The power thus lost appears to be thought lightly of, but it is not so insignificant, and represents a loss of fuel of from 25 lb. to 30 lb. of coal per hour, an amount which many locomotive engineers go to considerable expense in first cost by compounding in the endeavour to save. But it is not from this point of view that I consider the saving to be effected by reducing the friction of slide valves to be important. In the letter referred to, which with your permission I will quote here, I said:—"It is perhaps needless to state that the excessive friction of large unbalanced slide valves, besides being costly in working, leads also to cost in design, the excentrics, straps, and all gear have to be much heavier than would be necessary if friction could be reduced; and in marine engines and inside cylinder locomotives the space occupied by broad excentric straps can ill be spared. There is another loss produced by this great friction which is not measured by the mere horse-power required to drive the sheave inside the straps. This loss is occasioned by the loss of travel of the valve consequent on the spring and eventual wear and tear of the valve motion. From this cause valves may easily lose, after wear has taken place, $\frac{1}{16}$in. or even $\frac{1}{8}$in. travel, whereby the diagram is seriously affected."

I think that the above argument will be admitted to show that the loss from slide valve friction is more serious than has hitherto been considered to be the case, and that it is not measurable in terms of brake horse-power, treating the excentric straps as brakes.

STEPHEN H. TERRY.

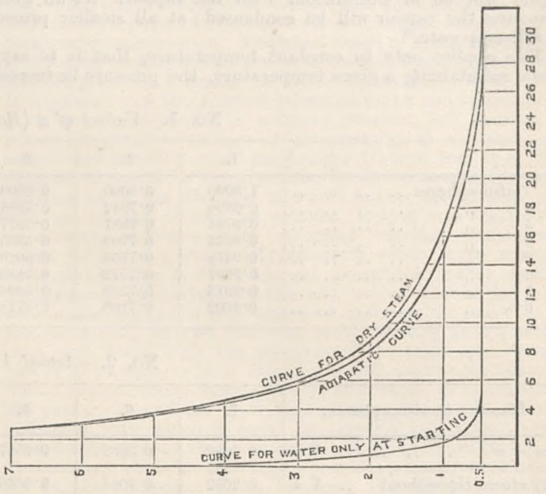
Local Government Board, Whitehall, S.W.,
February 15th.

CYLINDER CONDENSATION.

SIR,—In your leader on the above subject in your impression for February 4th, there are some remarks and criticisms on a letter of mine which call for a reply. Before discussing in detail the various questions raised, allow me to say that I think you have somewhat misunderstood the purpose I had in view when writing my previous letter. In your impression of January 7th you noticed the fact that condensation and re-evaporation actually take place in steam cylinders, and stated that "there seems to be good reason to believe that the presence of water has in some obscure way a powerful influence on the condition of steam," and remarked that the phenomenon had not been theoretically explained, and appeared to be somewhat shirked by scientific writers.

In my letter I attempted to show that as a matter of fact the effect of the presence of water in contact with steam had been theoretically investigated by certain writers, and I mentioned in this connection Rankine and Zeuner; I further pointed out that the results obtained from their formulæ—which are essentially the same—agreed in their tendency with the facts mentioned by you, and showed that both condensation and re-evaporation might take place during the expansion of steam in a non-conducting cylinder, and that the occurrence of these phenomena was greatly influenced by the quantity of water present with the steam at any given time. It is obvious that if re-evaporation can take place in a non-conducting cylinder—where there is no communication of heat from external sources—it will be still greater in those which are steam-jacketted, in which heat may pass from the jacket to the expanding steam.

In your leader the following passage occurs:—"We cannot name a single author who, writing on heat or steam, asserts that condensation and re-evaporation, and then condensation again, can take place in a steam engine. Such a sequence of phenomena is not referred to by Clausius or Rankine, and until we are put into possession of the experimental data on which Zeuner's theory is based, we must, with all deference to Mr. Bodmer, hesitate to accept the statement as true of any conditions which can exist in practice." Now to begin with, the theory referred to is not any special hypothesis of Zeuner's, but is simply the logical result of the application of the particular conditions obtaining in the case of saturated steam to the well-known and accepted laws of the mechanical theory of heat. The particular formula quoted by me for adiabatic expansion of steam in presence of water has been developed by Rankine, Clausius, and Zeuner, and the results it gives may be verified by anyone with the requisite mathematical

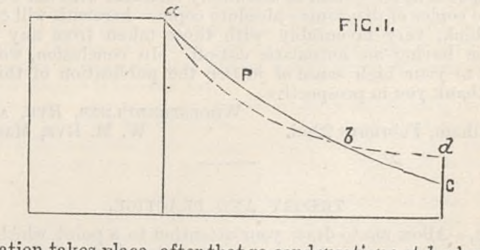


knowledge and tables of the usual quantities applying to steam and of hyperbolic logarithms.

In Rankine's work on the steam engine, page 384, § 281, the formula in question is given, it is essentially the same as those of Zeuner and Clausius. Rankine and Clausius, however, assume the specific heat of water to be constant, the result being that $\int\frac{d\,q}{T}$ can be expressed by J hyp. log. T, where J is the specific heat of water. On pages 385 and 386 of the above-named work may be read under the heading § 283, "Liquefaction of Steam Working Expansively":—" . . . It appears by computation that the volume *u* given by Equation 3 or Equation 5 of Article 282 is less than *v in all cases which occur in practice*, from which it follows that *when steam expands in driving a piston, and receives no heat from without, a portion is liquefied.*" And further on:—"The principle just stated as to the liquefaction of vapours by expansive working was arrived at contemporaneously and independently by Professor Clausius and the author of this work in 1849." The italics are mine. Rankine, it is true, says nothing of re-evaporation; but it will be noticed that he makes use of the expression, "for all cases which occur in practice," by which he probably means when little or no liquid water is present at the commencement of expansion. According, however, to the proportion of water present at any given pressure, subsequent expansion will cause either condensation or evaporation. Through a considerable range of pressures, when the proportion of water to steam exceeds about half, re-evaporation commences, but the proportion varies according to the pressure.

The formula, of course, applies either to expansion or compression, and may be used to ascertain the quantity of water which must be present at any given pressure in order that at another greater given pressure the whole of the steam may be compressed into water. In reference to this matter you say that it is quite apart from Mr. Bodmer's letter, but you will see on again reading the letter that I have particularly noticed this point. I think you will admit that what I have stated effectually disposes of the contention that with a falling pressure there can only be re-evaporation. In the course of your article occurs the passage, "If Zeuner be right, then it is clear that when steam is compressed in presence of a large quantity of water the line of compression will be made up of straight lines and curves." This—if I may be permitted to say it—is quite a mistake; the line of compression will be a perfectly continuous curve. If the curve *a b d*, Fig. 1, represent expansion or compression on the assumption that no changes take place in the relative proportions of steam and water present, then if a sufficiently large proportion of water be present at the beginning of the expansion, *a b c* would indicate on an exaggerated scale the course of the true adiabatic curve; up to a certain point P

FIG. 1.



evaporation takes place, after that re-condensation; at *b* where the two curves intersect, the proportion of steam to water has fallen to its original value, and from thence to *c* is less than the latter.

Within ordinary ranges of pressure, this evaporation and subsequent re-condensation only occurs when the ratio of steam to water is near 0·5, and the evaporation is very slight, the adiabatic curve during this period approximating very closely to that for a constant proportion of steam to water. In general there is either continued condensation or continued evaporation, according to the initial quantity of water present.

It is tolerably clear that if instead of having a non-conducting cylinder, we have—as in practice—one in which heat is at different periods of the stroke abstracted and communicated to the working fluid, condensation and evaporation may be much intensified, and the latter will commence with a smaller proportion of water present than will be the case with a non-conducting cylinder.

In the following table, for various initial values of x ranging from 1 to 0 at seven atmospheres pressure—absolute—the succeeding values assumed during subsequent expansion are given. The initial values of x, the ratio by weight of steam to water, appear in the horizontal line A. In column 1 the figures apply to steam assumed to be in the pure, dry, saturated condition when expansion commences. It will be seen that as the pressure decreases condensation increases, until at the moment when atmospheric pressure is reached, 11 per cent. of the steam has been condensed. On the other hand, if on starting $x = 0$—that is, only water under a pressure of seven atmospheres is present, by expanding down to one atmosphere, nearly $11\frac{1}{2}$ per cent. is evaporated. If therefore we wish to convert the whole of the contents of the cylinder into water, by compression from one to seven atmospheres, $88\frac{1}{2}$ per cent. of these contents must be in the liquid state.

In columns 4, 5, and 6, the values of x for initial values near 0·5 are given, and those which recur during the course of expansion are underlined; the point at which this recurrence takes place is that where the adiabatic curve intersects the curve for a constant proportion of steam to water. Columns 7, 8, and 9, represent continuous evaporation.

In table No. 2 will be found the actual volumes assumed by the steam—1 kilog. (1) Expanding adiabatically from an initially dry condition; (2) expanding so that it remains in the dry saturated condition; (3) expanding from a completely liquid condition. I will be seen that condensation makes a noticeable difference in the expansion ratio. Rankine's well-known formula for the expansion of originally dry steam is purely empiric, devised with the object of facilitating practical calculations, and the results agree approximately with those obtained under the same assumption by the accurate formula.

I venture to think that you have overlooked an important point in the passage from Clerk-Maxwell which you quote:—"Hence, for any temperature there is a determinate vapour density, and therefore a determinate pressure. . . . At this pressure the liquid will be in equilibrium with the vapour. At all greater pressures the vapour will be condensed; at all smaller pressures it will evaporate."

This applies only to constant temperature, that is to say, if, while maintaining a given temperature, the pressure be increased

advanced beyond Rankine's rule of making, by means of trial and error, the line of resistance for varying loads fall within the middle third of the Voussoir joints. For convenience in applying this rule, I lately attempted to calculate for varying loads that line of resistance which should most nearly coincide with the neutral line; but the resulting integrals were of such complexity as to be useless for practical purposes, and I abandoned the attempt.

In conclusion, "J. M. D." may assure himself that if the arch problem was capable of solution without taking account of the relative yielding of its constituents, it would not have remained for him to do so. H. M. MARTIN.

February 28th.

No. 1.—*Values of x (Ratio of Steam to Water in 1 kilo.).*

	1.	2.	3.	4.	5.	6.	7.	8.	9.
A. 7 atmospheres	1·0000	0·8000	0·6000	*0·5370*	0·5130	*0·5000*	0·4000	0·2500	0·0000
6 "	0·9896	0·7942	0·5988	0·5373	0·5136	0·5011	0·4034	0·2568	0·0126
5 "	0·9784	0·7881	0·5977	0·5378	0·5149	0·5026	0·4074	0·2647	0·0268
4 "	0·9643	0·7799	0·5955	0·5374	0·5150	0·5033	0·4111	0·2728	0·0423
3 "	0·9478	0·7704	0·5929	*0·5370*	0·5157	0·5042	0·4155	0·2824	0·0606
2 "	0·9257	0·7572	0·5886	0·5355	0·5153	0·5044	0·4201	0·2937	0·0831
1 "	0·8913	0·7359	0·5806	0·5317	*0·5130*	0·5029	0·4253	0·3088	0·1146
0·5 "	0·8602	0·7160	0·5718	0·5264	0·5090	*0·4997*	0·4276	0·3194	0·1392

No. 2.—*Actual Volumes of 1 kilo. of Steam.*

Pressure in atmospheres.	7.	6.	5.	4.	3.	2.	1.	0·5.	Expansion ratio.
For $x_1 = 1$ .. .. V =	0·2652	0·3032	0·3557	0·4324	0·5578	0·796	1·4711	2·7282	*10·31*
Dry steam throughout .. V =	0·2652	0·3064	0·3636	0·4484	0·5874	0·8598	1·6504	3·1715	*11·96*
For $x_1 = 0$ .. .. V =	0·0010	0·0047	0·0107	0·0199	0·0365	0·0724	0·1900	0·4420	*442·00*

or diminished, condensation or evaporation will be the result. The isothermal curve of saturated steam is obviously a horizontal straight line, as so long as the steam is in the saturated condition—in contact with water—there is a determinate pressure for a given temperature. The temperature being constant, constant pressure must follow.

Although there is much more that might be said on the subject, more especially with regard to the conditions obtaining in practice, I do not venture to trespass further on your valuable space. I have purposely dealt chiefly with the theoretical aspect of the case, and I think it will be seen that in this instance theory does not follow limping so far behind experience as sometimes happens, and as your remarks seemed to imply. G. R. BODMER.

11, Delahay-street, Westminster,
March 1st.

[Mr. Bodmer is at cross purposes with us. What we intended to convey is that a small quantity of water seems to possess abnormal powers of condensing steam during the time that the steam port is open. This may or may not be true. Mr. Bodmer deals with what takes place after the steam port is closed; that is to say, during the period of expansion. We have not space this week to consider the points he raises.—ED. E.]

THE ELECTRIC LIGHT AT WHITELEY'S.

SIR,—In your issue of the 18th inst. we note the account of the installation of the electric light at Mr. Whiteley's, Bayswater. We are pleased to learn that these engines, by Messrs. Joseph Richmond and Co., Bow, are running so perfectly steady. We say "pleased" advisedly, inasmuch as you write so highly of the very admirable arrangement for regulating the speed under the very trying conditions of machines being continually thrown on and off, and we are the inventors of this motion, it having been patented by our Mr. W. Rye, in 1876. Throughout the greater part of West Lancashire, and many places abroad, in Germany, Holland, Austria, and India, we have fitted this, our cut-off, in cases where extreme regularity of driving was essential, and are in a position to state, with an equal measure of success. In addition, we applied this arrangement to our engine in the Oldham Exhibition, 1884, which then drove the electric lighting, and to which a Moscrop's recorder was attached, the record of which was highly satisfactory. From the accompanying rough tracing, the work in which was put in in 1884, you will perceive the close similarity our arrangement bears to that of your illustration, and we say the least, it seems a most remarkable coincidence that Messrs. Richmond should have hit upon a novel system so absolutely identical with our own.

The copies of diagrams—absolute copies—herewith will compare, we think, very favourably with those taken from any class of engine having an automatic cut-off. In conclusion, we beg to leave to your high sense of justice the publication of this letter, and thank you in prospective.

WOOLSTENHULMES, RYE, AND CO.,
Oldham, February 22nd. W. M. RYE, Manager.

THEORY AND PRACTICE.

SIR,—Allow me to draw your attention to a point which doubtless has often occurred to you or been already pointed out in your columns, but which cannot well be repeated too often where remedies are available, viz.—That when any branch of science comes to a practical deadlock it takes long years to prove that the direct causes are haphazard and unsystematic treatment of the subject with which new doctrines and discoveries were ushered in and received. The remedy, of course, being a complete chapter of research, with elimination of all mere hints and guesses.

