COLONIAL CONTRACTS.

No. I.

The railways and other public works in the colonies which have been completed during the last ten years not only show conspicuous signs of progress, but indicate in the method of their design and construction a gradual emancipation from the leading-strings of the mother country which it is interesting to notice. The earlier colonial railways, were like those in India, designed by English engineers and made by English contractors, for there were no others who had the necessary organisation or experience. Following the plan which Brassey and his contemporaries had adopted on the continental railways made by them, small sections of the work and detached portions of separate kinds, such as excavations, masonry, and brickwork, were let to local contractors of small means, who, with the money and experience so acquired, have been gradually taking the place of the English contractors; and although when it is desired to let very large works in one contract, English firms are still, as at present in South Africa, occasionally employed, even this is coming to an end, and local contractors are eager to tender for work of any magnitude. There is no lack of opportunities for capable men; there are the usual combinations of capitalists and contractors in which the former demand, as in England, the preferential profit, and the only limit to such enterprises is the willingness of the colonial Parliaments to vote the money, and of the British capitalist to subscribe to loans. In regard to the utility of the colonial railways there are differences of opinion, for the selection of routes is influenced too often by political considerations and by the pressure which the members of Parliament may bring to bear in favour of their particular districts.

The want of uniformity in the gauge of the colonial railways is also a great disadvantage, this being especially the case in Australia, where the railways have been projected and the gauge determined by the local governments at a time when an intercolonial system appeared too remote to need consideration. Now, when the advantages of combination are apparent, and a trans-continental line is projected, the colonies having a narrow gauge find that they cannot make a satisfactory connection without widening their lines—a task of considerable difficulty in Queensland, for instance, where the railway was made with sharp curves suitable only to a narrow gauge, in order to surmount the steep inclines at the western end of the line.

The purchase in England of railway material has for many years been managed either by the Crown Agents for the Colonies or by the Agents-General in London for the respective colonies. The former body is an admirable organisation, available at a very moderate expense, because the charges are divided proportionately over the numerous dependencies for whom it acts; and although it is an adjunct to the Colonial-office in London, and, indeed, has a corner of the Downing-street building set apart for it, and is promoted and recognised by the Home Government, it is independent of English control, and is utilised by the self-governed colonies only so far and so long as they consider themselves benefitted. Most of the large self-governed or representative colonies have their own agents in London, and the duties of the Downing-street office are becoming more and more confined to the business of the smaller dependencies, which, having no Legislature of their own, are known as Crown Colonies, and are in general governed by the English Colonial-office.

South Africa was the largest domain left to the Downing-street officials, but the Cape Colony has lately established its own Agent-General in London, and, like the Australian colonies, will, for the future, manage its own affairs. Still the aggregate business left to the Crown Agents is very large. Natal, Ceylon, Tasmania, the Straits Settlements, Hong Kong, and most of the West India islands still remain, besides the civil business of such military stations as Bermuda, Malta, and Gibraltar. The tendency to set up exclusive agencies, though partly a mere restless desire for independence, arises also from other causes. Thus some of the colonies have to establish emigration agencies, or have political or financial schemes to promote, and think that the one organisation may serve for other purposes. Then continual disputes and misunderstandings occur between the officials in the colonies and the Crown Agents, the latter probably deeming colonists stupid or uninformed about what is best for them, and the colonist being exasperated by the red-tape delay and mistakes of the people at home. On the whole the Crown Agents have done their work well. First, they are honest, no small matter when the immense sums that they expend is taken into consideration, any corruption that occurs being confined to very minor personages, although, in regard to this, manufacturers in certain branches of trade complain of undue preference for favoured rivals. The rules by which the Crown Agents conduct their business are not more cumbersome than is usual in Government offices; and much of the routine which appears so irksome and dilatory is but the necessary precaution against fraud. In technical matters the Crown Agents take the advice of professional engineers, and the effect of this is seen in the public works of the colonies. The material sent out may be summarily described as good, strong, and typical of sound English manufacture, but often old-fashioned, and sometimes ludicrously inappropriate.

It is an old complaint in the colonies and in many of the foreign countries supplied by England, that due regard is not paid to the peculiar exigences of site, climate, and service, and that unnecessary solidity, and therefore expense, are bestowed on material required for a new and sparsely peopled district. In these matters the English engineers who may have decided the matter have exercised a benevolent care for the colony even against the immediate interests of the colonial taxpayer. For instance, there is a marked difference between the bridges erected over Australian and South African rivers and those which are furnished to the pioneer settlers in the Western States of America. The Yankee bridge-builder who seeks for orders in the English colonies has not yet been very successful, even though his offers appear tempting, and although he is often able, notwithstanding the high price of labour and materials in his own country, to offer bridges, not only cheaper, but of a kind which he affirms to be more easily erected than the English-made bridges. But the greater expense of the English bridge is probably due either to the ignorance of the colonial engineer who designed it, concerning the special contrivances which might have facilitated its erection; or, if the bridge be designed in England, to the old-fashioned notions of the English engineer in the same respect; or more probably still—for this is an almost universal failing—because insufficient information was sent home concerning the site and other local circumstances. But the English bridge, when once erected, will probably have thrice the life of an American bridge, and cause loss neither to life nor limb. Structures sent out by the Crown Agents have compared favourably with those exported by merchants, and in many cases are even conspicuously superior. This is the case, for instance, with iron roofs and buildings. A railway station or goods shed designed in Westminster, and having the strength and quality usually given to such buildings here, may stand side by side with iron storehouses having no framing to speak of, held together by scanty and loosely-fitting bolts, and covered with 26-gauge galvanised iron sheets. Band-box structures of this kind are exported in large numbers by merchants because of their cheapness, and such comparisons may show that the purchase of everything through merchants is not an unqualified benefit. But while the action of the Crown Agents on the whole tended to keep up a high standard of quality, their mistakes, however they may have arisen, have been enough to explain, if not to justify, a desire for change. If, for instance, the history of the South African railways could be written, the incidents might rank with those of the commissariat and transport services in the Crimean war. Rolling stock and locomotives were withheld till the service of the railway was impossible, and then sent out in such quantity as to overwhelm the recipient; expensive carriages and wagons were despatched with important parts missing, or of a kind altogether unsuited to the railway, so that they had to be altered and adapted to some inferior purpose; while locomotives were sent not only of wrong type, but shipped to ports where no cranes were available for landing them. The mistakes in England have been intensified in many cases by the incompetence of local officials, for while many of the most important posts have been filled by good railway men from England, and a fair sprinkling of such minor officials as drivers and guards, yet numerous posts in the highest grades have been filled up in the colony; and as there is not a special class available there to choose from as in England, and as political and other corrupt reasons too often guide the choice, men who have failed in other occupations—shopkeepers, pedlars—and men without even these qualifications, have been thrust into positions of authority for which they are entirely unfitted. Consequently they have not only failed in their own duties, but have rendered the position of the qualified men almost unbearable. It is said that South Africa is the grave of great reputations, and competent men persistently thwarted have indeed become discouraged. The most recent report from Cape Town is that Chinese Gordon, so renowned for his treatment of native races, and who was employed by the Cape Government to settle the Basuto difficulty, has at length resigned in disgust.

In regard to colonial public works and contracts, the English aptitude for self-government will no doubt assert itself in due time, and the colonies, though they are buying their experience dearly, may be the better for it in the end, but the untoward incidents of their experience are many and peculiar. The democratic influence is clearly seen, not only in the control which the uneducated class have in the management of affairs, but in the jealousy felt for all outsiders. It is partly to jealousy of the Crown Agents that the establishment of separate Agents-General is due, and strange as it may appear, the colonies have, in many cases, extended their jealousy to their own agents, veritable colonists sent specially to represent them. The extreme radicals in the army of the French Commune clamoured to elect their own colonels, but once elected they resented their authority, and so it appears to be with the officials sent there by the colonists. This may partly arise from the method of their appointment, which varies very much, and is subject to many contingencies. Occasionally a man is chosen for his fitness for the post, but too often for some political reasons, as a reward for services, as a sop to a political party, and often as a means of getting rid of a troublesome opponent. Instances are not wanting where the Premier of a British colony, finding that he had survived his usefulness in that capacity, exchanged his position for that of Agent-General, practically appointing himself, and what is more significant, has, at any rate in one case, created a vacancy by initiating and promoting the forced retirement of the holder. If the occupants of the sober looking offices which have gradually become grouped together in Victoria-street, Westminster, could be questioned, they would have strange experiences to relate, and they must have found that their life is not one of unalloyed happiness. The changes now occurring in the method of purchasing material, and to which we shall presently refer, are but one expression of the treatment they have been subject to, and may possibly be even a relief to those who are most affected by it.

In the method of inviting tenders, selecting manufacturers, and inspecting the goods, the system which has become established in the course of years in the great purchasing department at home has been available for imitation; the routine that has grown up in the Admiralty and in the India offices being, in regard to the kind of business undertaken, that which is in most cases applicable to them. In these English offices the substitution of highly-educated clerks for the idle young gentlemen of the old patronage days has created an official class of a very superior kind, difficult to cheat, and only in the rarest cases susceptible of bribery. When anything unfair or fraudulent does occur, it is generally due to combination of the traders themselves, who manage to adapt their plans to the very systems established to circumvent them, and actual bribery may be unnecessary. When it does occur—for it is by no means extinct in this country—it is generally of the milder kind adopted in self-defence to satisfy the black mail of minor officials who, having the power to do harm or cause unjust complaints, show themselves aggrieved if they are not paid for abstaining. In these respects there is as much room for harm in the offices of the numerous Agents-General as in the English Government departments, and indeed there are special opportunities due to the frequent change of agent and to the short experience of many of the permanent subordinates. But as a rule it may be said that, even if the various colonies do not always obtain the best results, they are most of them honestly served. Such exceptional cases as the Queensland scandal of a few years ago are fortunately rare, and even in that notorious case the rude simplicity of the methods adopted showed that there was no great experience of fraud, an interesting air of freshness pervading the affair which must have recalled to many the good old Admiralty contracts of fifty years ago, when a snug circle of friends inside and outside the offices divided the plunder between them. Now, he who would get the better of the English purchasing departments can no longer rely on these old-fashioned plans, but must exercise considerable ability and finesse. But just as colonial bishops now-a-days are supposed to lack some of the dignity of the genuine home episcopate, so one must suppose a Colonial Government personage and the inspecting engineers relating to him may, in their smaller circle, do things which would appal the Controller of Contracts at Whitehall. So when bridges for Northern Australia were wanted, and visions of percentages tempted, the peccant purchaser in London guided the contract into the necessary channel by simply omitting bridge-builders altogether from the list of invitations to tender, and by inserting amidst a miscellaneous list of tool-makers, steam engine builders, and other incongruous persons, the predestined firm in the secret. But whilst a supply of bridges may be obtained from a favoured ironfounder who does not ordinarily manufacture bridges, and in that capacity is unknown to fame, there is a rugged audacity, which may also be deemed colonial, in obtaining from the same willing ironfounder 15,000 tons of steel rails again by the process of inviting no possible competitors. The people in the colonies forgave the bridges, but the rails aggravated them a good deal when it became known that the transaction having been arranged at the time of a rising market, and the real purchase from the maker having been made in advance, a profit of no less than £4 per ton or £60,000, was divided between the ironfounder, who was allowed to invoice the rails to the colonial agent, and the very officials who had been appointed to safeguard the colonial interests.

It is obvious that honest firms are discouraged, and become disinclined to tender, or refrain from serious competition when such scandals become known. It is not only in the purchase of material, but in the arrangements for shipment or in other business where money has to pass, that corruption is possible; for when once officials covet illicit profits there are obviously many ways of getting them. Thus contracts may be guided into the hands of a favoured manufacturer by giving him private intimation of points which will command preference when the tenders come to be considered, such intimation reaching the manufacturer from the colony before the official instructions reach the Agent-General in London. The old device of inserting fictitious conditions in specifications is still available; and the more elaborate the article to be purchased the more numerous are the opportunities for this method. For instance, in the case of locomotives, shipment in London may be prescribed, and the manufacturer, whether in Glasgow or Manchester, will have to add a considerable sum for carriage to the Thames; but if, when the time of delivery comes, it is discovered that ships just as good and freights just as low are available in the Mersey or the Clyde, and the favoured maker is allowed to ship there without corresponding deduction, unkind critics may venture to surmise that this was anticipated from the beginning.

On more than one occasion when tenders for freight have been invited for Australian colonies, the collusion between officials and contractors has been so notorious that competitors outside the favoured circle have gracefully recognised their position and abstained from sending in real tenders. The mode of action in these cases was to insert onerous conditions in the contract which enhanced the rate of freight, these conditions, capable of fulfilment by only a few persons, being immediately withdrawn when they had served their purpose, and the contract was obtained by the favoured firm. It is possible that the publicity ultimately given to frauds such as these may have had a share in diminishing the affectionate confidence which Agents-General in London might otherwise claim from their friends, though it is hard that one office should suffer for the misdeeds of another. It is a bad sign of the times and of colonial morality that the offenders should still be retained in positions of trust, and that so far as the methods of contract are concerned and the kind of people employed, there is nothing to show that the same intrigues are not still going on.

THE MANCHESTER SHIP CANAL.

Mr. Alderman W. H. Bailey, at a meeting of the Manchester Scientific Students' Association in the Memorial Hall, Manchester, on Wednesday evening, November 15th, delivered an address on the Manchester Ship Canal. He said that more than forty years ago a society, similar in its objects to the society whose members have now the honour of addressing, had before it the same subjec which I have ventured to introduce this evening. In the year 1841, the members of the Manchester Royal Victoria Gallery of Practical Science met several times to discuss with great earnestness the practicability of a Manchester ship canal. A scheme was submitted, and it appears from the reports of the discussion that the unanimous approval of the members was given to the project. There seemed to be no difference of opinion as to the importance of a ship canal to this district, and even then there appeared to be no engineering difficulty in carrying out a well-devised scheme. The project received the favourable support at those meetings of such well-known Manchester men as William

Fairbairn, Alfred Binyon, Peter Clare, Richard Radford, J. F. Bateman, J. C. Dyer, and other public-spirited citizens. But nothing came of the agitation. The monopoly of the Irwell Navigation Company seemed to bar all efforts in this direction. When the subject was being discussed by the chief Manchester men as absolutely requisite for the development of trade, it may be of some interest to note that, so alarmed were the Liverpool people, that one of the newspapers published there, the *Liverpool Mail*, denounced Manchester and the scheme in good set terms, and even carried out its opposition so far as to say that "meddling with the river would be an act of felony." It is just possible that the severe competition of the then new railway from Manchester to Liverpool had some influence in preventing the use of more capital in developing the Irwell navigation. The Navigation Company, however, does not seem ever to have been of much advantage to this district, for one of the chief reasons urged by the promoters of the railway between Manchester and Liverpool was, that the Navigation Company had utterly failed in its duty to the community, that it was incompetent and did not provide proper accommodation for the increasing trade of the district. Indeed, it was given in evidence before the Committee of the House of Commons, that goods often were six weeks at the wharves of Manchester and Liverpool before they were delivered, and that piles of merchandise were heaped up in the warehouses of the two towns, waiting for boats, horses, and men. Canals are now gradually regaining their former position. Many of the old canals and navigable rivers which were used for horse-hauled traffic, were totally unfit for the new order of things. Steamboats could destroy and have destroyed their banks; and in the meantime railways have been developed before the proprietors of these waterways have fully grasped the altered conditions. Since, however, the introduction of the screw propeller in steamboats and the great improvements generally in marine engineering, the problem of river and canal traffic has become very definite in the minds of engineers and those who have studied the question. I venture to say that the waterways of this and all other countries will become formidable competitors with the ways of iron for public favour. It may be worth our consideration to notice that this subject has been elaborately reported upon by those who have examined the working expenses of nearly all the navigable canals in the world. Probably one of the most careful reports is one on the relative cost of rail and canal traffic, by Mr. Francis Conder, C.E., which was presented to the Wolverhampton Chamber of Commerce a short time ago. It may be sufficient for me to say that Mr. Conder declares his statistics show, after all expenses have been carefully gone into, that a canal may carry for 65 per cent. less than it is in the power of a railway to do the same work for. There now seems to me to be every likelihood of carrying forward a great undertaking, which will have an immense influence in the development of the heavy trades of this district. The large meeting held in our Town Hall yesterday, and the many other meetings that have been held on the question, will give such impetus to the movement as will enable the promoters to overcome all obstacles, and we shall then cease to be ashamed of our past neglect, and be proud to know that, after all, a Manchester man is not—

> A barren-spirited fellow, one who feeds
> On objects, arts, and imitations,
> Which, out of use and staled by other men,
> Begin his fashion.

It was mentioned by one of the speakers at the town's meeting yesterday, that the Manchester Steel Works had been unable to compete with other steel manufacturers, and had gone into the Bankruptcy Court. Now, as one of the shareholders in that company, having lost a considerable amount in the undertaking, and also as a director of a somewhat extensive iron company in this district, I speak with some confidence when I state that under the present conditions—unless we have some cheaper method of transit than we have at present to the coast—the heavier engineering and metal trades of this district will be sooner or later annihilated. You have been favoured with so many arguments by many speakers of greater authority than myself on the mercantile affairs of this city and the surrounding towns, that, as I have already said, we are bound to accept it as proved that water traffic is much cheaper than railway traffic; and it must be obvious that a ship canal to Manchester will be of supreme benefit to all the community, and especially to those who have to earn their bread under conditions of the most severe, and often cruel, competition. Bringing the sea up to Manchester is a very fascinating idea to the people of this district; and I must confess that when I read the reports of the authorities who had investigated the whole question, I was somewhat disappointed to find that after all we were not to have the tide washing the river banks in the Irwell valley. It is found, however, that that is impracticable; and the manner of carrying out a scheme that will work well seems to be as devised by Mr. Leader Williams, whose plan I will endeavour shortly to describe. I may say that I am under the greatest obligations to Mr. Leader Williams, and also to Mr. Arthur Jacob, the borough engineer of Salford, who have assisted me in these maps, and have been good enough to give me all the information they could as to the scheme. It has been described already in the public papers, and therefore I will make my description as brief as possible. From the reports of Mr. Leader Williams, together with the observations of Mr. James Abernethy, C.E., and aided by the reports of Mr. Jacob, made by him to the Salford River Conservancy Committee, I am enabled to give you a description which I think will be easily understood by the aid of the maps now before us. The Mersey and Irwell navigation is now little used. The depth of water only allows barges with small cargoes to pass during the greater part of the year. Frequently, in my experience, these barges stick fast in the river. Indeed, the Navigation Company for some time seems to have been doing its best to impede progress, for reasons which I cannot quite understand. At present the river is divided by locks and weirs into ten pounds, the total fall from Manchester to Warrington being nearly 60ft. The question at present is the best means of converting this into a wide and deep navigable river, suitable for sea-going vessels of large size. In a rejected scheme it was proposed to widen and deepen the channel so as to shorten the course of the river from Manchester to Runcorn, and by training walls and dredging in the tidal estuary from Runcorn to the sea, to bring up the tide through a deep cutting with a bottom width of 80ft. only to Manchester, where, as has been stated, it would rise 15ft. at spring and 12ft. at neap tides. Mr. Jacob, in his very able report on the subject, says:—"I cannot follow the author of the scheme to the conclusion that there would be a tidal rise and fall of 15ft. at Throstle Nest, nor, were the scheme carried out, do I think it would be desirable that there should be any material alteration in the level of the water at the docks at this point. As the tide rose at Runcorn a rapid current would be established up the canal, owing to the accumulation of the tidal water in the estuary, but not long after this heaping up of the water had reached its maximum at Runcorn, the tide in the estuary would turn and run out seaward, thus diminishing the head of water which impelled the current up the canal, and before the incoming tide had produced any very marked effect at a distance from the estuary the current in the canal would change its direction and follow the waters of the estuary out to sea, causing a constant ebb and flow in the lower end of the canal. It is needless to say that a constant current to-and-fro in a narrow channel would operate to some extent as a hindrance to the navigation of the canal." There seems to be a unanimity of opinion among engineers who can form a competent judgment on the scheme of bringing the sea direct up to Throstle Nest, that it is impracticable. The difference in the levels of 60ft. from the surface of the land to the water, and the difficulties with the tide mentioned by Mr. Jacob, are such as to have caused this proposed method of making the river navigable to be abandoned. I will now direct your attention to some of the principal features in the adopted design recommended by Mr. Leader Williams, C.E., which consists in straightening, and widening, and deepening the river beds from Manchester to Latchford, fifteen miles, and the gradual widening, and straightening, and deepening of the tidal portion of the river Mersey seaward towards Liverpool. In this scheme there are three locks, one at Barton, one at Irlam, and one near Warrington. The docks are in Salford, in the vicinity of Ordsal Hall, and of course in the neighbourhood of Regent-road and Cross-lane and the Manchester racecourse. Mr. Williams avails himself of the river channel to some extent, for the sake of directness and economy, but for the greater part of the length of the canal he has selected an independent line, following the general direction of the valley and avoiding the tortuous line of the stream. The canal will be perfectly straight in some parts, connected by gradual curves, through which large ships can be towed with as much ease and safety as if the line of the canal were straight from one end to the other, making the entire length very little longer than a straight line from Manchester to Warrington would be. You will see from the map that an entirely new portion of the river or canal is constructed between Warrington and Runcorn, where it enters the estuary of the Mersey. This has been considered by Mr. Williams to be better than using the old channel of the river, and he has thus been enabled to avoid the great cost of the training walls which would otherwise have to be constructed in the bed of tidal portion of the ship canal. Training walls, however, will be used between Runcorn and Garston, where the channel is of sufficient depth for large vessels at low water. The width of the canal will be 100ft., with a depth of 26ft. at ordinary level. The large dock is designed to be 70 acres in extent, with gates 80ft. wide. The dock gradually enlarges until it is 1350ft. wide, where four branch docks will extend out of the large dock. The ordinary height of the water in the dock will be 8ft. below the quay, which is designed to be on the average 8ft. lower than the present level of the ground. The total quay space will be four miles in length, and the water area over 100 acres. It is asserted that the Barton Aqueduct will form no impediment to the progress of very large vessels with their topmasts struck; but in order to permit large vessels to come up without striking their masts Mr. Williams proposes to construct a new aqueduct, the central portion of which will be a wrought iron caisson, kept full of water, which will swing on the central pier in the same way as a swing bridge, leaving a wide opening for the vessels to pass from either side. As to the question of the various railways that cross the river there can be no difficulty. If it is considered too expensive to take the railways on swing bridges above the river there will be no difficulty in taking them under the river. Greater difficulties than these have been overcome by engineers, and the time at our disposal will not permit me to mention in detail the various schemes which have been suggested for this purpose. Within the last few days a pamphlet has been issued, the author of which is a Manchester barrister, and the title of which is "Some Legal Considerations in Relation to the Proposed Manchester Ship Canal." The considerations raised in this pamphlet are of a most important character. The author clearly points out that various Acts of Parliament have been passed which protect the river navigation, and which will compel railway companies to give every facility, in the construction of their bridges, to the new Navigation Company. For instance, the Walton girder bridge of the London and North-Western Railway was constructed under the authority of an Act of Parliament, 15 and 17 Victoria, c. 218. This Act provides that the bridges shall be built so that the piers or abutments shall be applicable to bridges to be opened by swivel or other motion, and that if the proprietors of the Irwell and Mersey Navigation shall require at any time after the passing of the Act the bridges to be altered, the railway company shall within three calendar months after receiving notice in writing, convert the bridge into a swivel bridge or a bridge having similar motion. The Cheshire lines bridges have also been erected under a similar clause in their Act. The railway companies are permitted, if they are unwilling to provide swivel bridges, to make bridges high enough to allow steamers and other large ships to go under, or they have permission to make tunnels underneath the river. As the proposed ship canal, when completed, will be for the benefit of the inhabitants generally, it will be difficult, as the author of this clever pamphlet says, for the railway companies to exercise the present injurious monopoly in the carrying trade of the district. These considerations are so palpable, that it seems to me not only that it is the duty of the Manchester and Salford Corporations to obtain powers to be represented on the Board, but that the very fact of the corporations of this district joining the undertaking will, in all probability, have the effect of preventing great opposition to the Bill, and will have an enormous influence when it is before the House of Commons' Committee. And now I must conclude. I feel that I have left a great deal unsaid. The undertaking is not a great one, but its results will be of immense importance to the prosperity and welfare and trade of this populous district. The whole scheme sinks into insignificance when compared with many great works which have been accomplished—indeed, created—at home and abroad by Lancashire men. The only feeling in my mind is astonishment that such an obvious utilisation of the Valley of the Irwell has been for so many years neglected.

THE INSTITUTION OF CIVIL ENGINEERS.

RECENT HYDRAULIC EXPERIMENTS.

At the first meeting of the session 1882-83, held on Tuesday, the 14th of November, the president, Sir W. G. Armstrong, C.B., F.R.S., in the chair, the paper read was on "Recent Hydraulic Experiments," by Major Allan Cunningham, R.E., Honorary Fellow of King's College, London.

This paper was mainly a general account of some extensive experiments on the flow of water in the Ganges Canal, lasting over four years—1874-79. Their principal object was to find a good mode of discharge-measurements for large canals, and to test existing formulæ. There are about 50,000 velocity, and 600 surface-slope measurements, besides many special experiments. The Ganges Canal, from its great size, from the variety of its branches abounding in long straight reaches, and from the power of control over the water in it, was eminently suited for such experiments. An important feature was the great range of conditions, and, therefore, also of results obtained. Thus, the chief work was done at thirteen sites in brickwork and in earth, some being rectangular, and others trapezoidal, and varying from 193ft. to 13ft. in breadth, and from 11ft. to 7in. in depth, with surface-slopes from 480 to 24 per million, velocities from 7·7ft. to 0·6ft. per second, and discharges from 7364 to 114 cubic feet per second. For all systematic velocity measurements floats were exclusively used, viz., surface floats, double floats, and loaded rods. Their advantages and disadvantages had been fully discussed in the detailed treatise, "Roorkee Hydraulic Experiments"—1881. They measured only "forward velocity," the practically useful part of the actual velocity. The motion of water, even when tranquil to the eye, was found to be technically "unsteady;" it was inferred that there is no definite velocity at any point, and that the velocity varies everywhere largely, both in direction and in magnitude. The average of, say, fifty forward velocity measurements at any one point was pretty constant, so that there must be probably average steady motion. Hence average forward velocity measurements would be the only ones of much practical use. To obtain these would be tedious and costly, and special arrangements would be required to obviate the effects of a change in the state of water which often occurred in a long experiment, as when velocities at many points were wanted.

As to surface-slope, its measurement—from nearly 600 trials—was found to be such a delicate operation that the result would be of doubtful utility. This would affect the application of all formulæ into which it entered. The water-surface was ascertained, on the average of its oscillations, to be sensibly level across, not convex, as supposed by some writers. There were 565 sets of vertical velocity measurements, combined into forty-six series. The forty-six average curves were all very flat and convex down-stream—except near an irregular bank—and were approximately parabolas with horizontal axes; the data determined the parameters only very roughly. The maximum velocity-line was usually below the service, and sank in a rectangular channel, from the centre outwards down to about mid-depth near the banks. Its depression seemed not to depend on the depth, slope, velocity, or wind; probably the air itself being a continuous source of surface-retardation, would permanently depress the maximum velocity, whilst wind failed to effect this owing to its short duration. On any vertical the mid-depth velocity was greater than the mean, and the bed-velocity was the least. The details showed that the mid-depth velocity was nearly as variable from instant to instant as any other, instead of being nearly constant as suggested by the Mississippi experimenters.

The measurement of the mean velocity past a vertical was thought to be of fundamental importance. Loaded rods seemed by far the best for both accuracy and convenience in depths under 15ft. They should be immersed only ·94 of the full depth. The chief objection to their use, that—from not dipping into the slack water near the bed—they moved too quickly, was thus for the first time removed. A double float with two similar sub-floats at depths of ·211 and ·789 of the full depth would also give this mean with more accuracy and convenience that any instrument of its class: this instrument is new. Measurement of the velocity at §-depth would also afford a fair approximation.

One hundred and fourteen average transverse velocity curves were prepared from 714 separate curves. These average curves were all very flat, and were convex down stream—over a level or concave bed—and nearly symmetric in a symmetric section. The velocity was greatest near the centre, or deepest channel, decreased very slowly at first towards both banks, more rapidly with approach to the banks or with shallowing of the depth, very rapidly close to the banks, and was very small at the edges, possibly zero. The figure of the curve was found to be determined by the figure of the bed, a convexity in the bed producing a concavity in the curve and *vice versâ*, and more markedly in shallow than in deep water. Curves on the same transversal, at the same site, and with similar conditions, but differing in general velocity, were nearly parallel projections. At the edges there was a strong transverse surface-flow from the edge towards mid-channel, decreasing rapidly with distance from the edge. The discussion showed that it was almost hopeless to seek the geometric figure of the curves from mere experiment.

Five hundred and eighty-one cubic discharges were measured under very varied conditions. The process adopted contained three steps: (1) Sounding along about fifteen float-courses, scattered across the site in eight cross-sections; time, say four hours. (2) Measurement of the mean velocities through the full depths in those float courses, each thrice repeated; time, say four hours. (3) Computation, say two hours. This process was direct and wholly experimental; each step was done in a time which gave some chance of a constant state of water. From an extended comparison of all results under similar conditions, it appeared that the above process yielded, under favourable circumstances, results not likely to differ more than 5 per cent. The sequel showed that in a channel with variable regimen, a discharge-table for a given site must be of at least double entry, as dependent on the local gauge-reading, and on the velocity or surface-slope.

Special attention was paid to rapid approximations to mean sectional velocity. The mean velocity past the central vertical, the central surface-velocity, and Chézy's quasi-velocity—*i.e.* $100\sqrt{RS}$, where R = the hydraulic mean depth, and S = the surface-slope—were tried in detail; thus 100, 76, and 83 average values thereof respectively were taken from 581, 313, and 363 detail values. The ratios of these three velocities to the mean velocity were taken out, and compared in detail with Bazin's and Cutter's coefficients. Other formulæ were contrasted also in slight detail. Kutter's alone seemed to be of general applicability; when the surface-slope measurement is good, and the rugosity-coefficient known for the site—both doubtful matters—it would probably give results within 7½ per cent. of error. Improvement in formula could at present be obtained only by increased complexity, and the tentative research would be excessively laborious. Now the first two ratios varied far less than the third: thus their use would probably involve less error than the third, or approximation would be more likely from direct velocity-measurement than from any use of surface-slope. The connection between velocities was probably a closer one than between velocity and slope; the former being perhaps only a geometric, and the latter a physical one. The mean velocity past the central vertical was recommended for use, as not being affected by wind; the reduction coefficient could at present only be found by special experiment for each site. Three current-meters were tried for some time with a special lift, contrived to grip the meter firmly parallel to the current-axis, so as to register only forward velocity, and with a nearly rigid gearing wire. No useful general results were obtained. Ninety specimens of silt were collected, but no connection could be traced between silt and velocity; it seemed that the silt at any point varied greatly from instant to instant, and that the quantity depended not on the mean velocity, but probably on the silt in the supply water. Forty measurements of the evaporation from the canal surface were made in a floating pan during twenty-five months. The average daily evaporation was only about $\frac{1}{10}$in. The smallness of this result seemed to be due to the coldness of the water—only 63 deg. in May, with 165 deg. in the sun and 105 deg. in shade. Lastly, it must suffice to say that great care was taken to insure accuracy in both fieldwork and computation.

South Kensington Museum.—Visitors during the week ending Nov. 11th, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9847; mercantile marine, Indian section, and other collections, 3197. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1439; mercantile marine, Indian section, and other collections, 238. Total, 14,721. Average of corresponding week in former years, 13,266. Total from the opening of the Museum, 21,464,576.

The Forth Bridge.—The contract for the construction and erection of the Forth Bridge has been let to Sir Thomas Tancred, Bart., Mr. T. H. Falkiner, and Mr. Joseph Phillips, civil engineers and contractors, of Westminster, and Messrs. Arrol and Co., of the Dalmarnock Ironworks, Glasgow. Messrs. Tancred and Falkiner have already carried out about seventy miles of railway for Mr. Fowler, and are at present constructing the new line to Southampton. Mr. Phillips has had a very wide practical experience in bridge construction and erection, and Messrs. Arrol and Co. are contractors for the new Tay Bridge, so the works are in good hands. The contract sum is £1,600,000, which is within £5000 of the engineer's Parliamentary estimate. The tenders received ranged from £1,485,000 to £2,300,000, most of the leading firms being represented.