J. H. WILLIAMS.

THE ARCH PROBLEM.

SIR,—I am afraid that, in spite of the confident tone of its initial sentences, "J. M. D.'s" letter, contained in your last issue, can hardly be said to mark any advance in the arch question; in fact, like the rustic at the dinner party, I feel we are "no forrader." The theorem advanced by him seems correct, if for curvilinear, which might mean tangential, is read horizontal thrust, but seems no improvement on known graphic methods, and is, moreover, insufficient of itself to solve the arch problem, of whose real difficulty "J. M. D." appears in blissful ignorance. Given three points on the line of resistance which "J. M. D." assumes, viz., A C B, there is not the slightest difficulty in drawing the curves; but, as is well known, this assumption is simply begging the question, for it is the determination of any three points on the curve that constitutes the sole difficulty of the problem; for since any number of lines of resistance or linear arches are theoretically possible, the question is which of these is to be taken, and "J. M. D.'s" researches afford no light on this, the crucial point. It may be remarked here that the accurate solution of the arch problem is really of much greater complexity for masonry than for metallic arches. In the case of the latter, one has a homogeneous material of constant elasticity to deal with, and can consequently, either by applying the principle of work or by Culman's method, obtain an approximate solution; but the masonry arch presents what appears to be a hopeless conundrum, as far as obtaining an exact solution is concerned; for not only has the cement a different modulus of elasticity from the stone, but it would also appear from some stress-strain curves in my possession that the modulus for the stone itself varies immensely for not very different loads.

Up to the present, in designing these arches we have not

BURTON-ON-TRENT SEWAGE ENGINES.

SIR,—I observed in your last issue an illustration and description of the Burton-on-Trent sewage engines, and it is to be regretted that more complete details and data were not placed before your readers. Another source of disappointment to me individually is the fact that the entire credit of designing the engines appears to be divided between Mr. Mansergh and Messrs. Gimson absolutely. I have no desire to take undue credit to myself, but I do request to be allowed to affirm that I had more real responsibility regarding the actual construction and subsequent good behaviour of these engines than any one else. It is quite true Mr. Mansergh, using an American phrase, prepared a "skeleton" specification, and he undoubtedly interested himself in matters of a minor nature. In the early stage of my duties, however, with Messrs. Gimson, the contractors, two or three tracings from the first of my drawings were submitted to Mr. Mansergh for his approval and signature, but in a day or so they were returned, with the intimation that the responsibilities should rest with the Leicester firm, which virtually devolved upon me. I am not acquainted with the exact amount of admiration Messrs. Gimson may lay claim to, but at any rate, I have a letter of theirs wherein they award me all I desire confirmatory of my statements, for which I am in this instance deeply grateful.

I have written these few lines with the best of intentions, hoping that any one who may only occupy a moderate position like myself, and perchance be placed in similar circumstances, may at least not be denied a few crumbs of comfort from the rich man's engineering table. W. WALKER.

Smethwick, March 2nd.

LEGAL INTELLIGENCE.

IN THE ROYAL COURTS OF JUSTICE.—COURT OF APPEAL.

(*Before* LORDS JUSTICES COTTON, LINDLEY, *and* LOPES.)

IN RE THE TRADE MARK "NORMAL."

THIS appeal from a decision of Mr. Justice Chitty raised a question of considerable importance on the construction of the Patents, Designs, and Trades Mark Act, 1883. Shortly stated, the question is whether a person whose application to register a trade mark has been refused by the Comptroller is entitled—on such refusal—to apply to the Court as a person "aggrieved by the omission, &c.," under sec. 90; or whether, as pointed out by sec. 62, the refusal of the Comptroller is subject to appeal to the Board of Trade, whose decision is to be final, unless the Board of Trade shall think fit to refer the appeal to the Court. The Normal Company had applied to the Comptroller in June last for registration of the word "Normal" as a trade mark in respect of substances used as food or as ingredients of food. Acting under instructions from the Board of Trade not to register mere "dictionary words" as "fancy words" capable of registration as a trade mark within sec. 64 (1) (*c*), the Comptroller had refused to register the word "Normal," and the company, feeling that it was hopeless to appeal to the Board of Trade under sec. 62 (4) from such refusal, had applied to Mr. Justice Chitty for registration as "a person aggrieved by the omission, &c.," within sec. 90 of the Act of 1883. The preliminary objection having been taken by the law officers that the Court had no jurisdiction to deal with an application for registration which had been refused by the Comptroller, unless the applicant had first appealed from the Comptroller to the Board of Trade and the Board of Trade had refused the appeal to the Court, as pointed out by sec. 62 (4) and (5) of the Act of 1883, Mr. Justice Chitty held that the objection must prevail, and from this decision the present appeal was brought.

Mr. Aston, Q.C., and Mr. Chadwyck Healey appeared for the appellants; the Attorney-General and Mr. Ingle Joyce for the Board of Trade.

Lord Justice COTTON, in giving judgment for the Board of Trade, said Mr. Justice Chitty, without going into the merits, had decided that the matter submitted to him could not come before the Court unless it were referred by the Board of Trade. The question was whether sec. 90 of the Act of 1883 gave an applicant for registration of a trade mark who had been refused by the Comptroller a right to go to the Court at once. The great argument had been that sec. 5 of the Trade Marks Act, 1875, acknowledged the right of an applicant who had been refused by the registrar to appeal to the Court, and it was said that it could hardly be supposed that the Act of 1883 would take away a right, and therefore it was to be inferred that sec. 90 of the Act of 1883 must have been intended to do the same as sec. 5 of the previous Act. But that argument really had nothing to do with the matter. The right was simply a right under the Act of 1875, and the question was whether the Act of 1883 gave the same right. The words of the enactments were different. In the earlier Act there was a specific reference to refusal to register, and no other provisions as to appealing from the registrar. The appeal was necessary to the Court in that case; but in the Act of 1883 that consideration could not apply. If the Comptroller refused registration there was liberty to appeal to the Board of Trade, and it would be difficult to make out that an applicant would be "aggrieved" when he came to the Court. A special mode of remedying his grievance being provided by an appeal to the Board of Trade, it would be wrong to say he was aggrieved if he came first to the Court. But it was urged that the Act of 1883 could not mean that there was to be an appeal only to the Board of Trade, because there must be cases of law and of disputed facts which the legal tribunals must be better able to deal with than the Board of Trade. It was, however, to be observed that the Act did not commit large powers to the Comptroller and to the Board, and it was not unreasonable that questions relating to registration should have been left to be decided in the one way pointed out. It would be wrong to suppose that a department of State would exercise their discretion unreasonably, and, if necessary, they would refer a case to the Court. It was not their duty to do so, and if a case were submitted to them in which the point had been clearly decided already they would not send it to the Court, but generally they would do so. If a reasonable question were raised, and the Board did not feel competent to deal with it, they would exercise their discretion and send the case to the Court. As to section 90 of the Act of 1883, the position of it showed that its object and effect were to remedy defects in the register, and to enable the Court to remove from it what could not be the subject of trade mark. It was altogether a different question whether a particular thing was a trade mark proper to be registered. It would be a strained interpretation of the Act to say that on such a question there was an appeal from the Comptroller to the Court when another mode of appeal was pointed out in the Act. The appeal must be dismissed with costs.

Lords Justices LINDLEY and LOPES delivered judgment to the same effect, pointing out that the public was protected by the power given to the Comptroller to obtain the assistance of the law officers, and the fact that the Board of Trade could obtain the same assistance, and that it was unreasonable to suppose that a department of the State would use their powers otherwise than fairly.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Railroad excavator and wrecker.—The Vulcan Ironworks, of Toledo, O., have brought out a new and improved machine for doing all kinds of railroad excavation, filling, ditching, &c. It is operated by horizontal duplex hoisting engines of 50-horse power; the crane, swing circle, and chains are of steel. It is carried on an iron car, running on two four-wheel trucks of ordinary form; the axle bearings are 4½in. by 8in., and the machine is self-propelling. The excavator can handle from 1200 to 2000 cubic yards per ten hours. The improvements are a pair of duplex engines to force and hold the bucket into the bank; a pair of independent duplex engines for swinging the crane; a patented crane, most of cast steel; an improved form of friction gear having great power, and a steel dipper arm and attachments. A pile driver attachment can be fitted.

Division of profits.—Several firms, more especially in New England, are experimenting with, and some have adopted, the system of giving the employés an interest in the business. In March, 1886, a St. Louis, Mo., manufacturing firm issued a circular to the effect that after allowing 7 per cent. interest on capital invested, the remainder of the years' profits would be divided equally upon the total amount of wages paid and capital employed, each employé to get his proportion according to the amount of his year's wages. This applied to persons who should serve the company for at least six months of the year, and who had not been discharged for good cause. A representative chosen by the men held a contract to this purpose, and was authorised to inspect the books at the end of the year. In January, 1887, the head of the firm declared an amount of 4828 dols. for apportionment, the labour troubles having made the result considerably below the estimated amount. There were 150 employés who shared the dividend, receiving 5 per cent. of their annual wages; of these over 90 per cent. elected to leave their share as an interest in the business, receiving an interest-bearing certificate. The plan will be followed this year, and adopted as a permanency; one-tenth of the profits will go to a provident fund, one-fiftieth to a library fund, and one-tenth will be set aside to meet losses or pay dividends in unfavourable years. A firm at Norriston, Pa., has made an arrangement for the present year under which each workman who remains with the firm one year will receive an addition of 5 per cent. to his wages; those who remain nine months will receive 4 per cent., six months, 3 per cent.; and three months, 2 per cent. of the total amount of their wages. Employés giving a notice one week before leaving will receive a proportional percentage. By this system the men have an interest in the business, it is to their benefit to work well, and it forms a tie between the parties of "capital" and "labour."

A new steamship line to Mexico.—Messrs. L. Hueter and Co., of Hartford, Conn., have contracted with the Mexican Government for the establishment of an international steamship line between San Diego, Cal., and ports in Mexico and Central America, to run as far south as San Jose, Guatemala. The vessels will sail under the Mexican flag, and will receive a subsidy from the Mexican Government of 8000 dols. for each round trip for five years, 6000 dols. during the next five and 4000 dols. during the remaining ten years of the contract. Three first-class ships will be put into service, and the first one will leave San Diego in August.

Irrigation of alkali lands in California.—Professor Hilgard has issued a pamphlet, published from the State printing office at Sacramento, Cal., treating of the effect of irrigation upon the alkali and adobe lands and the need for under drainage. The same troubles that have been experienced in India are threatening irrigation in the southern part of the State, and the *Reb* plague that afflicted India has already made its appearance. He thinks that the quality as well as the quantity of irrigation water should be considered. Continuous irrigation has raised the water table, so that only from half to one-third the quantity of water is now needed; but there is danger of a superabundance of water forcing roots near the surface, while the alkali will also be brought near the surface and cause various evils to health, and would ultimately render the land unfit for cultivation unless relieved of the accumulation of alkali. He urges the establishment of a more definite system of irrigation.

Locomotives for the New York Elevated Railroad.—The New York Locomotive Works, at Rome, N.Y., are building twenty-five new engines of the same general type as the more recent ones, but with several improvements. The cylinders are 12in. by 16in., and the fire-box is of the Belpaire type. The boiler barrel is 42in. in diameter, and 67⅜in. in length, the smoke-box is 33in. long. The fire-box is 50in. long inside at the bottom, and 39½in. high, the crown being stayed to the boiler by 1in. stays, 21in. long; the side stays are ⅞in. The dome is 20¼in. in diameter, by 25½in. high.

Railroad prospects.—The prospects are decidedly encouraging, but though companies are being incorporated, contracts being let, and preparations being made all over the country, it is yet too early for a boom in actual construction. The Chicago, Santa Fé, and California Railroad Company—a company controlled by the Atchison, Topeka, and Santa Fé Railroad Company—has let large contracts to Mr. Arthur Brothers, of Keokuk, Ia.; Miller, Loomis, and Gill, of Chicago; Shephard, Winston, and Co., of St. Paul, Minn., and other big contracting firms. Arrangements have been made for the construction of the line from Colorado into Mexico, to connect with the Mexican National Railroad; the office is at Colorado Springs, Col. The first company organised under the charter of the Mexican Central Railroad Company, to form companies to build branches, is the Central Mexico Railroad Company, which will build the Tampico and Guadalajara branches. Contracts for a continuous line from Battle Creek, Mich., to St. Louis, Mo., have been let to Wm. Dallin, of Chicago. All the railroad contracting firms are preparing for a heavy business; the new trunk line, extension and branch, will probably make an enormous aggregate.

Trade items.—The few furnaces that have not contracted for their total output are taking lower prices, but the ruling prices, are high. Steel rails are active, 39 dols. to 40 dols. per ton at Eastern mills; spikes, 2·75 cents; spike plates, 2·20 to 2·25 cents; bolts and nuts, 3·10 to 3·55 cents; angles, 2·40 to 2·60 cents; steel angles, 2·60 to 2·70 cents; tees, 2·75 to 3·00 cents; beams and channels, 3·3 cents; tank plates, 2·45 to 2·60 cents; steel tank plates, 2·90 to 3·00 cents: shell plates, 2·7 to 2·8 cents; steel shell plates, 3·25 to 3·50 cents. Structural iron is dull, but will probably revive soon as the building season opens. Wrought iron pipe is in demand, and will be in greater demand as spring begins, owing to the vast number of waterworks projects now in hand. Hardware remains about as usual, very few alterations are being made. The termination of the coal handlers' strike has improved the condition of the market, and some of the big companies are taking immense contracts; prices for anthracite have advanced, and bituminous will be advanced next week. Wheat and provisions are quiet. The Stock Exchanges have been irregular.

Central Railroad of New Jersey.—A company has been organised as the "Jersey Central Improvement Company" to provide means for the development of the system in which the receiver's funds cannot be invested. The Corbin interest will soon have control. The new company's capital stock is 1,000,000 dols., and 350,000 dols. has been issued in payment of stocks and bonds of the Cumberland and Maurice Railroad, a recent addition to the Central system.

Hydraulic mining.—The Federal departments and Congress have held the usual methods employed in hydraulic mining to be unlawful, and have decreed that the work of restoring the navigable streams shall not be entered upon until there is cessation of these methods; the Secretary of War has been directed to proceed in the Courts to enjoin hydraulic miners from washing *dêbris* into the stream. The substitute for Senate Bill 51 proposes a system of restraining dams for mining *dêbris* by appropriators of water for mining purposes. A defect of the Bill is that it does not require the holding back of matter in suspension, and frees the hydraulic miners from liability for damage caused by the same, whereas it is the fine matter that is deposited in the slow currents of the valleys, and, besides seriously filling up the Sacramento river at Sacramento, is threatening the tidal waters of San Francisco Bay. The works are to be constructed under the approval and supervision of engineers or of a State engineer. On the whole, however, the Bill is inimical to the rights of people in the low lands, and is meeting with very strong opposition.

Rocky Mountain Tunnel.—Mr. Pomeroy, President of the Atlantic and Pacific Railroad Tunnel Company, at Denver, Col., has contracted with Thomas Vernon, of England, for the completion of the tunnel for railroad service. The tunnel, which was commenced for mining purposes seven years ago, begins at the base of Mount Kelso, in the main range, sixty miles west of Denver, and will pass through Gray's Peak, 4400ft. below the top of the Peak. Gold and silver veins will be reached. It will be 25,000ft. long, and is to be completed in 1890. First mortgage bonds for 2,000,000 dols. will be issued, and will be taken up by the English contractor.

Electric street railroad system.—Mr. Stephen D. Field has designed a new system of street railroad for electric power. There is an iron conduit 8in. high under each wheel, the conduits being spiked to wooden cross ties and held to gauge by tie bars. The wheels have a centre flange and two treads; the inner one of a little smaller diameter takes a bearing at curves, and thus slip is avoided. In each conduit is placed an electric conductor.

Tehuantepec Ship Railroad.—On February 17th the Bill passed the Senate by a vote of 46 to 7. An amended substitute offered by Mr. Vest was adopted. This authorises the incorporation of James B. Eads and eighty other persons as the Atlantic and Pacific Ship Railroad Company, the capital stock not to exceed 100,000,000 dols.—£20,000,000. When 10 per cent. is subscribed and 10 per cent. paid in, a meeting is to be held to elect directors, the stock subscribed for not to be assignable until the paid-in capital amounts to 5,000,000 dols. If these requirements as to stock are not complied with in two years the charter is to expire.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE demand for manufactured iron continues restricted. Neither merchants nor consumers seem to have orders of any magnitude to place. Under these circumstances it is not surprising that makers find a good deal of difficulty in obtaining better prices.

The advance which was declared in Birmingham a fortnight ago cannot be said to have passed into an accomplished fact. Rates are not much altered in actual business upon those which previously prevailed.

The firms who are best off are those who, in a considerable measure, anticipated the Birmingham restriction by quoting prices up upon the excessive minimum. That price is £5 5s. for common bars and strips, and £5 10s. for hoops.

Until there is a manifest improvement in the demand it is evident that the determination to force up prices can meet with but little success. The bulk of the firms would be well satisfied if they could get a 5s. advance.

Marked bars keep at £7 to £7 12s. 6d.; second quality marked bars, £6; and common, £5 5s. to £5 10s., nominal. Hoops are £5 10s. to £5 12s. 6d., and crown sorts £6 5s. Hinge strip is about £6, and common strip £5 5s.

Sheets continue to wear a cheerful aspect, since the demand from the galvanisers and from other buyers keeps up well. Specifications are rather more plentiful than a week ago, and the mills are pretty much in full swing. Prices are steady on the basis of £6 to £6 2s. 6d. for 20 gauge; £6 10s. for 24 gauge; and £7 10s. for 27 gauge.

The galvanisers maintain a pretty firm position. Firms who are inclined to make concessions are told by strong makers that they are "practically giving away 5s. to 7s. 6d. per ton" in so doing, since merchants will give full prices when compelled. The top price for galvanised sheets, f.o.b., Liverpool, is £10 10s., but other firms are selling at £10 5s., and, as regards Birkenhead makers, £10.

The pig trade is pretty much stationary. The extent of new business is small. Sellers of imported sorts will here and there accept 1s. reduction from recent maximum rates. Northampton pigs are 39s. to 40s.; Derbyshires, 40s. to 42s. 6d.; and Lincolnshires, about 42s. 6d., all delivered. There is also some little giving way by hematite sellers from their recent quotation of 60s. for forge sorts, delivered; but the Barrow Company in particular decline to make any change.

Superior steel upon a modification of the Siemens-Martin process is now being turned out at the works at Corngreaves, near Birmingham, of the New British Iron Company. The company can cover almost any quality, ranging from 24 tons to 54 tons per square inch tensile strain. Metal bearing the former strain, and suitable for smithy bar purposes, shows under test 36 per cent. elongation upon 8in., and a reduction of fractional area of 61 or 62 per cent., while metal of 54 tons strain shows an elongation of 13 per cent., and a reduction of area of 29 per cent. The metal is of such quality that it is being supplied to the Admiralty in bar form. The company are manufacturing steel plates possessing the special feature of having a very hard centre and a very soft exterior. The product is not the result of plates put in juxtaposition, but the metal is rolled all together. Safe and strong room manufacturers find it specially valuable. After performing upon it the varied fitting and drilling work required, the plates are heated red-hot and plunged into water, after which they cannot possibly be drilled. Continental and American safe-makers are expected to be customers.

Another material which is engaging increased attention at Corngreaves Works is a patent composite iron and steel which possesses the facility of welding which attaches to iron *in situ*, while the presence of the steel ensures a much higher tensile strain and much better wear. For engineering purposes, including boiler making, chain making, axle making, rivet manufacture, and other purposes, the composite material is, it is claimed, valuable. One-inch rounds made into chains have been tested to destruction at 43·55 tons, which is 31 tons or 262 per cent. over Admiralty proof. In the process of manufacture a case of iron bars is placed within a cast iron ingot mould, and Siemens-Martin steel is then run into the mould from the bottom, filling up all the spaces between the bars and forming one solid ingot. The bars are held at equal distances apart by the perforated plates forming the top and bottom of the cage through which they are threaded, and there is a perfect admixture of the iron and steel.

The injury that has for some time past been inflicted upon the marked iron trade of South Staffordshire by the sending out to India, Australia, and other export markets common iron branded as best Staffordshire, is being increased by the circumstance that Belgian and German iron is also being sold to native Indian merchants as best Staffordshire. The New British Iron Company has lately despatched a direct representative to India to expose to native merchants and buyers these nefarious practices, and to ascertain the exact necessities of the market. Its representative is already at work in India, and before he returns visits will probably be paid to the chief Australian cities.

At the annual meeting of the Mill and Forge Wages Board held in Wolverhampton on Monday the announcement was made that a number of important firms had during the year ceased to be members. The committee considered this state of things to be serious, since the Board could only be of service so long as it represented a fair majority of the employers and operatives. But it was pointed out that Staffordshire was not alone in this difficulty; the North of England Board was in the same position. The operative section of the Board intimated that formal notice will be given in a few days for an advance in wages. A sub-committee was appointed to consider the question of extras paid in the mills and forges.

Electric-light engineers are finding an increased call for dynamos and accumulators of accredited design. Not only are home orders growing for lighting and power purposes, but an extended trade is being done abroad—Australia, India, Spain, Holland, and Germany are all buying. The Elwell-Parker Company, Wolverhampton, are very busy, and are employing some 250 hands. Among the export work which they have recently executed were accumulators and dynamos of 70-horse power to supply 400 or 500 incandescent lamps for the lighting of a Spanish cotton mill; and a dynamo of 25-horse power for 100 incandescent lamps for the lighting up of a native Indian palace. The country work now in hand at these works includes accumulators and dynamos for Woolwich Arsenal. Other valuable home and foreign work is early expected.

Steam pump engineers are obtaining some good orders from collieries in the North of England and South Wales, and large pumps are also being purchased on export account. The late great reduction in standard prices of something like $33\frac{1}{3}$ per cent. has doubtless assisted to bring out orders and reduce stocks in makers' hands, but it has reduced profits to a considerable extent. Messrs. Joseph Evans and Sons, Culwell Works, Wolverhampton, have just obtained the contract for a large pumping engine to be erected in the South of England for railway dock work, which will raise 2000 gallons per minute, The colliery pumps which they have in hand on order have a capacity varying from 10,000 to 30,000 gallons per hour, and will lift up to 1000ft. Within the last few days the firm have despatched a 21in. double-acting plunger pump, with high and low-pressure steam cylinders, to the Hyderabad Waterworks. The pump has a capacity of 85,000 gallons per hour; and the firm have also booked a further order for another large pump for a waterworks in one of the North-West Provinces.

Complaints are made of the continued severity of American and German competition in hand pumps in the Colonies, India, and on the Continent. This is the more remarkable, since the quality of the English goods is indisputably superior.

At a meeting of the Brierley Hill ironworkers, held on Monday, it was decided to hold a national conference, but the details were not to be arranged until the feeling of the trade had been ascertained.

A miners' conference held this week at Walsall resolved to demand an advance of 6d. per day or shift on thick coal or 3d. per day on thin. The Cannock Chase men were given to the 10th inst. to formulate their demands.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business in the iron trade of this district remains in a completely stagnant condition. In the face of the persistent downward tendency of prices in the large iron centres of Glasgow and Middlesbrough, which necessarily has a depressing effect upon the market here, buyers are disinclined to operate, and, as a rule, only small hand-to-mouth orders are given out. So far as local and district makers of pig iron are concerned a tolerably firm tone is still nominally maintained, as they are well sold that they are under no immediate necessity to press sales, but there are low sellers in the market, in odd cases even amongst the makers, but principally amongst second-hand holders, who with the continual weakening of the market become more and more anxious to realise, and iron can be bought at fully 1s. 6d. per ton under prices that are nominally quoted as list rates. Hematite makers, although at present selling little or nothing, are also firm, more firm indeed than the makers of common pig iron, and it is only in warrants or second-hand parcels that any really low-priced lots are to be got. In manufactured iron trade drags on very slowly, and for prompt specification makers are willing to take very low prices.

There was about an average attendance on the Manchester iron market on Tuesday, but business was extremely slow. The inquiry for pig iron was of the smallest possible dimensions, and it was very exceptional where sales exceeded small hand-to-mouth parcels. For Lancashire pig iron quoted rates remained at 39s. 6d. to 40s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities delivered equal to Manchester, but local makers are only booking occasional orders where an advantage in the rate of carriage enables them to meet buyers on a lower basis of prices than the above. For district brands 39s. 6d. to 40s. 6d., less $2\frac{1}{2}$, delivered equal to Manchester, is also in one or two instances still the nominally quoted list price, but for Lincolnshire iron the actual average selling price is more nearly 38s. to 39s., less $2\frac{1}{2}$, and it could be got at even 6d. per ton under these figures. Outside brands offering here are decidedly easier to buy than last week, but Scotch and Middlesbrough makers do not follow closely the downward movement in warrants.

Hematites are being held by makers at about 58s. 6d., less $2\frac{1}{2}$, for No. 3 foundry qualities delivered into the Manchester district, but warrants and second-hand lots could be bought at considerably under this figure.

In manufactured iron the only activity that is being maintained is in sheets, and for these prices are steady at about £6 10s. to £7 per ton delivered into the Manchester district. For common bars the demand is extremely dull, and both local and North Staffordshire qualities can be bought without difficulty at about £5 per ton delivered into this district; hoops average about £5 7s. 6d. per ton delivered.

Here and there amongst engineers there are reports of more inquiry stirring, but the weight of actual new work coming forward is still very small, and it can scarcely be said that, taking the condition of trade generally, there is as yet any real improvement.

The Council of the Iron and Steel Institute has now formally announced its cordial acceptance of the invitation to hold the next autumn meeting in Manchester, and the dates fixed upon are the 14th, 15th, and 16th September.

The Manchester Exhibition buildings continue to make satisfactory progress towards completion, and the machinery section is now practically ready for the reception of some classes of exhibits. It seems that there is some rumour that the Prince of Wales is coming over to open the Exhibition, and that if the Manchester Ship Canal project has by that time been successfully launched, his Royal Highness will also during his visit to this city cut the first sod of the canal.

An interesting paper on "Continuous Pneumatic Railway Brakes," was read by Mr. George Kiernan, before the Manchester Association of Engineers, on Saturday. It had been found, he said, by experience that the system of utilising the atmospheric air in the pneumatic brake, for working a continous brake was the most convenient and gave the best results. In this country there were, practically speaking, three kinds of pneumatic brakes in operation—viz., the Westinghouse compressed air automatic, and non-automatic vacuum, and Gresham's non-automatic vacuum and Gresham's automatic vacuum. The latest Board of Trade returns showed that vacuum brakes were in use on 4092 engines and 24,035 carriages, and compressed air brakes on 4760 engines and 14,369 carriages In a general way Mr. Kiernan admitted that a non-automatic brake gave very good results in ordinary practice, but, besides being minus the great advantage of automaticity, it was not quick in action, and therefore could not bring a train to rest in so short a distance as would be accomplished by an automatic brake. The question as to the distance in which brakes would stop a train was one of the utmost importance, but it was very difficult to answer, as there were so many varying conditions that might influence a stop. Experiments which were made with two trains similar in every respect except the brakes, each train consisting of an engine, tender, and twelve six-wheeled coaches, with brake blocks on four wheels of each, on the same day over the same road, showed that one train running at fifty miles per hour and fitted with the compressed air brake was brought to rest in 20 seconds, or in a distance of 280 yards; the other fitted with a vacuum brake was stopped in 18 seconds, or in a distance of 253 yards. One of the most important points in a brake was the quickness with which it could be brought into action, and Mr. Kiernan maintained that a brake should always have its full power at command whatever calls might previously have been made upon it. In the discussion which followed, the Gresham brake was spoken of very highly as the simplest by far, and that in the various arrangements which had been devised to secure automaticity in its simplest form the inventor had attained as near perfection as possible.

The cause of the extensive subsidences of land which have been going on for some years past in the Cheshire salt district was dealt with in a paper, read before the Manchester Geological Society, on Tuesday, by Mr. Thos. Ward. After tracing the commencement and growth of these subsidences during the past century, and showing how their rapid and alarming extension during late years had been coincident with the rapid development of the salt trade of the district, and the enormous increase in the quantity of salt rock extracted and brine pumped up by the numerous works, Mr. Ward dismissed altogether the assumption, which had been formed a few years back, when an attempt was made to get an Act of Parliament to secure compensation for the injury done, that these subsidences were due to physical causes. The only practical conclusion was that these subsidences were the direct result of the operations carried on by the salt works in the district, and as the limits of the beds of salt were not known, and the water reached the salt beds from all directions and traversed them to the pumping stations, it was impossible to say how far these subsidences might extend. For the damage which was caused to property on the surface by these subsidences there was no remedy in law, as it was impossible to say which of the many brine pumps scattered over the large salt area was occasioning any particular injury, and this being so, it was evident a great injustice and wrong was being done to these property owners. In the discussion which followed, general concurrence was expressed with the conclusions set forth in the paper, Mr. Mark Stirrup, F.G.S., stating that if there had been no saltworks in the neighbourhood there would have been no subsidences, and according to the amount of brine pumped up so would these subsidences increase, and this would continue until the salt beds had been pumped out.