The Royal Society.—The following is the list of names of Council and officers which will be proposed for election at the anniversary meeting of the Society to be held on St. Andrew's-day, 30th inst.:—President, William Spottiswoode, M.A., D.C.L., LL.D.; treasurer, John Evans, D.C.L., LL.D.; secretaries, Professor George Gabriel Stokes, M.A., D.C.L., LL.D.; Professor Michael Foster, M.A., M.D.; foreign secretary, Professor Alexander William Williamson, Ph.D. Other members of the Council: Professor W. Grylls Adams, M.A., F.C.P.S.; John Ball, M.A., F.R.A.S.; Thomas Lauder Brunton, M.D., Sc.D.; Professor Heinrich Debus, Ph.D.; Francis Galton, M.A., F.G.S.; Professor Olaus Henrici, Ph.D.; Professor Thomas Henry Huxley, LL.D.; Professor E. Ray Lankester, M.A.; Professor Joseph Lister, M.D.; Professor Joseph Prestwich, M.A., F.G.S.; Professor Osborne Reynolds, M.A.; Professor Henry Enfield Roscoe, B.A., LL.D.; Marquis of Salisbury, K.G., M.A.; Osbert Salvin, M.A., F.L.S.; Warrington W. Smyth, M.A.; Edward James Stone, M.A.

RAILWAY MATTERS.

During the half-year ending 30th June last the engines of the London, Chatham, and Dover Railway made 1,627,283 train miles, and the total cost for locomotive power was £68,053.

Several of the railways entering Chicago now use coke exclusively as fuel in their engines running within the city limits, in conformity with a city ordinance on smoke consumption.

On the 11th inst. a passenger train ran off a trestle bridge near Bradford, in the Pennsylvania oil region, the cars falling a distance of 30ft. The engineer, stoker, and baggage master, with several passengers, were killed, and others were seriously injured.

The promoters of the newly-projected railway between Kidderminster, Bromsgrove, Redditch, and Hatton Junction, have received an application from the ratepayers of Henley-in-Arden, Warwickshire, asking that the scheme shall include communication with that town, by using the route of the Henley-in-Arden Railway.

According to the last half-yearly report of the directors of the Belfast and Northern Counties Railway, the total train mileage in the half-year was 293,028 by passenger trains and 141,843 miles by goods and mineral trains. The total cost for locomotive power, including every cost, was £13,244, while the cost of maintenance of way and works was £15,422, and that of carriages and wagons £4975.

The Prussian Minister for Public Works has given orders that cast steel rails should be laid in the various curves which occur on the newly-opened Stadt-Bahn, or local railway of Berlin. The *National Zeitung* states that on account of the heavy traffic, and consequent wear of the rails at such points, it has been ordered that new rails are to be laid every three months at these portions of the line. If this is correct, either the rails must be very poor or the traffic is different to that anywhere else on the Continent.

Messrs. Van der Zypen Bros., of Deutz, near Cologne, who employ 120 men in the smithy, are turning out railway wheels by the hydraulic press at the rate of 15,000 a year, finished and mounted, for Germany, Russia, Italy, Turkey and Australia. The spring ring is generally used for fixing the tire, and it is exclusively adopted by the German Government. The firm is now giving special attention to the manufacture of a carriage wheel like the Mansell, but of compressed paper, which is found to give good results.

On the evening of the 10th inst. a large and influential meeting was held at Messrs. Tattersall's establishment, Albert Gate, in opposition to the scheme of the London Tramways Company to extend their system from Westminster to Hammersmith by way of Victoria-street to Victoria Station, Buckingham Palace-road, Pimlico-road, Sloane-street, Knightsbridge, Kensington-gore, High-street, Kensington, and Hammersmith-road. Colonel Makins, M.P., presided. It was unanimously resolved that the meeting pledged itself to oppose the projected scheme by all means in its power.

At a recent meeting of the Berlin Polytechnic Society, Dr. Franke exhibited specimens of a condensed fuel prepared with a solution of dextrine and saltpetre, which, according to the quantity of the latter substance, burns from six to twelve hours, and is considered to be specially applicable to the heating of railway carriages and to other similar purposes. Such a fuel will, doubtless, save some trouble in German railway carriages, which are heated by cakes of a low-burning fuel placed in small horizontal boxes in each carriage, the carriages having iron frames and panels. The heating is much more efficient and less inconvenient to travellers than our makeshift hot-water boxes.

In a report to the Board of Trade on a collision which occurred on the 30th ult., at Crewe Station on the London and North-Western Railway, Major Marindin says, "In conclusion it should be observed that, as is usually the case when a driver has more than one class of brake at his command, some valuable time seems to have been lost in the application of them. Had the train been fitted with a quickly-acting continuous brake, fitted to the engine and all the vehicles, the whole train might have been braked by the same simple action which was taken by the driver when he applied his engine steam-brake, and the speed would have been very much less than it was, even if the train had not been altogether stopped before any collision took place."

In concluding his report on the collision which occurred on the 28th September at Chester, on the London and North-Western Railway, when fourteen passengers and Post-office sorters and the front guard of the mail train were injured, Major Marindin says: —"It is worthy of remark that, although there was sufficient time for the driver to reverse his engine, and to whistle for the guard's brake, for his fireman to apply the tender brake, and for the front guard to skid the wheels of his brake-van by means of his hand-brake, yet no attempt was made by either driver or guard to apply the patent chain brake, which, according to the regulations of the company, is to be used as an emergency brake only. This is quite in accord with my experience of the action of the servants of this company in other like instances, and it seems to me that it furnishes a strong argument in favour of the habitual, and not the casual, use of whatever continuous brake is adopted by any railway company."

Several of the trunk lines on the Continent have been giving special attention to the establishment of rapid train services between important points for the accommodation of through travellers. A more or less important saving of time is expected to be obtained when the working arrangements are fully completed. According to the *Hamburger Nachrichten* the general arrangements of the "lightning express," which it is proposed to run from Ostend to St. Petersburg (*vid* Aix la Chapelle, Düsseldorf, Berlin, and Königsberg), will correspond in every way with those of the train of the same description between Paris and Vienna. The halts will be few, and will only be for such lengths of time as the railway service requirements render indispensable. All the meals for passengers will be served in the dining-room of the train while in motion, and the arrangements for turning the saloons into sleeping cars are very complete. There is a gangway between each carriage, and the staff of attendants is to be sufficiently numerous to ensure the comfort of the travellers in every respect.

The Queensland Government seems more alive to the value of railways for opening up and developing a country than any of our colonies, though none are very slow. A considerable accession to the railway system of Queensland will shortly take place, both in additions to existing lines and also the formation of entirely distinct ones. In the latter category are two lines to connect the mineral areas of the table-land in the Cook district with the coast, the one running from Maytown to Cooktown, the other from Herberton to Cairns or Port Douglas. Both these lines will open up a rich mineral and agricultural district. Another railway of equal importance is proposed to start from Mackay and run through the sugar districts. As links in the chain of railways already made will be a line from Brisbane to the Upper Logan, which will probably be continually extended to the New South Wales border. Another will run north from Ipswich to Kilkivan, and will connect Maryborough with Brisbane, while a still further northern extension will be carried from the Burrum to Bundaberg. The Queensland Government has provisionally accepted a proposal of Messrs. Shaw and Blyth to make a railway on the land grant principle. It will start from a point about thirty miles to the east of Charleville on the Warrego River, and run southward to New South Wales for about 250 miles between the 145th and 146th parallel of longitude. The syndicate, principally composed of Victorian capitalists, asks for grants of 10,000 acres per mile, and offers the Government the option of purchasing the line at half the cost price within six years, taking the price in debentures. The trans-continental line proposed by General Fielding also starts from near Charleville and runs northward through Blackall on the Upper Barcoo, reaching the Gulf of Carpentaria at Point Parker.

NOTES AND MEMORANDA.

The electric resistance of 100 yards of No. 8 iron wire is roughly 1 ohm.

The diameter of a wire in millimetres, whose specific gravity is S, and which weighs W grammes per metre, may be found by multiplying the square root of W divided by S, by 1·12865.

Artificial turquoise are made in Paris and Vienna that cannot be distinguished by external appearances from the natural product, and when artistically made can only be distinguished by means of the file, being usually softer. The *Scientific American* says they are made from phosphate of alumina and phosphate of copper mixed together and subjected to hydraulic pressure. Even in chemical composition it resembles the natural mineral, which is a hydrated phosphate of alumina with 2 per cent. of oxide of copper.

It appears that it has lately been discovered that the Puget Sound district, Washington Territory, ceded to the United States in 1846, is likely to yield a splendid supply of fir, pine, oak, and cedar. Though a few saw mills have been working for some years by the rivers and estuaries, the forest seems comparatively intact. During the year 1881 the export of lumber from Puget Sound amounted to 174,176,700ft., valued at nearly 2,000,000 dols., and it is calculated that since the establishment of the first saw mill in 1851 about 2,500,000,000ft. have been cut, but it is thought that about sixty-four times that quantity remains.

If a liquid body sends vapour into an unlimited atmosphere there will proceed from each element of its surface, during a unit of time, a quantity of vapour proportional to an electric charge which is present and in equilibrium upon the element. *Les Mondes* says the lines of the vapour currents correspond to the lines of electric force, and the surfaces of equal vapour pressure to the surfaces of equal potential. The electric equilibrium of an infinitely small circular or elliptic plate is the electrostatic analogue of the problem of the evaporation of a liquid contained in a basin of circular or elliptic contour.

An improvement in the manufacture of pulp for cardboard or the like has been suggested by an English paper-maker. The object is to produce cardboard, paper, papier-maché, and the like, which shall be both luminous and damp-proof. The *Journal* of the Society of Chemical Industry says it consists in adding to the pulp phosphorescent powder for giving the luminous property, and gelatine for rendering the material damp-proof. The proportions preferred are as follows:—Water, 10 parts; paper-pulp, 40 parts; phosphorescent powder—by preference slacked for 24 hours—20 parts; gelatine, 1 part; saturated solution of bichromate of potash, 1 part.

The high percentage of phosphoric acid in the cinder obtained in the basic Bessemer process has suggested the possibility of using it for agricultural purposes in the place of phosphate. A German contemporary gives the results of some investigations made at a large steel works in Westphalia, the cinder from which contains, of silica. 6·20 per cent.; carbonic acid, 1·72; sulphur, 0·56; phosphoric acid, 19·33; iron, 9·74; manganese, 9·50; lime, 47·60; and alumina, 2·68 per cent. The result of tests was, that this cinder would do well as phosphate manure, and that it will not be necessary for this purpose to treat it with sulphuric acid, because a considerable proportion of the phosphoric acid is in a form which will allow it to be assimilated readily.

P. Weiskopf has given in the *Diamant* the following formulæ for the frit or mass used in Bohemia for making imitations of some of the precious stones:—Imitation agates: 10 kilos. quartz, 17 kilos. red lead, 3·2 kilos. potash, 2·2 kilos. borax, and 0·1 kilo. arsenic. The quantity of chloride of gold added is equal to that obtained from 0·4 of a ducat. Agate glass: 10 parts of broken glass are melted, and to it are added 0·15 part suboxide of copper, the same quantity of the oxides of chromium and of manganese, 0·02 part each of oxide of cobalt and nitrate of silver, 0·01 oxide of uranium, 0·4 red argols, 0·3 part bone meal. Each oxide is added alone and at intervals of ten minutes. After heating the mixture for an hour, 0·3 or 0·4 part of fine soot is put in. Red marble: 80 parts of sand, 40 of potash, 10 of lime, 2 of table salt, 1 of saltpetre, and 0·1 of arsenic. The mixture is melted, and then 25 parts of suboxide of copper and 1 part of saltpetre mixed in.

An interesting article on Lavoisier, Priestley, and the Discovery of Oxygen, by G. F. Rodwell, in *Nature*, contains the following:—"Now what are the facts in favour of Lavoisier? On November 1st, 1772, he deposited with the secretary of the Academy a note, which was opened on May 1st following, in which he stated that he had discovered that sulphur and phosphorus, instead of losing weight when burnt, actually gained it, without taking into account the humidity of the atmosphere. He traced this to the fixation of air during the combustion, and surmised that the gain of weight by metals during calcination was due to the same cause. He reduced litharge in close vessels 'avec l'appareil de Hales,' and observed the disengagement of a great quantity of air. 'This note leaves no doubt,' says Dr. Thompson, 'that Lavoisier had conceived his theory, and confirmed it by experiment, at least as early as November, 1772.' . . . 'Il est aisé de voir,' writes Lavoisier, just before his death, 'que j'avais conçu, dès 1772, tout l'ensemble du système que j'ai publié depuis sur le combustion.'" This date is apparently more than a year before Priestley discovered it without knowing it.

According to the Wurtemberg *Gewerbeblatt* the coal production of Germany has so enormously increased within the last two decades that there is reason to fear an exhaustion of the beds at no very distant date. While the production of England in that period has risen from 85·4 million tons to 149·3 million, that of France from 8·3 million to 19·4 million, that of Belgium from 9·6 million to 16·9 million, the German yield of coal has increased from 12·3 million to 59·9 million—a proportion reached approximately only by North America, which shows a rise in production from 15·2 million to 70·3 million tons. Considering that the coal-fields of Belgium comprise about 900 square miles, those of France 1800, those of Germany 3600, those of England 9000; and comparing with these the vast coal-fields of the East Indies—35,500 square miles—North America—193,870 square miles—and China—over 200,000 square miles—the question of so improving means of international traffic that the small cost of transport may render possible a continuation of industrial work on European soil even with foreign coal, becomes—in the opinion of the writer referred to—most important.

The following table is taken from a short paper "On the Hard Woods of Australia," by Mr. F. A. Campbell, by whom the compilation was contributed to the Royal Society of Victoria. The table gives in col. 1 the specific gravity of the wood, col. 2 and 3 the crushing weight with and across the grain, col 4 gives the modulus of elasticity calculated from the formula $E = \frac{l^3 w}{16\, a d^3 \delta}$, col. 5 gives the modulus of rupture, and col. 6 the tensile strength:—

	1	2	3	4	5	6
1. Ironbark	1·117	10,166	4,100	488,066	18,258	15,950
2. Tuart	1·169	9,340	—	447,700	13,890	10,284
3. Blackbutt	·990	8,449	8,064	313,600	13,529	—
4. Bluegum	1·017	7,730	6,600	509,750	13,140	20,100
5. Yellow Box	1·017	—	—	472,605	12,312	—
6. Bloodwood	·918	—	—	399,450	11,970	—
7. Spotted gum	·981	9,072	7,308	322,900	11,943	—
8. Stringybark	·995	7,744	6,650	231,850	11,656	22,000
9. Kari	·980	12,513	—	568,620	11,640	7,070
10. Woolybutt	1·054	7,297	2,968	285,995	11,524	—
11. Redgum	·990	—	—	433,000	10,250	16,400
12. Jarrah	1·007	7,166	—	177,690	9,250	2,940

He further gives the following as average values for the transverse strength of the timbers named, or as the moduli of rupture for all calculations for purposes of construction:—(1) Ironbark, 16,000 lbs.; (2) bluegum, 11,000 lbs.; (3) yellow box, 10,000 lbs.; (4) spotted gum, 10,000 lbs.; (5) stringy-bark, 9000 lbs.; (6) redgum, 8000 lbs.

MISCELLANEA.

Mr. E. R. Turner, senior partner in the firm of E. R. and F. Turner, the well-known milling machinery engineers, has been elected Mayor of Ipswich.

Notice is given that the offices of the Iron and Steel Institute have been removed from 7, Westminster-chambers, to Victoria-mansions, Victoria-street, Westminster.

The Gas Light and Coke Company at Bilston, South Staffordshire, have reduced their prices to consumers of 100,000 cubic feet of gas per quarter to 2s. 6d. per 1000ft.

Of the Electric Light and Power Generator Company, Limited, now known as the Maxim-Weston Electric Company, Limited, Mr. Hugh Watt has been appointed managing director.

Mr. Johnston, who has for the last fourteen years been one of the inspectors of factories in Birmingham, has now accepted the charge of the Bristol district. His place has been filled by Mr. S. H. Knyvett.

Messrs. W. Dickes and Co., the well-known lithographers and printers, whose names will have been noticed on our working drawings, give notice of the removal of their establishment to No. 6, Kirby-street, Hatton-garden.

The export of coal from Newcastle, New South Wales, for the week ending September 16th, was over 33,000 tons. It was reported that the colliery proprietors intended to raise the price of coal to 11s. per ton after January 1st next.

We are informed that the installation of the Edison incandescent electric light in Stockholm has been in successful operation since May, and that the advantage of electric lighting is especially noted in such buildings as the Café in front of the Royal Palace, where the heat attending a sufficiency of light from gas is very great.

The many objections and disadvantages which attach to overhead telegraph and telephone lines are beginning to be recognised in Birmingham, and the Telephone Company there are about completing negotiations with the Corporation for the laying of some of their lines underground. The work will be begun by placing underground the wires now crossing Stephenson-place.

In the matter of the electric light most of the towns in the Birmingham district have, as we have previously announced, either determined to support the applications of companies to the Board of Trade or to themselves apply for lighting powers. Contrary to these precedents, the Corporation of Dudley have just resolved to oppose the companies, and yet not to apply themselves.

The first part of a "Pattern Book for Art Metal Workers" has just been published by Mr. A. Fischer, of St. Bride-street. It is the first of fifteen parts, each containing eight clear lithograph plates of the best specimens of ironwork as found on the Continent and at home, the designs selected being such as are readily and most generally applicable by designers and workers in the modern revival of light ironwork.

We have received a copy of the balance-sheet, just issued, of the West Cumberland Iron and Steel Company, Limited, Workington, which will be placed before the shareholders at the meeting to be held on the 24th inst. at the Midland Grand Hotel. The production at the company's works during the year ended 31st September has been, Bessemer pig iron, 122,668 tons; spiegeleisen, 9956 tons; Bessemer and Siemens ingots, 116,720 tons; finished steel, viz., rails, forgings, plates, blooms, wire billets, 101,764 tons.

The opening meeting of the session of the Meteorological Society was held on Wednesday evening, the 15th inst., at the Institution of Civil Engineers, Mr. J. H. Laughton, F.R.A.S., president, in the chair. The papers read were on "Certain Types of British Weather," by the Hon. Ralph Abercromby, F.M.S. "On the Use of Kites for Meteorological Observations," by Professor C. Douglas Archibald, M.A.; and on "The Meteorology of Mozufferpore Tishoot, 1881," by C. M. Pearson, F.M.S.

At the opening meeting of the winter session of the Society of Arts on Wednesday evening, Dr. C. W. Siemens delivered an address in which he dwelt at considerable length on the present and probable future position and cost of electric lighting, and gave information leading to the conclusion that the progress of electric lighting had been greatly checked by that parasite, the promoter, that electric companies, even those promoted for work and not speculation, afford doubtful investment to present shareholders, that electric lighting can be accomplished at a less cost per year than gas, but that the plant will cost more.

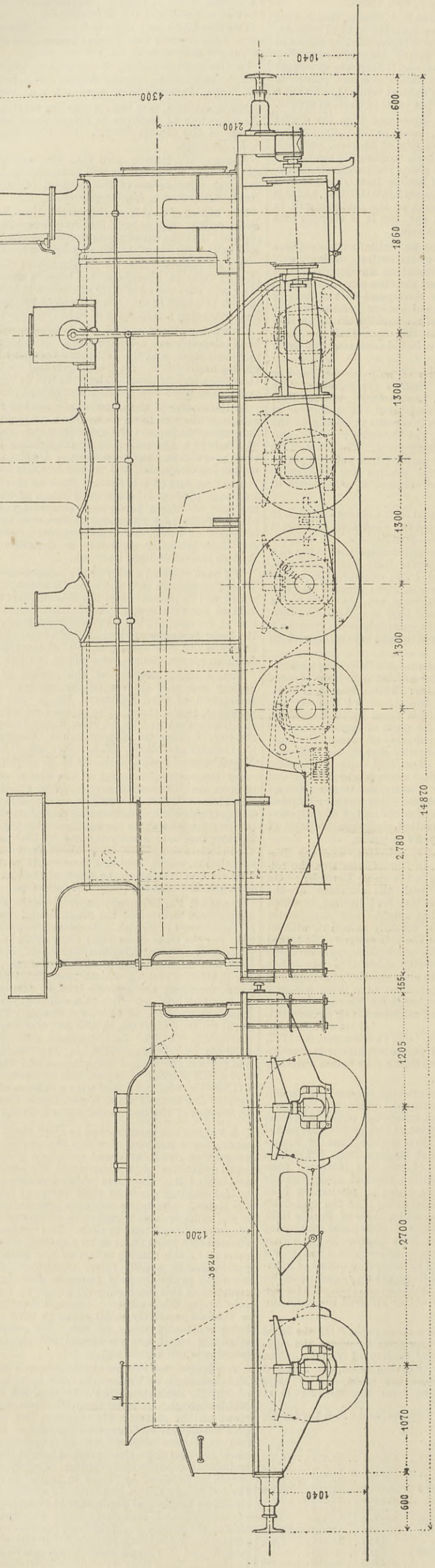
A recent Parliamentary paper gives the dues received and the expenditure incurred in the construction, repair, and maintenance of lighthouses in British possessions abroad during the year 1880-81. For the Cape Race light dues £4378 5s. 2d. was collected in ports of the United Kingdom, £29 7s. 3d. at St John's, Newfoundland, and £206 17s. 6d. in Canadian ports. The maintenance of the lighthouse and fog whistle cost £1571 3s. 6d. The balance in hand, including the amount brought forward from the previous year, is £5415 7s. 3d. The dues collected for the Great and Little Basses lights were as follows:—Bombay, £997 9s. 2d.; Burmah, £1231 9s. 9d.; Calcutta, £5353 3s. 4d.; Ceylon, £1318 16s. 3d.; Kurrachee, £4 13s. 5d.; Madras, £431 12s. 11d.; Mauritius, £125 14s. 8d.; Penang, £124, 1s. 1d.; Singapore, £1783 4s. 10d.; and ports in the United Kingdom, £3387 19s. 11d. Maintenance cost £3702 13s. 3d. The year was commenced with a balance of £11,530 13s. 6d., and closed with a balance of £15,266 8s. 6d. The amount due to the Public Works Loans Commissioners, however, on account of the last-named lights is £100,700.

A patent has been granted to Herr Beck, of Nordhausen, Germany, for a machine of which the motive force is supplied by gunpowder. In a horizontal cylinder a piston is set in motion by small quantities of powder, which are alternately ignited before and behind it. The gases which have been used escape through lateral openings closed by slide valves at the return movement of the piston. The heavy residuum accumulates in the deepest part of the cylinder, and is pushed by the piston into receptacles which are emptied from time to time. The ignition of the gunpowder is effected by a spirit flame or by a gas jet, which is brought to bear upon it by the sucking action of the piston, through an opening provided with a slide valve. A Cologne firm of engineers has, according to the *Deutsche Industrie Zeitung*, undertaken the construction of this machine, with a view to its being introduced for sale during this autumn. Amongst the advantages claimed for it is the comparatively small space it takes up, and the fact of its being constantly ready for use. The consumption of powder is relatively small, and no special attendance is required, as the machine is self-regulating.

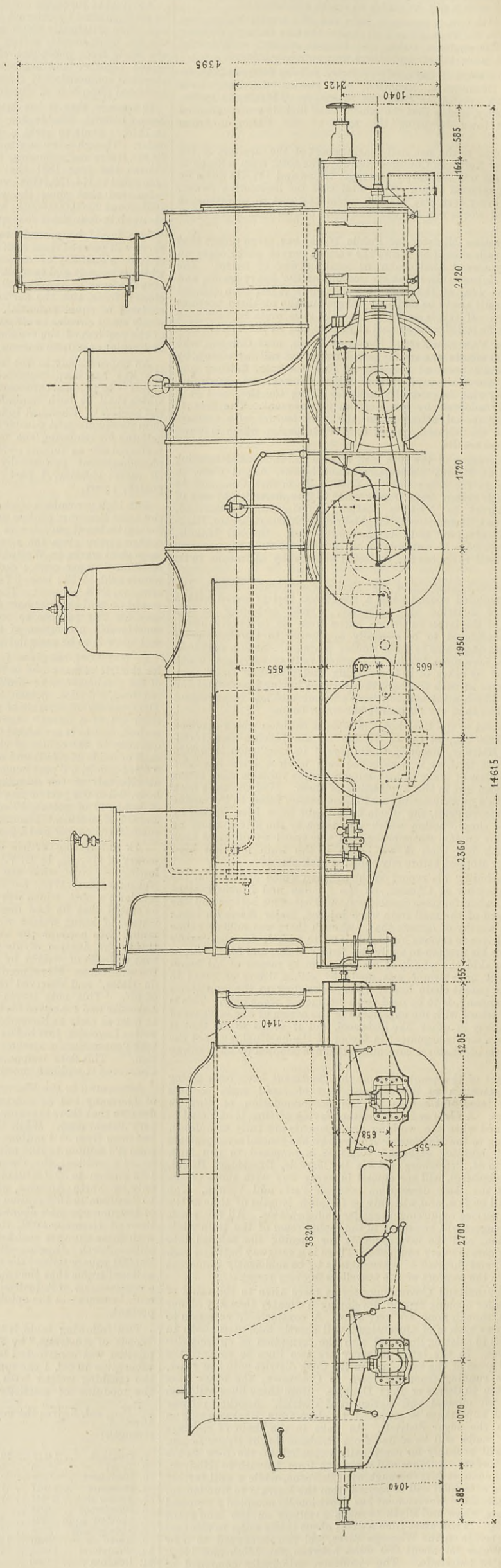
A meeting was held in the board-room of the Royal Exchange, Middlesbrough, on Friday, the 10th inst., to consider the proposal of Mr. B. Samuelson, M.P., to establish a school of science at Middlesbrough. A letter from Mr. Samuelson was read giving his views on the matter. He suggests, first, that the school should give theoretical and practical instruction in inorganic chemistry and in certain departments of physics, more especially heat. Secondly, that there should also be taught elementary mathematics, including mechanics and drawing. Thirdly, that the earlier courses should be followed by others in metallurgy, more particularly in the technology of iron and steel. Fourthly, that organic chemistry should be taught and pupils should be instructed in the technology of the chemical manufactures in the district. Mr. Samuelson thinks the school could be built for £5000 exclusive of land, and recommends that not less than £10,000 should be raised. The Science and Art Department would contribute, and a grant might be obtained from the City Guilds. Mr. Samuelson says he is willing to subscribe £2000 and £120 per annum. A committee was appointed to take the matter up. The trustees of the Middlesbrough High School propose to add to their building at a cost of £6000, and offer to give the science school the accommodation they require if a satisfactory arrangement can be made. The committee will take this offer into consideration.

SIX AND EIGHT COUPLED ENGINES FOR THE ST. GOTHARD RAILWAY.

(For description see page 369.)



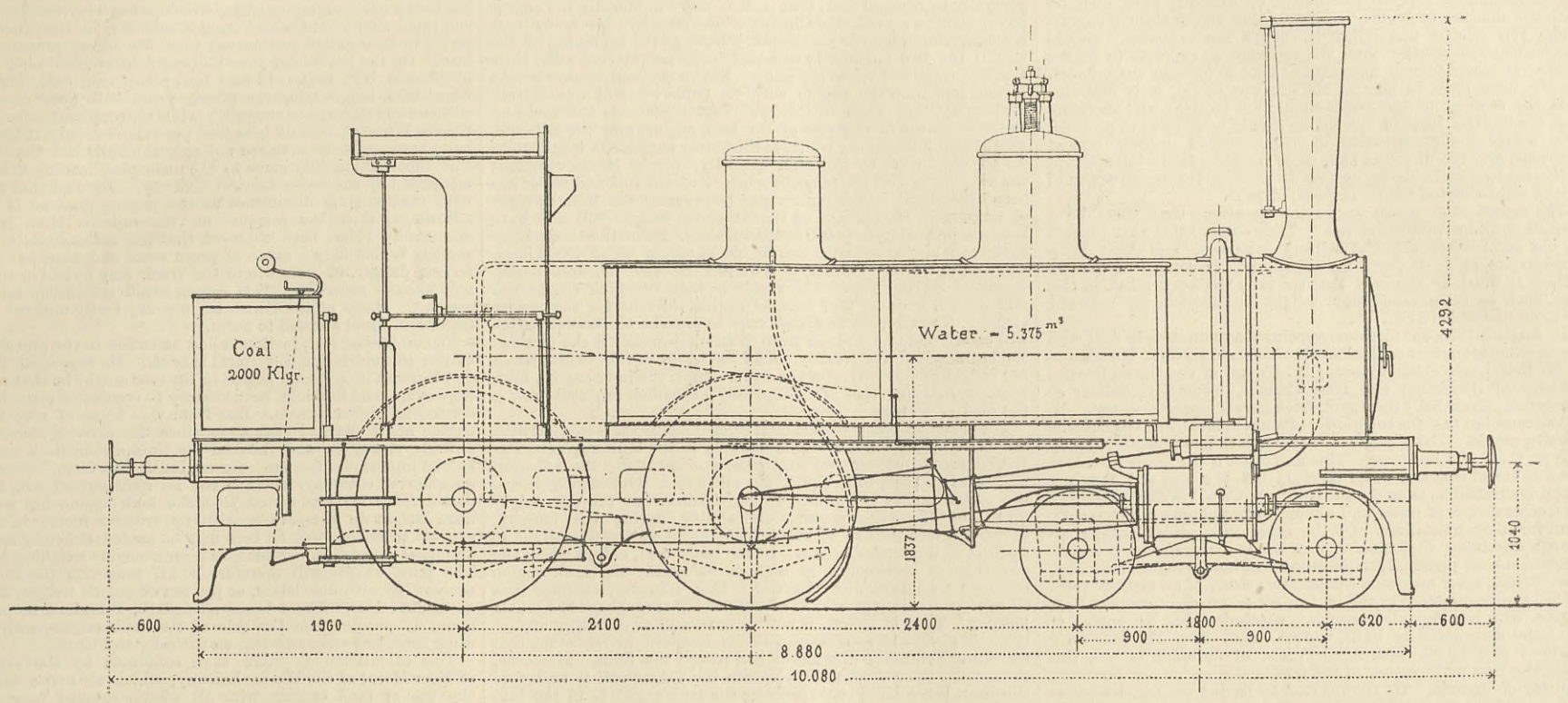
Class D—EIGHT-COUPLED TENDER ENGINES.



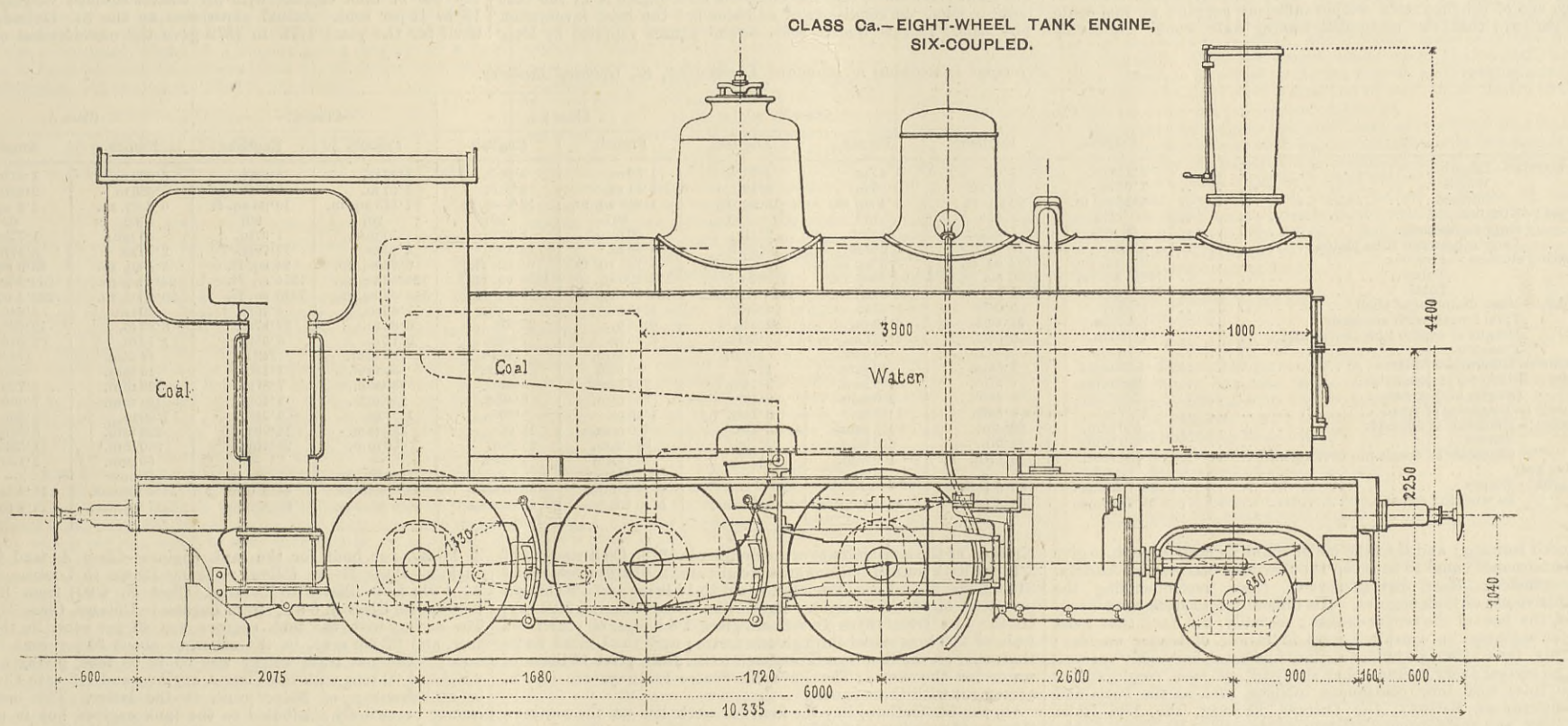
Class Cb.—SIX-COUPLED TENDER ENGINES

PASSENGER ENGINES, ST. GOTHARD RAILWAY.

CLASS B.—FOUR-COUPLED TANK ENGINE, WITH BOGIE



CLASS Ca.—EIGHT-WHEEL TANK ENGINE, SIX-COUPLED.



REPORT ON LOCOMOTIVES FOR THE ST. GOTHARD RAILWAY.

We give below a condensed translation of a report made to the International Commission charged with the superintendence of the St. Gothard Railway, by the Board of Directors and the engineers. The importance of the subject with which it deals, namely, the best type of locomotive for working heavy traffic over mountain railways, and the information it contains as to continental experience in this matter, is a sufficient excuse for presenting it to our readers in an English dress :—

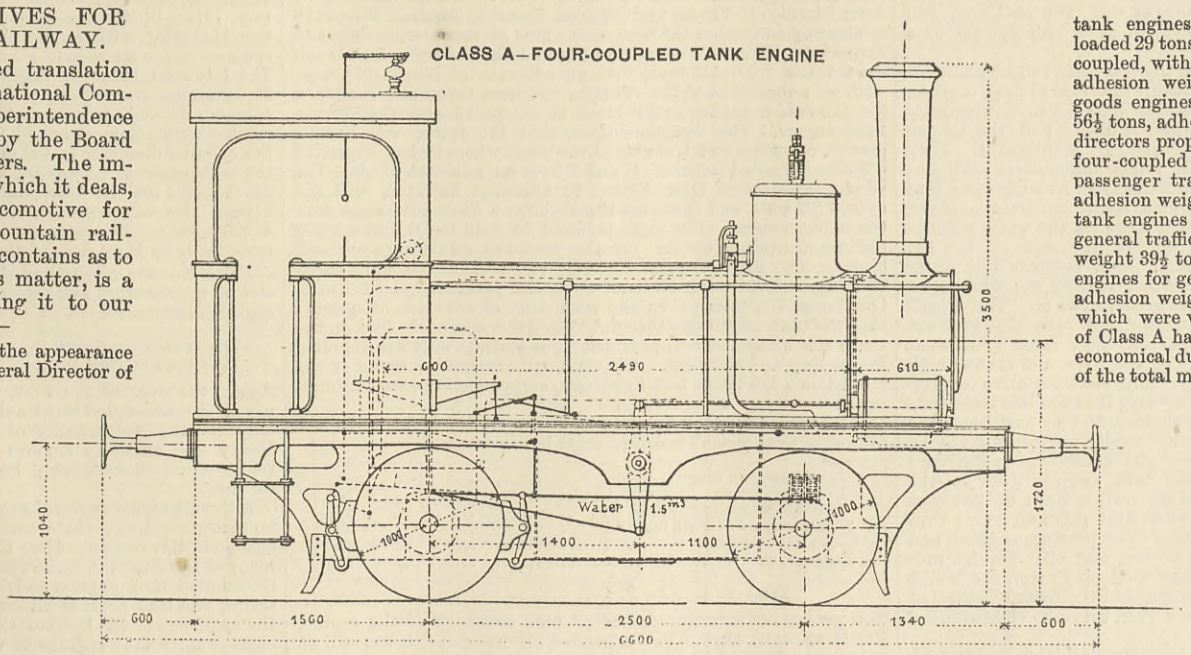
The occasion of the report was the appearance of a paper by Signor Massa, General Director of the Railways of Upper Italy, in which he objected to the directors' decision to order fifteen tank engines for the St. Gothard line. In this paper it was observed that, according to the statistics of the Mont Cenis Railway, the traffic reached large dimensions immediately after the opening, and increased very slightly in the seven following years. In 1878 the number of passengers carried was 270,000, and there were nearly 300,000 tons of luggage, cattle, and goods. The St. Gothard traffic would probably be larger; and it was held necessary to order at once fifteen eight-coupled tender engines for the mountain section, and probably ten more six-coupled engines in the immediate future.

This question the report sets itself thoroughly to examine. It first gives the estimated traffic for the St. Gothard, which is as follows :—

Traffic to be carried yearly.—First five years, 150,000 passengers, 250,000 tons goods; five to ten years, 200,000 passengers and 400,000 tons goods; after ten years, 260,000 passengers and 500,000 tons goods.

Make-up of trains.—(*a*) Express :—Five coaches and two vans, or 55 tons total weight without engine, for 50 passengers. (*b*) Passenger :—Eight coaches and two vans, or 95 tons, for 100 passengers. (*c*) Mixed :—Six coaches, one van, ten wagons, or 150 tons, for 60 passengers and 40 tons of goods. (*d*) Goods :—Twenty-five wagons and one van, or 250 tons, for 100 tons of goods.

CLASS A—FOUR-COUPLED TANK ENGINE



Duty of the locomotives.—Valley section :—For trains (*a*) and (*b*), 33,000 kilos a year; (*c*) and (*d*), 28,000 kilos a year. Mountain section :—For (*a*) and (*b*), 30,000 a year; (*c*) and (*d*), 24,000 a year.

Locomotives required.

	First period.	Second period.	Third period.	Already existing.
Four-coupled engines	11	14	16	8
Six-coupled ,,	18	25	32	6
Eight-coupled ,,	15	23	27	—
Total	44	62	75	14

It thus appeared that thirty engines were required at once, to which must be added four for working the branch line over the Monte Cenere, which for the present takes the place of the intended main line by the Lago Maggiore. The fourteen existing engines were divided into the following three classes :—(A) Four four-coupled tank engines—total or adhesion weight when loaded 29 tons; (B) four six-wheeled engines, four-coupled, with tender—total weight loaded 53 tons, adhesion weight 24 tons; (C) six six-coupled goods engines with tender—total weight loaded 56½ tons, adhesion weight 37½ tons. To these the directors proposed to add as follows :—(B) Six four-coupled tank engines with bogie in front, for passenger trains—total weight loaded 42½ tons, adhesion weight 27 tons; (C *a*) fifteen six-coupled tank engines with uncoupled leading wheels, for general traffic—weight loaded 51½ tons, adhesion weight 39½ tons; (C *b*) sixteen six-coupled tender engines for general traffic—weight loaded 65 tons, adhesion weight 42 tons. Of the existing engines which were working in the Ticino Valley those of Class A had given far the most satisfactory and economical duty, having, in fact, made 59 per cent. of the total mileage. The engines of the new class (B) were for the valley section, and were of a type recommended by Herr Bridel, the present chief engineer of the line. Similar engines had since 1864 worked the whole traffic on the line from Biel to Berne, including express trains running over forty miles an hour, and were especially recommended for their stability, whilst in power they compared favourably with the later express engines of the Paris and Marseilles Railway. They could draw on a gradient of 1 in 100 and a curve of 300 metres radius a train of 100 tons weight at twenty-five miles per hour. A similar type was recommended, chiefly on account of its steadiness, by the French Commission on the Prevention of Railway Accidents, appointed in July, 1880.

The new class (C *b*) of sixteen tender engines was intended for goods trains in the valley section, and both for goods and passengers in the mountain section. It was intended to have twenty-three engines regularly working on the latter, or one to every 4 kilometres, and on the former twenty-eight engines, or one to every 6·8 kilometres.

It had been originally designed to build fifteen eight-coupled engines for the mountain section. It was, however, recommended both by Herr Urban, one of the directors, and Herr Gottschalk, late engineer of the Southern Railway of Austria, to build six-coupled engines only. The latter pointed out that the St. Gothard permanent way was adapted for a working load of 7 tons per

wheel, and that six-coupled engines might therefore be used with a total or adhesion weight of 42 tons. Such engines, on a gradient of 1 in 40, would draw passenger trains of 120 tons at nine to twelve miles an hour, and goods trains of 150 tons at six to nine. Considering this, and also the fact that heavier engines could be built at a later period should they be found necessary, the directors and their engineer came to the resolution that no eight-coupled engines should be built for the present.

From the figures published by Herr Abt, of Berne, of the number of kilometres run per locomotive on different lines, together with the amount of traffic, it appears that the number of engines under this scheme was sufficient, though not excessive. Should the traffic prove greater than the estimate, as expected by Signor Massa, it would become necessary at once to increase the number. At the same time, so long as the line was single, it is desirable that the number of the trains should not be large, and therefore that the tractive force of the engine should be as large as possible. This makes the construction of eight-coupled engines appear desirable, and the directors have come round so far to the opinions expressed by Signor Massa, as now to propose the construction of fifteen eight-coupled tender engines, class D.

The report then passes on to the question, shall there be a class of tank locomotives or not? They observe that this touches an old controversy amongst railway engineers, and that it is necessary to study it from the beginning. In comparing the two classes it must be observed that the tank engines are not, in this case, such as utilise the whole weight for adhesion, but have one or more uncoupled axles.

In August, 1878, the directors appointed a committee to deal with the question of the best engines for the mountain section. It consisted of M. Bridel, now chief engineer; M. Urban, of the Grand Central Railway of Belgium; and Herr Cramer, locomotive builder at Innsbruck. Eventually these gentlemen gave in separate reports. M. Urban considers that the superiority of tank engines for steep gradients is indisputable. The objections to them, with one exception, apply only to those of a bad type. This exception is the limit placed to the amount of coal and water carried; but, if a load of 7 tons per wheel is admissible, as on the St. Gothard, then it is easy to arrange for 6 cubic metres of water and 4 cubic metres of coal, which is sufficient for all circumstances. On the other hand, Herr Kramer, although admitting that tank engines are to be preferred *à priori*, recommends on practical grounds the use of tender engines. Finally, Herr Bridel, after making a comparative study of an eight-coupled tender engine on one side and on the other an eight-coupled tank engine, with leading axle uncoupled, concludes that an engine of the latter class could be built, which should draw 175 tons on a gradient of 1 in 40, with a coefficient of adhesion of ·16, this being the best performance of the tender engines on the Southern Railway of Austria. He showed that by having coaling stations at each end of the mountain section sufficient supplies of fuel could be carried; that the uncoupled leading axle would cause very systems is that in the tank engine the coal and fuel add to the force of the adhesion, whilst with the tender engine they absorb part of the tractive power. This difference is of special importance on mountain sections, and forms a recognised advantage on the side of the tank engine. Signor Massa himself admits this, but considers that the absolute tractive force must be less. Now, in any engine there are two limits to the tractive force it can exert—one being given by the cylinder dimensions and by the steam pressure, the other by the adhesion of the wheels. On steep inclines the latter will generally be reached first, that is, it is easier to increase the engine power than to prevent the slipping of the wheels. The latter limit need therefore alone be considered. Now, at the beginning of the trip, if the two engines have equal loads per driving axle, their absolute tractive force is the same. But as the tank engine weighs 14 tons less than the engine with its tender, it will draw a train heavier by that amount. As the engine proceeds the fuel and water diminish in the case of the tank engine, and the adhesion weight also diminishes; whilst in the tender engine the weight to be drawn diminishes by the same quantity. Signor Massa compares the two engines at the moment when ·4 of the fuel and water has been expended. In the tank engine he assumes the initial weight of these to be 7000 kilogs., so that the total weight will now have been diminished from 48,000 to 45,000 kilogs. But of this total weight that available for adhesion was 38,500 kilogs, of which 4500 kilogs. was fuel or water. Deducting ·4 of this, we have left an adhesion weight of 36,700 kilogs. The result is that the tank engine can still draw a train of 90·7 tons, as against 87 tons for the tender engine. To this must be added that in practice the tender engine will clearly take no heavier train than that which it can move at the beginning of the journey, when the tender is full. This gives a net weight of 83 tons. On the other hand, the tank engine, even when its coal and fuel are completely expended, can still draw a net load of 85 tons.

The present report gives a similar comparison to the above, but with some alterations which are unfavourable to the tank engine. The results are shown on two diagrams, one assuming the adhesion weight at starting to be equal, the other that the tank engine has the advantage by two tons. In the former case the net weight drawn by the tank engine, diminishing during the journey, becomes before the end of the journey equal to the net weight at starting in the tender engine. In the latter case, except where the coefficient of adhesion is as high as one-sixth, the tank engine retains its advantage to the end. This, however, assumes that there is a continuous incline of 2·7 per 100 throughout the whole journey. This, of course, is not the case, and as a matter of fact it would always be possible on the St. Gothard to renew the coal and water before the diminution had passed the limit. Moreover, the smaller the coefficient of adhesion the longer will it be before this limit is reached; and therefore the tank engine is in the best position when the conditions of adhesion are the least favourable. The report further quotes some actual figures supplied by Herr the difficulties are of course less. This part of the report concludes with two quotations, one from Herr Petzholdt in the "Railway Handbook" of Hausinger von Waldegg, and the other from Herr Horn, locomotive superintendent of the Werra Railway, both of which state that the objection to tank engines, on account of their smaller stores of water and fuel, is found in practice to have no weight whatever.

The report now goes on to consider the special advantages of the tank engine with uncoupled leading wheels. The tender engine has heavy overhanging weights, which cause very unsteady going, and rapid wear of the wheel flanges, and are, in fact, much more severe in their action on the road than the direct pressure of the load. On the Berne and Jura Railway four-coupled tank engines of Class A, with bogies, 13 tons load per driving axle, and 20½ft. wheel base, have worked for fifteen years with good results, and without any damage to the rails; while six-coupled tender engines, Classes B and C, with 12 tons load per axle, but only 12·2ft. wheel base, have seriously damaged not only the rails but the sleepers. The superior stability given by the uncoupled leading axle is also recognised by the Swiss Central Railway. The fact that the load with tank engines diminishes as the journey goes on is here an advantage, since the pressure on the rails is thus gradually decreased. It has been observed that the unsteadiness of tender engines is not only a cause of great wear and tear, but even of serious danger, in cases where the track may be bad or the speed may become excessive. This danger is not sufficiently taken into account. Many of the Swiss engines are really unfitted for the maximum speed allowed to them.

Signor Massa had further called attention to the probable difficulties in ventilating the spiral tunnels. He suggested that the employment of a second engine in the rear might be thus rendered impossible, and it would be necessary to organise a more frequent service at higher speeds. But from this point of view the tank engine has a marked advantage, since the driver's stand can be entirely closed in, and the bad air thus excluded—a matter of special importance for the rear engine of the train. Finally, the question of economy, which is not an unimportant one, must be considered. It is admitted that the tank engine has a smaller dead weight in comparison with its tractive force; in fact, an express train weighing 55 tons may be hauled either by an engine and tender weighing 62 tons, or a tank engine weighing 48½ tons. The gross weight will therefore be 117 tons with the former, as against 103 with the latter, or per ton of engine weight, 2·13 tons as against 1·88. There is an advantage, therefore, in power of about 13 per cent. on the side of the tank engine, with, at the same time, less wear and tear on the rails and tires.

This calculation is more than confirmed by the experience of Herr Horn, of the Werra Railway, which showed a saving by the use of tank engines with all wheels coupled varying from 18 to 42 per cent. Actual experience on the St. Gothard line itself for the years 1876 to 1879 gave the consumption of coal

Principal Dimensions of Standard Locomotives, St. Gothard Railway.

	Class D.		Class B.		Class Ca.		Class C.		Class A.	
	French.	English.	French.	English.	French.	English.	French.	English.	French.	English.
Fire-grate:—Length	2·125 m.	7·0ft.	1·45 m.	4·75ft.	1·80 m.	5·90ft.	1·80 m.	5·90ft.	0·600 m.	1·97ft.
Width	1·02 m.	3·31ft.	0·96 m.	3·15ft.	1·01 m.	3·31ft.	1·01 m.	3·31ft.	0·680 m.	2·23ft.
Surface	2·15 sq. m.	23 sq. ft.	1·4 sq. m.	15 sq. ft.	1·818 sq. m.	19·6 sq. ft.	1·818 sq. m.	19·36 sq. ft.	0·4 sq. m.	4·3 sq. ft.
Tubes:—Number	225	225	150	150	207	207	207	207	69	69
Outside diameter	50 mm.	1·97in.	51 mm.	2·1in.	50 mm.	1·97in.	50 mm.	1·97in.	45 mm.	1·77in.
Length between tube plates	4·2m.	13·78ft.	4·016 m.	13·18ft.	3·90 m.	12·79ft.	3·90 m.	12·79ft.	2·49 m.	8·17ft.
Heating surface:—Fire-box	9·5 sq. m.	102 sq. ft.	7·3 sq. m.	78·5 sq. ft.	8·745 sq. m.	94 sq. ft.	8·74 sq. m.	94 sq. ft.	2·5 sq. m.	26·9 sq. ft.
Tubes	148·5 sq. m.	1600 sq. ft.	96·3 sq. m.	936·0 sq. ft.	126·326 sq. m.	1366 sq. ft.	126·82 sq. m.	1354 sq. ft.	24·4 sq. m.	262·5 sq. ft.
Total	158·0 sq. m.	1702 sq. ft.	103·6 sq. m.	1014·5 sq. ft.	135·571 sq. m.	1460 sq. ft.	135·57 sq. m.	1448 sq. ft.	26·9 sq. m.	289·4 sq. ft.
Boiler:—Mean diameter of shell	1·535 m.	5·04ft.	1·23 m.	4·03ft.	1·45 m.	4·76ft.	1·45 m.	4·75ft.	·804 m.	2·64ft.
Total length with smoke-box	7·445 m.	24·42ft.	6·40 m.	21·0ft.	6·82 m.	22·4ft.	6·82 m.	22·37ft.	3·85 m.	12·63ft.
Height of centre line above rails	2·100 m.	6·89ft.	1·837 m.	6·03ft.	2·25 m.	7·38ft.	2·12 m.	6·95ft.	1·72 m.	5·64ft.
Pressure	10 atm.	149 lb.	10 atm.	149 lb.	10 atm.	149 lb.	10 atm.	149 lb.	12 atm.	178 lb.
Frame:—Thickness of plates	35 mm.	1·38in.	33 mm.	1·3in.	30 mm.	1·18in.	30 mm.	1·18in.	10 mm.	·39in.
Axles:—Diameter of journals	200 mm.	7·87in.	146 mm.	5·75in.	160 mm.	6·3in.	200 mm.	7·87in.	120 mm.	4·72in.
Length of journals	240 mm.	9·45in.	240 mm.	9·40in.	240 mm.	9·40in.	240 mm.	9·40in.	180 mm.	7·10in.
Wheels:—Diameter of tread	1·17 m.	3·84ft.	1·58 m.	5·18ft.	1·30 m.	4·26ft.	1·33 m.	5·24ft.	1·00 m.	3·28ft.
Engine:—Diameter of cylinder	520 mm.	20·4in.	410 mm.	16·1in.	480 mm.	18·9in.	480 mm.	18·9in.	220 mm.	8·66in.
Stroke	610 mm.	24·0in.	612 mm.	24·1in.	640 mm.	25·2in.	640 mm.	25·2in.	350 mm.	1·38in.
Diameter of crank pin driving axle	130 mm.	5·12in.	100 mm.	3·97in.	125 mm.	4·92in.	—	—	80 mm.	3·15in.
Valve gear	Gooch	—	Allan.	—	Heusinger.	—	Heusinger	—	Broun	—
Weight:—Empty	44·7 tonnes	44·0 tons.	—	—	41·4 tonnes.	40·7 tons	45·7 tonnes	44·8 tons	11·6 tonnes.	11·4 tons
In working order	51·7 tonnes	50·8 tons.	44·2 tonnes.	43·5 tons.	57·0 tonnes.	56·1 tons	66·9 tonnes	65·8 tons	14·7 tonnes.	14·4 tons

smooth running; and that the boiler could be large enough to give a performance equal to those on the Southern Railway of Austria. Nevertheless, Herr Bridel shrank from recommending the exclusive use of tank engines. His difficulties seem to have been, first, the loss of the tender brakes; secondly, the fact that most of the engineers he consulted were in favour of tender engines; thirdly, that although tender engines had been thoroughly successful on several short inclines, they still had not been employed for main lines with long continuous inclines, such as the Paris and Mediterranean Railway, the Orleans Railway, the Alta Italia Railway, and the Southern Railway of Austria. He leant to the idea of ordering some tender engines at once, but obtaining full designs for tank engines, with a view to their employment at a later period.

On the other hand Herr Stocker, the locomotive superintendent of the St. Gothard Railway, was strongly in favour of tank engines, and was supported by other engineers, such as the superintendents of the Jura Railway, the Central Swiss Railway, and the United Swiss Railways, and Mr. Charles Brown, of Winterthur. They pointed out that the true reason why tender locomotives were preferred—for instance on the Southern Railway of Austria—was that it was necessary to have engines which could circulate over the whole extent of the line, in many parts of which the water stations were at long distances apart, as is not the case on the St. Gothard. The greatest difference in level between two water stations, those of Amsteg and Gurtnellen, is 192·7 m.; whereas on other railways there are differences as great as 334 m. The experience with tender engines in Switzerland has been that they use more fuel and oil than tank engines, that they cause great wear and tear of the rails, and especially of the tires, and that at high speeds they are much more unsteady. Thus the locomotive superintendent of the Swiss Central Railway says that the line from Bale to Olten is worked entirely by tank engines, and by engines on the Engerth system, the experience with tender engines not having been favourable. Again, a report of the United Swiss Railways states that their new eight-coupled tank engines draw on the mountain section from Rorschach to St. Gall a train of 200 tons at fifteen miles an hour, or 250 tons at nine miles an hour; thus they do more than double the work of their previous engines, and with a lower relative consumption of fuel and oil. Foreign railways using tank engines give similar testimony; *e.g.*, the Werra Railway, the Bavarian State Railways, and the Grand Central of Belgium, the last of which has no less than fifty-two eight-coupled tank locomotives of the same type.

The directors have thus been induced to decide on trying tank engines for the St. Gothard on a large scale. They apprehend no difficulty from the mixture of types. The two types will, in fact, be equal as far as leading dimensions, power, &c., are concerned; many even of the smaller parts will be interchangeable. The tank engines will weigh 51,500 kilogs.—say 51 tons—which is thus distributed: Weight empty, 37,000 kilogs.; water in boiler and coal on grate, 4500 kilogs.; supplies of water and coal, 10,000 kilogs.; total, 51,500 kilogs. The last item is higher by 3 tons than Signor Massa's estimate, so that they easily stand comparison with the tender engines in this respect. The total load on the three driving axles is 39,720 kilog., while it is 42,000 in the tender engines. These loads are not too high for the heavy rails of the St. Gothard, and in fact the wear of rails is much more a matter of steadiness than of mere pressure.

With regard to tractive force, the difference between the two Kramer, of the mail trains over the Brenner in 1878. On a gradient of 2·13 per 100 a train of 200 tons gross weight used 256 litres of water and 34·1 kilogs. of coal per kilometre, equal to 14 litres and 1·86 kilogs. per metre of vertical height. Again, the Swiss Central Railway, on the line from Olten to Siffach, gives 1·6 kilogs. of coal for a train of 200 tons raised through one metre; and the United Swiss Railways, on the line from Rorschach to St. Gall, gives 14 litres of water for the same. The Bavarian States Railways are also in agreement with these figures.

On the St. Gothard line the heaviest work lies on the southern side, on the gradients of 2·7 per cent. from Biasca to Giornico, 2·6 from Giornico to Fiesso, and 2·5 from Fiesso to Airolo. When the tender engine reaches the foot of the first of these, it has already expended 1·3 tons of fuel and water, and the net train load it can draw varies from 155 tons, with an adhesion of $\frac{1}{8}$th, to 67½ tons, with an adhesion of $\frac{1}{10}$th. This is the least favourable condition for the tender engine, and it must be compared with that of the tank engine. The diagrams show that the latter will have a greater net weight of train up to the point where it has expended 4·2 tons for an adhesion of $\frac{1}{8}$, and 8·5 for an adhesion of $\frac{1}{10}$. The whole expenditure from Biasca to Giornico, however, will not exceed 2·7 tons, and therefore it maintains a clear advantage over the tender engine. The same is found to hold for the two other inclines mentioned above. On the northern side things are still better. The distance from Erstfeld to Göschenen is only about 18 miles, and the expenditure of water and fuel is not above 4 tons. On the whole, taking $\frac{1}{7}$ as the coefficient of adhesion, it appears that the tank engine can surmount the worst approach, that on the south side of the tunnel, provided three stations only are supplied for coaling and watering. On the southern incline alone of the Mont Cenis the trains halt five times, stopping sixty-three minutes in all.

With regard to the weights to be drawn on the Mont Cenis, the following total weight is drawn daily in ten trains:—

	Tons.
50 coaches at 6 tons	=300
10 vans at 7 tons	= 70
15 goods wagons at 6½ tons	= 97½
750 passengers at 0·075 ton	= 56
60 cattle at 0·5 ton	= 30
Baggage, &c.	37½
Total	591

This gives a net average load of 59 tons exclusive of the engine. But if the tank engine has expended all its stores, it has still an adhesion weight of 34 tons, which even with so low a coefficient as one-ninth, gives a net train load of 84 tons. It is therefore amply sufficient at any rate for express trains, for which the net train weight may be taken at 55 tons.

With such trains the total expenditure of water, in travelling from Biasca to Erstfeld, would be 6·2 tons, and from Erstfeld to Biasca only 5·1 tons. It therefore appears that the latter trip might be made without stopping at all, and the former with a single stop at Airolo. It is, however, necessary to stop before entering the tunnel in either direction in order to see that the train is in good order. On the corresponding section of the Mont Cenis the express trains halt two to three minutes at Meana, the same at Chiomonte, six minutes at Salbertrand, three at Oulx, eight to fifteen minutes at Bardonnechia. There is, therefore, no fear of the St. Gothard express trains being longer on their journey than those of the Mont Cenis. With passenger trains and mixed trains in kilogs. per hour for the tank engines—Class A—and tender engines—Class B—as follows:—From Biasca to Locarno, Class A, 4·91; from Biasca to Locarno, Class B, 6·90; from Lugano to Chiasso, Class A, 6·31; from Lugano to Chiasso, Class B, 7·47. The saving with the tank engines was 40 per cent. in the one case, and 22 per cent. in the other, or about 30 per cent. in the mean. The net train weight was 60 to 65 tons, giving a gross weight of 90 tons with the Class A engines, and 113 with Class B, or an advantage of 26 per cent. to the latter. This economy cannot be entirely attributed to the tank engines, but it is confirmed by the experience of other lines, especially the Jura Railway. Here in 1880 the consumption of coal per engine kilometre was 11·0 kilog. with tender and engine, and 9·54 with the tank engines, or per train axle kilometre 0·460 and 0·406 respectively. The lubricant used per engine kilometre was 31·6 grammes and 28·0 grammes respectively. The economy on the side of the tank engine is about 13 per cent. The two classes of engine were doing similar work—have equal wheel diameter and equal stroke; but the cylinder diameter is 450 mm. in the tender engines and 400 in the tank engines. Assuming a saving of 10 to 12 per cent. on the St. Gothard line, in which the fuel will cost not less than £16,000 a year, this will represent the not inconsiderable sum of about £1500 a year. This agrees very closely with the theoretical estimate made by Herr Abt, of the Swiss Railway Department.

Nor is this the only source of economy on the Jura Railway; the cost of maintenance and repair have been as follows, in francs, per engine kilometre:—

	1876.	1877.	1878.	1879.
Tender engines, class C	·157	·106	·099	·081
Tank engines, class D	·082	·117	·074	·058

Again, the wear of the tires, which is greatly diminished by the use of the uncoupled front axle, becomes an important point, not only for the maintenance of the engine, but also of the road. Heavy and unsteady engines injure the sleepers so much as to render them unserviceable long before they become too rotten for use.

Although tender engines have hitherto been exclusively employed on mountain lines, there are indications in other quarters of a change in this respect. Herr Kamper, head of the Control Department of the Austrian Railways, has proposed for the Arlberg line six-coupled tank engines, with bogie in front, for the passenger trains, and tank engines all coupled for the goods trains. Again, the engineers of the Belgian Central Railway, which has fifty-two eight-coupled tank engines of the latter type—twenty of them as old as 1866—states that they consider them far superior to the tender engines of the Paris and Mediterranean Railway, which are more costly to maintain and give a less duty. Even if this type should prove unequal to the main work of the St. Gothard, no harm would result to the company, since they could be employed for the Monte Cenere section. This line, leading from Bellinzona to Lugano, is very similar in length and vertical height traversed to the line from Basle to Olten, which is regularly and satisfactorily worked by tank engines. For such lines, which are partly on the level and partly on steep inclines, an engine of this type, which can equally well run quickly over the former or slowly over the latter, is specially suitable. The directors, therefore, have recommended, on the whole, the building of a class of tank engines; but that the number should be restricted to eight, this being the number which would find employment on the Monte Cenere line.

Finally, the report discusses the question raised by Signor Massa,

whether the rolling stock already ordered is sufficient. The Mont Cenis traffic for 1878—which is taken as the basis—was 281 vehicles per day. This, at an average weight of 9 tons per vehicle, gives 2529 tons to be transported. Now to fix the number of engines required for this traffic, it is necessary to know the net train load which a six or eight-coupled engine can draw, and therefore the figure to be taken as the coefficient of adhesion. The differences of opinion on this latter subject quite throw into the shade the differences between tank and tender engines. Signor Massa assumes a coefficient of one-ninth, giving a net train load of 90 tons, while a figure of one-sixth would give a load of 158 tons. On the Brenner, six-coupled tender engines can take more than 160 tons from Innsbruck to the summit at a speed of six to nine miles an hour. The passenger engines take trains of 110 to 125 tons at a speed of nine to twelve miles per hour. The question of tunnels, as pointed out by the late Max von Weber, becomes of great importance here, for, owing to the damp, &c., in a long tunnel, the adhesion there is permanently reduced to about the figure usual in times of frost on an ordinary line. For this reason the gradient in the St. Gothard tunnels has been reduced; but this is not in itself sufficient, and careful inquiry on this head has been made by Herr Stocker on the Brenner, Mont Cenis, and other mountain lines. This has shown clearly the abnormal wear of rails in tunnels from frequent slipping, but at the same time the advantage gained by sanding, if with good sand, or by washing the rails with hot water, as lately introduced on the Jura and Hauenstein Railways. From these results it follows that, in a tunnel rising 2·3 per cent., an engine at slow speed will draw a train of 150 tons. This corresponds to an adhesion of one-sixth on a gradient of 2·7 per cent., which is the steepest on the St. Gothard. The report, however, takes 125 tons as the train load for a six-coupled, and 175 for an eight-coupled engine. Calculating on this basis, they obtain fifty-nine as the number of locomotives required to transport a gross traffic of 2500 tons per day. This is eight more than the directors had previously decided upon, but it of course assumes that the traffic will at once attain much larger proportions than was expected. The directors recommend, therefore, an increase in the number to be ordered, and that this increase, to make perfectly sure of ample power on the mountain section, should be in eight-coupled tender engines. Their final recommendation, therefore, which has been confirmed by the Board of Control, is to order eight tank engines with six-wheels coupled, Class C, and fifteen tender engines with eight wheels coupled, Class D.