In the coal trade there is a decided falling off in the demand for the better classes for house fire consumption, but otherwise there is a fairly steady business doing, and the large quantity of the second and lower qualities of round coal still being shipped prevents any pressure of surplus supplies in these on the market. The local demand for iron-making and general trade purposes is, however, only indifferent, and slack, except for mill purposes, is only in poor demand. Pits are still kept going pretty near full time, and except a little weakness in best coal prices are steady at last month's rates. At the pit mouth best coal averages 9s.; seconds, 7s. 6d.; common house coal, 6s.; steam and forge coal, 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton. For shipment, 7s. 6d. is very readily got for steam coal, and about 9s. per ton for seconds, house coal delivered at the high-level, Liverpool or the Garston Docks.

The miners in the South Lancashire district having wisely abandoned their applications for an advance of wages, have now so modified their proposed restriction of the output that it is not likely to give rise to any very serious objection except from the day wagemen at the pits, who will be considerable sufferers if the proposed change is carried out.

Barrow.—The trade in hematite pig iron is steady, and a good inquiry has been experienced during the week; but the sales have chiefly been on the part of speculators, who have done business as low as 46s. per ton and up to 47s. per ton, but these reductions in prices have not in any way been brought about by any weakness of tone in trade, but by the exigencies of circumstances incidental to holders of iron. Makers are firm in their prices, and quote 50s. per ton net f.o.b. for mixed parcels of Bessemer iron, and 49s. for forge and foundry No. 3, and they are prepared to wait until trade can be done at these rates, as they have so many orders in hand and have practically sold their make for some months to come. Very large shipments of pig iron are being made to America, the Colonies, and the Continent, and there is also a heavy shipping trade in rails, blooms, billets, &c., for the same markets. Steel rails are this week quoted at an advance in price—£4 6s. 3d. per ton net f.o.b., for ordinary heavy sections, instead of £4 5s., at which business was done last week. Some large sales of rails are reported to have been made to India and America at about £4 5s. per ton, and others are in course of negotiation. The trade in blooms is especially good, and plenty of inquiry is to hand, especially from America. Makers are putting up their prices for this class of steel, and they will very probably secure the advance because the demand is so active. The fact of the matter is that rails pay a heavy import tariff, and blooms are regarded as unfinished goods, and are therefore admissible at a low figure, giving the Americans who use them an advantage over those who buy the manufactured rails from this country. There is not much doing in hoops, bars, or wire. Steel casting is a poor trade at present, and forge work is quiet. Finished iron is in quiet demand, and last week's prices are ruling. In shipbuilding there is a very poor business doing. No new orders have been booked during the week, and the local yards are becoming more and more empty, The prospect of new contracts is, however, better than it was, and it is thought probable that during the present month a few orders will be placed in the hands of local builders. The demand for iron ore is steady and brisk, and prices are firm at from 12s. to 13s. 6d. per ton at the mines. Several old pits which have been closed for some time are being reopened, and the output of ore is being increased. The coal trade is steady, and in coke a larger business is doing, but prices are not better than they have been. Shipping is better employed than for some time past, and the probabilities are in favour of a brisk season's trade. Last week there was shipped from Barrow 6778 tons pig iron, 2260 tons bars, 1804 tons blooms, and 1210 tons of rails.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

SHEFFIELD is still concerned about the production of steel at Woolwich. Some light has been thrown on the subject by the replies of Mr. Stanhope to questions put by Mr. Mundella and Mr.

Howard Vincent, the members for the Brightside and central divisions of the cutlery capital. Mr. Mundella asked the Secretary of State for War to state the total amount of steel produced from the Government factories at Woolwich in 1884, 1885, and 1886, and what had been the heaviest weight of any small casting in each of those years. Mr. Howard Vincent inquired about the nature of the undertaking given by Mr. Stanhope as to the Government support of the steel trade—whether it applied to large ingots only, or to all the gun forgings required by the War Department. Mr. Stanhope was not explicit in his replies. His return showed the output at Woolwich thus:—In 1883-4, 1564 tons; in 1884-5, 1698 tons; in 1885-6, 2279 tons. The heaviest single casting in each of the first two years was about 19 tons, and in the last year about 12 tons. He further informed Mr. Vincent that the undertaking he had given applied to forgings of all sizes, and in the coming financial year, he proposed, subject to unforeseen contingencies, to give to the trade nearly three-fourths of all the gun forgings in England.

These figures are widely different from those given at Sheffield. A steel-maker, who has taken a special interest in this subject, went so far as to say that in certain departments of Woolwich Arsenal, where steel had not previously been produced, nearly 3000 tons had been manufactured last year. He also estimated the loss to Sheffield thereby at £300,000. It is perfectly clear that Mr. Stanhope's figures and these statements cannot be reconciled. It will be interesting to learn what will be said of the Government undertaking in regard to gun forgings. It would be unreasonable to expect that Woolwich should not make steel; but it is clear, even from the War Secretary's explanation, that the Arsenal authorities are rapidly increasing the production, the increase from 1698 tons in 1884-5 to 2279 tons in 1885-6 being by no means inconsiderable.

The Midland Railway Company has not yet placed its contract for the whole of the steel rails required. One local firm—Messrs. Steel, Peach, and Tozer, Phœnix Bessemer Works—have taken 5000 tons; but it is understood that the company requires at least four times that weight. Values are steadily going up, consequent on the increased quotations for raw material. It is expected by several firms that this year will see steel rails at £5 to £6 per ton at works. Of course, a collapse of the American demand would disappoint that expectation; but in addition to America, a large trade is expected to be done with India and other dependencies.

Two deputations from Sheffield have waited on the Home Secretary in reference to false marking since my last letter. The first, on Friday, was from the Federated Trades Council; and the second, on Monday, from the Sheffield Town Council. I accompanied both deputations. They asked for a Royal Commission to inquire into fraudulent marking of Sheffield and other British goods. The Town Council, by the casting vote of the Mayor, decided that the Royal Commission, if appointed, should inquire into malpractices in other trades besides those of Sheffield, and it was to present this resolution that the deputation proceeded to London. Though the Home Secretary did not definitely decline to recommend the issue of a Commission, it was pretty clear that he had made up his mind for immediate legislation rather than to wait the result of further investigation. Sufficient is already known, he holds, to justify an effective measure being passed, and he has accordingly determined to have a Bill passed, if possible, this year. There are now two Bills before the House—that of the Government, and another tabled by Mr. Mundella. It is probable that both Bills will be referred to a Select Committee, with the result of strengthening the measure to become law.

A very remarkable man has passed away in the death of Mr. Samuel Fox, founder of the firm of Samuel Fox and Co., and a limited company, with a capital of £300,000, and employing 2000 hands at Stockbridge Works, Deepcar, near Sheffield. More than half a century ago Mr. Fox came to Sheffield from Bradwell, a remote hamlet in North Derbyshire. He was apprenticed to the steel trade, and afterwards saved sufficient money to start on his own account at Stockbridge. His staff at first consisted of himself and wife, one man and a boy. Struck by the weight and rigidity of the umbrella, he hit upon the idea of substituting for whalebone and solid metal hollow ribs of steel to form the frame, and by allowing more "play" in the socket for the ribs to work gave additional elasticity. The idea was a success, and an immense fortune was made, and is still being made out of the umbrella notion which is known the world over as "Fox's Paragon Frames." A branch establishment at Amiens was established to get over the tariff restrictions of France, which were found very vexatious. Mr. Fox, in the days of balloon skirts, cleared a goodly pile out of crinoline steel, and he invented many adaptations of steel wire to the cotton and woollen trades, all of which were remarkably lucrative. The company has never paid less than 10 per cent., and for years has paid 15 per cent. The shares, which are £80 paid up, are now at £146. Mr. Fox purchased a large estate in Oxfordshire and another in the East Riding, where he died last Friday, in his 72nd year.

Mr. Charles Belk, J.P., President of the Chamber of Commerce, who was suddenly struck down a fortnight ago at a friend's house, is still in a very weak way. The blood-vessel which burst upon his lungs gives serious trouble to the doctor, hemorrage occurring again and again. The local newspapers speak hopefully of his condition, but private information is not so gratifying.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The improvement in the tone of the Cleveland pig iron trade which was noticed on Tuesday, the 22nd ult., did not continue long. Merchants were then asking 36s. per ton for prompt delivery, but by the end of the week a reaction had set in, and at the market held at Middlesbrough on Tuesday last lower prices were accepted. No 3 g.m.b. was offered at 35s. 6d. per ton by several sellers. For delivery to the end of June 36s. 6d. was quoted, but less would have been taken for a good order. Forge iron has fluctuated less than No. 3. The demand for it is fairly well maintained, and last week's price, viz., 34s. 6d. per ton, is still paid. Makers who have not much in stocks will not, however, take less than 34s. 9d.

Messrs. Stevenson, Jaques and Co.'s current quotations:—"Acklam Hematite," Mixed Nos., 50s. per ton; "Acklam Yorkshire"—Cleveland—No. 3, 39s. per ton; "Acklam Basic," 40s. per ton; refined iron, 54s. to 64s. per ton.

Warrants, which realised 36s. 1½d. at Glasgow last week, had fallen by Tuesday last to 35s. 1½d.; at that price some sales were made.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store is now again rapidly increasing. On Monday last the total accumulation amounted to 312,388 tons, or 1590 tons more than a week previously.

There is nothing new to be said in respect of the finished iron trade. The demand is as poor as ever, and prices are tending downwards.

Statistics showing the quantities of pig and manufactured iron and steel exported from Middlesbrough during February were issued on the 1st inst. The pig iron exports amounted to 52,620 tons, which is 1000 tons more than during January. The principal destinations were as follows, viz.:—To Scotland, 22,238 tons; to America, 8450 tons; to Wales, 5700 tons; to Holland, 4405 tons; to Sweden, 3687 tons, and to France 1445 tons. The shipments of manufactured iron and steel reached 35,901 tons, being 2000 tons more than during January. India was, as usual, the best customer, 17,961 tons of railway material having been sent thither. British Burmah took 3256 tons; America 1900 tons, and Egypt 1127 tons.

The continuance of the colliers' strike is having a more and more disastrous effect upon the Northumberland coal trade. All coalowners in other districts are finding a benefit, and, indeed, they are absorbing among them without trouble and without effort the orders and the business for which they have long contended in vain. Much of this trade will never return to the North, and in view of this the proprietors of the worst situated of the idle collieries are already contemplating permanent abandonment. It is said that one or two firms have already decided on this course. Meanwhile the demand for coal for household purposes and for gas making is gradually diminishing as the spring advances.

The various trades unions at Newcastle and throughout the neighbourhood are subscribing towards the support of the strike hands. The Durham colliers are prominent in this work, and so are the *employés* at the Elswick Works. The officials of the Northumberland Colliers' Union profess to be well satisfied with the efforts which are being made, but it is not generally believed that the £8000 per week which is needed will be forthcoming.

At several of the east coast shipyards the orders booked last autumn are nearly completed, and that without replacement by others. Inquiries are fairly plentiful, but they are not leading to business. The prospect is scarcely so good as it was for the shipbuilding industry. Various efforts recently made to raise capital from the general public for the purpose of buying existing steamers at low prices or building new ones with all modern improvements have not been altogether successful. It seems clear that small investors, at all events, have not forgotten the losses of the past, and they still prefer the safety and convertibility of public stocks to the risk of shares in shipping, whatever the prospects of high dividends held out to them.

One of the Cleveland ironstone mines, known as the Boosbeck Mine, and hitherto worked by Messrs. Stevenson, Jaques, and Co., of Middlesbrough, has been stopped for the present. An enormous quantity of water was recently encountered, so much that the pumping machinery was quite unable to cope with it. Consequently, ironstone to supply the furnaces belonging to the firm has been obtained from elsewhere, and the mine, which at one time employed several hundred men has been laid in. It will be remembered that some years since, a great deal of litigation was caused by the subsidence of the surface above this mine, involving the ruin to a greater or less degree of several streets of the town of Boosbeck.

The Commissioners for the Conservancy of the river Wear are carrying forward their useful work with diligence and energy, notwithstanding that their revenue in common with all others has been considerably affected by trade depression. For the last four years they have been engaged in constructing extensive pier work at Roker, a small town on the coast a little to the north of the mouth of the river.

The rocky point called Raven's Wheel, which has for long been a hindrance to safe navigation, is being gradually removed. The gates and sills of the old docks are being altered, and the graving docks enlarged, to suit the needs of the times. The Commissioners hope some day to have a graving dock capable of accommodating a vessel of 7000 tons burden.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron warrant market has been much depressed. Early in the week there were heavy sales, chiefly in the hematite department of the market. Very little was doing in Cleveland pigs, and Scotch were also lower. The past week's pig iron shipments were fair, amounting to 6078 tons, as compared with 7699 in the same week of last year. The inquiry from all quarters was reported slow, and the prospects of the trade were, on the whole, not considered very cheering on Change. Several of the firms who were obliged to put out furnaces during the colliers' strike are now relighting a proportion of these. Considerable additions are being made to the stock in Messrs. Connal and Co.'s Glasgow stores.

Business was done in the warrant market on Monday at 43s. 11½d. to 43s. 5d. cash for Scotch pigs. On Tuesday transactions occurred at 43s. 9d. to 43s. 4d. cash. On Wednesday business took place at 43s. 1½d. to 43s. 2d. cash. To-day—Thursday—the market was slightly firmer, with business at 43s. 2d. to 43s. 4d. cash, closing with buyers ½d. less.

The quotations of the principal makers' brands are rather cheaper in the market than they were a week ago, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s.; No. 3, 44s. 6d.; Coltness, 57s. and 49s.; Langloan, 53s. and 46s. 6d.; Summerlee, 55s. and 44s. 6d.; Calder, 52s. and 43s. 6d.; Carnbroe, 47s. 6d. and 42s. 6d.; Clyde, 48s. and 43s.; Monkland, 45s. 6d. and 41s. 6d.; Govan, at Broomielaw, 45s. 6d. and 41s. 6d.; Shotts, at Leith, 50s. and 45s.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 49s. 6d. and 43s. 6d.; Eglinton, 45s. 6d. and 41s. 6d.; Dalmellington, 47s. 6d. and 43s.