It may be worth while to add that the wisdom of this provision has been confirmed by the facts, the traffic since the opening having already become so large that an extra supply of rolling stock is already under order.

At the same time we give diagrams of the four main types of engine now under construction—as mentioned in the report—viz., eight-coupled tender engines (class D), six-coupled ditto (class C*b*), four-coupled tank engines with bogie (class B), and eight-wheel tank engines, six-coupled (class C*a*). We also give a diagram of a new class of light four-coupled engines (class A), which are now under construction, but are not included in the report.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents.*]

ROAD LOCOMOTIVE LEGISLATION.

Sir,—In an article on this subject published August 18th last—page 120 of the present volume—you drew attention to the importance of the question of road locomotive legislation, and gave figures showing the number of self-moving engines at work in this country, and the saving over horse labour effected by their use. You also showed by tables that the weight of an 8 ton traction engine—9 tons in road trim—with 16in. wide wheels, is only 420 lb. per inch width of tire, whilst a Pickford spring van to carry 2 tons—3 tons 1 cwt. complete—is 854 lb. per inch, or more than double that of an engine capable of hauling 20 tons, and the lighter pressure is accompanied by a slower speed, never exceeding four miles per hour, and is borne by wheels of large diameter, whilst the heavier pressure is accompanied by a quicker speed, thus producing violent hammering action, and the load is carried on wheels of smaller diameter than in the case of traction engines. The reason, then, for the alleged increased injury to roads by the use of steam must be sought for otherwise than from the mere weight of the wheels per inch width of tire, since this is all in favour of engines and against horse-drawn vehicles. In cases where damage to roads is unquestionably done by the use of road locomotives it will generally be found that the metalling of the road is so thin and the substratum so soft as to be absolutely incapable of carrying without entire destruction of surface contour weights of 8 or 9 tons, no matter how wide may be the four wheels on which that load is distributed. Something must, no doubt, be attributed to the augmentation of traffic by the use of steam, for owing to the cheapness and economy of the road locomotive as a hauling power, conveyance of goods of low intrinsic value by road, as bricks, manure, clay, chalk, stone, coal, and other minerals, is being developed to an extent impossible with horse haulage.

If, as I believe, the above-named causes are predominant in producing the alleged increased injury to roads by steam over horse haulage, the moral to be drawn from them is tolerably evident. In the first place roads to be equal to modern requirements must be sufficiently well made, both as regards quality and quantity of metalling, to carry without injury loads of 10 tons distributed over four wheels 20in. wide. The moral to be deduced from the other cause of injury, namely, increased traffic, scarcely requires pointing out, but I think I will do so, stating that if by the use of engine power for haulage, local industries are called into existence and developed, which, if dependent on horse haulage for transport of materials, could never have flourished, it is evidently the duty of those in authority to facilitate improved means of transport, thereby aiding instead of crushing local industries. It will no doubt be urged as an argument against this line of action that the highway rates will be raised consequent on increased wear and tear of the roads from the extra traffic thus brought on them. It should, however, be borne in mind that with improvement in local industries comes generally increased rateable value, so that although the actual sums required for road maintenance may be greater, yet the percentage on rateable property may remain the same, or in some cases may even decrease.

Whilst on the subject of injury to roads, I cannot help saying that I think some traction engine owners have themselves to blame for the heavy sums they have in certain cases paid as compensation for road damage to highway boards—although the morality of a highway board known to me, which employed traction engines under time-contract to draw road material, and then refused to pay the owner of the engine on the ground of alleged injury to the road by the traffic, is open to question—in consequence of the reckless way in which engines have been allowed to draw heavy loads of bricks, &c., on roads rendered soft by the breaking up of frost. In such cases it is surely better policy to remain a day or two idle than to continue working for earnings more than swallowed up by the fines subsequently enforced—and in such cases rightly enforced—for road damage. It is this oversight or neglect of an obvious principle of political economy which is largely to blame for the hostile feeling so often manifested by highway boards and town councils towards owners of traction engines.

In a case tried at Rochester petty sessions some few months since, a Highway Board claimed £137 19s. 1d. from a traction engine owner, for damages caused by excessive weight and extraordinary traffic along a road in the district. The engine used was of 8-horse power nominal, and weighed 9 tons complete. The weight was distributed over four wheels. The driving-wheels were 16in. wide, and carried about two-thirds of the weight; the front wheels were 12in. wide. The engine drew two four-wheeled trucks, with wheels 8in. wide, the hinder wheels of each truck being 16in. wider gauge than the front wheels, so that the traffic should be distributed over a larger surface of road. The loads carried were 2500 bricks in each wagon—at 60 cwt. per 1000, 7½ tons each. The weight of each truck was 30 cwt. The total weight of the train, supported on twelve wheels, was: 15 tons the load, 3 tons the wagons, and 9 tons the engine; total, 27 tons. The engine made seven double journeys, returning light. The total number of bricks drawn was 35,000—105 tons—and the contract price was £11 7s. 6d. The greatest weight per inch width of engine driving-wheels was 420 lb., and of the trucks 630 lb.

Over the same road, and at the same time, 120,000 bricks—360 tons—were drawn by horses in wagons weighing about 1¼ tons, having wheel tires 2½in. wide, and carrying about 670 bricks—2 tons—having thus a total weight of 3¼ tons on a bearing surface of 10in.—728 lb. per inch width of wheel tires. And more than three times as many bricks were drawn by horses as by steam in this case, and yet the magistrates found that the damage to the roads was all done by the engine, whose unfortunate owner had to pay £137 19s. 1d. and costs, whilst his earnings by the contract amounted to only £11 7s. 6d. Appeal was made to the Court of Queen's Bench upon two points of law, but without success.

I may briefly show by figures the actual relative damage done to the road in this case by the horse and steam traffic. The length of the journey was about three miles, a double journey would therefore be six miles. The engine and trucks made seven double journeys—seven single journeys loaded and seven light—the weight of a train consisting of an engine and two trucks being as under:—Loaded, 27 tons; "ton miles," 567; with a mean road-pressure on the 120in. wide bearing surface of the twelve wheels of 504 lb., (maximum pressure per inch, 630 lb. on the wagon wheels). Light, 12 tons; ton miles, 252; with a mean road pressure of 224 lb. (maximum on engine driving wheels, 420 lb). Distance run, twenty-one miles in each case. Total ton mileage of engine and train, 819. Taking the case of the horse-drawn wagons I find that with wagons weighing 1¼ tons and carrying 2 tons of bricks, 180 double journeys must be made; of each journey three miles would be loaded and three miles light. Loaded, 540 miles by 3¼ tons = 1755 ton miles at a mean road-pressure of 728 lb. per inch width of tire. Light, 540 miles by 1¼ tons = 675 ton miles, at a mean road-pressure of 280 lb. per inch width of tire. Total ton mileage of horse-drawn wagons, 2310.

In the above figures it will be noticed that I have taken no account of the weight of, or damage done by, the horses themselves. I will now add the weight of these to my figures. Each wagon and load weighing 3¼ tons would want four horses to draw it; allowing 10 cwt. for each horse, or 2 tons per wagon for 180 double journeys of six miles each, 1080 miles × 2 tons gives a total ton mileage as under:—Ton mileage of horses, 2160; wagons and load, 2310; total, 4470 ton miles to draw 360 tons of bricks three miles by horse; the total ton mileage to draw the same amount by steam would be 3042, thus conveying the load with 31 per cent. less ton mileage by steam than by horse-power, so showing that even if an equal number of bricks had been drawn by steam as by horse-power, the roads should have received less damage by 31 per cent. than by horse-power, and inasmuch as that in the present instance out of a total of 465 tons of bricks the engine only drew 105 tons, or less than one-fourth, it is tolerably evident that the engine was not the only or even the principal cause of damage to the roads. A correspondent—see p. 155, September 1st, 1882—objects to your figures of the saving effected over horse-power by the use of steam, on the ground that the self-moving engines of this country, by which I suppose you mean all road engines which have the power of transporting themselves from place to place by steam—although they may often work stationary—do not indicate anything like the power I stated, namely 20-horse power. He gives as the result of his observations 5-horse power as the average indicated by engines working in Derbyshire. These engines, he says, are engaged in hauling coal wagons. He gives no figures as to the capacity or weight of the wagons, but they must be very different from most traction engine wagons if they do not hold from 4 tons to 6 tons of coal, and the practice in Derbyshire must differ from that in any other county if each engine does not haul two wagons, which together—taking as the load of each wagon 5 tons of coal—with the weight of the two wagons 30 cwt. each, will weigh 13 tons—by no means an exceptional load for an 8-horse power engine. Accepting these figures as approximately correct, I fail to see how an engine exerting only 5-horse power could even move such a load.

Turning to "Molesworth's Pocket-book," page 241, twenty-first edition, I find the resistance to traction on level macadamised roads is given as from 44 lb. to 67 lb. per ton, whilst on gravel roads it is as high as 150 lb. The roads spoken of by your correspondent are alleged to be much cut to pieces; I may, therefore, fairly take the resistance at something between the figures given for macadam and gravel—say, 80 lb. per ton. The tractive force of a horse, according to the same authority, is but 83 lb. per ton. It would, therefore, appear that an engine drawing the load named would have to exert not 5 but 13-horse power over and above that expended in its own propulsion. The total indicated power would be 13 + 9 = 22-horse power for level ground, and on a rising gradient, although the speed would fall off, the indicated power would probably increase, as the mean cylinder pressure would be greater. Your correspondent has probably taken into account that the engines are returning to the coal depôt light, and in this way may be giving out only 3-horse power beyond that necessary for their own propulsion, and he may have thus estimated his horse-power lower than appears to me consistent with possibility.

It must not be forgotten moreover that whether the hauling power be horse or steam, the motor and wagons have in most cases to return light to the depôt; it is not, therefore, fair to debit the engine with the loss occasioned by returning empty unless the horses are similarly debited. I have already shown the comparative dead load passing over a given road to convey a given weight of materials by horse and steam haulage. It is in favour of steam to the extent of more than 30 per cent., and shows even more favourable results on very hard and level roads where three wagons instead of two could be drawn by steam, the dead weight of the engine being, of course, less in proportion to the larger load. I presume you did not take 20 as the average indicated horse-power of the self-moving engines of this country without due thought, and propose to substantiate your figures on the point. About one-third of the self-moving engines are employed in steam ploughing and cultivating, either on the direct or roundabout systems. The ordinary size of these engines is 12-horse power, but there are a large number of 14-horse power engines also, and they are capable of indicating as much as 60-horse power. Let us take the case of an engine pulling a five-furrow plough, ploughing 10in. deep, the implement moving at four miles an hour. Dynamometer experiments made by the Royal Agricultural Society have shown that at such speeds each mouldboard will absorb from 6 to 8-horse power. Taking the lowest figure 6, we have, therefore, 30-horse power absorbed by the implement itself, and we shall find beyond this that the loss of power in engine, drum, and rope, is very considerable.

A ploughing engine, one of a pair on the double system, capable of doing such work, would be of the following dimensions:—12in. cylinder by 14in. stroke, revolutions 120 per minute, piston speed 280ft., boiler pressure average 100 lb., cut off ¼ stroke, effective pressure on piston about 50 lb. per inch; this gives 48-horse power. Although it may be objected that in the double engine system one engine is idle half the time, and that therefore my figures to give the average horse-power of the two engines through the day must be divided by two; even if this is done, I find that I have 24-horse power—20 per cent. above what you gave as the mean—which is a good margin.

It must not be lost sight of, in comparing steam power for ploughing and hauling with horse-power for the same purposes, that although the engine may be only occasionally required to exert its full power when a steep gradient in the one case or an extra heavy piece of land in the other has to be dealt with, yet that reserve of power must be there just as in the case of horses; for although two horses may draw with comparative ease a three ton wagon on a level hard road, yet if the distance were above a few miles or the ground undulating it would be necessary to have four horses, and these horses require feeding whether they are exerting their full power or not; they have to be fed nearly to the same extent whether they work or remain in the stable. Now with steam this is entirely different, for with a good driver an engine will only consume coal in proportion to the power required; so that taking an engine capable of indicating 20-horse power per day of ten hours on a consumption of half a ton of coal, and such engine was only required to indicate 6 or 7-horse power, the consumption would fall nearly in that proportion, and on days when the engine was not working consumption of coal is of course *nil*. These are points which your correspondent appears to have lost sight of. I presume that you do not say that the 4000 engines throughout this country are constantly exerting power at the rate of 20-horse power each, but that they are doing work for which it would be necessary to keep and feed 80,000 horses. I accordingly believe that your estimate of the saving effected by the use of steam is correct, more especially if it be borne in mind that in agriculture—for which the majority of these engines are employed—more than in most other things, times and seasons are of vital importance.

Your correspondent objects to your figures as to the indicated power of engines. I venture to call attention to his own as to a day's work for six horses. Taking his own figures for the cost of a day's work of an engine and two trucks—though I think he should have put it at £1 10s., or even higher, instead of £1 2s.—in drawing 10 tons of coal ten miles and returning light, I find the figures as under:—

Cost of drawing by steam:—

	£	s.	d.
Interest and maintenance of value and repairs on £500 (?) per annum on 300 working days, per day		6	8
Wages of two men		8	0
Half-a-ton of coal at 10s. (?)		5	0
Oil, waste, &c.		2	0
	£1	1	8

Cost of drawing by horse-power:—

	£	s.	d.
Six (?) horses at 5s.	1	10	0
Wages four (?) men at 3s.		12	0
Total according to your correspondent	2	2	0
	1	1	8
	£1	0	4

Balance £1 0s. 4d. in favour of steam.

I will now give my ideas of what the cost of hauling ten tons of coal ten miles by horse power would be. To begin with, the double journey of twenty miles is a very good day's work for a cart horse, irrespective of the load. Ten tons of coal to be drawn by horses would not be loaded more than two tons in a wagon; five wagons would therefore be required, which would make only one double journey daily. These five wagons would weigh 1¼ tons each, 6¼ tons must therefore be added to the ten tons of coal, making a total of 16¼ tons to be drawn ten miles, and 6¼ tons to be drawn back ten miles for every ten tons of coal delivered.

In proper coal wagons one good horse will pull two tons coal, and two horses would take such wagons ten miles with two tons of coal, and thus only ten horses will be required; and if the roads are not good, 30 cwt. loads would only want fifteen horses.

The total weight of each wagon loaded would be 3¼ tons, a weight for which I have already shown four horses to be necessary for such a distance as ten miles. I find, therefore, that instead of six horses, twenty would be required. The cost of transport by horses will now be as under:—

	£	s.	d.
Twenty horses at 5s. per day	5	0	0
Five men at 3s.		15	0
Total cost per day	£5	15	0

And these figures take no account of the capital invested in wagons, and only allow one man with each wagon, whilst the general practice is to have a man and boy with each team of horses on journeys of this kind; with these additions the total cost of haulage would mount up to at least £6, instead of £2 2s., according to your correspondent's calculations, thus showing as against my estimate for the cost of steam haulage:—

	£	s.	d.
Cost of day's work of twenty horses	6	0	0
Day's work of 8-horse power engine	1	10	0
Balance in favour of steam	£4	10	0

or a charge on the coal of 3s. per ton, instead of 12s.

Stephen Harding Terry,
November 13th. Assoc. Mem. Inst. C.E.

ELECTRICAL STANDARDS OF MEASUREMENT.

Sir,—Permit me to tell "An Electrical Student," in reply to his letter in your last impression, that I have not put any erroneous meaning on his first letter. But whether I did or did not affects the matter in hand not a jot. In either case he is mistaken, as he will see on further reflection. The work of starting a train or accelerating a load of any kind may be regarded as divided into a series of infinitely small successive efforts n, n^1, n^2, n^3, and so on, and the period of acceleration into a corresponding set of divisions, t, t^1, t^2, t^3, and so on, and the resistances into a series, x, x^1, x^2, x^3, and so on, and $x = n$, $x^1 = n^1$, $x^2 = n^2$, and so on to the end. Whether motion is being accelerated or retarded, the resistance in all cases is equal to the driving force, no more and no less. If your correspondent will take time to think, he will see that if a pull equals a resistance, motion ought not to continue, and I have yet to learn from him how an incongruous value, motion, can affect the relations of two forces, namely, pull and resistance. I have already clearly explained my views, and pointed out the important deductions to be drawn from them, and would ask your correspondent to read what I have already written before he carries this correspondence further. If, having read, he is not convinced, I shall be happy to give him any explanations I can.

London, November 14th. Φ. Π.

FIRE DOOR RINGS.

Sir,—We observe in last week's issue a notice of "Boulton's fire-door ring." We may say that we have for some years made and used rings of a somewhat similar construction, excepting that instead of being a plain surface, we chase a thread on the outside and tap through both external and internal plates in a similar manner to putting in a marine stay tube. We leave a slight taper in the hole, and force the screw tube in under a powerful drilling machine. We then caulk round the plate to a taper mandril, and bead over the tube both inside and out. We have used these door rings not only for locomotive and launch boilers, but for vertical boilers, a matter of greater difficulty, on account of the curvature of the plates and the threads running out. In all cases they have remained perfectly tight, the only difficulty being that unless protected by a false ring inside, the action of the rake or slice wears the inner edge away in time.

We think this plan a better one than that you illustrated last week, and until your notice were not aware that there was any novelty in it. J. Copley and Co.

Middlesbrough, November 15th.

THE CASTING OF PIPES.

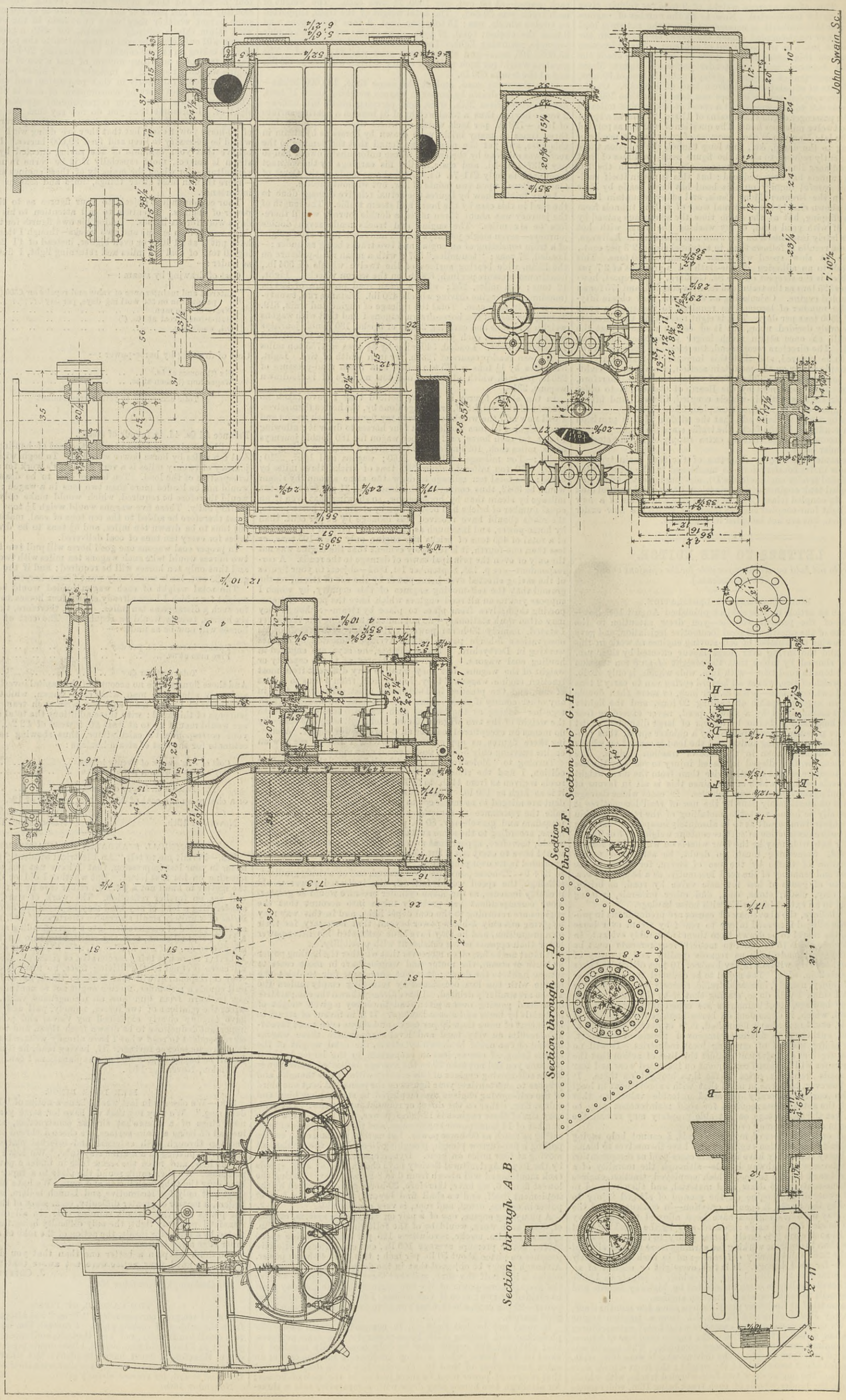
Sir,—I see your correspondent "Prior" has altogether departed from the subject of casting pipes. I can tell him he is not talking to a small ironfounder, nor one that depends upon old-fashioned plant; as I have told him before, I have made pipes sockets up and down, therefore, I must have the plant; but what I say is, that after casting both ways, those pipes cast with their sockets up were the most sound, for reasons already given. Experience.

November 14th.

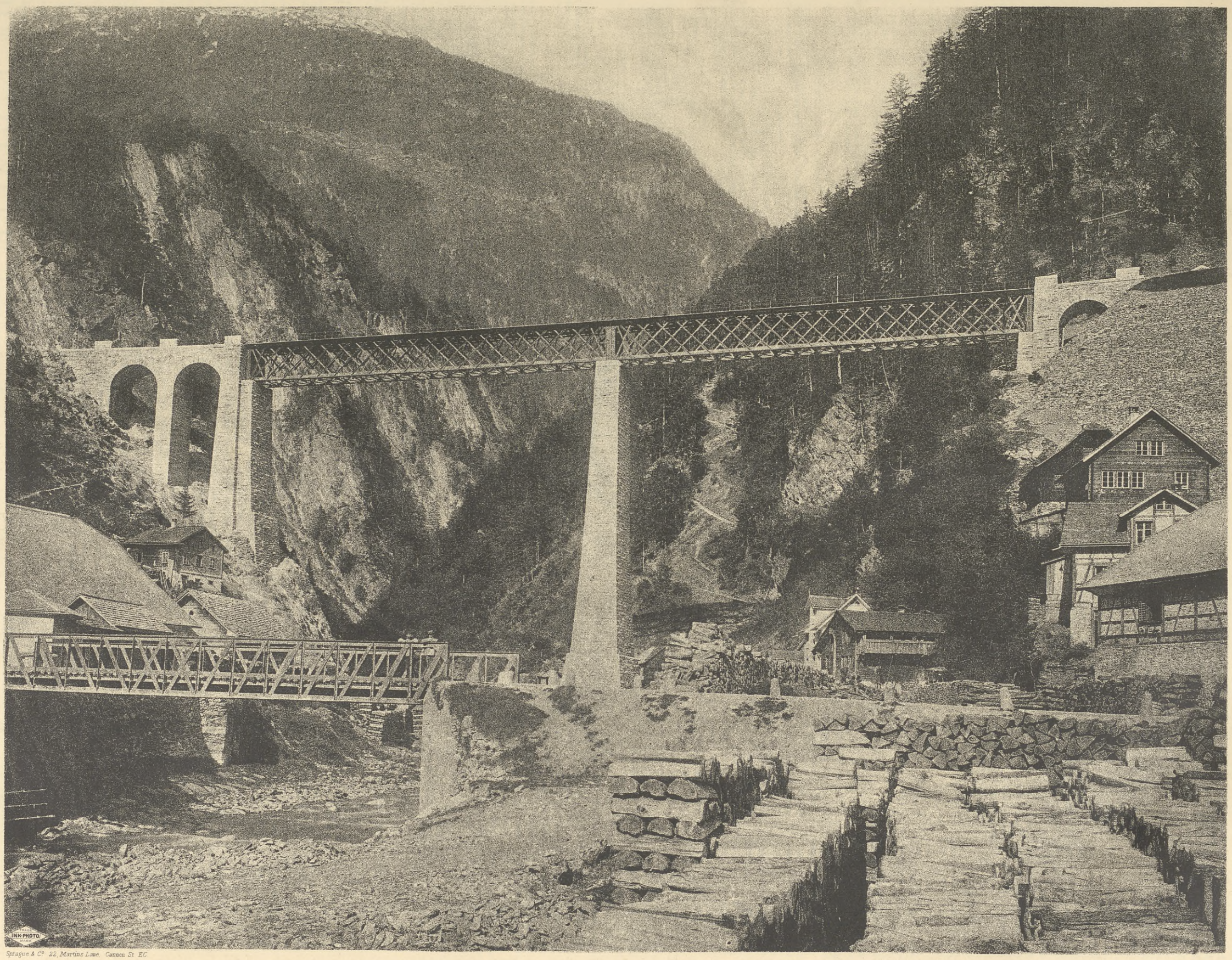
ENGINES OF THE STEAMSHIP LEERDAM—DETAILS OF CONDENSER AND STERN TUBE.

THE NETHERLANDS STEAMBOAT COMPANY, FYENOORD, ROTTERDAM, ENGINEERS.

(*For description see page* 214.)



KARSTELLENBACH BRIDGE, ST. GOTHARD RAILWAY.



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*** *With this week's number is issued as a Supplement, an illustration of the Karstellenbach Viaduct, St. Gothard Railway. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

*** *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.*

*** *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.*

Young Reader.—*It is the subject of a patent, No.* 596, *of* 1880.

T. R.—"*Art of Brewing,*" *by F. Faulkner, published by F. W. Lyons. A new edition has recently or is about to be published.*

A. C. B.—*Hammer scale is used for fettling puddling furnaces, and in making malleable castings. It is saleable, but not worth much. Advertise it.*

D. B. (Edinburgh).—*You will find the rules for calculating the strains in cranes in almost any elementary treatise on statics. The subject is well handled in the "Treatise on Cranes," published in Weale's Series by Crosby Lockwood and Co. In your crane the action was that of a bell crank lever, and the strain on the lower pivot was—assuming the weight to be lifted vertically under the pivot of the jib—equal and opposite to that on the top pivot. The magnitude of the strains is found by a simple rule-of-three sum. As* 24*ft., the height of the crane post, is to* 22*ft. the length of the jib, so is* 9 *tons the load lifted to* 8¼ *the shearing strain in tons. This, we need hardly say, was inadequate to shear across a pivot* 3¾*in. in diameter, even after the weight of the jib has been allowed for. Possibly the chain was extended a long way beyond the radius of the jib, in which case the strain might be enormously increased.*

VARNISH FOR DRAWINGS.

(*To the Editor of The Engineer.*)

Sir,—Can any of your correspondents inform me of a varnish for drawings which can be used without sizing or isinglass as a preparation?

Leicester, November 11th. W. W.

PATENT TRICYCLES AND BICYCLES.

(*To the Editor of The Engineer.*)

Sir,—I shall be obliged to any reader who will give me the names of the patentees of the Rudge bicycle and of the Coventry rotary tricycle; also of the special Zephyr tricycle and the Coventry Zephyr tricycle?

London, November 16th. Wheeler.

STEAM BOILERS HEATED BY NAPHTHA.

(*To the Editor of The Engineer.*)

Sir,—Can any reader tell me where I can procure a steam boat boiler of about 100 indicated horse-power, with the furnace constructed for burning naphtha fuel only, or the name of a firm who make the same?

London, E.C., November 11th. J. H.

HOPKINSON'S SAFETY VALVE AND AIMAN'S PATENT FIRE-DOORS.

(*To the Editor of The Engineer.*)

Sir,—We shall be extremely obliged if any of your correspondents can inform us who are the manufacturers of Hopkinson's safety valves and Aiman's patent fire-doors. S. W. and Co.

Wolverhampton, November 16th.

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*** *Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of* The Engineer, 163, *Strand.*

MEETING NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, Nov. 21st, at 8 p.m.: Paper to be discussed, "Recent Hydraulic Experiments," by Major Allan Cunningham, R.E.; and, time permitting, the following paper will be read:—"American Practice in Heating Buildings by Steam," by the late Mr. Robert Briggs, M. Inst. C.E.

Society of Telegraph Engineers and Electricians.—Thursday, Nov. 23rd, at 8 p.m.: "Notes on the Telegraphs used during the Operations of the Expeditionary Force in Egypt," by Lieut.-Colonel C. E. Webber, R.E., President.

Society of Arts. — Wednesday, Nov. 22nd, at 8 p.m.: Second ordinary meeting, "Ice Making and Refrigeration," by Dr. John Hopkinson, M.A., F.R.S.

THE ENGINEER.

NOVEMBER 17, 1882.

THE FOUNDERING OF THE AUSTRAL

The sinking of the Austral last Saturday morning in Sydney Harbour, while lying in supposed security, and in the course of receiving her coal on board, has naturally produced considerable anxiety in the public mind. It seems to be one of those cases of naval disaster which have from time to time occurred and taken the world by surprise, as there has been no danger anticipated and no previous warning. The case may be classed with the loss of the Royal George and of the Mary Rose, to each of which it is similar in many respects. The Austral is one of the Orient Steam Navigation Company's line of steamers. She is a large and powerful vessel of about 5500 tons; her length is 456ft.; her breadth, 48ft. 2in.; and depth of hold, 33ft. 9in. She is a perfectly new ship—having started on her first voyage in the spring of this year—and her owners and builders had good ground for being well satisfied with her construction, and also with her performance up to the date of her foundering. The facts in connection with the accident—for such it doubtless was, whether associated with culpable negligence, as stated by the secretary of the company in his letter to the *Times* of Monday last, or not, we do not presume to say—appear to be as follows, so far as they have yet reached us:—The vessel arrived at Sydney on the 3rd inst. She had discharged the whole of her cargo except 200 tons of iron, and was receiving her coal in the usual way on Friday last, while lying in apparent security at her mooring in harbour. The coaling was carried on through Friday night, which seems to indicate that the weather was calm, and that there was no unusual swell on the water. At four o'clock on Saturday morning, when 1500 tons of coal had been placed on board, the ship "heeled over and sunk."

Now it is a well-known fact that many good steamships have not enough initial stability to enable them to stand upright, when light, without ballast; but it does not necessarily follow that they are in any danger on this account. They may be brought just upright by means of ballast, or they may be allowed to loll over a few degrees. In any case they possess great righting force if heeled over to a considerable angle, and are in no danger of coming to grief on account of their small initial stability alone. It may be as well to consider upon what conditions the stability of a ship depends. The weight of the ship may be regarded as a single force acting downwards through her centre of gravity; and this force must be equal to the upward component pressure of the water, which may also be regarded as a single force acting upwards through the centre of buoyancy of the ship, the centre of buoyancy being the centre of gravity of the volume of the water displaced by the ship. When the ship is floating freely and upright these two equal forces act in the same vertical line; and the ship has stability if when she is inclined a little these two forces move so as to form a mechanical couple acting in such a direction as will tend to restore her to the upright. If the action of this couple tends to turn her further from the upright she is unstable, and was only balanced in the upright position, and was on the point of falling away from it. Whether or not the couple will tend to restore the ship to the upright when she heels over a little will depend on the relative positions of the centres of gravity and centre of buoyancy, and also on the shape of those parts of the ship near the water line which are moved out from the water on the one side and into the water on the other. The centre of buoyancy almost invariably lies some distance below the centre of gravity. As the vessel heels over, the form of the volume of the water displaced by the ship undergoes a change; a wedge-shaped portion of the figure is rolled out of the water on the one side, and on the other side a wedge-shaped figure is added by the part of the hull rolled into the water. These wedge-shaped figures are equal in volume, as the total volume of the water displaced, which is equal in weight to the weight of the ship, must remain unchanged. Obviously as the shape of the volume displaced by the ship is changed by removing a certain volume from one side and adding an equal volume to the other, the centre of gravity of the whole volume of water displaced by the ship, *i.e.*, the centre of buoyancy, must move out towards the side on which the volume is added, which is the side towards which the vessel is heeling. The distance it moves is measured by the volume of the wedge removed from one side and added to the other, multiplied by the distance between the centres of gravity of the two wedges, and divided by the total volume displaced by the ship. If the vertical through the centre of buoyancy in its new position, along which the resultant upward fluid pressure will now act, passes on the same side of the centre of gravity of the ship as the side towards which the ship heels, the mechanical couple formed by the weight of the ship and the upward pressure of the water will tend to restore the vessel to the upright position, and she will be in stable equilibrium; and if the vertical through the new centre of buoyancy passes the centre of gravity in the opposite side, the reverse will be the case—the ship will tend to be turned further from the upright and she will be in unstable equilibrium. It will be seen that if the couple tends to restore the ship to the upright, the vertical through the new centre of buoyancy will cross the line which was the vertical through the centre of gravity and centre of buoyancy when the ship was upright, at a point situated above the centre of gravity; and this point is high or low according to whether the centre of buoyancy moves out much or little, *i.e.*, whether the righting force is great or small. If the couple tends to upset the ship this point falls below the centre of gravity. This point is called the metacentre, and from the foregoing it follows that if it lies above the centre of gravity the ship has initial stability, the amount of initial stability being measured by its height above the centre of gravity; whereas if it falls below the centre of gravity the ship has no initial stability and will not stand upright. Thus the initial stability depends, as we have said, on the lowness of the centre of gravity, and the moment of the wedges immersed in the one side and emerged on the other, when the ship begins to heel over, *i.e.*, on the shape of the vessel at the waterline.

Now let us consider what conditions hold if a ship is unstable in the upright position. The metacentre falls below the centre of gravity, and consequently the vessel will not stand upright. If she were brought into this position the least force would move her slightly from it, and then a couple would be brought into action which would turn her further still from the upright. The position in which the ship will rest is that in which the centre of buoyancy and centre of gravity are again in the same vertical line; and this will occur at an early angle in an ordinary high-sided ship. As the wedges immersed on the one side and emerged on the other become larger, the centre of buoyancy moves out more rapidly, and consequently the vertical through it crosses the line which was the vertical through the centre of gravity and centre of buoyancy in the upright position of the ship higher up; and therefore the upsetting couple becomes less. When this vertical passes through the centre of gravity the upsetting couple vanishes; and if the ship heels further this vertical falls on the other side of the centre of gravity, and there is a couple formed tending to restore her towards the position in which the centre of gravity and centre of buoyancy are in the same vertical. In this position, inclined from the upright to a certain angle, the ship has stability, for if she be turned through a small angle from this position in either direction a mechanical couple is formed which tends to restore her to this position. The ship will remain thus lolled over either to port or to starboard in perfect safety, and may have a very considerable range of stability beyond this angle, for the rapidity with which the centre of buoyancy will move out will go on increasing as the ship heels over until the edge of deck passes into the water; and even after this has happened the centre of buoyancy will continue to move out for some time. On the other hand, the centre of gravity of a ship might be situated so high above the metacentre that the centre of buoyancy would never move out far enough for the vertical through it to pass through the centre of gravity, in which case the ship would roll over.

Returning to the case of the Austral, we observe that she was fitted with tanks along her bottom capable of containing 800 tons of water ballast, which were used when the vessel was light. Probably she would not stand upright without this ballast, as it was pumped in by steam power as the cargo was removed; but that she was perfectly safe when light with this water ballast on board was demonstrated satisfactorily in April last, when she made a passage from the Clyde to the Thames with absolutely nothing on board but the 800 tons of water ballast. It is stated that the water ballast had been pumped out while the coaling proceeded, and it is suggested that the coal being untrimmed, and the water ballast gone, the vessel would become top-heavy, and any pressure on the side, arising from either wind or tide, would cause her to heel over, and allow the water to enter the coaling ports, and finally lead to her rolling over. The Austral was coaled through specially constructed coaling ports, close up under the main deck, and which were probably on this occasion several feet above the surface of the water. A large portion of the 1500 tons of coal would certainly have been trimmed, and have found its way to the bottom of the bunkers; and it is not easy to see how the general effect of this 1500 tons in increasing the stability could have been much less than that of the 800 tons of water ballast. It was more than one-half of the total coal to be received; and the coal yet to be placed on board would certainly, in the aggregate, stand above that already stowed. But even supposing that the stability was less with the coal than with the water, and suppose, as an extreme case, that the centre of gravity had been even so raised as to lie somewhat above the metacentre, so that the ship had no stability when upright, and consequently, according to the explanation given above, was forced to lie over on one side, still we think this suggestion as to the cause of the accident does not wholly account for it. As we have seen, the ship would loll over until the centre of buoyancy came immediately under the centre of gravity, but she would probably resist going to a great angle beyond this with considerable force. Every ton of coal placed on board would slightly raise the centre of gravity and allow her to heel a little further, but right up to the time when the water came level with the coaling ports there would be no tendency to overbalance and roll over from this cause. Moreover the men coaling would observe the vessel gradually heeling over and the coaling ports getting nearer and nearer to the water, and would trim the coal below and bring her upright. The telegrams which have reached us seem to indicate that the vessel suddenly heeled over from the upright position to such an extent that the water flowed in at the coaling ports, when of course her fate was sealed. One telegram states that "the vessel overbalanced, and, the portholes being open, she sank." Another states that the vessel "while coaling heeled over and sank at her moorings." This sudden oversetting cannot, as we have seen, be explained by a simple reduction in the stability due to raising the centre of gravity, and we are driven to the conclusion that, if it took place in the manner indicated, it must have been due to the action of free water in the hold in some form or other. Either the whole of the water had not been removed from the ballast tanks, or water had been allowed to enter in some other part. The former appears to have been not unlikely, for this water may only have been in course of being pumped out. If this were the case, as the ship heeled over the centre of gravity moved out in the same direction as the centre of buoyancy, on account of the weight of water shifting over on that side; and it is quite conceivable that the ship might heel to such an extent as to bring the coaling ports into the water. Possibly we may shortly get information which may clear up these points, and in view of this what we have said may seem a little premature; it is, however, desirable to ventilate the subject as much as possible, and if our remarks do not bear in every detail upon this case, they do on another case which has recently come to our notice, in which a ship was at least in great danger of foundering.

ELECTRIC LIGHTING RISKS.

The most prominent risk attending electric lighting is that those who invest in the shares of electric lighting companies will lose their money, and when we consider the

number of such companies now going or about to go into liquidation, it appears that the risk is serious. However, it is not with dangers of this kind that we now propose to deal, but with the risks of physical injury, or even of death, which attend the use of dynamo machines and current-bearing wires. That there are risks of this kind is indisputable ; the fact is proved by the death of several individuals since electric lighting became common. Mr. Edison has been consulted on the subject by an enterprising interviewer, and he has poked his fun at the public through the reporter. Mr. Edison is the patentee of an elaborate and clever system of laying wires under the streets, and it is not likely that he is quite unprejudiced in his condemnation of overhead lines. Mr. Park Benjamin has, as we stated last week, also been interviewed, and he is even more alarming than Mr. Edison. The latter gentleman deals largely in possibilities, but Mr. Park Benjamin is more precise. He goes so far into minutiæ as to explain that if the handle of a fireman's axe was wet, and if he cut a line wire, the consequences might be fatal. All this is simply sensational writing, which is attractive to a section of the readers of the New York press. Here, and no doubt in the States also, such statements as those of Mr. Edison and Mr. Benjamin are taken for what they are worth ; that is to say very little. History repeats itself. We cannot call to mind a single important invention, with which the public at large was nearly concerned, which has not been denounced as dangerous. When the extended employment of railways was first proposed, about 1829, and for many years after, the press teemed with warnings. The engines would burst, the rails would give way, the bridges break ; indeed, the British public were gravely informed that should a speed of twenty-five or thirty miles an hour be attained, suffocation must at once ensue, as it would be impossible to breathe. The denunciators of steamships were even more violent. When the use of gas to light streets and houses was first proposed the alarmists went to work with a will, and house property fell rapidly in value near gasworks ; not because of the smell of gas lime, or other nuisance, but because it was feared that the gas-holders would blow up sooner or later, spreading death and destruction around. An accident which occurred to Clegg in 1813, at Peter-street, Westminster, did much to strengthen the alarm, and it was found necessary to appoint a committee of the Royal Society to investigate the whole subject, and their report helped to reconcile the previously timorous to the use of gas. Everyone is supposed to know in the present day that unless certain precautions are taken very dangerous explosions may take place in any house where gas is used ; but this fact has in no way limited its use. The Tottenham-court-road series of explosions were attended with consequences far more serious than any which could possible ensue from an accident with electric lighting tackle ; but we are not aware that the consumption of gas has diminished even in the neighbourhood of Tottenham-court-road. It is impossible, in fact, to employ any of the great forces of nature in our service without incurring some risk, and this is just as true of electricity as of any other force ; but electricity is on the whole much less dangerous than either gas or steam.

The special risks attaching to electric lighting are two in number. The first is the danger of setting fire to woodwork in out-of-the-way places by the overheating of line wires ; the second is the risk incurred by workmen and others of getting a current of electricity passed through their bodies. The first is not greater than the somewhat similar risk entailed by the use of gas ; the second requires consideration. That people can be killed by the passage of a current of electricity through them is indisputable ; but the way in which they are killed presents some peculiarities. Thus, an enormous quantity of low tension electricity may be passed through the body without doing the slightest harm, without, indeed, the recipient being conscious of what is going on, but a very small quantity of high tension electricity will kill in a moment. Thus, for example, the quantity of electricity which can be stored by a Leyden jar, with a couple of square feet of surface, is extremely minute ; but its tension is very high ; and such a jar discharged through the arms and chest of the operator will impart a shock which he will not soon forget, or care to receive a second time. No one knows why electricity kills ; all that is understood is that it acts in some mysterious way on the nervous system. Death by a heavy charge of electricity—as, for example, by lightning—is, so far as is known, absolutely instantaneous and painless. There is no precise analogy between a death of this kind and one caused by a dynamo. So far as we are aware, there is not an instance on record of instantaneous death caused by a dynamo. Such an occurrence as that suggested by Mr. Benjamin, namely, the death of a fireman brought about by cutting a line wire with an axe, is, we venture to say, quite out of the question. The idea is, of course, that during the infinitesimal period occupied by the passage of the axe through the wire the current would be passed through the body of the fireman and would suffice to kill him. The idea is erroneous. There is not in use any dynamo which produces electricity with a sufficiently high potential to kill in this way. All the deaths which have been caused by dynamos appear to have been comparatively slow. The sufferer unites through his own body two terminals in some way and is killed. Thus, an operator is, we will say, holding one line wire in his left hand, and unwittingly he lays hold of the other or return wire. His fingers instantly close on them by muscular contraction ; the muscles of the chest are paralysed by a species of cramp ; the sufferer utters a low moan and falls, sometimes quite dead, the process of killing occupying perhaps three or four seconds. But in many instances the shock of the fall knocks the wires out of his grasp and restores him to life. Indeed, more than one electrician now living owes his existence to the presence of mind of a comrade, who, seeing him gasping and dying, has knocked him down with a straight blow of his fist. Hardly in any instance have bad consequences as regards health ensued. Thus, a man may be in the very jaws of death at one moment, and in an hour afterwards at work again, as though nothing had happened ; but this is not an invariable rule. It will be seen that there is a wide difference between all this and death by lightning. While the momentary passage of a very small quantity of high-tension electricity will kill in a moment, electricity of lower tension, such as that from a dynamo, is more tedious in its effects ; and it is, perhaps, not too much to say that there is not a dynamo in existence from which a "shock" might not be taken without risk of life, although to grasp the terminal wires instead of touching them both at the same time with metal rods held in the hands would mean certain death. We do not advise any one to try the experiment, for even the momentary passage of the current from a high-tension Brush dynamo, for example, will be found so extremely unpleasant that no one would care to repeat the operation. It seems to be clear that if the most moderate precautions are used, it is very improbable that a death can be caused by a dynamo. The mere instantaneous short-circuiting of the machine through the body will not suffice to kill, and it is very unlikely that any one should hold both wires at the same time, although this has been done. Thus, probably, the first death which took place in connection with electric lighting occurred on board the Livadia. The man killed was, it was stated, holding an arc lamp in one hand, and he laid hold of the positive wire, which was uncovered, with the other. He was dead in a couple of seconds. In the case which occurred at Hatfield it appears that a naked wire was led along a wall, and that a man standing on a garden bed of damp earth inadvertently laid hold of the wire. The current then passed through his body, and killed him, but not, we imagine, instantaneously.

The precautions to be used are very simple. Mr. R. E. Crompton has written some instructions in the form of hints to workmen. The first runs, "Rubber goloshes are useful on wet days." This means that non-conducting materials interposed between the body and the ground reduce the chances of a current being taken to earth through one. A man wearing woollen socks, stout dry shoes, and standing on dry ground, is an excellent non-conductor. It would be very difficult to pass a current through him to earth which would do him any harm. On the other hand, if his stockings and shoes were wet, and if he stood on moist ground, he would find that he afforded an admirable medium for taking a current to earth. Under such circumstances india-rubber goloshes would be invaluable. Stout tennis shoes with india-rubber soles will be found safe wear for workmen dealing with electric light fittings ; and so long as lengths of uninsulated wire have to be dealt with, as in making circuits, for example, or trying for short circuits about machines or lamps, rubber asbestos gloves should be worn. These will be found to insulate the hands from all but very high tension currents, and to confer almost entire immunity from the reception of greater or less shocks. In dealing with the risks of electric lighting it would be wrong to omit to say that for most purposes low tension machines may be used which are incapable of killing under any possible circumstances. There are two or three dynamos of this type in the market. The Burgin is one, the wires of which may be handled with comparative impunity. Some of the Brush machines are also wound for low tension. For example, the great dynamo which worked the 180,000-candle lamp, with carbons 2in. in diameter, at the Crystal Palace in the early part of the present year, was an exceedingly low tension machine, and the wire cables which led to the lamp were uninsulated. The electric light has been so hampered and damaged by the use which has been made of it for speculative purposes, that it can ill afford to have another stone thrown at it. It is to be regretted that erroneous ideas should be permitted to gain currency concerning its danger. An admirable example of the absurd notions afloat concerning this subject is supplied by a letter signed "A. I. C. E.," which appeared recently in the columns of a contemporary. It is worth reproducing in part. "It is no secret," writes its clever author, "that more than one theatrical manager has in contemplation, or has already decided, to employ the electric light in the coming Christmas pantomimes or extravaganzas as a personal ornament for their hobgoblins and fairies. This can only be done by means of some form of accumulator carried by, or attached to, the individual, and whether the star light is to form an ornament for the head, or to glisten at the end of a wand, the constant danger is patent. There is no need to be an electrician to understand this." We hasten to reassure "A. I. C. E." The accumulator cannot well be used for the purpose, or in the way he fancies. It would require an extremely muscular fairy to carry a storage battery which would give much light. It is stated that a 20-candle light has been maintained for some hours with a battery weighing only 3 lb., but a single light of this kind would not produce much effect. But in any case the current produced could not pass through the fairy. There is nothing whatever new in the idea of using the electric light as a personal adornment, nor is there the slightest danger incurred. The fairy carries a small galvanic battery concealed in her clothing. It need not be much larger than an octavo book. Coupled with a little Rhumkorf coil as big as a reel of cotton, a current can be got which will set Giessler vacuum tubes glowing. Not long since fire-fly scarf pins of this kind could be bought with battery complete in Paris. It would not be difficult to so manage matters that a pantomime fairy might take about the stage with her two well insulated slender wires which would convey electricity enough to brilliantly illumine a tiara or make a belt glow with fire, and all this without the slightest risk being incurred by the performer or anyone else. "A. I. C. E.," like many others, has yet to learn that there is such a thing as low tension electricity, and that for many purposes quantity can be made to take the place of tension.

DELUSIVE CONTINUOUS BRAKES.

A REPORT to the Railway Department of the Board of Trade, by Major Marindin, on a collision which occurred on the 22nd September, at Liverpool Central station, on the Cheshire Lines Railway, affords an example of the way in which an engine driver may be made a scapegoat in order that the deficiencies of a bad brake may be hidden. In this case, as the 2.55 p.m. Midland express from Manchester to Liverpool, consisting of an engine and tender, brake-van, bogie composite, Pullman car, bogie composite, bogie third-class carriage, and rear brake-van —six vehicles in all, equal to ten ordinary vehicles—was running into the Central station upon No. 2 platform line at about 3.40 p.m., it failed to stop at the proper place, and struck a brake-van which was standing at the end of the line, driving it against the buffer stops. Three passengers are stated to have been injured, and also one person who was on the platform, and a good deal of damage was done. The Central station at Liverpool is a terminal station. The approach to the station is through a tunnel 986 yards in length, the mouth of which is 311 yards from the buffer stops. Major Marindin says the train was well provided with brake power, but we shall see further on that this only refers to quantity. The engine, a four-wheel coupled engine with leading bogie, was fitted with a steam brake, working blocks upon the four coupled wheels and upon the six tender wheels, and the whole of the vehicles in the train were fitted with the Midland automatic vacuum brake. This brake is capable of being applied by the engine driver, by the movement of the same handle which actuates the steam brake ; the first movement applying the automatic brake, and a further movement the steam brake. Now it is one of the company's rules that drivers are to enter terminal stations at such a speed that they can stop their trains by means of the ordinary hand brakes alone, and though no actual rate of speed for entering this particular station is laid down, Major Marindin considers himself bound, in face of this rule, to conclude that "the driver is solely to blame for this collision, first for having disobeyed this rule, and secondly for not having made use of all the brake power at his command until he was dangerously near to the end of the platform, for he admits that he was running at fifteen miles an hour when only 311 yards from the buffer stops, and that he did not attempt to apply the steam brake on his engine and tender until he was within 150 yards of the buffer stops." As everyone knows, this speed would not be considered too great by the most careful man provided with a trustworthy brake, and Major Marindin adds :—"It would, however, appear from the evidence that the brakes upon this train did not act as they should have done when they were last applied, for, if they had, the train brake, which was undoubtedly applied when leaving the tunnel mouth, 311 yards from the buffer stops, or very soon after, ought certainly to have so reduced the speed that the driver might without difficulty have stopped his train at the proper place, by the application of the steam brake, when he had still 140 yards to run." This failure of the brake to act properly was probably, he thinks, due to the driver not having taken steps to maintain the necessary power. Reviewing the evidence, he says :—"It is probable that the brake was applied slightly only after passing the distant signal, and remained slightly on until the home signal was sighted, the power gradually diminishing on account of the leak hole in the piston heads ; that, when the driver released the brake near the home signal he did not make sufficient use of his large ejector, and consequently did not take the brake fully off, and did not create sufficient vacuum to render the brake effective when he resorted to it after leaving the tunnel. I think that the unsatisfactory manner in which the train brake behaved upon this occasion strongly supports the conclusion which was arrived at by Colonel Rich, when reporting upon the somewhat similar accident which occurred on the 25th April, 1882, at Portskewet on the Great Western Railway, viz., that the efficiency of this class of brake is materially interfered with by the leakage hole in the piston head." Here, then, is a case in which a driver is running into an important station at about a usual speed, and relying a little on a brake is deceived. He shuts off steam at a distance which would enable him to stop by means of the common brakes if it had been really necessary ; but as the driver in this case relied upon his brake to allow him to approach at a higher speed, a collision resulted, the whole blame of which is then laid upon the driver because of the existence of a rule which is always ignored, and which is only necessary to cover the shortcomings of bad brakes. It will be seen that owing to the use of the leak hole in the piston of this brake, the brakes commence to leak off as soon as put on, and as it takes some time to re-form the vacuum, the driver is under such circumstances as the above in the position of having no brake just at the time when he wants its instantaneous assistance. Every railway man knows these rules cannot be strictly followed; but to settle all quibbles on the question, and to remove the element of brake efficiency, Major Marindin proposes that the only safe regulation would be that trains entering this and other terminal stations are to be brought to a stand, or at any rate to a walking pace, at the home signals, letting the driver then apply steam if necessary, to draw the train up to the platform.

THE PREPARATION OF THE METAL CAESIUM.

IT will probably be in the remembrance of many of our readers that Bunsen and Kirchhoff, when working on the method of spectral analysis, which they completed in 1860, hit upon two metals which gave lines in the spectroscope that were quite new to them. They were called rubidium and caesium. The salts and the metal itself, in the first case, were soon prepared and studied ; the second metal has only just now been obtained in a free state. It has been accomplished by Dr. Carl Setterberg, whose paper has been communicated to the Academy of Sciences at Stockholm, and the work was done at Marquart's laboratory in Bonn, where, as a bye-product from the manufacture of lithia from lepidolite, the alums of these metals were to be obtained in hundreds of hundredweights. By allowing a hot concentrated solution of the alums of the two metals and of potash alum, for of these it consists, to stand, all the alum of the rare metals first separated out ; the process is repeated several times, and in this way 40 kilog. of rubidium alum and 10 kilog. of caesium alum were crystallised out. Boiling water dissolves much more of the rubidium alum than of the caesium alum—at 0 deg. 3·74 times as much. and at 80 deg. 4·08. To get the hydrates of the metals from the alum they are treated with barium hydrate, which throws down both the alumina and the sulphuric acid. This was then in the case of the caesium converted into cyanide by passing perfectly dry hydrocyanic acid into a solution of the hydrate of caesium in alcohol. It is absolutely necessary that the materials should be quite anhydrous. The reduction of the cyanide was conducted in a little clay cell, as described by Professor Bunsen in his paper on the isolation of other metals, like lithium, calcium, &c.; and a mixture of four parts of caesium cyanide with one of barium cyanide, and a current of the intensity 25, expressed in absolute measure, employed. The actual reduction of the metal from the cyanide was effected at Heidelberg in the laboratory of Professor Bunsen ; and here it was that the long-desired view of the curious metal was first obtained. The metal closely resembles the other alkaline metals in appearance ; it is silver white in colour, can be drawn out, and at ordinary temperatures is very soft. It may be stated here that Professor Bunsen told the writer of these lines some fifteen years ago that he expected caesium would be like mercury, a liquid metal ; for in this group of metals

the temperature of fusion falls as the atomic weight increases. Though not liquid, it melts at a low temperature, between 26 deg. and 27 deg. Cent.—at about 26·5 deg. Cent. In contact with water it swims on the surface, flame being evolved, as do potassium and rubidium ; when exposed to the air it soon takes fire. Two determinations of the density of the metal showed it to be 1·88 and 1·87. All experiments made with a view to reducing the chloride were attended with difficulty, and led to the employment of the cyanide instead. A curious point in connection with the history of caesium was the analysis by Pisani, of Paris, of a specimen of the mineral Pollux, from Elba, which he published in 1863. Plattner held it to be a silicate of alumina and potash, but his numbers fell short to 92·75 per cent., and finding the result inexplicable he published it. It was afterwards found that the supposed loss was due to the oxide present being, not potash but caesia, of which it contained 34·07 per cent., and thus brought the analysis up to the 100, and made it come right. This shows the importance of setting down the results of an analysis conscientiously without making up the "loss."

REMARKABLE OUTPUT OF SHIPPING ON THE CLYDE.

A NOTEWORTHY and remarkable contribution to the output of shipping tonnage on the Clyde was made last Saturday alone, when no less than 11,500 tons were put into the water. A large screw steamship of 4800 tons gross measurement, named the Paramatta, was successfully launched from the yard of Messrs. Caird and Co., Greenock, for the Peninsular and Oriental Steam Navigation Company. The London and Glasgow Shipbuilding Company, Govan, turned out a steamer of 2800 tons for the Hall Line, of Liverpool. Messrs. Charles Connell and Co., Scotstown, put into the water a four-masted iron sailing vessel of 1800 tons, and Messrs. Russell and Co., of Port Glasgow, also launched a sailing vessel of 1700 tons, both vessels being for local owners ; Messrs. T. B. Leath and Co., of Rutherglen, on the same day put into the water a small screw steamer of 320 tons register. The total number of vessels launched up to date is 233, giving an aggregate tonnage of 312,425. There is every prospect that the present year's output will exceed that of last year—unprecedented as that was—by several thousand tons. Berths as they are vacated are immediately occupied by keels of new vessels, the number of orders on hand being commensurate with the vacancies thus created.

LITERATURE.

Railways and Locomotives. Lectures delivered at the School of Military Engineering at Chatham in 1877 by J. Wolfe Barry, M.I.C.E., and Frederick J. Bramwell, F.R.S., M.I.C.E. London : Longmans, Green, and Co. 1882.

IF the proposal to establish a "Railway Corps" is carried out, as no doubt it will, for every modern war has shown the important part railways may play in warfare, a sound directly applicable theoretic knowledge of railway engineering, though not necessarily very extensive, must be given to the men of such a corps by thoroughly practical teachers ; men who know what are the questions upon which instruction is most needed to enable those who have been some time in the works and on a railway to act intelligently under any circumstance of practical railway warfare, and not to go at railway work or attempt to overcome railway difficulties by the simple application of superabundant force, accompanied, as it often has been in these matters, by reckless stupidity. In the book before us there is much that will help such an instructor.

Although the lectures given at Chatham are usually printed for circulation among members of the corps of Royal Engineers, and not for publication, it was considered that the lectures composing this book might furnish a useful book for the general public. Nine were given in all, six of these being by Mr. Barry on the construction of permanent way, signalling and switch and crossing working arrangements under different systems, rolling stock and its use and maintenance. Those who know Mr. Barry's text-book on "Railway Appliances" in Longman's series would at once recognise it in these lectures, even if the fact that it formed the greater part of the three first lectures had not been mentioned in the preface, and they will see that the same book really provides text notes for other lectures. This does not detract from their value, but rather adds to it, as giving them a systematic treatment which perhaps would have not been so well arrived at without reference to so good a text-book. In lecturing, however, our author feels at liberty to enter into questions which are matters of practical or every-day working experience, and in this way will convey to his audience, more of this class of information than he would in writing. These lectures have their value in this fact, and may be said to form a supplement to the book referred to.

The three lectures on the locomotive commence with a brief statement of the history of the locomotive, commencing with Cugnot's, tried in 1769 and 1771, and ending with Stephenson's engines, an interesting reference being made to the evidence given by a Mr. Chapman before a committee on boiler explosions in 1817, showing that the existence of locomotives as used at the time in Durham and Northumberland was not at all generally known, and also showing that limited ideas prevailed on steam boilers, of which it was said that they "may last twelve months safely, provided the bottom be made of charcoal iron beat, not rolled." The lecturer then plunged into a discussion of those points which are essential to a comprehension of the work and working of a locomotive, beginning with an estimate of the hauling power of a passenger and of a goods locomotive. The distribution of the weight of the engine and the weights on each wheel, the load on the pistons under different circumstances, and use of steam economically, are illustrated by examples which exhibit Sir Fred. Bramwell's usual clearness of explanation. The consumption of fuel, and the necessary heating and grate surfaces, and the cause and manner in which these differ from the same areas in fixed or marine boilers are explained, and credit given to Nicholson for the insertion of the steam jet to excite draught. After some remarks on the strength of boilers and modes of staying fire-boxes, a very simple and ingenious explanation is given of the action of the Giffard injector. The lecturer dwelt upon the arrangement of locomotives, and especially upon the relative claims of inside and outside cylinders, his preference being for the latter, his readers being referred for some of his reasons for this preference to his paper, "Proceedings," Institution of Civil Engineers, vol. xxii.; the chief reasons, however, being that great crowding and the use of cranked shafts are necessary with inside cylinders. A simple method of testing a supposed flaw in a crank or other shaft is described, the method being to have the shaft wiped clean along the suspected place, and then to set up rapid vibration in the shaft by beating the end with a sufficiently heavy hammer. If there really is a crack it will be seen as a fine black line of exuded oily matter, which can be printed off on a piece of paper. In dealing with the different forms of wheels, the lecturer stated, amongst the objections to tires fastened to the wheel ring or body with screws, that the hole in the tire weakened it. This is no doubt true when the hole is not completely through the tire ; but it can be shown that when the hole is quite through, as when conical or long cylindrical headed bolts are used, that tires break rather through the solid than through the bolt hole, as shown in "Proceedings," Institution of Civil Engineers, vol. xlvii., p. 43. A good deal of attention was paid to the slide valve and its movements, as controlled by the different positions of the excentric on the crank shaft, and by the reversing gear, and nearly one-third of the space occupied by the three lectures is taken up with this subject, together with a consideration of indicator diagrams, the early and modern systems of link motion and reversing gear. Modern locomotives were illustrated by sectional elevations of Mr. Kirtley's modern London, Chatham, and Dover engines, and by engines of the South-Western Railway. The lecturer's style is very clear and concise, and these lectures afford much information not so conveniently given elsewhere.

London Water Supply : an Analysis of the Accounts of the Metropolitan Water Companies. Compiled and arranged by ALFRED LASS, F.C.A. London : W. King. 1882.

THIS analysis is one which comprises, in a condensed form, a great deal of the most necessary information for all who are in any way intimately interested in London water-supply questions. The analysis relates to the whole of the London supply companies, and shows their capital, income, expenditure, profits, and dividends, per 1000 gals. of water supplied, for the year ended 31st December, 1880, and 31st March, 1881. It also gives the quantity of water supplied, the estimated daily quantity supplied for domestic and other purposes, the quantity supplied per head of population, the maximum and minimum daily supply during the different months, the number of houses, and the figures relating to the present constant supply. It further gives tables showing the rates of supply, the amount required per 1000 gallons of water supplied to pay 10 per cent. dividend upon that portion of the dividend bearing capital which is not expressly limited to a lower rate, and the maximum dividend upon that portion of the dividend-bearing capital which is limited. A statement showing the basis on which the water rates are assessed by each company, and statutory powers as to dividends. The information contained in the thirty-two pages of this analysis represents an enormous amount of work, which will only be fully appreciated by those who have had to deal with the engineering and financial considerations involved in a discussion of metropolitan water supply questions. It is the author's intention to publish similar statistics yearly.

Statistics of the Water Supply of the Principal Cities and Towns of Great Britain and Ireland. Compiled from official returns. By G. W. USILL, Assoc. M.I.C.E. London : 110, Cannon-street. 1881.

THIS compilation is another very useful addition to the available amplified statistical information for the use of engineers and others engaged on water supply. It gives the following particulars relating to 237 towns, besides those of five waterworks supplying groups of towns, such as the Staffordshire Potteries Waterworks, supplying a group of towns containing a population of 180,000 ; name of town, county, whether supplied by gravitation or pumping, present population, by whom the works were constructed, date of their construction, cost of works, name of engineer, name of surveyor, distance of source from town, whether constant or intermittent supply, number of people supplied, number of houses supplied, present death-rate per thousand, death-rate per thousand previous to execution of waterworks, whether charged by measure or on rental, whether covered service reservoir, if any, capacity of impounding or service reservoirs, if any, in gallons, area of impounding reservoirs, maximum period of storage in days, and remarks, the last relating to alterations and extension of works, and explanations relating to sources and modes of supply when these are double or by two methods. These statistics thus contain much information, the compilation of which must have placed Mr. Usill in possession of, and made him familiar with, a mass of important facts.

The Metal Turner's Handbook : A Practical Manual for Workers at the Foot Lathe. By PAUL N. HASLUCK. London : Crosby Lockwood and Co. 1882.