The malleable iron and steel works of Lanarkshire are again getting into full working trim, after being in many cases partially and in some wholly stopped by scarcity of coals during the colliers' strike. Orders in hand are fair, but there are many conditional ones that were placed when the prices of iron and steel were advancing, in respect of which merchants were not prepared to issue specifications on account of the material drop in quotations. These orders will, at least, be kept back until it is seen whether better prices can be obtained.

After lasting upwards of four weeks, and extending over a large part of the mining districts, the colliers' strike was brought to an end at the close of last week, the men returning to work on a promise that within ten days a conference of employers and workmen's representatives should be held, to discuss the circumstances of the trade, and the demand of the men for a higher rate of pay. Coals are now becoming plentiful, and the prices are rapidly falling towards the old level, but it will be some time before the shipping trade is brought fully back to the ports.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The latest great colliery sinking, the Albion, a few miles from Pontypridd, has been a success, the 4ft. steam coal being won there a few days ago. This may be said to end the deep sinkings of Glamorganshire steam coal. I question if there is any more untaken ground of any importance; so the celebrated smokeless steam coal of Wales is entering upon its last era, but there are ample stores for many years to come.

Prices look better during the last few days, and sales have been effected in some cases at 3d. per ton advance. Present quotations best steam are 8s. 9d.

The export coal trade is looking up. The vigour of Dowlais management is strikingly shown, and it is questionable whether the briskness there has been paralleled for a long time. Its despatches of coal, blooms, tin bars, sleepers, and its receipts of iron ore, coke, &c., keep up a constant ferment. One day last week nearly 10,000 tons of ore came to port, and of this Ebbw Vale have had large consignments.

Swansea sent off one consignment last week of 3000 tons steel blooms for Baltimore.

Trade generally, iron, steel, and coke, shows distinct improvement. Prices, unfortunately, in all matters of steel are still low. Taking the increase in price of foreign ore, pig, and coke, makers are only a slight shade better off. Some quotations are still about £4 10s. steel rails, certain specification, and sales have been effected at £4 5s.

The coke trade is brisk, and large quantities are being sent principally by rail for home requirements. Small coal is in brisk demand at improved rates. Little of the best can be had under 5s.

There was a meeting of the Sliding Scale Committee, Coalowners' Association, in Cardiff on Saturday, when it was announced that the last audit showed a necessity for a reduction of wages to the extent of 2½ per cent. This came into effect on the 1st of March. It was generally supposed that a 5 per cent. reduction would have been necessary, seeing the downward market which has ruled so long. Enginemen and stokers will have to suffer the same reduction on and from April 1st.

In tin-plate there is a healthier sign in the Pontypool district, and I am glad to hear that the men and masters are coming to terms, and so will have a slice of the good fortune that is now prevailing in the Swansea district.

The despatch from Swansea last week was heavy, including 1400 tons tin-plates for Baltimore, and 500 tons for New Orleans. In all the shipment totalled up 66,000 boxes. Cokes and Bessemers range from 13s. 3d. to 13s. 9d.; Siemens, 14s. to 14s. 3d.; and at these rates a good deal of business is being done. Siemens plates are particularly stiff in price. The season for a good demand is now opening, and a great deal of tact will be required to place forward business even at existing quotations. Stocks in Swansea are lessening rapidly.

The inquest on the Cwtch colliery disaster will take place about the middle of the month. No theory as to the cause seems as yet tenable.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

Although the political situation has this week again had its influence on the iron markets of this country to the extent of keeping back all but the less important orders, still nearly all the prices have remained unaffected; indeed some, especially for steel manufactures, have gone up. The momentary position of the iron trade may be said to be at most at a standstill in its progress, and that now the happy result of the elections is known, a favourable turn is with certainty to be prognosticated. The Silesian market continues very buoyant, and the works maintain a firm price for pig iron, and will only contract for the third quarter at enhanced prices. The newly made arrangement of the common office for the undivided sale of all the wrought iron made is already bearing fruit, and commercial bars have attained the price of M. 111 p.t.; also the neighbouring market of Austria has an advance in prices to record. As regards the Rhenish-Westphalian market, the sale of ores, favoured by the recently reduced railway rates, is good, and on the whole, prices have been maintained, although there has been a slight tendency to a downward pressure in consequence of the less firm quotations of late on the Spanish ore market, which, however, are now advancing again a little, and shipments increasing. The demand has also latterly been quieter than it was a week or two back. Through the reluctance of buyers to come forward for the moment, the pig iron market has become quieter, but as the works are all well sold forward for this and next quarter, there is at present no likelihood of prices becoming weaker. Spiegel costs from M. 50 to 59, according to contents in manganese; forge pig is noted at 46 to 48; basic, 42 to 43, and sometimes higher; Luxemburg, 43 to 46; Bessemer, 49 to 52; and foundry, 49 to 55 to 56 p.t. Forge pig is very firm, and only to be bought at higher prices far ahead, and as there are no more stocks remaining, it is in project to increase the present production shortly. Neither spiegel nor foundry iron are so much sought after as formerly, but the prices remain stable. Basic and Bessemer pig are in full request, at prices rather rising than the reverse. The total output of pig iron for the month of January was 293,879 t.; spiegel and forge, 144,295; Bessemer, 31,267; basic, 80,008; and foundry, 38,312 t.; January, 1886, 296,896 t. The rolling mills are so full of work that they can only take new orders—which, by the way, are not coming in so briskly as heretofore, for the reasons often before given—at two months' term of delivery, and in such conditions, of course, the prices can be well maintained. For this month in the year both bars, girders, and other sectional irons are in great demand, and are noted M. 105 to 110; angles, 106 to 113; girders, 108 to 110; hoop, 110 to 115; Bessemer billets, 112 to 125, and even 130 is here and there paid; iron boiler plates, I.Q., 145 to 148; common Q., 135 to 140; steel do., 140 and up to 160 and even 165; charcoal plates 140 to 145; iron wire rods ordinary Q, 112; steel ditto, 110 to 112; drawn wire in iron and steel, up to 130; steel sleepers, 115 to 125; steel rails at last tendering 120 and odd p.fg.; complete wheels and axles, 300 to 320; axles, 230 to 235; steel tires. 215 to 220 p.t. Boiler plates are firm at the noted prices and rising rather than falling, and latterly the demand has much increased, so at last they also have begun to feel the improvement which has set in. The same may be said of sectional irons of all sorts. As for wire rods, what with the demand from abroad and for home use for wire drawing, nails, small rivets, and screw making, &c., for which it is used, and the prices for which manufacture has become remunerative again, the mills are so full of orders that they have been obliged to close their books for a while, but at the same time it must be noted that orders have become seldomer than they were. Steel railroad materials are firm as to price, otherwise there is little to note in particular. A small order for 2750 t. of rails and 2880 t. of sleepers was given out last week by the Government at Cologne. No foreigners bid. The lowest tender for rails was M. 122, and for sleepers M. 115 p.t. at works. 580t. of point and crossing sleepers M. 118 p.t. at works. One hundred covered wagons are to be tendered for soon at Berlin, otherwise the works are badly off for orders. The machine and boiler-making shops and foundries are receiving a few more orders than lately was the case, which is so far encouraging, but prices are still much depressed.

The ice in the rivers has been a great hindrance to the coal and coke trades, otherwise the business is rather more satisfactory both in house and industrial coal and coke, and the miners are no longer inclined to book for long delivery ahead, especially for coke, which is expected soon to command a better price.

In Belgium orders are coming to hand in regular but moderate amount, and larger orders are more rare than they were. The Cockerill Company has one order in hand for the Panama Canal Company for twelve locomotives, and others for Russia and Spain for blast engines, whilst another works has eighteen steam engines to deliver, and on the whole the machine factories are satisfactorily engaged. Prices have remained pretty stationary the last fortnight, and the syndicates prices for wrought iron have been maintained at for merchant bars, 100; girders, 100; angles, 115; iron plates, No. 2 Q., 120 to 130; No. 3 Q., 150; merchant sorts, 170; and ditto in steel, 165 f. p.t.

In France mixed lots of wire rods, No. 2 gauge, for drawing out cost 150f. p.t. Steel ingots 95, blooms 105, billets 110 to 112·50, and basic pig 49f. p.t.; girders in Paris are 140, and merchant bars 145, old rails 90f. p.t. Buyers are holding aloof. The foundries are momentarily better employed, but, as everywhere else, prices are low and by no means satisfactory.

Another of those accidents has occurred not long after the boiler was examined and hydraulically tested at an ironworks at Dortmund, killing one and injuring five workmen by its explosion. It was a vertical one, and fortunately the pressure of steam was not high at the time, or from the nature of the explosion it is believed it would have completely wrecked the works and destroyed many more lives. Again, last week a boiler burst in the same district, demolishing a saw mill and killing three men. This clearly shows that, even where a strict Government inspection is enforced, it is no absolute remedy for these disastrous explosions.

A new gun factory for making the repeating rifles for the Hungarian portion of the Austrian army is about to be established at Buda-Pest. The capital is £300,000, with a like sum in priority shares. The Loewe Company at Berlin is entrusted with the internal arrangements and the mountings of the establishment. The Union Bank at Vienna finances the affair.

AMERICAN NOTES.

(From our own Correspondent.)

New York, February 18th.

The latest reports from the Interior, as far west as Chicago and St. Louis, point to a little reaction in the heavy demand that has been reported from week to week since the opening of the year. The reason for this temporary falling-off is due to two or three causes, the chief one being that all large buyers throughout the country purchased actively during January in order to provide themselves with material against an advance which they thought they saw coming. The very effect of this activity in buying was to crowd prices higher than they otherwise would have gone. The advance which was thus crowded compelled consumers to draw out of the market for the time being, and we are now in the midst of that lull. It may continue two or three weeks, but in the meantime preparations are being made for the heavy spring and summer trade for railway equipments and appliances of all kinds, and for machinery for mills, factories, and mines. The extent of this new demand will determine the prices for late work during the spring. Nearly all of the large establishments are now supplied with orders that will run them up to May 1st; while in the case of the rail mills the orders now in hand will extend at least to October 1st.

Reports just received from several Southern States show that a multitude of industrial establishments are springing up, and that the machinery for most of them is coming from points north of the Ohio. The large machinery establishments of New York, Philadelphia, and of some of the New England States have their contract books filled for three months.

The prices of iron during the week have been held at the figures ruling on February 1st, excepting in old rails and in billets and slabs. Foreign makers find it necessary to shade prices about 1 dol., in order to meet the American views. Steel rails have advanced 1 dol., while old rails have declined 1 dol. Merchant bar is selling at 2c. to 2·25. Nails are 2·40 dols. to 2·60 dols. Wrought iron pipes have been advanced 2½ per cent. Wrought iron pipe contracts are in for two months. Several large lines will be built as soon as the weather will allow of outside operations. Locomotive builders have booked orders for 100 engines within two weeks; three weeks alone securing orders in ten days for sixty engines. The car builders have been crowded with orders, and in several cases have been obliged to refuse new offers until present work was completed. 25,000 tons of Bessemer pig were ordered within a few days, and brokers in this city are now arranging for heavy deliveries of steel rails in the South-West, where a number of large railroad building enterprises are not yet supplied. The demand for all kinds of railway equipments will press upon the capacity of makers. Car-wheel builders and axle makers are very busy, and the demand for palace cars is keeping the works at Chicago overcrowded.

Merchant steel is also ruling high, and as the production is no more than will be wanted for actual consumption, the steel makers are looking forward to a year of unusual activity. Crude iron for mill purposes is selling at 19 dols. to 19·50 dols. A good deal of interest is felt in the possible importations of Middlesbrough iron, though the American makers profess to regard the possibilities as very remote.

NEW COMPANIES.

The following companies have just been registered:—

Adjustable Horseshoe Syndicate, Limited.

This company was registered on the 19th inst., with a capital of £20,000, in £1 shares, to acquire and work patent rights and other monopolies; but the particular invention to be acquired by the company is not mentioned in the memorandum of association of the company. The subscribers are:—

	Shares.
J. C. Bates, 2, Harrington-street, N.W., shorthand writer	1
H. J. R. Liversage, 45, Swinton-street, King's Cross, law stationer	1
J. C. Masters, 41, Holly-street, Dalston, accountant	1
A. E. Bale, 28, The Avenue, Acre-lane, Brixton, law student	1
W. R. Edwards, 7, Cambridge-terrace, Hyde Park, commission agent	1
W. Alexander, 23, St. George's-road, Peckham, clerk	1
H. J. Kidd, 12, Teviot-street, Bromley-by-Bow, clerk	1

The number of directors is not to be less than two, nor more than seven; the subscribers are to act as directors until others are appointed; qualification, 250 shares; remuneration, £500 per annum.

Bengal-Nagpur Railway Company, Limited.

This company proposes to enter into a contract with the Secretary of State in Council of India, in the form scheduled to an agreement of 22nd inst. between the said Secretary of State and Robert Miller; and under the same, to construct, m intain, and work the railways and works from time to time constituting the "undertaking" defined in such contract. The company was registered on the 23rd inst., with a capital of £3,000,000, in £20 shares. The subscribers are:—

	Shares.
*Samuel Hoare, M.P., 7, Hereford-gardens, W.	500
*Lieutenant-General C. H. Dickens, 75, Lexham-gardens	50
*Robert Miller, 27, Austinfriars, merchant	500
*D. T. Robertson, 41, Onslow-gardens	500
*A. H. Campbell, 63, Cornhill, merchant	50
*Colonel F. S. Stanton, R.E., Warrington, Somerset	100
G. Miller, 27, Austinfriars, merchant	500
D. A. M. Christie, 6, Russell-road, Kensington	500
Lieutenant-Colonel E. Manyat, Horley, Surrey	250

The number of directors is not to be less than five, nor more than nine; qualification, fifty shares, or equivalent stock; remuneration, £2000 per annum. The first six subscribers, and Lord Lawrence and John Cleghorn, Esq., are the first directors.

Barrowdale Plumbago Mines and Manufacturing Company, Limited.

This company proposes to acquire certain plumbago mines referred to in an agreement of the 12th ult., between John Shepherd Sawrey and Thomas North. It was incorporated on the 18th inst., with a capital of £65,000, in £1 shares. Power is taken to trade as blacklead and pencil manufacturers, and as makers and dealers in plumbago and other blackings for metal founders. The subscribers are:—

	Shares.
Charles Clifford, C B., Cannock Stafford	1
A. H. Evans, 27, Throgmorton-street	1
Lieutenant-Colonel M. S. Fielden, Catford	1
A. R. Robertson, Dashwood House	1
J. S. Sawrey, 20, Bucklersbury, engineer	1
G. S. Howatson, 20, Bucklersbury, engineer	1
O. H. Sconeham, 29, St. Swithin's-lane, chartered accountant	1

The number of directors is not to be less than three, nor more than seven; qualification, 200 shares, or a corresponding amount of stock; remuneration, £1000 per annum, and a further sum of £500 out of the balance of profits remaining after payment of 10 per cent. dividend, and a further £500 when 20 per cent. is paid.