THIS volume is not expensive, and may have its use as a description of foot lathes and their parts, and separate tools, as made by different tool makers, whose names and prices are given. It will be useful to amateurs, but it is in no sense a guide to the use of the foot lathe, or rather to the art of turning and shaping which may be accomplished with the nice lathes, rests, shaping, and cutter attachments which are described and illustrated.

THE KARSTELLENBACH VIADUCT, ST. GOTHARD RAILWAY.

WE publish this week, as a supplement, the first of a series of views illustrating points of special interest on the St. Gothard Railway, as described in the interesting letters from our correspondent, which we have inserted under the title "Through the Alps by Locomotive." These views are copied by a special ink photographic process from some admirable photographs, lately executed by Messrs. Braun, of Domach, by special order of the directors. The present example represents the Karstellenbach Viaduct as completed. This viaduct is noted by our correspondent as marking the commencement of the real "tug of war," in ascending from Fluelen. It crosses the narrow gorge by which the torrent from a well-known Alpine valley, the Maderaner Thal, descends to the Reuss. There are two spans, each of 50 m.—164ft.—as well as two stone arches of 7 m. span at one end, and one of 6 m. at the other. The height above the stream is 54 m.—178ft. As will be seen, there are two main girders of the Warren type, well braced by cross girders at bottom and top. On the latter are laid the sleepers and rails, and the floor is not boarded, so that the eye looks right down into the gulf below. There is a slight hand-rail for foot passengers. The effect is heightened by the fact that you emerge upon the viaduct directly from a tunnel about 180 yards long, and look down the narrow gorge to the still deeper cleft—called Hölle—in which the Reuss is here engulphed. The viaduct is throughout on a gradient of 1 in 40.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty :—George N. H. Mitchell, chief engineer, to the Arab, vice Bray ; Richard S. Kiernan, engineer, to the Achilles, vice Long ; William J. C. Brown, engineer, to the Asia, additional, vice Kiernan ; and John A. Lemon, chief engineer, to the Fly.

RAILWAYS IN WAR.—The improvised Railway Corps sent to Egypt, even with the crippled engines and wrecked permanent way, with which at the beginning of the campaign it had to work the traffic, having proved how essential such an organisation is to a modern army, Mr. Childers proposes to establish it on a permanent basis, and, in co-operation with the existing railway administration of the country, to afford it constant practice in railway traffic and maintenance. The ironclad train employed by the British in the operations around Alexandria, following the bombardment, proved a puzzling antagonist to Arabi's gunners, as it dashed in and out of the British lines with reconnaissance parties ; and during the concentration of the English force at Ismailia, and the subsequent advance to Cairo, the single track road, which follows the bank of the fresh water canal from Ismailia to the capital, proved of the greatest service to the invading force. Provision for the railway transport service had been made in good time by the authorities in England. As early as July 6th negotiations had been completed under the directions of Sir Andrew Clark, the inspector-general of fortifications, for the purchase of four engines and five miles of "permanent way" material ; and a company of the Royal Engineers were daily instructed and practised in railroad working on the London, Chatham, and Dover Railway under experienced officers. The British Secretary of State for War, the Right Hon. Hugh Childers, M.P., is an old railroad man, so this careful preparation was only to be expected. Mr. Childers was for several years president of the Great Western Railway of Canada—including the Detroit, Grand Haven, and Milwaukee Road—and has been connected with several important railways in England. It may be here remarked that the application of armour-clad gun trains was advocated eleven years ago by Mr. John Evelyn Liardet, who took out a patent in 1871 for a method of mounting guns on railway trucks.

LIVERPOOL ENGINEERING SOCIETY.—At a meeting of the above Society, held at the Royal Institution, Colquitt-street, on Wednesday evening, 8th inst., Mr. F. B. Salmon, president in the chair, a paper, by Mr. C. E. Hannaford, Stud. M. Inst. C.E., on "The Testing of Materials for Use in Engineering Structures," was read. In the paper the author, for want of space, dealt only with two classes of materials, viz., limes and cements and metals. He selected these on account of there being many differences of opinion with respect to some of the methods of testing, and therefore will, he hopes, leave more matter for a discussion thereon. After relating briefly the usual tests applied to hydraulic limes, with a view of ascertaining their quality, he passed on to Portland cement. In dealing with this material reference was first made to the different methods of manufacture, after which he described at some length the various tests to which it should be subjected, including compressive and tensile strength, fineness of grit, weight, colour, &c., and then pointed out that by actually breaking sample by either tension or compression is given the most reliable information of its quality. He then described, and showed by the aid of diagrams, the various forms of bricquette which have been used at various times, giving the preference to the last form introduced by the Metropolitan Board of Works, as being the one, he believed, calculated to give the most accurate results. He then entered at some length into the various methods of making the bricquette, the amount and nature of the water found most beneficial under different conditions, and other details, and concluded this section with some remarks on the utmost necessity, in comparing the relative strengths and other properties of two or more samples, that all the details of gauging and manufacture should be as nearly as possible identical. In dealing with the section on metals, the author described the various but usually applied tests to cast and wrought iron and steel, pointing out several tests which, although occasionally resorted to, are, in his opinion, to be condemned. In referring to the forge test of these last two metals, he quoted the latest tests required by the Admiralty for these metals, and concluded this section with a review of the connection which exists between the chemical and mechanical qualities of iron and steel.

WHITBY AND SALTBURN RAILWAY.—Practically the line of railway which unites the ancient little borough of Whitby to the new and increasing watering place of Saltburn is completed. It was surveyed a few months ago, and some of the bridges were deemed to require additional works, and the completion of those will probably pave the way for the early opening of the line. It has been long in course of construction. Commenced by the independent company whose name it bears, it fell through in the commercial dulness that fell upon the North of England, and was ultimately acquired by the North-Eastern Railway Co., which some time ago opened it from Saltburn to Loftus, and has now completed it to its junction at Whitby with its own North Yorkshire branch. The new line passes partly through an agricultural district and partly through a district where ironstone is known to abound, whilst it is likely to develope an important fishing traffic, and to serve to a considerable extent in opening out the coast of north-east Yorkshire to tourists. There are no very large towns on the line, Saltburn, the northern terminus, and Whitby, the southern one, being the chief ; but the growing town of Loftus, the iron mining villages of Brotton and Skinningrove, and the sea-fishing villages of Staithes and Hinderwell, are served, whilst the line forms a link in an important coast line that needs only small sections now to complete it from Newcastle by West Hartlepool and Middlesbrough to Scarbrough, and thence on to Hull. It is too soon to estimate the extent of the traffic, but it does not at the present promise to be very great, though the possible exhaustion of the ironstone in the west of the part where it is now worked may force at some early date a much greater working of the mines in the district served by the railway, and may cause a rapid development of traffic and travel along its route. The time of opening the new line is not yet fixed ; indeed, it has been rumoured that there are some little difficulties in the way which will prevent that for some time ; but the fact that the North-Eastern Railway Co. has expended £225,000 out of the £300,000 it estimated that the completion of the works would cost, may be taken as a proof that early the line will be made productive to some extent. At the same time the chairman of the company has not concealed his belief that the line will not be very remunerative to its owners or workers ; but being completed, it must, it is evident, be early set to work, and in that working it may be expected that a large traffic will be developed.

THE HARBOURS AND TRADE OF FOLKESTONE.

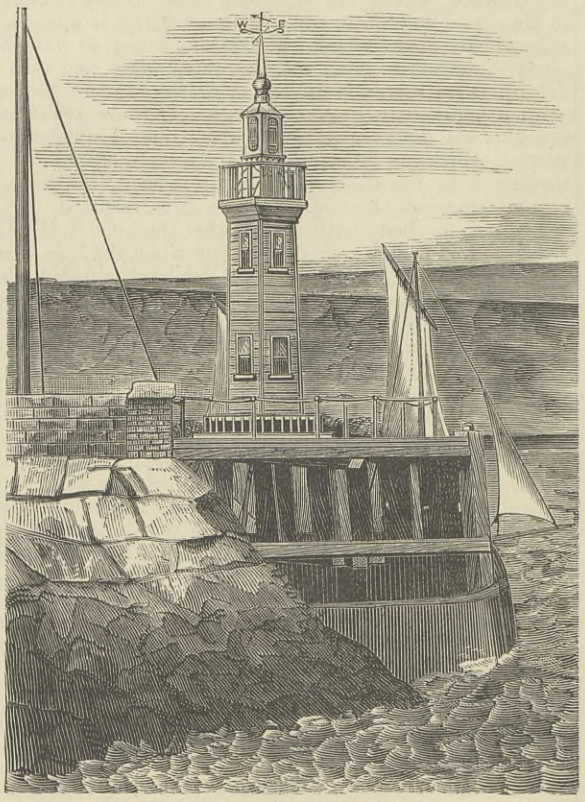
PART I.

GENERAL information as to the early history of the port of Folkestone is not to be found in ancient works specially devoted to the subject, for no such books exist; the particulars have to be gleaned in the various histories of Kent, which are few in number. "Domesday Book," compiled in 1086, contains a fairly long notice of the town. The oldest printed history of Kent was written by a London lawyer, William Lambard, and published by "Ralphe Newberrie, dwelling in Fleetestreete, a little aboue the Conduite, *Anno.* 1576." It is a black letter volume, and contains a little about Folkestone. Another historian, "Richard Kilburne of Hawkherst, Esquire," gives two pages to Folkestone in his "Topographie of the County of Kent," published in Holborn in 1650. In 1659, the "*Villare Cantianum*, or Kent Surveyed and Illustrated," by Thomas Philipot, of Clare Hall, Cambridge, was published; it is an elaborate work, containing much about Folkestone families, also a map of Kent, including Folkestone. "The History of Kent," by John Harris, D.D., F.R.S., published in 1719, is an elaborate work, richly illustrated, and meagrely indexed. It contains two maps in which Folkestone appears. One of them—p. 344—shows the position of the beacons in Kent in the time of Queen Elizabeth. The lighting of these beacon fires gave warning of the approach of hostile fleets; the flaming warning could be sent from Folkestone, Hythe, and Romney Marsh, through the centre of Kent, to the London beacon, which stood on the top of Hampstead Heath. The chief historian of Kent is Edward Hasted, F.R.S., of Canterbury, who, in his ponderous four volumes, has saved much valuable information from oblivion. His work is dated 1790, and contains a great deal of the early history of Folkestone. It contains a picture of Folkestone as it existed in his day, also a map of the district. A "History of the County of Kent," by W. H. Ireland, was published in four volumes in 1829; it gives valuable information about Folkestone, and a picture of the town as it appeared at that time. A "Handbook of Folkestone for Visitors," published a few years ago, and still on sale in the town, was written by Mr. S. J. Mackie, F.G.S., and displays both literary and scientific ability. There are also other local guide books. The best of those now out of print is an elaborate one by Mr. H. Stock, with good steel and wood engravings, published in 1848. Some interesting old maps of Folkestone, the property of the Earl of Radnor, are in the keeping of Mr. W. G. S. Harrison, the Town Clerk; and items of information about the vicissitudes of Folkestone Harbour are to be found in various Acts of Parliament devoted to the subject. Lastly, but ten or eleven weeks ago the *Folkestone Express* began to publish weekly a series of gleanings of more than local interest from ancient municipal documents in the possession of the Corporation of Folkestone. Strange to say, no steps have been taken to preserve the gleanings in book form, and already some of the numbers of the journal containing them are out of print, and unobtainable in Folkestone itself. The oldest charter in the possession of the Corporation is dated January 28th, 1313, in the fifth year of the reign of Edward II. The oldest general records of the Corporation at present in existence date from 1464. Particular, as distinguished from general information about early Folkestone, is to be found in the church register, dating from 1635, and the register of the Society of Friends at Folkestone, dating from 1656.

It would be foreign to the purposes of this journal to give a lengthy outline of the early vicissitudes of the port by way of preface to the particulars to follow, so reference to the past must be brief.

Folkestone was called Fulcestone by the Saxons, and in early Norman times was known as Fulcheston. The following is a translation of the first part of the entry in Domesday Book relating to Folkestone:—"In Linwart Lest, in Fulcheston Hundred, William de Arcis holds Fulcheston. In the time of K. Edward the Confessor it was taxed at 40 sowlings, and now at 39. The arable land is 100 and 20 carucates. In demesne there are 200 and 9 villeins, and four times 20 and 3 borderers. Among all they have 45 carucates. There are five churches from which the Archbishop has 55 shillings. There are three servants and seven mills of 9 pounds and 12 shillings. There are 100 acres of meadow. Wood for the pannage of 40 hogs. Earl Godwin held this manor." The date of the foregoing entry is 1086, when Folkestone belonged to Odo, the great Bishop of Bayeux, half brother of William the Conqueror.

The foregoing paragraph carries us back through a long vista of centuries to early English history, and includes a few words more or less Saxon—a language which in the beginning of the sixteenth century was not only dead in this country, but had been buried and utterly forgotten for four hundred years. Its study was subsequently revived for theological and legal purposes, but the original life and beauty have never been put into the ashes, although somewhat of the meaning of the Saxon writers can be interpreted in these modern times. The word "Lest," just quoted, is used in Domesday-Book in connection with Kent alone; the word is stated in the laws of Edward the Confessor to mean "a riding," of which there were seven in Kent, one of them "Linwart." "Caracute" means 100 acres of land; a "sowling" is as much land as can be tilled in a year and a day with one plough. "Pannage" means the mast of the beech and the acorns of the oak which the swine fed upon in the days of early English agriculture. "Villeins," subsequently "villains," were bondsmen who could not leave their lords, and



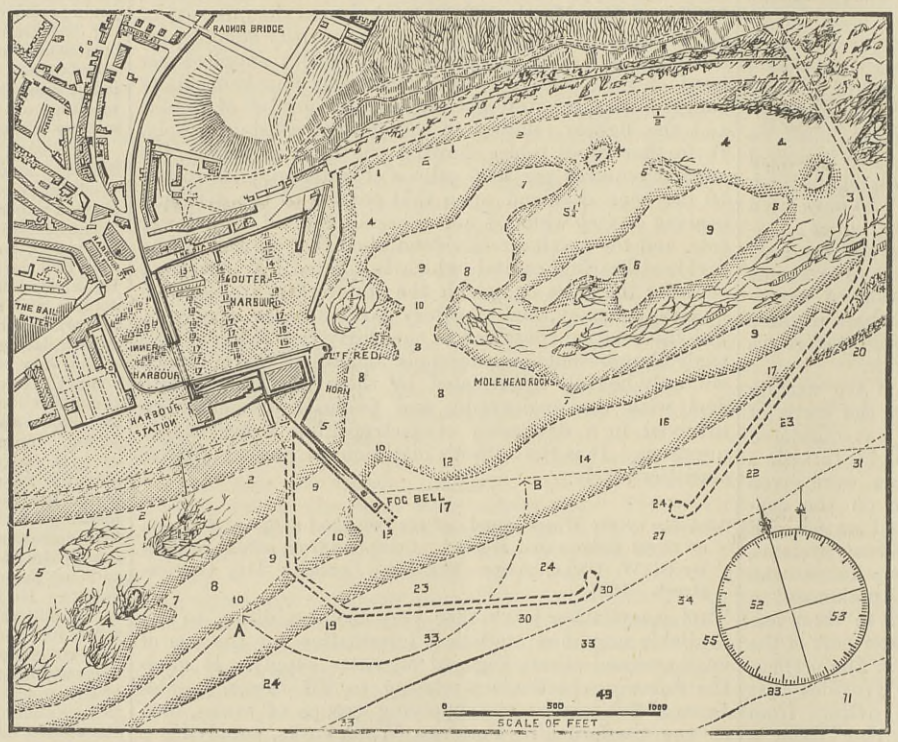
FOLKESTONE HARBOUR LIGHTHOUSE.

who, if stolen, could be claimed at law like lost cattle; they could be granted land by their lord for a term of years, and were the predecessors of the modern copyholders. "Borderers" were in a less servile condition; they were boors owning houses larger than cottages and with some land attached. A "demesne" consisted of lands "manually occupied in the lord's chief manor place."

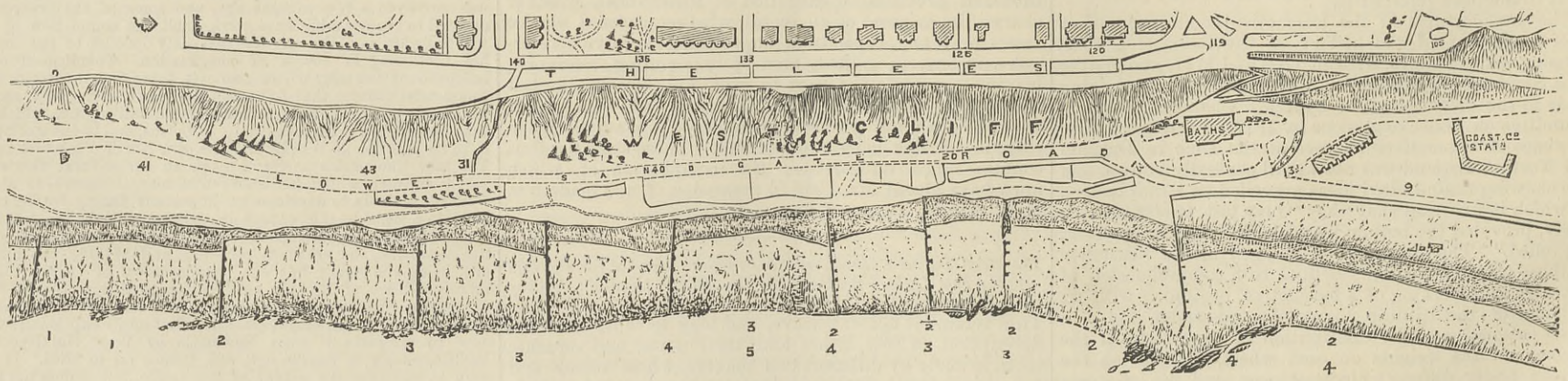
Many Roman coins have been found in the vicinity of Folkestone, and Roman encampments may be found on the adjacent hills, but no historical records relating to the occupation of the site by the Romans are extant. Eadbald, sixth king of Kent, built a castle here near the sea; his daughter Eanswithe became abbess of a nunnery he founded at Folkestone soon afterwards, and the parish church of the present day is dedicated to St. Mary and St. Eanswithe. Convent and castle were destroyed in 1052 by Earl Godwin and the Danes, and Nigel de Mundeville, Lord of Folkestone, in 1095 built a monastery on the site of the nunnery, and made it a cell to the abbey of Lonley, in Normandy. The cliff afterwards slipped down to the sea, jeopardising the building, so that the monks had to shift their quarters. At the dissolution of monasteries, the revenue of that at Folkestone was estimated at £63 0s. 7d. Folkestone, before the time of Henry I, was made a member of the town of Dover, but was reincorporated with a mayor and jurats by Edward III. Most of the town is said to have been burnt by the Scots and French united in 1378, but this is improbable. It remained an unimportant place until the last century, when its fishery, its trade with France, and its salubrity as a watering place, caused it to begin to rise.

For about 700 years after the mention of Folkestone in Domesday-book, it remained an insignificant place, and a natural difficulty in the way of providing it with a harbour consisted in the fact that the sea tended to thwart each attempt by choking the water area with shingle. There is a slow motion of the beach from west to east, and this piling up of beach at Folkestone slowly removes the sea farther from the town. The present railway station, now high and dry, is built upon piles, and waves boiling below it could in former times be seen through the crevices of the platform. The site of the present Pavilion Hotel was once all sea. Yet, when it is remembered that four of the five ancient churches of Folkestone were destroyed by the falling in of the cliff on which they were built, it might at first sight seem that in those days the sea was gaining on the land. Although the sea beach has been encroaching on the sea under the observation of persons now living, the ground further inland than the beach has still been falling at places, the latter phenomenon being in reality due to land springs at the base of the cliffs. The Earl of Radnor, to whom the property belongs, did not wish to see the road below the cliffs, or the chief marine parade of Folkestone at the top of the cliffs, known as "the Lees," gradually fall into the sea, so employed engineers to devise and apply a remedy. The cliffs are composed of the Folkestone beds of lower greensand, and are full of land springs; underneath them, at about the level of the beach, are beds of dark clayey sand, containing a larger proportion of clay than the greensand beds above. The lower beds uphold the water till their surfaces become a kind of bog, on which the superincumbent cliffs slide and topple over by their own weight. By the advice of Mr. Francis Brady, the present engineer of the South-Eastern Railway Company, Lord Radnor's engineer ran a heading at a low level from near the Folkstone bathing establishment to near the tollgate on the lower road to Sandgate; by this adit all the springs were tapped and the water drawn off, whereby the mischief seems to have been stopped. This was about 1856. Mr. Brady accelerated the accumulation of beach opposite the same cliffs, by running out groynes designed by him on what he calls the "knife-edge" principle, the wooden portion being made to present a thin edge to the sea. Double railway metals were rivetted together at the flanges, then driven into the beach like ordinary piles, and buttressed with other rails; a single thickness of planking was then fixed between the metals. The plan has since been adopted in various other places. The great thing is to keep the planking but a little above the surface of the shingle, so as to give the waves the smallest possible surface to beat against. Other groynes had been previously tried, but were found to be more expensive to make and maintain, and more liable to damage because of the large surface they present to the water. The beach at this part of the coast consists of small rounded pebbles, and the sea obtains its supply of them from beyond Dungeness Point to the westward. It then proceeds to fill up the bay with the shingle, and has so far succeeded that Folkestone's neighbouring town of Hythe is built on the solid foundation thus thrown up by the ocean.

Some of the remains of an ancient harbour, perhaps the harbour alluded to by early historians as existing in the fifth or sixth century, were found at Folkestone in 1852, when removing a blacksmith's forge on the quay. Henry VIII. visited the town while the harbour was undergoing repairs, and in the Corporation records for 1635, in the days of Charles I., it is ordered that on the blowing of the horn, "every householder," or his deputy, "provided with shovelles, or other fittinge and meete tooles," should set to work to clear the shingle out of the harbour, so long as the mayor might deem necessary, and in default should pay a fine of sixpence — a large sum in those days. In those primitive times the town crier summoned the townspeople to their public duties—which were often performed in the open air under the shadow of the cross then in the churchyard—by a horn instead of by a bell. The veritable horn once used is now suspended behind the mayor's chair in the council chamber of the town hall. A picture of it is given in Stock's guide to Folkestone. In part of the seventeenth and eighteenth centuries there were jetties on either side of the town; these jetties facilitated the landing of goods, and they also served the purpose of



THE OLD AND NEW HARBOURS OF FOLKESTONE.
(The works now in progress are denoted by double rows of dotted lines.)



THE SEA BEACH, GROYNES, AND GAULT-SUPPORTED CLIFFS.

that time he says :—"The fishery, since the stop put by the Legislature to the contraband trade with France, has within these few years greatly increased ; and there are now eight or ten lugger boats and cutters, employed chiefly in the herring and mackerel fisheries, besides about thirty small boats employed in the same, and in the catching of plaice, soles, whitings, skate, and such kind of fish, in their proper seasons ; which altogether do not employ more than between 200 and 300 men and boys, who are under no regulation as a company. The fish are conveyed to the London markets either by boats or by expeditious land carriage."

The foundation-stone of the present harbour was laid May 3rd, 1808 ; it contained 99 cubic feet, and was computed to weigh 7 tons 15 cwt. It bears the following inscription :—" F. H., Apr. XXX., MDCCCVIII., this stone was laid by Thomas Baker, Esq., Mayor." The story is now current in Folkestone that Mr. Baker complained that he could not lay the foundation-stone on the top instead of the bottom of the works, for he did not wish his name to be almost constantly hidden under water. The Pent stream enters the north of the harbour through a sluice gate, and helps to clear it out. The western pier of the harbour was first carried out about 140 yards, then extended parallel with the shore for 217 yards. The eastern pier is 236 yards long, leaving an entrance 123ft. wide. The first steam packet crossed to France from Folkestone on the 28th of June, 1843.

The Act for the construction of the present harbour was passed in 1807 ; the foundation stone was laid as already stated. The designs were by Telford. After £22,000 and £30,000 had been successively raised in £50 shares, the total amount proved insufficient, and a subsequent loan from the Government of £10,000 on mortgage also proved inadequate ; the work was then abandoned in despair, and the tidal currents afterwards gradually choked up the harbour with mud and silt. Ireland, writing in 1829, says that the new pier had been carried out 1500ft., and the piling up of shingle against it was accompanied by a deepening of the water to the east. He also says : "Since the formation of the pier the sea has made great encroachment upon the town at its eastern point, and a stone quay has been in consequence erected. The harbour is defended by a small fort on the south eastern point of the eminence whereon the church stands, near the site of the ancient monastery, and by the neighbouring martello towers on the cliff to the eastward. The fort above mentioned mounts only four guns, but is provided with furnaces, &c., for supplying them with red hot balls." He further states that the population of Folkestone in 1821 was 3989, and the number of houses 794.

In 1842, Mr. Baxendale, then chairman of the South-Eastern Railway Company, bought the harbour for £18,000, and the other directors willingly released him from the responsibility of the act by taking it off his hands. They cleared out the harbour, erected landing platforms, put on a line of steamboats to Boulogne, and soon raised Folkestone to a state of prosperity it had never previously experienced. A plan of the harbour as it was when the South-Eastern Railway Company first took possession of it, appeared in these columns on the 25th of August last.

On reference to that plan it will be seen that the sea then washed the southern wall of the harbour; it was only by the gradual deposition of beach against the wall by the sea that so much ground was formed to the south of the construction. The harbour as it was then and as it stands at present enclosed an area of fourteen acres. This area is at present divided into an inner and outer port by the double line of railway which crosses the water over a viaduct of timber piles and a swing bridge. The harbour walls are built of dry random rubble, consisting of large blocks of Kentish rag placed on edge, with a slight batter to the land. The Stade quay, built some twenty-five years ago north of the harbour by the railway company, from the designs of Mr. Francis Brady, is constructed of solid concrete. Old rails were first driven, like piles, into the ground and 4ft. 6in. apart, with a slight batter, to form the quay front. The space between the rails was then filled in with planking. This facing was then backed with solid concrete about 5ft. in thickness, but varying at different places. The planking stood well for many years, and much of it may be seen at this day, but its presence or absence is now immaterial. The plan of the Stade quay wall is represented in Fig. 1.

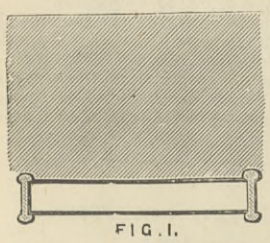


FIG. 1.

Telford gave the outer extremity of the harbour a horn shape to oppose the formation of a shingle bar at the entrance. This, however, proved but a partial protection, so that slowly and surely a bar in those days was constantly forming across the mouth, and the accumulated shingle had to be removed from time to time by excavation. The shingle thus raised was used on the spot to ballast ships. The South-Eastern Company afterwards commenced the lengthening of the sea wall to the south of the mouth of the harbour, known and marked in the accompanying map as the "Horn." This wall was extended very gradually for some years, the end of it being always kept a little in advance of the shingle slowly piled against it by the sea. Thus a double purpose was achieved ; the mouth of the harbour was kept open, and land available for building purposes was made by the automatic action of the sea. If the wall had been carried out suddenly, the purpose of the designer would have been self-defeated by creating a heavy "set" of sea, which would have washed out the shingle. The outer wall of the future harbour is now being slowly constructed on the same principle. The portion finished is denoted by shading on the map.

The harbour can berth about twenty brigs, in addition to giving accommodation to the company's steamers. The inner harbour is chiefly used by colliers supplying coal to the town ; its depth of water at the western wall is 5ft. less than at the main entrance to the port. The outer harbour is chiefly used by the company's steamers and by fishing luggers. The last steamer of the company, the Mary Beatrice, 265ft. long, is the largest the harbour will accommodate, so nothing can be done in the way of lengthening the Folkestone-Boulogne steamers until the new harbour is in an advanced state. Folkestone is not used as a harbour of refuge. Ships of 12ft. draught can be safely accommodated within it. The mouth of the harbour is dry at low water; spring tides rise 22ft., and are sometimes driven up a foot higher by heavy gales ; neap tides are sometimes as low as 10ft. at high water. The gridiron in the harbour is 220ft. long, and a vessel which draws 9ft. of water when lightened can be placed on it at spring tides. A coal wharf constructed to the south of the gridiron is capable of carrying nearly 1000 tons of coal. A patent slip, now disused, is at the north-eastern end of the harbour; it is 450ft. long, 19ft. gauge, with an incline of 1 in 24. Near the upper end of the patent slip is an engineering shed, in which minor repairs of the ships and machinery are executed; six blacksmiths are constantly employed therein. Some of the company's carpenters have sheds close by. Two repairing jetties run out from the north wall of the harbour. At present about 300 men, including ships' crews and all officers and managers, are employed at the harbour and railway terminus at Folkestone, by the South-Eastern Railway Company. Of course the Custom House staff being under the Government is not included in the above number. Six crews are employed by the company. The crews for the large passenger steamers, including officers and all hands, number about twenty-four each boat.

The South-Eastern Railway Company obtained power by Act of Parliament on 27th June, 1843, to acquire Folkestone Harbour. The contract for making the swing railway bridge in the harbour was entered into in May, 1847, and the Folkestone harbour branch of the South-Eastern Railway was opened on 1st of January, 1849.

In 1861-2 the company erected the low-water landing pier to the south of the railway terminus. The pier was, before the commencement this year of the works now in progress, 680ft. long; it varied in breadth from 22ft. to 35ft. This pier has had its day, and is undergoing changes hereinafter to be described ; its plan of construction has thus been recorded by Mr. Mackie :—"The pier is beautifully designed, combining lightness and strength in a great degree. It is formed from the old rails taken up when the South-Eastern line undergoes repair. Lengths of these rails were first of all firmly fastened together, end to end, by the 'fish joint,' and were then driven, as piles, to a sufficient depth. Six rows of these being driven, across the top of each transverse row of piles were fixed baulks longitudinally to support the rails. T-shaped iron stay-rods were used to connect the whole together, and the lower part filled up to a little above half-tide with rock, the greater portion of which was brought for the purpose from the company's own quarries near Maidstone, it being unnecessary to finish the work right up, as the steam vessels go into the harbour when there is 7ft. of water. There is a depth of 12ft. of water at low tide along the whole side of the pier. Wooden piles were then driven all round it ; suitable landing places were erected at different parts of the pier, and the whole of the upper part laid with planking 3½in. wide, the edges of each plank being cut bevelled, and one overlapping the other, to prevent the spray washing up to the annoyance of the foot passengers using it. This low-water pier affords important facilities in despatching pilots to shipping ; vessels daily passing the port with signals flying for assistance need not now run into the dangerous vicinity of the Goodwin Sands, as they can obtain the aid from Folkestone which they require." Mr. Mackie says that in like manner the pier is a boon to fishermen, and clinches his summary by saying, "This simple low-water pier brings the port of Folkestone into complete equality with the expensive Admiralty works at Dover." This pier was designed by Mr. Peter Ashcroft and Mr. Francis Brady. The exertions of the company in relation to the new harbour are at present chiefly concentrated on the lengthening and broadening of this pier. The work has been commenced at the outer end of the pier, and has so advanced that the last pile at the outermost end of the new work was driven two months ago. The submarine masonry is in an advanced state, but progress is necessarily slow, diving operations being so dependent upon the state of the weather. What is being done is the lengthening and broadening of the old pier F, at A, B, Fig. 2. When this is finished, the work will be continued backwards over the length A, E, until the old pier is finally built into the new one.

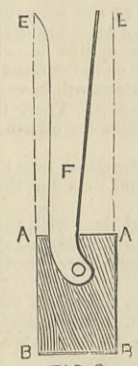


FIG. 2.

The accompanying map, which is adapted from the latest Admiralty chart, but with a plan of the new works added, gives the depths outside the old harbour in feet at *low* water spring tides ; the datum of the soundings is 30ft. below the coping of the pier, near the north side of the harbour lighthouse. The underlined figures in the harbour show the depth at *high* water spring tides. The magnetic variation indicated on the map is that of 1874, and it has been decreasing about nine minutes annually. The anchorage off Folkestone is exposed and limited, so is used only by ships waiting to enter the harbour; it affords room for not more than five or six ships at the same time, and gives a holding ground of clay and sand in from seven to ten fathoms of water. A lighthouse, 31ft. high, is on the south pier head of the outer harbour, and 244 yards distant south thereof, at the end of the south pier, is a skeleton lighthouse, 31ft. high, exhibiting a fixed light visible at six miles distance in clear weather. The light shows green over the arc A B of 144 deg. in the accompanying map. It shows white to the northward of these bearings, so that a change from green to white informs the mariner when his ship is in the stream of danger. A fog bell is suspended within the skeleton framework. These lighthouses, as well as the steam-fleet and harbour, are under the superintendence of the company's harbour master, Captain J. A. Boxer, R.N.

The tide signals exhibited at the south pier-head of the harbour for the guidance of shipping are a red flag half-mast high by day, and a red light by night, when there are from 12ft. to 14ft. of water at the entrance of the harbour. The red flag is quite up when the depth reaches 14ft. A black ball is exhibited under the red flag and a white light under the red light when the depth of water exceeds 14ft. The flag hauled down to the base of the staff or the red light blinked at intervals, signifies "caution." When the red flag is not shown, or the lights not exhibited, the meaning is that less than 12ft. of water are at the harbour entrance, or that the harbour is inaccessible, from obstruction or from the state of the weather.

The average depth between the harbour pierheads, as indicated by the tidal gauge, has been compiled as follows by Captain Boxer, as the result of his practical experience. Each column shows the depth, according to the time of high water on the particular day :—

Between 12 and 1.	Between 1 and 2	Between 2 and 3	Between 3 and 4	Between 4 and 5	Between 5 and 6
ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
18 3	17 6	16 8	15 3	13 11	13 5

Between 6 and 7.	Between 7 and 8.	Between 8 and 9.	Between 9 and 10.	Between 10 and 11.	Between 11 and 12.
ft. in.	in.	ft. in.	ft. in.	ft. in.	ft. in.
13 6	14 7	15 5	16 8	17 6	18 6

The exceptionally high spring tides previously mentioned by us, occur only during stormy weather or northerly winds ; the exceptionally low level neaps occur only during a continuance of settled, fine weather.

The population of Folkestone by the census of 1881 was :—Town, 15,398 ; parish, 3735. Rateable value, town, £83,879 parish, £30,624.

The engravings accompanying this article are—(1) The lighthouse at the entrance to Folkestone harbour, as seen looking north ; a fishing lugger is leaving the harbour, and the construction of the "horn," begun by Telford, is shown. This woodcut is from a photograph by Mr. Blackall, of Folkestone. (2) A plan of the old harbour, and the one in course of construction. (3) A portion of the beach west of the harbour, with groynes, and a portion of the length of cliffs from which the water is drawn off by the adit. The figures on shore denote the level above high-water mark.

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

(From our own Correspondent.)

YESTERDAY—Wednesday—in Birmingham the ironworkers argued their claim for a 10 per cent. advance before Alderman Avery, the new president of the Mill and Forge Wages Board. They used substantially the same arguments they advanced a week or two ago before the masters; but the employers uncompromisingly opposed the application. Agitation continues among the colliers upon the wages and sliding scale questions. These labour agitations had to-day in Birmingham, as in Wolverhampton yesterday, a tendency to strengthen a market not otherwise much stronger upon the week. Nevertheless, certain of the marked bar houses reported more buying at the full 10s. advance. Common and medium qualities were in less active request, and full work is not now universal. Bars and rods and strips were all quoted at £6 15s. as a minimum, but might have been bought at a fraction less. Sheets were unaltered at £8 10s. firm for singles, up to £10 15s. easy for lattens.

There is no falling off in the excellent sheet prospects. Galvanised sheet sales have augmented. One of two additional works will be ready to turn on steam on Monday. The works belong to Messrs. Hill and Smith.

The inquiries for plates, angles, and T sections are well maintained. Plate-makers are not without hope that in this district will fall an order for India which will consume a heavy quantity of iron. Some five miles of iron irrigation canal are needed. Tenders have been sent in from this part of the kingdom, and there is a fair measure of probability that the work will come this way.

Bridgework needed by the Great Western Railway Company upon its Oxford and Worcester section is also likely to come into this district.

The facts which have come out touching the Forth Bridge contract, a portion of which engineering firms here tried to get, are confirmatory of the information which I last week sketched. If rumour be in this matter no liar, the difference in the prices named by the several firms who would have gladly done the work is as much as three quarters of a million. So great a difference in a contract of one million six hundred thousand is undoubtedly much in excess of the variations which the tenders for such work usually show.

Heavy pipe founders and the rest find it hard work to get to this district the orders which have to be given out from the chief London exporting firms.

The chief mail received this week has come from Australia. When it left Melbourne, favourite brands of galvanised sheets were offered at £21 to £21 10s., while ordinary brands were quoted at £20 10s. These prices have since been confirmed by telegram. Bar and rod iron was quoted at £8 10s. to £9, and black sheets were firm at £10 for Nos. 8 to 18, and £13 for Nos. 20 to 26. Plates were quiet at £9 to £9 10s., and hoops were saleable at £10 to £11. In fencing wire, Nos. 6, 7, and 8 were moving quietly at date of mail at the quotations respectively of £12, £12 10s., and £13. Telegraphic advices, however, show a drop on these quotations of 10s. Tin-plates were offered at 15 per cent. advance on invoice for good assortments, I.C. coke plates being 19s. 6d.

Pig iron has not been easy to sell this week, but there has been few or no alterations in quotations. Most consumers are well bought. Hematite, No 1 (Tredegar brand), was quoted 75s. to-day, and forge qualities 70s. Similar prices were named for Barrow iron. Native all-mine pigs were 70s., and part mine 55s. to 60s.; while Lincolnshire brands were 55s. to 52s. 6d.

Coal was somewhat more firmly held, not only because of the wages agitation, but likewise because of the recent heavy rains having stopped several pits in the Willenhall and other localities, upon which certain ironworks were depending for their supplies.

The mills and forges in North Staffordshire keep on nearly full time, and this activity promises to continue up to Christmas. But the raw orders coming to hand are not of the value which had been anticipated. Buyers, whether on export or home account, are still reluctant to place forward contracts at the late advances. The customary slackening of merchant orders, which marks the closing months of the year, is also observable. Makers, however, are steady at £7 and upwards for crown bars, and £6 10s. for common bars. Girder and tank plates are in regular out-turn, but some of the mills are now getting rather short of orders, and prices, though between 5s. and 10s. per ton better than in the summer, yet at the moment are easier. Hoops are in active sale, largely on export account. Pig makers have contracts that will last over the end of the year. Best sorts are 60s. and common sorts 42s. 6d.

The new list of prices determined upon by the association which has been formed in the galvanised iron hollow-ware trade shows an advance upon the rates previously prevailing for buckets and other hollow-wares of some 15 to 20 per cent.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—Contracts in hand still keep both pig and finished ironmakers in this district well employed, but consumers only come forward very sparingly with further orders at present rates. There appears to be a strong belief amongst buyers that by waiting they will be able to secure more favourable terms than makers now offer, and as the large purchases made before the rise will pretty generally carry consumers over this year, actual requirements, which necessitate orders being placed out at present, are only very limited in extent. Although makers are easier to deal with, they are far from showing any disposition to offer material concessions to secure orders, and where there is any wavering in price it is chiefly amongst second-hand holders of iron.

The Manchester market on Tuesday was again very quiet, and I could hear of very few inquiries of any importance stirring. Lancashire makers of pig iron are still only effecting a few occasional sales of small quantities ; but deliveries against contracts are taking away the whole of their present output, and as they are well sold over the year, they are very firm in their prices, 49s. to 50s. per ton, less 2½ per cent., being the minimum figures quoted for forge and foundry qualities delivered equal to Manchester. In district brands there has also been very little business doing, and, if anything, prices in some cases are a shade easier. Lincolnshire iron is now quoted at 49s. to 50s., less 2½, delivered here, and Derbyshire can be bought at about the same figures net.

Forge proprietors have plenty of work to go on with, but the bulk of it is on account of contracts taken before the advance, and although they are generally pretty firm in holding out for their prices, merchants come in at less money, and it can scarcely be be said that any business of importance is being done at the full rates asked by makers. Business itself is also quieter, the demand both for home requirements and for shipment having fallen off recently. For delivery equal to Manchester prices average about

£6 10s. to £6 15s. for bars, £7 to £7 5s. for hoops, £8 12s. 6d. to £8 15s. for local sheets, and about £9 for Staffordshire qualities. There is, however, some underselling at the above figures.

The engineering trades continue generally well employed, but the reports I received from well-informed quarters are to the effect that in many cases old orders are being worked off with but few new ones coming in to take their place. The reports received through the various branches of the Amalgamated Society of Engineers in this district return, however, trade as still good, and in the Manchester and Salford district not more than 2 per cent. of the total number of members are on the books as out of employment. The demand for pattern-makers, and also for smiths, is good, both in this and in the outlying districts.

As an addition to last week's notice of the Stockport Gas Appliance Exhibition, I may mention that one feature which has attracted considerable attention has been the introduction, since the opening, of several of the new Grimstone burners, which may be regarded as one of the latest novelties in gas lighting. These burners, which are practically a Siemens burner turned upside down, give a perfectly white flame without any shade, and during the tests in the exhibition have given a light of 63-candle power with a consumption of $9\frac{5}{10}$ft. of gas per hour.

The project for the construction of a ship canal to Manchester is being pushed forward with a vigour which bids fair to overcome all obstacles in the way of the realisation of the scheme. Constant meetings are being held, at which resolutions are passed in favour of the project, which is evidently being heartily taken up by all classes, and it is announced that upwards of £30,000 has already been subscribed towards the preliminary expenses. A special journal is also being published to advocate the merits of the scheme, but, somewhat ungraciously, fault has been found in its first issue that the local press have not devoted sufficient of their space to reports of proceedings in connection with the project.

Business in the coal trade has fallen off considerably since the commencement of the month, and stocks are again beginning to accumulate, although at a large number of the pits the men are still only working about five days a week. The falling off is chiefly in house fire classes of fuel, for which prices are in some cases rather easier; fuel for ironmaking and steam purposes moves off fairly well. At the pit mouth prices average about as under:—Best coals, 10s. 6d. to 11s.; seconds, 8s. to 9s.; and common coals, 6s. 6d. to 7s. 6d. per ton according to quality; burgy, 5s. to 5s. 3d. and ordinary slack 3s. 6d. to 4s., with better qualities fetching 4s. 3d. per ton.

The shipping trade is only quiet, and there is some underselling; steam coal delivered at the high level, Liverpool, or at Garston Docks do not as a top price realise more than 8s. 6d., and second house coal 9s. to 9s. 6d. per ton.

Barrow.—The quiet tone in the hematite iron trade noted last week still prevails, but makers are well sold forward, and the orders on hand will suffice to keep them busy for some time to come. They do not seem anxious for new; but no doubt they will quote lower values if the quiet now prevailing continues much longer. Bessemer No. 1 is quoted this week at 57s. 6d.; No. 2, 56s. 6d.; and No. 3, 55s. 6d. net at makers' works, with a three months' delivery; but for early delivery the quotations are lower. Although second-hand parcels have been sold at better prices, stocks have not materially changed, as delays in shipment, owing to bad weather, have caused the accumulation of several parcels. Steel makers are well employed all round, but especially in the steel rail department. Shipbuilders have recently accepted new contracts, and they are actively employed, and it seems likely from the contracts on hand the trade will be active for some time to come. There is no marked change amongst engineers, boiler makers, &c., there being plenty of work.

There is a good request for railway rolling stock, but the employment at the works is but indifferent, and Mr. Clay's works are closed altogether. There is a good business done with iron ore at 14s. per ton, and for inferior qualities, 12s. 6d. to 13s. The coal and coke trades are steady, and there is no change in the quotations.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Clay Cross Colliery Explosion has caused the deaths of forty-five out of ninety miners who went down the pit. If the 7th had not been an off-day there would in all probability have been 300 in the workings at the time. One-half of the ninety had been drawn up shortly before the explosion occurred. The loss of life, though lamentable, is not one-half of what would have been under the ordinary circumstances. The explosion is believed to have been caused by a sudden fall of roof liberating the pent-up gas, which, mixing with the air, would form an explosive mixture igniting with the naked lights which were freely used in the pit. There are evidences that such a fall of roof has occurred in the northern part of the workings, where the effects of the explosion are most marked.

The Board of Trade returns for October last bring out several facts of considerable trade interest. In hardware and cutlery there is a falling-off in the export trade in comparison with last year, and a large increase in the shipment of coal, steel rails, and machinery. Russia, Holland, France, the United States, West India—foreign—British North America, British Possessions in South Africa, and Australia, all show decreases in hardware and cutlery. The United States has declined from £57,776 to £42,452. France has fallen from £22,621 to £14,464—a distinct result of the new hostile tariff. British North America has decreased from £27,522 to £19,924; and British Possessions in South Africa from £23,883 to £14,108. This latter falling-off, which is the most serious of all, is largely attributable to the determination of the Boers to have nothing whatever to do with British goods, and English merchants now find the Transvaal practically closed. The decline in Australian exports is very trifling—from £59,472 to £58,349. The improving markets are Germany, which has advanced from £13,090 to £17,427; Spain and Canaries from £10,430 to £11,051; the Argentine Republic from £11,138 to £17,000.

In steel rails Russia shows a blank, and Germany has had none for two years—the German rail maker being very carefully protected. Spain, Italy, the United States, British India, and Australia have all taken greater weights. Spain during last October took steel rails to the value of £7279—October, 1881, £23,271; Italy has made the enormous stride of from £18,755 in October, 1881, to £42,087 last October; United States has advanced from £96,331 to £152,146; Brazil, from £18,773 to £20,542; Chili, from £1026 to £2080; British India, from £16,527 to £31,732; Australia, from £69,518 to £70,370, the total value being £529,369, or an increase over the corresponding month of 1881 of £128,000. Every country except France and Australia shows an improvement in hoops, sheets, and boiler and armour-plates. Italy took £6666 in October, 1881; last October her exports were £18,525, mainly in armour-plates; the United States increased from £14,639 to £29,068; and British India from £28,714 to £46,347. Australia, on the other hand, fell off from £101,482 to £78,146. Steam engines were exported during the month to the value of £294,194, a decrease of £13,824. Russia decreased from £18,538 to £8866; Spain and Canaries, from £61,666 to £12,856; British India, from £45,619 to £37,043; Australia, from £48,543 to £31,347. On the other hand, Brazil only took £1892 in October, 1881; last October her exports of steam engines realised £24,103, while Holland advanced from £2937 to £9801; Germany, from £9383 to £26,317; and France, from £11,471 to £29,055.

Mr. B. Pickard, secretary of the Rotherham and Manchester Conference, has issued a circular to the miners of the United Kingdom calling a national Conference, to be held at Leeds on the 5th December, to consider the best means of putting the reduction of the output of coal into operation, "so as to enhance and preserve prices to coalowners, and wages to miners."

There are several minor disputes in the South Yorkshire coalfield, but they are gradually being settled on the basis of a 10 per cent. advance. The whole of the collieries belonging to the Staveley Coal and Iron Company, viz., Springwell, Ireland, Old Hollingwood, and Hartington, have been thrown idle for a whole week, in consequence of the pony-drivers—lads—striking for the 10 per cent. They were offered one halfpenny per score, and datal boys one penny extra per day, but the boys demand 10 per cent., like the men. The Seymour Colliery worked on Monday, but the boys visited it, and persuaded the Seymour lads to join them. Coke-burners, banksmen, and others are all idle, owing to this strike of pit lads. A notice has been posted at each pit stating that all classes of workmen must be re-engaged before re-commencing work.

A branch of the wire trade which has long been dull, owing to the freaks of fashion, is again very brisk—viz., the manufacture of crinoline steel. The abolition of distended dresses caused several local establishments great loss, and one or two altogether collapsed. Now the crinolette is rapidly giving way to crinolines, and our wire workers are again briskly employed on what was for years one of their most profitable specialities.

Mr. John Fee, silver and electro-plate manufacturer, Norfolk Works, 171, Eyre-street, has just perfected an invention by which ivory and pearl can be greatly economised in the hafting of cutlery of all sorts, fish carvers, fish eaters, desserts, trowels, butter knives, scoops, &c. It consists of a patent handle, which is grooved, with the top saw pierced; the ivory or pearl scale fits into the groove, and is firmly secured by an invisible rim at that end, while the ferule locks it at the other. No rivets, pins, or cement are required. The goods look and handle well, and are undoubtedly durable. By this means ivory and pearl handles can be produced at one-half the former cost—a most material consideration when the scarcity and increasing dearness of ivory are taken into account.

The Sheffield Town Council, by the casting vote of the Mayor, have resolved to apply to the Board of Trade for a provisional order authorising the Council, as the local authority, to supply electricity for public and private purposes within the area of the borough. The motion was strongly opposed on the ground that electricity was as yet in its infancy, and that it would be better for Sheffield to wait and profit by the experience of other towns, instead of being the pioneer.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

ONLY a very small amount of business was done at the Cleveland iron market on Tuesday last, but the tone was nevertheless firm and cheerfnl. The action of the "bears" during the last fortnight has had scarcely any effect. The principal producers hold firmly to their quotation of 45s. per ton for No. 3 g.m.b.; a few other makers ask 44s. 6d. per ton, and merchants quote 44s. per ton; the latter have, however, only very small quantities to dispose of. Producers have shown conclusively that they are at the moment well able to hold their own, and it is probable that a brisk business will be done at present prices before long. The output is not likely to be increased during the winter, either here or in Scotland, and the conviction that production will remain constant will have a tendency to steady and perhaps strengthen the market. There is still nothing being done in warrants, though holders are offering them at 43s. 6d. per ton f.o.b.

On Monday last there were 102,141 tons of Cleveland iron in Messrs. Connals' store, being a reduction of only 106 tons for the week.

The wet weather has recently interfered a good deal with the shipments. The quantity shipped in the Tees up to Tuesday night was as follows:—Pig iron, 33,119 tons, and manufactured iron, 10,765 tons.

Business is very quiet in the finished iron trade, and prices are the same as last week, viz.:—Ship plates £6 12s. 6d. to £7, according to specification; angles, £6; and common bars, £6 5s. per ton, free on trucks at works, cash 10th, less 2½ per cent. discount.

The plate-makers held a meeting on Tuesday last to consider the feasibility of restricting the output and of raising prices. A committee was appointed to look into the matter, and a report will be made at the next meeting.

Messrs. William Gray and Co., shipbuilders, of West Hartlepool, have purchased 5 acres of land for the purpose of erecting marine engine works in that town. They intend to commence with the necessary buildings at once, and hope to have the works in full working operation in about eight or nine months' time. Mr. Thomas Mudd, who has been on the staff at Messrs. T. Richardson and Son's Middleton Engine Works, Hartlepool, for a number of years, has been appointed manager of the new works.

Sir J. W. Pease, M.P., has fixed Saturday, the 18th inst., for hearing the evidence of the employers and the workmen in the northern finished iron trade wages dispute. The hon. baronet has already received the written cases of both parties. The meeting will be held at ten a.m., at the Town Hall, Middlesbrough.

Sir J. W. Pease, M.P., has written as follows, on the subject of sliding scales, to a correspondent in Wales:—"There can be no doubt a sliding scale has in many instances worked exceedingly well. It is now in force in the Durham coal trade, and there is a strong feeling, I believe, on the part of masters and men to uphold it. A scale involves a certain relative proportion between the price of the article and the payment for the labour employed in producing it, as the best and only standard to denote the value of the labour upon the market. At the same time it does not always follow that the value of labour rises or falls in exact proportion as the value of the article produced by it; but if both parties are content to adopt that standard it will in the long run work out perfectly fairly. The question as to how frequently masters' books are to be examined, in order to fix the price of wages, is a question which has not unfrequently arisen. It has occurred to me, as acting lately as arbitrator, that the present three months should be shortened. At the same time it is well there should not be a constant unsettlement in the rate of wages."

The Ironworkers' Association held another meeting at Consett on Saturday last, and it was unanimously agreed that unless one-half of the operatives employed at the Consett Ironworks join this Association, none of its members will represent them on the Board of Arbitration.

The blast furnacemen employed at the Skinningrove Iron Company's furnaces at Carlin How, have decided to join the Cleveland and District Blast Furnacemen's Association, notwithstanding that their employers say that they are paying above country prices, and in that case would have to reduce wages.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow iron market has been quiet during the week, with little alteration in prices. The demand for pig iron for consumption at home continues extensive, and the shipments are not at all unsatisfactory for the present season. For the past week they aggregated 12,199 tons, as compared with 12,890 in the corresponding week of 1881. Another furnace having been put into blast at Coltness, there are now 115 in operation, against 106 at the same date last year. The Canadian market may be regarded as practically closed, but there have been some additional inquiries from the United States. The continental demand is quiet, but with a fair business doing with several countries. The stocks of pigs in Messrs. Connal and Co.'s Glasgow stores continue to decrease, although not to the same extent as formerly. The demand for special brands of makers' iron has been so brisk that in almost every case the current make is required to supply present orders. There is just now little speculation in warrants, and the market for them is dull.

Business was done in the warrant market on Friday forenoon at 50s. to 50s. 1d. and 49s. 11d. cash, and 50s. 3½d. to 50s. 4½d., and again back to 50s. 2½d. one month; in the afternoon the quotations were 49s. 10½d. to 49s. 11½d. cash, and 50s. 2d. one month. On Monday forenoon business was done at 49s. 10d. to 50s. 1d. cash, and 50s. 1½d. to 50s. 3½d. one month, the afternoon figures being 50s. 1½d. to 50s. 3½d. cash, and 50s. 5d. to 50s. 6d. one month. Transactions were effected on Tuesday at 50s. 4d. to 50s. 1d. and again 50s. 3d. cash, and 50s. 6d. to 50s. 4d. one month. Business was done on Wednesday at 50s. 4d. to 49s. 11½d. cash, and 50s. 6½d. to 50s. 2½d. one month. To-day—Thursday—transactions were effected at 49s. 10½d. to 49s. 11½d. cash, and 50s. to 50s. 2d. one month.

There is not much change in the quotations of makers' iron, which is as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 64s.; No. 3, 54s. 6d.; Coltness, 69s. and 55s.; Langloan, 67s. 6d. and 56s.; Summerlee, 64s. and 54s.; Calder, 63s. and 53s.; Carnbroe, 57s. 6d. and 51s. 6d.; Clyde, 54s. 6d. and 52s.; Monkland, and Govan, each 51s. and 49s. 6d.; Quarter, 50s. 6d. and 49s.; Shotts, at Leith, 66s. and 56s.; Carron, at Grangemouth, 52s. 6d.; specially selected, 57s. and 51s. 6d.; Kinneil, 50s. and 49s. 6d.; Glengarnock, 57s. 6d. and 51s. 6d.; Eglinton, 52s. and 50s.; Dalmellington, 52s. 6d. and 50s. 6d.

The refusal of the ironmasters at their meeting a week ago to advance the wages of the miners in their employment has given rise to a good deal of comment. The ground upon which the refusal was placed was that, with iron at 50s. per ton, the masters could not really afford to pay higher wages. It has been pointed out that the employers have thus fixed upon the lowest price of g.m.b. as a justification of their refusal, keeping out of view the fact that they have for a considerable time been receiving much better rates for their special brands of pig iron. But the employers are of opinion that they have put the case in a fair enough light, and for the present they seem disposed to adhere to the resolution.

The malleable iron trade is still in a satisfactory state, and the prospects are quite as good as they have been for months back, in consequence of the booking of fresh contracts which are expected to yield additional employment to this department. There is no alteration in the values of malleable iron. The other branches of the manufactured iron trade are in a satisfactory condition.

There is a very good business doing in coals in the West of Scotland, the following being the f.o.b. prices at Glasgow:—Main coal, 7s. 3d. to 7s. 9d. per ton; Ell, 8s. to 9s.; splint, 7s. 9d. to 8s. 9d.; steam, 8s. to 9s. 3d. At this port there is not quite so great a pressure for shipment as of late weeks, and as vessels in the coasting trade are scarce at the moment, freights have a tendency to increase. In Ayrshire the trade is good, and the average shipping quotations about 8s. per ton. The tone of the trade in the counties of Fife and Clackmannan is not so active as of late, this being particularly evident at the shipping ports. But the dulness is not unusual at this season, and the severe weather now prevailing will help the inland trade.

The wages question is again causing some uneasiness both in the east and west. In Lanarkshire the sale coalmasters have generally granted the colliers an increase of 6d. per day, but there is a possibility of their position being somewhat complicated by the refusal of the advance by the ironmasters. It is hoped, however, that the difficulty threatened on this account may be averted. A fresh difference has arisen between the coalmasters and miners. Some weeks ago the masters gave an advance of 10 per cent., but the men, while accepting it, still adhered to their demand for 15 per cent., in order to enforce which they have since been working only five days per week. The employers feel it to be very inconvenient for them that when steamers are awaiting cargoes the men will nevertheless persist in keeping an idle day weekly. They refuse to give the advance of 15 per cent., and they threaten to prosecute the workmen for not adhering to the rule that they shall work at least eleven days in the fortnight. On the other hand, the men contend that the rules are illegal, not having been signed or endorsed by them.

The strike of Clyde ships' joiners, after lasting for three months, is now at an end, the men having at a meeting held on Monday last, resolved by a large majority to return to work on the old terms of 7d. per hour.

In the course of October, 77,500 lb. of gunpowder were shipped from the Clyde, being 65,000 lb. below that of the preceding month. The gunpowder was consigned in the proportions of 10,000 lb. to Adelaide, 30,000 lb. to Singapore, and 37,500 to Valparaiso.

At a general meeting of the shareholders of the Indian Gold Mining Company, Limited, held in Glasgow a few days ago, the chairman reported that the directors had received from India a case of pyrites, which was to contain a considerable quantity of gold, but he was sorry to say it did not contain what they were led to expect. It was resolved to make a further call of £2 10s. per share.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A RAILWAY is contemplated from the Risca great coal district to Cardiff, running through a quarter which is now a feeder to the port of Newport. Strong opposition may be expected to it, but the result of careful surveys is to show the feasibility of the scheme, and it has, moreover, the advantage of being in good hands.

I am glad to learn that the creditors have accepted the terms offered by Mr. Joseph, of Dunraven Colliery, and the arrangement entered into will be advantageous to the Rhondda and Swansea Bay scheme, which is now in a fair way. This week the share lists were closed.

The Cyfarthfa line connecting the new steel works with the Great Western Railway will go through Georgetown, and the arrangement is that as the place is thickly inhabited, the rate of the trains will not exceed four miles an hour.

The staple industries are full of vigour. In steel rails a better trade is being done, and a little more profit is realised, though there is ample scope for improvement in this respect. The iron shipments amounted to 4000 tons for the week, and the imports of iron ore from Bilbao and elsewhere exceeded 20,000 tons. The principal ore is from Bilbao, though the value of the Elba ore is known and appreciated.

With reference to Welsh ore, it is a singular fact that the stocks accumulated at most of the collieries have been swept off for consumption in Staffordshire and other places. A little is used at the Welsh works for certain specifications, but the bulk goes North. Still, it is questionable whether the prices obtained will justify re-opening the mine levels and pits when stocks are cleared away. I think not.

Special examinations have been made lately of the disused works of Penydarran and Plymouth. What the object is cannot be stated, though an impression prevails that they are simply for the purpose of seeing what the old iron will realise. Plymouth plant has been valued at £80,000, which is a large proportion of the sum needed either to put up a small steel works or renovate the old bar trade. There was a rumour some time ago that one of the large railway companies had it in contemplation to make a bid for the place for railway plant, and considering the cheapness of labour, lowness of rents of houses, and its central position, many worse places might be selected.

The Merthyr valley is admirably adapted for new industries, and the wire works proprietary who are now in full action have found this out, labour being much cheaper than at Cardiff. This dearness of labour and high cost of rent, &c., may have a great deal to do in the closing of so many iron industries at Cardiff. Few seem to thrive, though, on the seaboard, a place which our best authorities maintain will be the site of the steel works of the future.

The colliery ambulance question finds a little favour. Time, however, is required. The Welsh colliers are liberal to a man in their politics, but very conservative in their notion of social or industrial change.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

7th November, 1882.

5304. Producing Dynamo and Magneto-electricity, H. Mayhew, London.
5305. Adapting Pencil-cases, &c., for Holding Postage Stamps, &c., C. A. Drake, London.
5306. Looms for Weaving, J. F. Brown, Glasgow.
5307. Velocipedes, R. E. Phillips, Anerley.
5308. Cleaning Grain, W. R. Lake.—(*L. Gathmann, Chicago, U.S.*)
5309. Envelopes, W. R. Lake.—(*A. C. Fletcher, New York, U.S.*)
5310. Cooking Ranges, &c., J. G. Whyte, Bo'ness.
5311. Looms for Weaving, T. Blackhurst, Preston.
5312. Gas Stove, J. Bartlett, London.
5313. Regulating the Supply of Steam to Steam Engines, C. D. Abel.—(*A. Guhrauer and R. C. Wagner, Budapest, Hungary.*)
5314. Shaping Machines, J. Wetter.—(*E. Berger, Leipzig.*)
5315. Insulating Compounds, &c., J. Wetter.—(*R. S. Waring, Pittsburg, and J. E. Hyde, New York.*)
5316. Silicious Copper and Bronze, &c., J. C. Mewburn.—(*L. Weiller, Angoulême, France.*)
5317. Starting and Stopping Gear for Tramway Cars, P. G. Hepworth, Clapham.
5318. Bolting Mills, W. R. Lake.—(*J. Mills, U.S.*)
5319. Combing Wool, &c., J. H. Whitehead, Leeds.
5320. Reeling Silk, Cotton, &c., W. R. Lake.—(*J. M. Grant, Hartford, U.S.*)
5321. Digging Apparatus, F. Proctor, Stevenage.
5322. Compound Plates of Homogeneous Metals, *S. and S. R. Chatwood, Bolton.*

8th November, 1882.

5323. Manufacture of Explosive, &c., Substances, R. Hannan and E. J. Mills, Glasgow.
5324. Ornamenting Glass, A. J. Nash, Wordsley.
5325. Coupling Vehicles, H. P. Hogton, Manchester.
5326. Opening and Closing Carriage Doors, W. H. St. Aubin, Bloxwich.
5327. Valves, F. Gill, South Shields.
5328. Match Box Holders, J. A. Francis, London.
5329. Portable Baking Ovens, C. D. Abel.—(*T. Girolamo, Turin.*)
5330. Bleaching, &c., Textile Fabrics, J. Gibson, jun., Mottram, and J. Platt, Manchester.
5331. Watches, F. Wirth.—(*G. Speckhart, Nürnberg, Germany.*)
5332. Producing Light, E. P. Chaimsonovitz, Leytonstone.
5333. Bottle Stoppers, J. J. Varley, Brixton.
5334. Decorticating Rice, &c., J. H. C. Martin, Walthamstow.
5335. Tool Holders, J. F. Allen, Brooklyn, U.S.
5336. Apparatus for Whipping Eggs, &c., G. Kenworth, Huddersfield.
5337. Mixing Air, &c., for Lighting Purposes, G. A. Schoth, London.
5338. Warming Railway, &c., Carriages, T. Perkins, Hitchin.
5339. Distributing Seed, Artificial Manure, &c., J. H. Wood.—(*Messrs. McLean Brothers and Rigg, Melbourne, Victoria.*)
5340. Reciprocating Cylinder Printing Presses, S. Pitt.—(*W. C. Walker, Madison, U.S.*)
5341. Tellurians, A. M. Clark.—(*J. Spicer. U.S.*)
5342. Preparing Wire for Securing Corks in Bottles, &c., H. H. Lake.—(*O. R. Chaplin, Boston, U.S.*)

9th November, 1882.