English and Foreign Patents Company, Limited.

This company was registered on the 18th inst., with a capital of £5000, in £1 shares, to acquire, work, and develope patents and inventions, and to dispose of the same. The subscribers are:—

	Shares.
W. M. Bullivant, 72, Mark-lane, merchant	100
W. B. Wright, C.E., 148, Cromwell-road	100
T. A. Mitchell, Chislehurst	100
A. T. Dacre, 60, Queen Victoria-street, engineer	100
J. B. Martin, Victoria Mansions	100
Harold Brown, 7, Walbrook, solicitor	100
S. G. Spreat, 4, Belsize-square, solicitor	1

Registered without special articles.

Grant Envelope Machine Company, Limited.

This company proposes to purchase from Sidney Austin Grant and Walter Whitfield Bostwick, upon terms of an unregistered agreement of the 9th inst., the letters patent No. 13,614, dated 15th October, 1884, and No. 11,200, dated 2nd September, 1886, for improvements in envelope machines. It was constituted on the 17th inst., with a capital of £75,000, in £1 shares, with the following as first subscribers:—

	Shares.
Walter Jameson Waterlow, 24, Birchin-lane, stationer	1
S. A. Grant, 46, Kirby-street, Hatton-garden, mechanical engineer	1
J. Richmond, 30, Kirby-street, Hatton-garden, engineer	1
J. Norris Pimm, 12, Garlick-hill, envelope manufacturer	1
W. Hooper, Broadley, Bowes Park, clerk	1
W. W. Bostwick, 40, Kirby-street, engineer	1
Thos. Winter, 19, Bowness-road, Catford, clerk	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first; qualification, 100 shares; remuneration, £750 per annum, and one-tenth of the net profits remaining after payment of 10 per cent. per annum dividend.

National Underwriting Association, Limited.

This company proposes to transact business as underwriters and marine insurers in all branches. It was registered on the 18th inst. as a company limited by guarantee to £5 in respect of each policy issued. The subscribers are:—

H. Radcliffe, Cardiff, shipowner.
R. Holmah, 23, St. Mary Axe, shipowner.
*H. Hooper, Cardiff, shipowner.
W. Milburn, jun , Billiter-avenue, shipowner.
*T. V. S. Angier, 118, Bishopsgate-street, shipowner.
*D. G. Pinkney, Sunderland, shipowner.
T. C. McIntyre, 101, Leadenhall-street, shipowner.

The first court consists of the subscribers denoted by an asterisk, and Messrs. J. R. Christie, Thos. and Philip Morel, John Dent, G. Roberts, C. Furness, and A. M. Hay.

Patent Warp Polishing Company, Limited.

Registered on the 18th inst., with a capital of £20,000, in £1 shares, to acquire the letters patent No. 7939, dated 15th June, 1886, granted to John Burn, for improvements in the method and apparatus for polishing warp threads; and also to acquire the machinery, plant, and stock-in-trade of Mr. Burn as a polisher and dyer of cotton and other threads. The subscribers are:—

	Shares.
R. Gaunt, Fareley, near Leeds, worsted spinner	1
J. H. Mitchell, Bowling, near Bradford, spinner	1
R. Moore, Bradford, wool stapler	1
F. D. Moore, Bradford, wool stapler	1
T. Peel, Bradford	1
G. Townend, Bradford, stuff manufacturer	1
J. Burn, Bradford, manufacturer	1

The number of directors is not to be less than three, nor more than seven; the subscribers are the first; qualification, 250 shares. The company in general meeting will determine remuneration.

Star Patent Fuel Company, Limited.

This company proposes to acquire the Star Compressed Fuel Works—formerly the Maindy Ironworks—at Cardiff, and the business of compressed fuel manufacturers carried on in connection therewith. It was registered on the 21st inst., with a capital of £25,000, in £100 shares, with the following as first subscribers:—

	Shares.
C. B. O. Clarke, 4, St. Dunstan's-alley, E.C.	1
*H. Kent, 52, Shepherd's Bush-green, coal factor	1
S. R. Clarke, 4, St Dunstan's-alley, coal factor	1
J. Lothian, 432, Commercial-road, E., clerk	1
A. Clarke, Perry Vale, Forest-hill	1
J. W. Neil, 2, Ham Frith-villas, Forest Gate, clerk	1
F. C. Collingwood, Stoney Down Cottage, Walthamstow, accountant	1

The number of directors is not to be less than three, nor more than five; the first are Hy. Kent, J. S. Tamburini, and J. H. Insole; qualification, 10 shares. The company in general meeting will determine remuneration.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

22nd February, 1887.

2698. Muff and Hand Bag Combined, H. Friederberg, London.
2699. Paper Envelopes, E. S. Norcombe, W. E. Reeves, and J. G. Stevens, Edgbaston.
2700. Bicycles, &c., H. Pipe, London.
2701. Road Wire Stranded Ropes, G. W. Westgarth, Gateshead-on-Tyne.
2702. Chucks for Lathes, H. W. Tonks, Birmingham.
2703. Extinguishers for Oil Lamps, &c., F. R. Baker, Birmingham.
2704. Securing Ball Castors to Iron Bedsteads, &c., T. E. Bolton, Manchester.
2705. Meat Cutting and Filling Machine, J. Cheshire, Hockley.
2706. Shell Stone, &c., Smasher, E. S. Norcombe, Birmingham.
2707. Air-tight Stopper for Bottles, &c., J. E. Mellor, Nether Edge.
2708. Gas Lighting, T. G. Marsh, Lytham.
2709. False Grates, W. Hoyle, Halifax.
2710. Filtering Machines, J. A. Crocker, London.
2711. Filtering Machines, J. A. Crocker, London.
2712. Electrical Mail Indicators, H. J. Allison.—(*A. F. Hochstadter, United States.*)
2713. Lubricators for Engines, W. Grimes, Manchester.
2714. Valve Gear of Steam Engines, G. H. Baxter and J. Weir, Edinburgh.
2715. Saving Life at Sea, S. Hart, Hull.
2716. Connecting Metal Pipes, S. Hart, Hull.
2717. Safety Valves, &c., H. Hitchen, Halifax.
2718. Automatic Tipping Scoop, W. Malcolm, Glasgow.
2719. Pencils, W. Routledge, jun., Carlisle.
2720. Tin Plates, J. A. Maskrey, London.
2721. Electric Batteries, C. G. Curtis, F. B. Crocker, and S. S. Wheeler, London.
2722. Castings, J. Banham and S. W. Wilkinson, Sheffield.
2723. Automatic Delivery of Goods, &c., C. F. J. B. Bécherel, London.
2724. Converting Reciprocating into Rotary Motion, J. C. Sellars, Liverpool.
2725. Preventing Draughts of Air between the Sashes of Windows, D. H. Cheetham, Eccles.
2726. Slipper, J. Blakey, Halifax.
2727. Foundations of Cards, S. Roberts, H. Law, and J. V. Curry, Halifax.
2728. Stopping Bottles, W. Ball, Stalybridge.
2729. Metal Self-adjusting Tie, &c., G. R. Adams, Dundee.
2730. Post Cards, H. Johnson, London.
2731. Fastening Brooms to Handles, M. J. Booker, Broughton.
2732. Tea Chests, R. R. Rowntree, London.
2733. Coupling, &c., Railway Carriages, G. W. Moon, London.
2734. Wristband for Shirts, E. Dummer, London.
2735. Metallic Wheels for Carriages, &c., J. K. Starley, London.
2736. Attaching Tripods of Photographic Cameras, H. Bolden, London.
2737. Camera Stands, H. Bolden, London.
2738. Feeding-bottles, A. Wilesmith, London.
2739. Printing Chronograph, A. Guye, jun., London.
2740. Extracting Metals from Ores, M. Constable, and J. R. Bingle, London.
2741. Softening Water, C. E. Gittins, London.
2742. Flooring for Bridges, H. T. Shaw and C. Chittick, London.
2743. Machinery, H. T. Shaw and C. Chittick, London.
2744. Punching Machinery, H. T. Shaw and C. Chittick, London.
2745. Driving Mechanism, J. Standfield, London.
2746. Mechanical Counter, E. F. Bamber.—(*S. J. Kilby, Calcutta.*)
2747. Centrifugal Machines, J. Gray, Glasgow.
2748. Camera Stands, M. O. Hund.—(*E. Calix-Toussaint, Switzerland.*)
2749. Gas Fuel, A. J. Boult.—(*H. W. Brookes, United States.*)
2750. Crain Cleaners, W. E. Sergeant and J. H. Cook, London.
2751. Lubricating Devices, A. J. Boult.—(*O. H. Warren, United States.*)
2752. Enriching Gas, H. J. Seibel, jun., London.
2753. Remedy for Cholera, &c., A. J. Boult.—(*A. T. Estabrook, United States.*)
2754. Printing the Transfers for China, W. H. Turner, London.
2755. Charging Cartridge Shells, A. J. Boult.—(*H. T. Hazard, United States.*)
2756. Printing Transfers for China, W. H. Turner, London.
2757. Excavating, T. Whitaker, Liverpool.
2758. Railway Switches, P. M. Justice.—(*R. A. Isbell, United States.*)
2759. Clinical Thermometer, E. S. Arrighi, London.
2760. Musical Boxes, &c., A. Eisen, London.
2761. Propulsion of Ships, W. Macgowan, Glasgow.
2762. Evaporation of Salt, &c., in Closed Vessels, H. E. Newton.—(*A. Miller, United States.*)
2763. Photographic Developing Dishes, R. E. Atkinson, London.
2764. Spinning and Twisting Cordage, E. M. Fulton, London.
2765. Transmitting Gear for Electric Motors, J. Y. Johnson.—(*W. H. Knight, United States.*)
2766. Decantation Apparatus for Purifying Water, J. Y. Johnson.—(*La Société G. Boone et J. Nory, France.*)
2767. Disintegrating or Pulverising Machinery, W. Boulton, London.
2768. Saucepans, &c., A. Line, London.
2769. Constructing Graves, E. Edwards.—(*P. Jacquieaux, France.*)
2770. Transparent Grained Films for Lithographic Forms, M. and G. E. Walker, and J. B. G. Bonnaud, trading as Sampson Bridgwood and Co., London.
2771. Woven Fabrics on Lace Machines, E. Davenière, London.
2772. Engine Governors, H. H. Lake.—(*A. D. Quint, United States.*)
2773. Petroleum and other Lamps, H. H. Lake.—(*A. Stewart, United States.*)
2774. Moulds for Metal Castings, A. E. Outerbridge, jun , London.
2775. Tricycles, B. Green and S. Lee, London.
2776. Lamps, C. Crastin and A. B. Cunningham, London.
2777. Unwinding of the Warp or Chain in Looms, E. F. Brulé, London.
2778. Car-coupling, R. Haddan.—(*G. Kramer, United States.*)
2779. Harvesters, La V. W. Noyes, London.
2780. Steel, J. Dahl, London.
2781. Musical Instruments, P. Boehm, London.
2782. Heating, H. H. Lake.—(*W. W. Batchelder, United States.*)
2783. Engines, J. H. Knight, London.
2784. Locking Points of Railways, G. Edwards, London.
2785. Stop Blocks, W. J. Gaultier, Middlesex.
2786. Floor Boards, S. P. Wilding.—(*G. Vogel, Germany.*

23rd February, 1887.

2787. Cog, L. Anderson, London.
2788. Folding Hosiery, &c., C. Cresswell, Nottingham.
2789. Spring, J. Robertson, London.
2790. Dial, W. F. Mason, Manchester.
2791. Tricycles, W. Butcher, Kent.
2792. Chalking Cues, C. Sandall, Bristol.
2793. Lithographic Printing, W. Bramhall, Manchester.
2794. Stoppering Bottles, R. Goldseller, Manchester.
2795. Stop Tap, J. Wedge, Winchester.
2796. Lubricating Valves, J. Lumb and E. C. Mills, Manchester.
2797. Solitaires, &c., G. Pritchard, Birmingham.
2798. Combined Rolling, &c., Machine, J., P., A., F., and A. Cave, Rushden.
2799. Rim Latches, P. Stringer, Wednesfield.
2800. Spinning, &c., Fibrous Materials, J. Gullery, Belfast.
2801. Tanks, &c., R. C. Jay, London.
2802. Patterns for Marking Out Wearing Apparel, F. C. Noar, Manchester.
2803. Back for Photograph Mirror Frames, W. D. Wilkinson and F. Fowler, Birmingham.
2804. Fare Punches, R. and J. Porter, J. E. Morgan, and T. Prior, London.
2805. Safety Sash Fastener, E. Lloyd, London.
2806. Ventilating Waterproof Garments, B. Kempner, London.
2807. Cooking Ranges, J. M. Shaw, Glasgow.
2808. Pumps, A. Lewin, London.
2809. Axle and Box, A. C. Henderson.—(*E. Jeanningros, France.*)
2810. Driving Gear of Elevators, G. Cottrell and J. Hancox, London.
2811. Door Knobs or Handles, J. and W. W. England, London.
2812. Tying and Untying of Parcels, J. Whyte, London.
2813. Ventilating, &c., Buildings, R. W. Hellyer, London.
2814. Cleansing, &c., Spun Fabrics, J. A. Berly.—(*Messrs. G. Lombard et Compagnie, France.*)
2815. Condensers, A. H. Byng, London.
2816. Water Waste Preventers, J. T. Harris, London.
2817. Self-locking Bolts, H. J. Moore, London.
2818. Imitation Turkey Carpets, &c., E. Edwards.—(*H. F. Keuller, Belgium.*)
2819. Operating Electric Lamps, H. Nerlinger, Germany.
2820. Paving, A. J. Boult.—(*M. Runkel and F. Bisson,* ———.)
2821. Printing of Tiles, &c., W. H. Turner, London.
2822. Fastening Bills on Walls, &c., A. C. Morgan, London.
2823. Chills for Casting Metals, J. R. Whitney, London.
2824. Setting Switch Points and Signals, H. Williams, Glasgow.
2825. Dynamo-electric Machines, J. G. Statter, London.
2826. Velocipedes, M. Reilly, London.
2827. Injectors, J. Thiry and G. Chantrenne-Soiron, London.
2828. Punching and Rivetting Machines, R. H. Tweddell, J. Platt, and J. Fielding, London.
2829. Fluid Pressure Apparatus, R. H. Tweddell, J. Platt, and J. Fielding, London.
2830. Removing Fibre from Cotton Seed, J. Y. Johnson.—(*M. Crawford, United States.*)
2831. Disinfecting, &c., J. H. Harford and W. W. Reeves, London.
2832. Frames, &c., used in Beehives, S. W. Abbott, London.
2833. Lamps, H. Fricker.—(*R. M. Wanzer, Canada.*)
2834. Treatment of Iron Ore, H. Gardner.—(*R. J. Henderson, United States.*)
2835. Electric Batteries, G. V. Lagarde, London.
2836. Transmitting Primary Motion into Secondary Motion, E. Frankenberg, London.

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2837. Spring Bellows, &c., Pumps, J. Leckie, Gourock.
2838. Cutting Oval Discs, A. T. F. Rose, Birmingham.
2839. Educational Puzzle, &c., H. and F. Reason, London.
2840. Furnace Bars, &c., D. Russell, Leeds.
2841. Internally Stoppered Bottles, W. H. and W E. Carmont, and W. Giffard, Manchester.
2842. Nozzles, J. Roberts, Stalybridge.
2843. Sanitary Water-closet Apparatus, T. Kemp, London.
2844. Heated Air Engines, A. Koerber, London.
2845. Device for Knitting Machines, T. Walker and A. Hamer, Leicester.
2846. Velvets, &c., J. W. Hall and E. Lord, Manchester.
2847. Revolving Seat, A. Weir and A. Weir, Glasgow.
2848. Plough Planes, W. Kimberley, Birmingham.
2849. Gas Stoves, A. Hill, Birmingham.
2850. Automatic Fire-extinguishing Apparatus, J. B. Hannay, Glasgow.
2851. Automatic Switch or Cut-out for Electrical Circuits, T. Parker, Manchester.
2852. Securing an Accurate Fit in Artificial Dentures, W. R. Bennette, Birkenhead.
2853. Metal Corners for Boxes, E. Crowe and L. W Stone, Banbury.
2854. Pulleys or Drums, A. House, Openshaw.
2855. Railway Chair-keys or Fastenings, J. Ireland, Glasgow.
2856. Hat Ventilation, V. Bondi, Vienna.
2857. Closing the Mouths of Bottles, J. McEwen and D. Rylands, Barnsley.
2858. Stoppering Bottles, F. Gartside, Glasgow.
2859. Pumping Engines, H. Davey, Headingley.
2860. Automatically Raising Sewage, H. Davey, Headingley.
2861. Air-guns, C. Lane, Croydon, and W. J. Jeffery, London.
2862. Preventing Explosion in Kitchen Boilers, S. Earl, London.
2863. Manufacturing Dyes, &c., R. H. W. Biggs.—(*C. M. De Lahorie, Paris.*)
2864. Valves for Inflating Life-belts, R. D. Kay, London.
2865. Intermixing Tinsel with Straw Plait, H. Sprague, London.
2866. Scutching or Decorticating Machines, E. M. Armand, London.
2867. Self-contained Spindles for Spinning, &c., Fibrous Materials, S. H. Brooks, T. Goodbehere, and F. G. Goodbehere, London.
2868. Twist Lace Fabrics, A. and F. H. Lees, London.
2869. Steel Wire Skeleton Hinges and Spring Hinges, S. S. Bromhead, London.
2870. Heating Air to a High Temperature, J. A. Eaton.—(*S. H. Shaw, India.*)
2871. Leaf-holder for Music Stands, &c., A. Cary, London.
2872. Complete Atmospheric Tubular Pneumatic Action for Organs, J. R. Cousans, Lincoln.
2873. Steeping or Soaking Wheel for Bottle Washing, A. J. T. Wild, London.
2874. Grinding Mills, H. Albert, London.
2875. Auxiliary Picking Strap for Power Looms, I. Sowden, Bradford.
2876. Coiling Mechanism for Rolling Mills, P. M. Justice.—(*F. H. Daniels, United States.*)
2877. Kneading Dough, G. Puchmueller and Friedrich Westendorff, trading as Petzold and Co., London.
2878. Embroidery Stitch, E. Cornely, London.
2879. Clearing Away Fog, R. Ballard, London.
2880. Surgical Instruments for the Treatment of Stricture of the Urethra, E. D. Maddick, London.
2881. Filter, B. J. B. Mills.—(*J. Rétif, France.*)
2882. Filling and Finishing Cartridge Cases, G. Hone, London.
2883. Fire-extinguishing Appliances, F. Moore, London.
2884. Insurance Devices, W. W. Walker and E. A. McAdam, Liverpool.
2885. Measuring the Distance between Balls on a Billiard Table, C. W. Engelhardt, London.

2886. Breech Action for Fire-arms, E. Palliser.—(*C. G. Harston, Canada.*)
2887. Marking Soap, C. Wilkins, London.
2888. Stopping Bottles, C. Wilkins, London.
2889. Combined Pencil Sharpener, Point Protector, and Ink Eraser, J. Kelway, jun., London.
2890. Knife Boards, D. B. Morley, London.
2891. Photographic Albums, C. Lunn, London.
2892. Combined Chair Table, and Easel, W. E. G. Forbes, London.
2893. Cleaning Currants, &c., R. W. Penrose, London.
2894. Windmills, &c., W. H. Tooth, London.
2895. Watch Escapements, E. Edwards.—(*L. Kniep, Germany.*)
2896. Automatically Supplying Cigars, &c., E. Edwards.—(*C. Bach, Switzerland.*)
2897. Rotary Engine, J. A. Wade and J. Cherry, London.
2898. Combination Advertising Envelope, A. H. Deakin, London.
2899. Steam Generators and Engines, J. Neil, Glasgow.
2900. Match-box Making-machines, F. Lundgun, London.
2901. Drying Coffee Beans, H. H. Lake.—(*A. F Drousberg, Holland.*)
2902. Affixing Pieces of Nacre, &c., to Wood, &c., J. F. Pouget London.
2903. Connecting Muff to Boas for Ladies' Attire, J. Jacobs, London.
2904. Refining Oils, &c., D. G. Joy, Kingston-upon-Hull.
2905. Diffusing Apparatus, H. H. Lake.—(*La Compagnie de Fives-Lille, France.*)
2906. Commutating Switches for Electric Circuits, E. W. Beckingsale, London.
2907. Lowering Coffins into Graves, C. A. Schubert, London.

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2908. Metallic Capsules for Bottles, &c., C. Cheswright, London.
2909. Feed-water Heater, A. MacLaine, Belfast.
2910. Filtering Materials, J. C. Thresh, Manchester.
2911 Polishing, &c , Felt Hats, &c., W. Morgan, Manchester.
2912. Stove Grates, J. Barber, Sheffield.
2913. Cooking Ranges, D. Cowan, Glasgow.
2914. Hydraulic Packing Machinery, E. Durden, Manchester.
2915. Filter Presses, J. Critchlow, T. Forester, W. Forester, H. Forester, and L. Forester, Longport.
2916. Pickers and Picking Sticks, D. Thornton, Halifax.
2917. Sewing Machines, W. E. Hickling, Leicester.
2918. Vapour Distributing Kilns, A. T. Winn and W. E. Hainsworth, Dewsbury.
2919. Boxes or Cases, J. Jeffs and R. Rear, Manchester.
2920. Regenerative Gas Furnaces, D. Rylands and R. Potter, Barnsley.
2921. Washing Machines, J. Summerscales and H. C. Longsdon, Halifax.
2922. Tilting Barrels, &c., G. Appleyard and I. Shaw, Conesbrough.
2923. Cutting Mouldings, J. Kershaw, Bradford.
2924. Locking Bolt Heads, G. V. Jameson and E. W. Hughes, London.
2925. Spring Double Hook for Traces, &c., G. L. Holloway and H. Stanning, London.
2926. Name Bands for Umbrella Handles, &c., G. Barnley, Wigston Magna.
2927. Candle Shades Apparatus, A. B. Lloyd, Newcastle-on-Tyne.
2928. Stirrup Leather Bar, P. A. Martin, Birmingham.
2929. Cullender, A. J. Rudland, Wolverhampton.
2930. Curvilinear Planing Machines, B. C. Tilghman and G. Richards, Broadheath.
2931. Safety Heel Pad, E. Duckenfield, Birmingham.
2932. Looms for Weaving, D. Barbour, J. Christie, and M. Corrigan, Glasgow.
2933. Lighting Enclosed Gas Lamps, G. E. Webster and F. H. Bright, Sydney, N.S.W.
2934. Secret Bedstead, G. R. Barnfather, Newcastle-upon-Tyne.
2935. Preparing Steel for Roller Bars, J. Dickson, Sheffield.
2936. Treatment of Brewers' Grain, G. Epstein, London.
2937. Treatment of Coffee, G. Epstein, London.
2938. Rocking Horses, &c., G. Lines and J. Lines, London.
2939. Bustles, T. P. Taylor, London.
2940. Handles for Cutlery, T. H. Heard, Sheffield.
2941. Paving, C. S. Lumley and J. Northrop, London.
2942. Clips for Finishing Woven Fabrics, D. P. Smith, London.
2943. Preventing Accidents in Mines, E. Robertshaw, London.
2944. Lids for Sheet Metal Kegs, &c., A. Read, Liverpool.
2945. Hydrocarbon Gas from Coal, G. E. Saville, Manchester.
2946. Receiving Coins Paid in Omnibuses, F. S. Lees, London.
2947. Toboggan Sledges, W. Stobbs, E. L. White, and W. Bullard, London.
2948. Combined Pot and Tank Gas Furnace, J. Yelland, London.
2949. Magazine Guns, P. Hawkins, London.
2950. Lamps, H. J. Grafham, London.
2951. Ships' Berths, E. Lawson and E. W. de Rusett, London.
2952. Latch, &c., Cases, J. Woodward, London.
2953. Wind Motors, C. Hawkins, London.
2954. Transmission for Traction, &c., M. Immisch, London.
2955. Post Cards, A. H. Farrow, London.
2956. Securing the Mouths of Bags, D. A. B. Murray.—(*T. Cleary, New York.*)
2957. Decoration of Tiles, &c , T. White, London.
2958. Check for Tills, &c., R. K. Day and R. H. Ward, London.
2959. Combined Bell-push and Automatic Switch, H. C. Chocqueel, London.
2960. Mechanical Musical Instruments, A. Schmidt, London.
2961. Telegraphic Writing Machines, H J. Haddan.—(*B. F. Christiansen, Denmark.*)
2962. Gauges for Steam Generators, J. Y. Johnson.—(*Lebrun and Cormerais, France.*)
2963. Production of Chlorine, A. and L. Q. Brin, London.
2964. Printing Machines, J. Freeman, London.
2965. Wheels of Carriages, &c., F. Bird, London.
2966. Sulphate of Alumina, J. J. Hood and A. G. Salamon, London.
2967. Steam Boilers, J. A. Batley, London.
2968. Cutters for Soles, &c., of Boots, A. V. Newton.—(*J. and H. C. Keats, Germany.*)
2969. Cases for Tobacco Pipes, J. S. Raworth, London.
2970. Lags, &c., used in Looms, T. Stone and J. Burnett, London.
2971. Frictional Gear, W. Pitt, London.
2972. Baker's Ovens, C. H. Harding and A. Hunt, London.
2973. Finishing, &c., Hats, C. Vero, London.
2974. Motors, O. Smith, London.
2975. Lamps, H. R. and H. Hume, London.
2976. Increasing, &c., Power of Illumination Lamps, F. C. Pattison, London.
2977. Steam Ferry Raft, J. Caudwell, France.
2978. Conveying, &c., Grain, J. B. Stoner, London.
2979. Safely Operating Coupling Links, B. Rhodes, Bradford.
2980. Automatic Weft Counter for Looms, W. Rigg, Bradford.
2981. Safety Adjustable Seat, M. J. Oliver and T. Treleaven, London.
2982. Projectiles, H. P. F. Jensen, T. Ballard, and J. Jensen, London.
2983. Carbon for Filtering, &c., G. F. Marshall, London.
2984. Feeding Bottles, J. Lakeman, London.
2985. A Methylene Blue, O. Imray.—(*The Farbwerke vormals Meister, Lucius and Brüning, Germany.*)
2986. Corset, B. B. Fuchs, London.
2987. Creating Draught in Steam Boilers, M. A. Despeissis, London.
2988. Gloves, G. W. Glover, London.
2989. Bottom Chamber for Fuel Economisers, Sir E. Green, London.
2990. Determining Speeds at a Distance, J. G. Statter. London.
2991. Marine Governor, J. G. Lorrain.—(*F. Finlayson and G. A. Gosselin, India.*)
2992. Hand-power Saw Benches, H. H. L. Lewis, London.
2993. Safety Razors, B. J. B. Mills.—(*A. S. Aloe, United States.*)
2994. Rivetting Boiler Plates, H. H. Lake —(*E. L. Sibley, United States.*)
2995. Rivets, &c., H. H. Lake.—(*E. L. Sibley, United States.*)

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2996. Latch Lever Key, D. Campbell, London.
2997. Attaching Calks to Horse-shoes, S. A. Ward, Sheffield.
2998. Valve Boss, H. Roberts, Sheffield.
2999. Briquettes, L. A. Brode, Glasgow.
3000. Safety Coupler, A. H. de Wind, Comber.
3001. Preventing the Inflow of Water into Damaged Ships, W. Mackie, Turriff.
3002 Window-blind Fittings, W. Lord, London.
3003. Advertising Baby Carriages, R. Phillips, London.
3004. Roller Springs, O. Bradley and G. Whalley, Bradford.
3005. Heating, &c., Tools, C. Burgon and C. D. Davage, Sheffield.
3006. Decorating Metallic Bedsteads, J. Brookes, Smethwick.
3007. Combined Bed and Cot, W. Stead and C. Bussey, Halifax.
3008. Plough Coulters, J. Brawn, Birmingham.
3009. Trousers, J. T. Steen.—(*J. J. Macky, New Zealand.*)
3010. Steam Boiler Furnaces and Flues, E. Earnshaw, sen., T. Davies, and E. Earnshaw, jun., Manchester.
3011. Indicators, E. W. Wrigley and R. Patterson, Manchester.
3012. Railways, T. Keeling, Liverpool.
3013. Sectional Water Boilers, J. Keith, Glasgow.
3014. Reversion of Bar Frames for Beehives, R. Grose, jun., Bodmin.
3015. Velocipedes, J. Barwell, London.
3016. Centrifugal Pumps and Fans, R. R. Evans, London.
3017. Perambulator Joints, T. R. Voce, Birmingham.
3018. Ships' Logs, W. M. Walters, London.
3019. Packing for Steam and other Engines, W. Partridge, London.
3020. Magazine Fire-arms, A. J. Boult.—(*A. N. Russell and A. Brill, United States.*)
3021. Solitaires or Studs, F. McIlvenna, Manchester.
3022. Anti-vibration Frame, &c., for Bicycles, W. C. Burton, Rochdale.
3023. Evaporating, &c., Liquids, W. A. Keay, Kent.
3024. Intermittent Supply of Liquid to Chemical Plant, &c., M. Schwab, London.
3025. Covers for Footballs, W. R. Thomlinson, Glasgow.
3026. Lanterns, J. Bowman, sen., and J. Bowman, jun., Glasgow.
3027. Leather Compositions, E. Tuteur and W. J. Goulborne, London.
3028. Producing Hydroxylamin, F. Raschig, London.
3029. Preparing Fibres for Paper-making, J. B. Spence, London.
3030. Compressing Apparatus, F. Weldon, London.
3031. Lubricant, A. G. Wass, London.
3032. Fire-lighter, W. T. Lane, London.
3033. Elevators for Grain, &c., P. McVane, London.
3034. Automatic Brake for Four-wheeled Vehicles, H. Douglas-Willan, London.
3035. Latches, W. A. Peirce, London.
3036. Bottles, &c., S. Holman, London.
3037. Ordnance, H. H. Lake.—(*J. H. Brown, United States.*)
3038. Locking Railway Switches, H. H. Lake.—(*H. K. Whitner, United States.*)
3039. Ink for Marking Linen, J. Hickisson and A. Layland, London.
3040. Breech-loading Fire-arms, G. B. de Overbeck, London.
3041. Self-binding Harvesting Machinery, M. J. Oliver, London.

28th February, 1887.

3042. Artistic Chromo Design Advertising, T. Perry, London.
3043. Elevator Buckets, J. B. Sutton, Manchester.
3044. Fixing Railway Rails in the Chairs, G. Sykes, Arnside.
3045. High Pressure Taps, G. F. Belling, Manor Park, Essex.
3046. Registering Earthquakes, &c., T. Gray.—(*J. Milne, Japan.*)
3047. Driving Chain, W. Morgan, Birmingham.
3048. Feed Valves for Cylinders on Steam Engines, W. Shufflebottom, Dukinfield.
3049. Small-arms, W. Tranter, Birmingham.
3050. Grinding the Revolving Flats of Carding Engines, J. Macqueen, Withington.
3051. Marking out the Courts of Lawn Tennis, J. Sunley, Leeds.
3052. Water-heating Apparatus, R. Hallewell, Manchester.
3053. Damping, &c., Textile Fabrics, J. J. Ashworth, Rochdale.
3054. Testing the Strength of Yarn, J. Berkeley, Belfast.
3055. Fire-bars for Furnaces, &c., T. Crook and G. Bryant, London.
3056. Commutator, H. Aylesbury and J. Milne, Bristol.
3057. Commutator, H. Aylesbury and J. Milne, Bristol.
3058. Guard Cordons for Protecting Ships, &c., T. Favarger, Paris.
3059. Hand-hole Plates for Closing Orifices, W. Fairweather.—(*The Babcock and Wilcox Co., United States.*)
3060. Swivel for Leather Gig, &c., Backbands, T. W. Fines, Heanor.
3061. Pen Extractor and Eraser, W. Timms, Darlington
3062. Colour Printing Machine, A. J. Storer and C. Freund, Paris.
3063. Heating Coils, J. Keith, Glasgow.
3064. Pneumatic Apparatus for Signalling, D. Graham, Glasgow.
3065. Tobacco Pipes, J. C. and C. W. White, Glasgow.
3066. New Game, M. A. Weir, Upper Norwood.
3067. Supplying Oils to Burners, J. B. Fenby, Sutton Coldfield.
3068. Checking Fares, E. Ashort, Liverpool.
3069. Applying Brake to Tramcars, G. T. Budd, Plymouth.
3070. Padlocks, J. Marlin and H. Taylor, Bloxwich.
3071. Delivery of Articles, F. Foster, London.
3072. Safety Apparatus for Lifts, S. and T. Newton, Manchester.
3073. Window-sash Fastener, J. Knowles and Sons, Willenhall.
3074. Necktie Clip, C. T. Austen, London.
3075. Sheet Metal Kegs, A. Read, Liverpool.
3076. Winding Yarn, J. W. Makant and P. Parkinson, London.
3077. Steam-engines, S. Denton, London
3078. Effecting the Sale of Cigars, C. H. Bingham, London.
3079. Obtaining Contours from Animate and Inanimate Objects, J. Hunter, London.
3080. Basting Meat, T. S. Archer, London.
3081. Clinometers, W. F. Stanley, Surrey.
3082. Furniture Castors, H. D. Booth, Surrey.
3083. Packing Gland and Box, D. Gillies, jun., London.
3084. Internally Stoppered Bottles, T. P. Greene, London.
3085. Automatic Lever, A. Fehlen, London.
3086. Adjusting Necktie to Collar, W. Tierney, London.
3087. Dynamo-electric Machines, E. Wilson, Germany.
3088. Artificial Manures, H. Stevenson and J. T. Hazeldine, London.
3089. Thermo-chronographic Apparatus, F. A. da Silveira, Brazil.
3090. Coverings for Hay Ricks, &c., R. St. J. Allison, London.
3091. Parasols, P. Rogers, London.
3092. Umbrellas and Parasols. P. W. Davis, London.
3093. Gun Mountings, J. T. Williamson, London.
3094. Preparation of Food for Animals, E. Wylam, London.
3095. Spring Clips, T. B. Heathorn, Westminster.
3096. Photographic Cameras, J. E. Brown, London.
3097. Lifting Gear, E. Pohl and J. Jungk, London.
3098. Electric Candles, B. J. B. Mills.—(*A. Million, France.*)
3099. Gas and other Lamps, R. H. Hughes, London.
3100. Papier-mache Hollow Vessels, &c., P. Cook, Glasgow.
3101. Pockets for Billiard Tables, G. Atkins, sen., and E. J. Surl, London.
3102 Diaphragm for Acoustic Telephones, J. Cotton, Bradford.
3103. Washing Machines, R. Laws, London.
3104. Music Stands, &c., W. I. Harrow and L. Pratt, London.
3105. Covers for Books, O. W. L. J. Nordenfalk, London.
3106. Lubricators, E. Tate and S. Smirke, London.
3107. Bath and Lavatory Fittings, H. Hunt, London.
3108. Actuating Pneumatic Brakes, J. Fairfield, Germany.
3109. Engines or Motors, A. Spiel, London.
3110. Cages of Hoists, &c., H. H. Lake.—(*M. Rossbach, Germany.*)

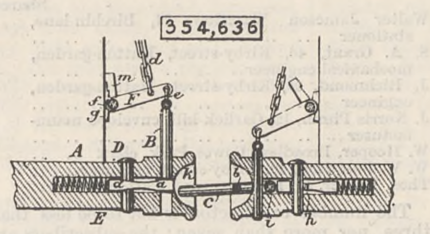
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office Official Gazette.*)

354,636. Car Coupling, *Harvey Haddan, Peekskill, N.Y.—Filed April 29th*, 1886.

Claim.—The combination, for the purposes of a safety car coupling, of the following elements: a draw head provided with a longitudinal rectangular chamber *i*, said chamber having a height adapted to support a coupling link in nearly a horizontal position and a length to receive a sliding block and spring, and terminating at its outer end in a semicircular opening *k*, a slotted sliding block *a*, provided with

354,636

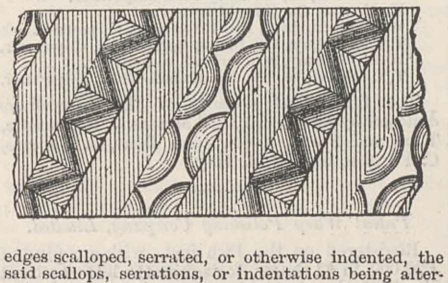


square ends and a reduced thickness at its central portion, a pin D, to limit the movement of block *a*, and having a strength equal to that of the coupling pin, a spring E, a shoulderless coupling pin B, a link *e*, an arm F, provided with a stop *m*, a shaft *f*, a bearing *g*, secured to the end of a car, and a chain *d*, all operating together as herein described and set forth.

354,702. Tire for Traction Engines, *E. Huber, Marion, Ohio.—Filed October 7th*, 1886.

Claim.—A tire for traction or portable engines, having a series of parallel transverse or diagonal cleats secured thereon, the said cleats having their opposite

354,702

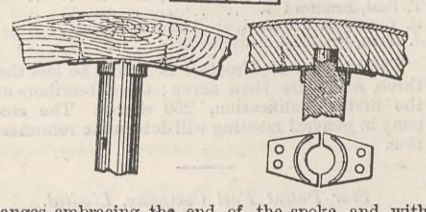


edges scalloped, serrated, or otherwise indented, the said scallops, serrations, or indentations being alternate in position on the opposite edges of each cleat, substantially as set forth.

354,792. Spoke Socket, *Charles S. Kershaw, Sherburne, N.Y.—Filed May 6th*, 1886.

Claim.—The combination, with a felly and spoke, of a clip divided diametrically and the respective sections thereof introduced between the felly and adjacent shoulder of the spoke, and provided with

354,792

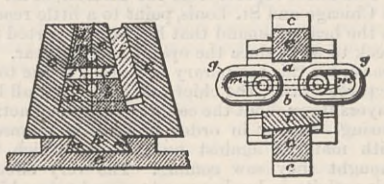


flanges embracing the end of the spoke, and with extensions secured to the felly at opposite sides of the spoke, substantially as shown and described.

354,732. Mould for Casting Chains, *William Penman, Gateshead-on-Tyne, Durham, England.—Filed December 19th*, 1884.

Claim.—(1) The combinatiou of a cradle *c*, lower mould sections, upper mould sections, and securing chock, the mould sections being formed with upper link space *m* and end spaces *f* between them, and the upper sections being formed with get-hole *h* and air-hole *l* between them, substantially as set forth. (2) The combination of a cradle *c*, lower mould sections, upper mould sections, and securing chock, the mould sections being formed with link spaces *m* and m^1 and end spaces *f* between them, and the upper mould sections being formed with get-holes *h* and h^1 and air-holes *l* and l^1 between them, substantially as set forth. (3) The combination of a bed-plate, a series of cradles, tongue and groove connection between the cradles and bed-plate, the chain mould sections, and chock, substantially as set forth. (4) The combination of a cradle *c*, lower mould sections, upper mould sections, and the chock *i*, the cradle being formed with an incline i^2, and the chock being tapered both from side

354,732

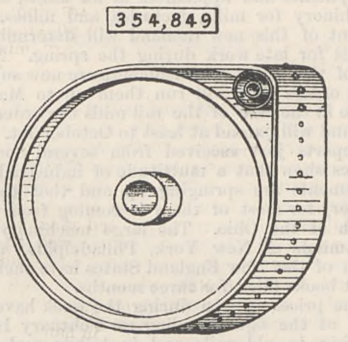


to side and from top to bottom, substantially as set forth.

354,849. Belt Gearing, *Benjamin F. Barnes, Rockford, Ill.—Filed March 2nd*, 1886.

Claim.—The combination, in a belt gear train, of an untoothed pulley and a toothed pulley of less diameter

354,849

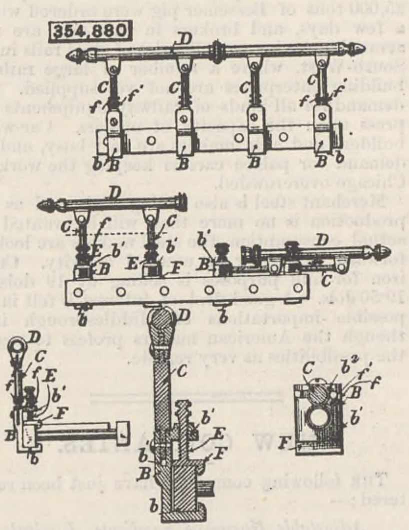


than the untoothed pulley, and a perforated belt adapted to receive the teeth of the smaller pulley substantially as described.

354,880. Safety Attachment for Scaffolds, *Lawrence Amon, Louisville, Ky.—Filed July 8th*, 1886.

Claim.—(1) An improved safety attachment for scaffolds, consisting of a guard rail divided into connectible sections, balusters pivotally connected to said rails, and also pivotally connected to clamps for embracing the sides of a scaffold, substantially as described. (2) The combination, with the blocks B, having projections *b* b^1 b^2, and carrying the movable jaws F, with their adjusting screws E, of the balusters pivotted to said blocks, the rail sections pivotally connected to said balusters, the screw ring detachably uniting the said sections, and the pins F, with their

354,880

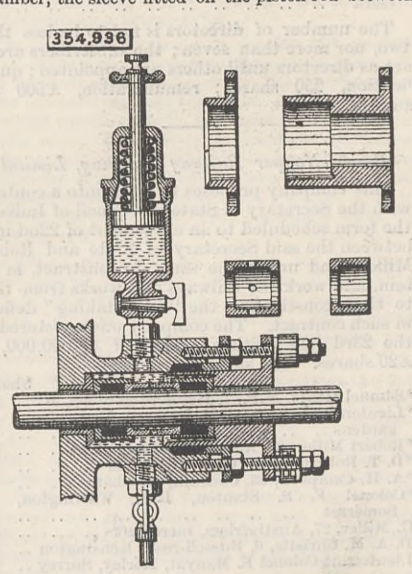


rings f^1, as and for the purpose specified. (3) In combination with the clamp B, the balusters C, pivotted to the clamps and carrying the guard rail, and the locking ring f^1, movable on the balusters and carrying a lock, pin, or projection *f*, as set forth. (4) In combination with the guard rail D, made in connectible sections, the balusters C, pivotally connected at their lower ends to the guard rail, and independent locking devices for each section of the guard rail, whereby any one of the sections with the balusters may be lowered without disturbing the other sections, as set forth. (5) In combination with the clamps B, the balusters C, pivotted to the clamps, the guard rail D, pivotted to the balusters, and the locking ring f^1, to lock the balusters to the clamps.

354,936. Packing for Piston-rods, *C. Rohn, Newark, N. J.—Filed September 1st*, 1886.

Claim.—The combination, with the fluid chamber of a stuffing box and a reciprocating piston-rod working therein, of the packing boxes fitted on the piston-rod and of less diameter than the diameter of the said chamber, the sleeve fitted on the piston-rod between

354,936



the packing boxes and having a chamber surrounding the piston-rod, which chamber is in communication with the fluid chamber at all times to constantly maintain a thin film of fluid around the piston-rod, and the packings fitted in the packing boxes to effectually close the ends of the chamber of the sleeve substantially as described, for the purpose set forth.