5343. Gill Stoves, &c., C. J. Henderson, Edinburgh.
5344. Regenerative Gas Furnaces, W. Hackney, Swansea, and J. W. Wailes, Wednesbury.
5345. Drawing Compasses, J. Brookes, Sheffield.
5346. Incandescent Electric Lamps, J. Jameson, Newcastle-upon-Tyne.
5347. Smokeless Grates, R. Crane, London.
5348. Cop-winding Machinery, J. Place, Leeds.
5349. Miners' Safety Lamps, T. Thomas, Ynishir.
5350. Driving Gear, H. Thresher, London.
5351. Railway Signals, R. Clay, London.
5352. Paper Holder, B. Schoof, Wiesbaden, Prussia.
5353. Carbons for Electric Lighting, H. C. B. Shalders, London.
5354. Finishing Machinery for Stretching Textile Fabrics, J. Littlewood, Newsome.
5355. Stays and Corsets, M. G. Totterdell, Landport.
5356. Hydraulic Accumulators, W. Smith, Aberdeen.
5357. Collapsible Boxes, A. M. Clark.—(*W. H. H. Rogers, Brooklyn, U.S.*)
5358. Transportable Baking Ovens, E. A. Brydges.—(*D. Grove, Berlin.*)

10th November, 1882.

5359. Insulating Electric Wires, W. J. Temple and T. F. Hobbs, Bristol.
5360. Hooking and Cutting Cloth, W. Lee, Manchester.
5361. Washing, Wringing, &c., Machines, J. P. Rothwell, Lytham.
5362. Lamps, J. Ungar, London.
5363. Distributing, &c., Compressed Air, T. A. English and J. Sturgeon.—(*C. Hanssen, Germany.*)
5364. Tricycles, &c., H. S. Watkin, Waltham Abbey.
5365. Treating Fibrous Substances, J. A. Graham, London.
5366. Bleaching Fibres, &c., J. A. Graham, London.
5367. Coating Iron with Lead, J. Graham, London.
5368. Boiler for Effecting Chemical Operations, J. A. Graham, London.
5369. Velocipedes, J. Noad, East Ham, H. Blackwell, jun., and H. B. Bunkell, Finsbury Park.
5370. Packing Fresh Meat, &c., W. P. Thompson.—(*M. Closset, Liége, France.*)
5371. Gas, B. Russ, London.
5372. Fountain Pens, W. R. Lake.—(*C. W. Livermore, Providence, U.S.*)
5373. Electric Lamps, J. M. Boullon, I. Probert, and A. W. Soward, London.

11th November, 1882.

5374. Picture, &c., Frames, J. Fisher and T. Wolstencroft, London.
5375. Folding Pocket Scissors, A. J. Boult.—(*Böntgeu and Sabin, Solingen, Germany.*)
5376. Guards for Circular Saws, J. Wetter.—(*Gretschel and Heinemann, Leipzig.*)
5377. Balls for Playing Games, J. Wetter.—(*Gretschel and Heinemann, Leipzig.*)
5378. Fastening Window Sashes, R. Plush, London.
5379. Lubricators, W. L. Wise.—(*E. Baudet, Paris.*)
5380. Valves and Cocks, F. P. Preston, J. T. Prestige, E. J. Preston, A. T. Cornish, and W. G. Simmons, Deptford.
5381. Washing, Breaking, and Beating Engines, C. Aitchison, Loanhead.
5382. Manufacturing Lace, L. Marceuil, Paris.
5383. Water Supply for Urinals, &c., J. J. Tylor, London.
5384. Composition of Bearings, A. M. Clark.—(*E. F. Canda, New York, U.S.*)
5385. Raising Sunken Vessels, A. M. Clark.—(*P. Oriolle, Nantes, France.*)
5386. Shearing and Punching Metal Plates, A. J. Lehmann, West Hartlepool.
5387. Regulating Electrical Currents, P. R. Allen, London.
5388. Compounds for Insulation, A. Parkes, Bexley.
5389. Hoisting, &c., Heavy Weights, S. S. Sugden, Woodford.
5390. Obtaining Zinc and Copper from Ores, W. R. Lake.—(*L. L. C. Krafft and J. E. Schischkar, Paris.*)

13th October, 1882.

5391. Telegraphing the Score of Games, C. Green, Ashton-under-Lyne.
5392. Receptacles for Biscuits, &c., J. Hall, Sheffield.
5393. Pipe Joints, W. N. Hutchinson, Wellesbourne.
5394. Brushes, J. J. Danks, London.
5395. Ornamenting Terra-cotta Plaques, A. Tuck, London.
5396. Grinding Lawn Mower Cutters, T. H. Gillott, Royston.
5397. Injectors, C. Nelson, London.
5398. Hydraulic Lifts, J. S. Stevens, C. G. Major, and T. W. Barber, London.
5399. Metallic Alloys, A. K. Huntington, London.
5400. Carbons, J. E. T. Woods, London.
5401. Removing Burrs, &c., from Wools, A. J. Boult.—(*F. Müller, Hanover.*)
5402. Steam Winches & Cranes, W. Allan, Sunderland.
5403. Separating Liquids, G. H. Botten and J. R. Wylde, Widnes.
5404. Winding Paper into Rolls, G. W. Osborn and W. Yates, London.
5405. Extension Rule, J. F. Stephens, Bristol.
5406. Punching and Rivetting Machines, J. D. Morrison, Gateshead.
5407. Filters, J. Wetter.—(*J. Grant, Boston, U.S.*)
5408. Treating Textile Materials with Liquids, J. Wetter.—(*O. Obermaier, Lambrecht, Bavaria.*)
5409. Electric Lighting, J. Muirhead and T. M. Collet.—(*G. A. Grindle, Bombay.*)
5410. Steam Steering Apparatus, J. Duncan, London.
5411. Furnaces, W. Felton, Wilden.
5412. Bisulphide of Soda, E. Carey and F. Hurter, Widnes.
5413. Circular Shuttles for Sewing Machines, F. O. Schmidt, Berlin.
5414. Regulating Electrical Currents, P. R. Allen, London.
5415. Velocipedes, F. Weldon, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

5279. Clocks for Signalling by Electricity, W. R. Lake, Southampton-buildings, London.—A communication from the Standard Time Company, Incorporated, New Haven, Connecticut, U.S.—*4th November*, 1882.
5280. Signalling by Electricity, &c., W. R. Lake, Southampton-buildings, London.—A communication from the Standard Time Company, Incorporated, New Haven, Connecticut, U.S.—*4th November*, 1882.
5320. Reeling Silk, Cotton, &c., W. R. Lake, Southampton-buildings, London.—A communication from J. M. Grant, Hartford, Connecticut, U.S.—*7th November*, 1882.
5335. Tool Holders, J. F. Allen, Brooklyn, U.S.—*8th November*, 1882.
5340. Reciprocating Cylinder Printing Presses, S. Pitt, Sutton.—A communication from W. G. Walker, Madison, U.S.—*8th November*, 1882.

Patents on which the Stamp Duty of £50 has been paid.

4530. Travelling Jib Cranes, T. Dixon, Leeds.—*6th November*, 1879.
4605. Fusible Boiler Plugs, G. Platts and F. Wood, Salford.—*12th November*, 1879.
4730. Forming Button-holes, &c., G. Browning, Glasgow.—*20th November*, 1879.
4563. Interchanging the Temperature of Fluids, J. H. Johnson, London.—*8th November*, 1879.
4589. Generating Electric Currents, &c., C. F. Heinrichs, London.—*11th November*, 1879.
4663. Portable Fan Forges, W. Allday, jun., Birmingham.—*15th November*, 1879.
4804. Rock and Ore Crushers, J. T. King, Liverpool.—*25th November*, 1879.
4626. Cutting Hedges, &c., A. Ridgway, Macclesfield.—*13th November*, 1879.
4664. Polishing Needles, V. Milward, Redditch.—*15th November*, 1879.
4686. Locking Mechanism for Safes, &c., L. Varicas, London.—*18th November*, 1879.
4567. Drawing, Measuring, and Raising Beer, &c., F. Bolton, Salford.—*10th November*, 1879.
4578. Washing and Wringing Machines, C. Harvey, Preston.—*11th November*, 1879.
4581. Locomotive, &c., Engines, H. F. Shaw, Boston, U.S.—*11th November*, 1879.
4604. Boots and Shoes, H. Ward, Derby.—*12th November*, 1879.
4642. Pockets for Wearing Apparel, C. Levy, Manchester.—*14th November*, 1879.
4670. Constructing Steamships, &c., T. McCarter and T. Cooper, Londonderry.—*17th November*, 1879.
4795. Centrifugal Machines, J. H. Johnson, London.—*24th November*, 1879.
4837. Bats, H. Richardson, Liverpool.—*26th November*, 1879.
4591. Preparing Coke, J. Gothard, Chesterfield.—*11th November*, 1879.
4597. Stoves and Fire-grates, D. O. Boyd, London.—*12th November*, 1879.

Patents on which the Stamp Duty of £100 has been paid.

3867. Steam Pumps, M. Neuhaus and J. E. Hodgkin, London.—*6th November*, 1875.
4179. Explosive Compounds, H. E. Newton, London.—*2nd December*, 1875.
3920. Exposing Porous Materials, &c., to Mutual Reactions, H. Deacon, Widnes.—*11th November*, 1875.
3715. Printing Measuring Tapes, W. Chesterman, Sheffield.—*26th October*, 1875.
3907. Refrigerating Apparatus, H. F. Stanley, Tottenham.—*10th November*, 1875.
3908. Anchors, E. A. Inglefield, Malta, and G. C. L. Lenox, London.—*10th November*, 1875.
3954. Bleaching Cotton, &c., T. Fletcher, Newton Hyde.—*13th November*, 1875.
3990. Railway Sleeper Chairs, W. MacLellan and J. P. Smith Glasgow.—*17th November*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 1st December, 1882.

3140. Ladder Tapes for Venetian Blinds, T. French and J. Monks, Manchester.—*4th July*, 1882.
3142. Submarine Telegraph Cables, G. E. Vaughan, London.—A communication from S. Trott and F. A. Hamilton.—*4th July*, 1882.
3143. Grapnels, G. E. Vaughan, London.—A com. from S. Trott and H. Kingsford.—*4th July*, 1882.
3153. Generating Gas for Furnaces, W. F. Browne, London.—*4th July*, 1882.
3154. Manufacturing, &c., Gas, W. F. Browne, London.—*4th July*, 1882.
3155. Evaporating Liquids, W. F. Browne, London.—*4th July*, 1882.
3171. Governing Marine Engines by Electricity, W. W. Girdwood, London.—*5th July*, 1882.
3175. Electric Insulating Apparatus, W. Bottomley, J. Barry, and J. Lunday, London.—*5th July*, 1882.
3180. Propelling Ships, A. Rickarby, Newcastle-upon-Tyne.—*5th July*, 1882.
3190. Electric Tell-tales, A. Schweitzer and T. Lawrie, London.—*6th July*, 1882.
3196. Filling-in Wool upon Shade, &c., Cards, W. Greenwood, Halifax.—*6th July*, 1882.
3205. Milling Machinery, J. Cadogan, New Ross, Ireland.—*6th July*, 1882.
3210. Looms for Weaving, W. Buckley, Delph, and J. Hollingworth, Dobcross.—*6th July*, 1882.
3214. Sulphate of Ammonia, J. Coates, London.—*7th July*, 1882.
3225. Construction of Cabs, &c., J. Abbott, Bideford.—*7th July*, 1882.
3226. Electro-magnetic Motor, E. Toynbee, Willesden.—*7th July*, 1882.
3227. Bearings for Rolling Stock, J. Hope, Wednesbury, & J. Dickson, jun., Seaforth.—*7th July*, 1882.
3234. Bottles and Stoppers, O. G. Abbott, Huddersfield.—*7th July*, 1882.
3239. Machines for Tentering, &c., Fabrics, J. Ashworth, Rochdale.—*8th July*, 1882.
3242. Tape Ladders, J. Carr, Hulme, Manchester.—*8th July*, 1882.
3257. Internal Stoppers for Bottles, A. T. King, Nottingham.—*10th July*, 1882.
3259. Pickers, &c., for Looms, E. Booth, Manchester.—*10th July*, 1882.
3277. Stopping Runaway Horses, B. J. B. Mills, London.—A communication from J. Goudet and G. Durozad.—*11th July*, 1882.
3284. Locking, &c., Screw-nuts, W. R. Lake, London.—A com. from J. F. Goodridge.—*11th July*, 1882.
3285. Indicating the Length of Cloth, J. Darling, Glasgow, and J. Darling, Shotts.—*11th July*, 1882.
3311. Disinfecting, &c., Hides, J. C. Mewburn, London.—A communication from La Société Guillemin et Compagnie.—*12th July*, 1882.
3345. Attaching Bolsters, &c., to Cutlery, J. E. Beal, Sheffield.—*14th July*, 1882.
3357. Manufacture of Lace, F. E. A. Büsche, Westphalia.—*14th July*, 1882.
3410. Passenger Tickets for Railways, &c., J. A. Francis, London.—*18th July*, 1882.
3545. Treating Steel Ingots, J. Gjers, Middlesborough-on-Tees.—*26th July*, 1882.
3633. Tachygraphical Apparatus, H. H. Lake, London.—A com. from V. A. de Celada.—*31st July*, 1882.
3636. Separating Metallic Ores, T. S. G. Kirkpatrick, London.—*31st July*, 1882.
3656. Cigarette Machines, W. R. Lake, London.—A com. from the Cowman Cigarette Machine Company for Foreign Countries.—*1st August*, 1882.
3724. Manufacture of Sulpho-Acids, F. Wirth, Frankfort-on-the-Main.—A communication from the Farbfabrick von Brönner.—*4th August*, 1882.
3768. Lamps, H. Cullabine, Sheffield.—*8th August*, 1882.
3842. Suspending Telegraph Wires, H. C. Jobson, Dudley.—*11th August*, 1882.
3873. Printing, &c., Indexes, W. R. Fordham, London.—*14th August*, 1882.
3922. Check-reins, A. M. Clark, London.—A communication from H. T. Harding.—*16th August*, 1882.
4082. Cans for Holding Oil, T. S. Marriage, Reigate.—*26th August*, 1882.
4418. Motors worked by Gas, &c., J. Watts and H. E. Smith, Bristol.—*16th September*, 1882.
4420. Gaseliers, &c., M. Merichenski, London.—*16th September*, 1882.
4580. Decomposing Alloys, W. R. Lake, London.—A com. from H. R. Cassel.—*26th September*, 1882.
4596. Measuring Electric Currents, S. Z. de Ferranti & A. Thompson, London.—*27th September*, 1882.
4636. Manufacture of Bismuth Bronze, J. Webster, Solihull.—*29th September*, 1882.
4690. Safety Hooks, H. H. Lake, London.—A communication from W. K. Rairigh.—*2nd October*, 1882.
4736. Preventing the Radiation of Heat, J. Roberts, Oldham, & G. Travis, Failsworth.—*5th October*, 1882.
4746. Starting, &c., Rotary Motion, C. D. Abel, London.—Com. from F. Reuleaux.—*5th October*, 1882.
4758. Obtaining Ammonia from Furnace Gases, J. and J. Addie, Glasgow.—*6th October*, 1882.
4768. Covering Wire for Electrical Purposes, J. J. C. Smith, New York, U.S.—*7th October*, 1882.
4770. Cooling Liquids, C. Pieper, Berlin.—A communication from H. Egells.—*7th October*, 1882.
4778. Telephones, H. B. T. Strangways, London.—*7th October*, 1882.
4812. Incubator, T. Christy, London.—*10th October*, 1882.
4870. Facing Points for Tramways, H. Scott, Liverpool.—*13th October*, 1882.
4949. Fluids for Washing Sheep, B. Nickels, London.—*18th October*, 1882.
4957. Road Vehicles, J. Macdonald, Wimbledon.—*18th October*, 1882.
5256. Artificial Ice, T. D. Kyle, London.—*3rd November*, 1882.

(Last day for filing opposition, 5th December, 1882.)

3245. Separating Tar from Ammoniacal Liquor, J. and R. Dempster, Elland.—*8th July*, 1882.
3249. Looms for Weaving, C. Thompson, Halifax.—*8th July*, 1882.
3258. Retaining Stockings, &c., in Position, J. Parry, London.—*10th July*, 1882.
3262. Dyeing Cotton, E. Heppenstall, Huddersfield.—*10th July*, 1882.
3265. Emery Wheels, R. R. Gubbins, London.—*10th July*, 1882.
3266. Paring the Curls of Hat Rims, J. Cree, Denton.—*10th July*, 1882.
3275. Compound Surface Condensing Engines, A. W. Robertson, West Ham.—*11th July*, 1882.
3287. Regulating Supply of Gas, W. Cheyne, Briton Ferry.—*11th July*, 1882.
3289. Hame Plates of Harness, R. and B. Garrington, Darlaston.—*11th July*, 1882.
3305. Ammonia, J. P. Rickman and J. B. Thompson, London.—*12th July*, 1882.
3307. Rotary Steam Engines, &c., P. Goldschmidt, G. Hahlo, & A. Heussy, Manchester.—*12th July*, 1882.
3312. Water Level Indicator, G. R Hugon, London.—A communication from J. B. Lefèvre and P. Renaux.—*12th July*, 1882.
3313. Folding Chairs, L. Field, Birmingham.—*12th July*, 1882.
3338. Clay Press Trays, J. Brindley, Burslem.—*14th July*, 1882.
3391. Wire, T. Morgan, London.—A communication from E. I. Levavasseur.—*17th July*, 1882.
3393. Electric Lamps, J. D. F. Andrews, Glasgow.—*17th July*, 1882.
3396. Printing in Colours, J. Davies, Hatcham, T. A. Middleton, Staines, and W. G. White, Deptford.—*17th July*, 1882.
3406. Securing the Handles of Cutlery, H. Bottom and C. Rose, Sheffield.—*18th July*, 1882.
3444. Artificial Stone, &c., Pavement, E. L. Ransome, San Francisco, U.S.—*20th July*, 1882.
3463. Corsets, &c., R. Hunting, London.—A communication from J. G. Avery.—*21st July*, 1882.
3478. Actuating the Valves of Steam Engines, P. R. Allen, London.—*21st July*, 1882.
3484. Ejector Nozzles, J. L. Norton and J. Sturgeon, London.—*21st July*, 1882.
3494. Rubbing Mechanism for Carding Machines, C. A. Day, London.—A communication from J. Barker.—*22nd July*, 1882.
3503. Hammocks, R. H. Holman and W. C. Draper, Grantham.—*22nd July*, 1882.
3550. Automatic Apparatus to Ensure Safety in Case of Fire, C. S. Beauchamp, London.—*26th July*, 1882.
3562. Treatment of Sewage, J. Young, Kelly, N.B.—*27th July*, 1882.
3568. Hoes, J. P. Goss and F. Savage, King's Lynn.—*27th July*, 1882.
3741. Bricks, Tiles, &c., A. Bouquié, Paris.—*5th August*, 1882.
3790. Improved Paint, &c., E. P. Wells, London.—*9th August*, 1882.
4045. Signalling Apparatus, H. Diggins and A. Glück, London.—*23rd August*, 1882.
4162. Electric Lighting, T. T. Smith, London.—*31st August*, 1882.
4402. Supply and Waste Valves, S. S. Hellyer, London.—*15th September*, 1882.
4463. Buttoned Boots, C. Chambers, London.—*19th September*, 1882.
4499. Stitching Machines, B. Hague, Nottingham.—*21st September*, 1882.
4500. Doubling, &c., Machinery, J. and J. Horrocks, Manchester.—*21st September*, 1882.
4509. Drain Pipes, F. H. Noot, London.—*21st September*, 1882.
4590. Treatment of Soap Leys, A. J. Lawson and H. L. Sulman, Bristol.—*27th September*, 1882.
4790. Velocipedes, G. W. Quartremaine, Stratford-on-Avon.—*7th October*, 1882.
4792. Treatment of Hides and Skins, W. Maynard, Liverpool.—*7th October*, 1882.
4868. Improved Lounge, A. J. Wilkinson, London.—*13th October*, 1882.
4912. Perambulators, T. F. Simmons, Croydon.—*16th October*, 1882.
4945. Blasting, &c., Coal, M. Settle, Bolton.—*17th October*, 1882.
5011. Slide Valves, J. Dunbar, Southampton.—*21st October*, 1882.
5019. Iron and Steel Tubular Telegraph Poles, J. C. Johnson, Wednesbury, and R. Martin, West Bromwich.—*21st October*, 1882.
5197. Flushing Water-closets, W. R. Lake, London.—A com. from J. Cooper.—*31st October*, 1882.
5279. Clocks, W. R. Lake, London.—A com. from the Standard Time Company.—*4th November*, 1882.
5280. Signalling by Electricity, W. R. Lake, London.—A communication from the Standard Time Company.—*4th November*, 1882.
5340. Reciprocating Cylinder Printing Presses, S. Pitt, Sutton.—A communication from W. G. Walker.—*8th November*, 1882.

Patents Sealed.

List of Letters Patent which passed the Great Seal on the 10th November, 1882.)

2126. Gas Motor Engines, S. Worssam, London.—*5th May*, 1882.
2221. Holding the Globes of Gas Lamps, J. Archer and T. L. Archer, Manchester.—*11th May*, 1882.
2232. Generating Electric Currents, J. M. Stuart, London.—*11th May*, 1882.
2233. Electric Lamps, J. M. Stuart, London.—*11th May*, 1882.
2236. Improved Alcoholic Beverage, J. H. Loder, Leiden, Holland.—*11th May*, 1882.
2243. Construction of Capstans, A. Kennedy, Marquis of Ailsa.—*12th May*, 1882.
2257. Gas Engines, O. Mobbs, Northampton.—*13th May*, 1882.
2258. Ships' Windlasses, W. H. Whettem, Gateshead.—*13th May*, 1882.
2260. Planing Metals, G. Richards, Manchester.—*13th May*, 1882.
2262. Manufacture of "Purl," F. and E. Stanton, Lewisham.—*13th May*, 1882.
2267. Fastening Devices for Gloves, W. R. Lake, London.—*13th May*, 1882.
2274. Flour Milling Machinery, A. B. Wilson, Holywood, Ireland.—*15th May*, 1882.
2279. Pricking-up Apparatus for Leather Stitching Machines, J. Day, Stafford.—*15th May*, 1882.
2283. Gold and Silver Thread, F. Wirth, Frankfort-on-the-Main.—*15th May*, 1882.
2284. Rotary Engines and Pumps, E. C. Peck, Charlton.—*15th May*, 1882.
2292. Woven Fabrics, E. Briggs, Bradford.—*16th May*, 1882.
2305. Registering the Number of Persons Entering Public Vehicles, J. Morris, Liverpool.—*17th May*, 1882.
2320. Water Wheels, &c., A. Figge, London.—*17th May*, 1882.
2448. Yarn-winding Machines, E. Ashworth, Bolton-le-Moors.—*24th May*, 1882.
2457. Determining the Situation of Vessels at Sea, P. M. Justice, London.—*24th May*, 1882.
2460. Thrashing Machines, P. Gibbons and A. S. F. Robinson, Wantage.—*24th May*, 1882.
2467. Cotton Presses, W. R. Lake, London.—*24th May*, 1882.
2514. Signalling on Railways, J. White, London.—*26th May*, 1882.
2543. Looms, W. R. Stitt and J. Lees, Belfast.—*30th May*, 1882.
2616. Churns, G. Hathaway, Chippenham.—*3rd June*, 1882.
2761. Paper Bag Machines, M. Campe and L. Campe, Berlin.—*12th June*, 1882.
2771. Dynamo-electrical Machines, J. Farquharson, London.—*13th June*, 1882.
3026 Blow-pipe Lamp, J. T. Garrett, London.—*27th June*, 1882.
3398. Producing Transparent Patterns on Glass, D. Reich, Berlin.—*17th July*, 1882.
3460. Crank-shafts, D. Purves, London.—*20th July*, 1882.
3642. Sculling Boats, T. J. Edwards, London.—*1st August*, 1882.
3643. Ammonia, A. Feldmann, Bremen, Germany.—*1st August*, 1882.
3668. Lubricating Machinery, B. A. Dobson, Bolton.—*2nd August*, 1882.
3672. Figured Cloth, J. Kirkman, R. Smith, and P. Entwistle, Bolton.—*2nd August*, 1882.
3814. Electric Lamp Apparatus, H. J. Haddan, London.—*10th August*, 1882.
3917. Disinfecting Compounds, C. Lowe and J. Gill, Manchester.—*16th August*, 1882.
3950. Dynamo-electric Machines, S. Z. de Ferranti and A. Thompson, London.—*17th August*, 1882.
4113. Sewing, &c., Knit Goods, J. H. Johnson, London.—*29th August*, 1882.

(*List of Letters Patent which passed the Great Seal on the 14th November*, 1882.)

1908. Strainers for Straining Pulp, G. Tidcombe, jun., Watford.—*21st April*, 1882
2275. Bedsteads, &c., T. Welton, London.—*15th May*, 1882.
2306. Fountain Inkstands, F. F. Benvenuti, Swansea.—*17th May*, 1882.
2307. Earth Closets, F. Versmann, New Charlton.—*17th May*, 1882.
2309. Spring Motors, H. J. Haddan, London.—*17th May*, 1882.
2310. Reversible, &c., School Desk, W. R. Thomas, Peterborough.—*17th May*, 1882.
2311. Submarine Cable Grapnels, Sir J. Anderson and W. C. Johnson, London.—*17th May*, 1882.
2312. Children's Chairs, G. W. von Nawrocki, Berlin.—*17th May*, 1882.
2313. Tables, G. W. von Nawrocki, Berlin.—*17th May*, 1882.
2314. Roofs, &c., for Carriages, G. W. von Nawrocki, Berlin.—*17th May*, 1882.
2316. Marking Lawn Tennis Courts, W. Burrows and G. Dawson, Leeds.—*17th May*, 1882.
2323. Preserving, &c., Beverages, W. A. Barlow, London.—*17th May*, 1882.
2327. Attaching Knobs to Spindles, T. H. P. Dennis, Chelmsford.—*17th May*, 1882.
2329. Gas Engines, W. B. Hutchinson, London.—*18th May*, 1882.
2332. Adjustable Reclining Chairs, J. Cowan, Liverpool.—*18th May*, 1882.
2333. Navigable Vessels, J. T. Grindrod, Liverpool.—*18th May*, 1882.
2235. Fittings for Electric Lamps, C. Defries, London.—*18th May*, 1882.
2344. Hammerless Breech-loading Fire-arms, T. Woodward, Birmingham.—*18th May*, 1882.
2348. Incandescent Electric Lamps, S. H. Emmens, London.—*18th May*, 1882.
2349. Electrical Apparatus, S. H. Emmens, London—*18th May*, 1882.
2356. Slide Valves for Steam Engines, J. Emery, Erith.—*19th May*, 1882.
2364. Dynamo-electric Machines, R. Werdermann, London.—*19th May*, 1882.
2377. Gullies, H. Kelly, Hampstead, London.—*20th May*, 1882.

2386. Drawing Apparatus for Spinning Machines, L. A. Groth, London.—20*th May*, 1882.
2387. Mechanical Cab, N. D. Spartali, Liverpool.—20*th May*, 1882.
2401. Agglomerating Minerals, J. Wetter, London.—22*nd May*, 1882.
2413. Lawn Mowers, R. Kirkman, jun., Cosby.—22*nd May*, 1882.
2420. Covering, &c., Wall Surfaces, W. S. Morton, Edinburgh.—23*rd May*, 1882.
2449. Treating Spent Lyes, F. H. T. Allan, Warrington.—24*th May*, 1882.
2459. Sweeping Streets, &c., B. W. Stevens, Birmingham.—24*th May*, 1882.
2473. Pianos and Pianinos, F. C. Glaser, Berlin.—24*th May*, 1882.
2483. Embroidering Machine, W. E. Gedge, London.—25*th May*, 1882.
2506. External Lamps for Railway Trains, A. M. Silber, London.—26*th May*, 1882.
2510. Frames for Stay Laces, A. W. L. Reddie, London.—26*th May*, 1882.
2554. Vulcanising India-rubber, J. H. Johnson, London.—30*th May*, 1882.
2582. Measuring Speed of Railway Trains, F. C. Glaser, Berlin.—31*st May*, 1882.
2622. Arresting Persons Attempting to Enter a Door, &c., E. L. Missonier, London.—3*rd June*, 1882.
2684. Ships' Steerage Berths, A. Nickels. Liverpool.—8*th June*, 1882.
2876. Bicarbonate of Soda, H. Gaskell, jun., and F. Hurter, Widnes.—17*th June*, 1882.
3276. Piston Valve Musical Instruments, B. J. B. Mills, London.—11*th July*, 1882.
3353. Brick-making Machinery, G. Dalton, Leeds.—14*th July*, 1882.
3538. Permanent Way of Railways, A. M. Clark, London.—25*th July*, 1882.
3571. Breaking, &c., Stone, G. Dalton, Leeds.—27*th July*, 1882.
3664. Fastening for Tarpaulins, T. Marlborough and J. Cunningham, Sunderland.—2*nd August*, 1882.
3779. Electric Lamps, B. J. B. Mills, London.—9*th August*, 1882.
3782. Bicycles, J. Beale, Blackheath.—9*th August*, 1882.
3818. Type and Space Holders, J. C. Mewburn, London.—10*th August*, 1882.
3832. Self-acting Steam Traps, L. Dove, Stratford.—11*th August*, 1882.
3880. Leather, J. H. Johnson, London.—15*th August*, 1882.
3888. Lubricating Apparatus, W. R. Lake, London.—15*th August*, 1882.
3942. Improved Pump, W. B. Tibbits, Clifton.—17*th August*, 1882.

List of Specifications published during the week ending November 11th, 1882.

1098, 8d.; 1272, 6d.; 1582, 2d.; 1583, 6d.; 1597, 6d.; 1602, 6d.; 1625, 6d.; 1639, 4d.; 1661, 8d.; 1663, 6d.; 1664, 6d.; 1668, 8d.; 1672, 1s.; 1673, 2d.; 1674, 6d.; 1676, 2d.; 1677, 2d.; 1678, 2d.; 1679, 6d.; 1680, 6d.; 1681, 6d.; 1684, 6d.; 1686, 2d.; 1689, 6d.; 1690, 2d.; 1692, 6d.; 1693, 4d.; 1695, 6d.; 1696, 4d.; 1698, 6d.; 1700, 6d.; 1701, 6d.; 1704, 4d.; 1706, 6d.; 1709, 6d.; 1710, 2d.; 1711, 2d.; 1714, 4d.; 1715, 8d.; 1716, 6d.; 1718, 2d.; 1720, 6d.; 1721, 4d; 1723, 2d.; 1725, 4d.; 1727, 6d.; 1728, 4d.; 1730, 2d.; 1731, 6d.; 1732, 6d.; 1736, 2d.; 1739, 2d.; 1743, 6d.; 1744, 6d.; 1751, 6d.; 1754, 6d.; 1755, 4d.; 1756, 6d.; 1768, 2d.; 1769, 6d; 1770, 2d.; 1771, 6d.; 1774, 6d.; 1776, 2d.; 1779, 6d.; 1781, 2d.; 1782, 2d.; 1786, 2d.; 1801, 6d; 2142, 6d.; 2328, 6d.; 2352, 6d.; 3039, 6d.; 3041, 6d.; 3178, 1s. 6d.; 3292, 6d.; 3362, 4d.; 3489, 2d.; 3881, 6d.; 3959, 6d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

1098. Working Velocipedes, *J. M. Taylor, Seer Green, and G. Wethered, Maidenhead.—7th March*, 1882. 8*d.*

The object is to apply the action of rowing to the driving of tricycles, and it consists in the use of a sliding seat working on an inclined frame and raised by the rider pressing on the footboard, the seat being connected to the driving axle by ropes and pulleys or drums.

1272. Appliances to be Worn by Children and Invalids for Protecting the Body from Contact with Urine or other Matter, *C. Rubens, Grosvenor-square.—16th March*, 1882. 6*d.*

This consists of a pad shaped to fit the wearer, and perforated to allow urine or excrementitious matter to pass to a reservoir beneath.

1582. Process for Producing Copies of Writings, Drawings, &c., *M. Farmer, Chelsea.*—31*st March*, 1882.—(*Void.*) 2*d.*

This relates to the use of a composition to receive the transfer, which shall not require to be first moistened.

1583. An Improved Electric Bell and Electric Battery, *H. Binko, South Hornsey.*—1*st April*, 1882.—(*A communication from M. J. Siegel, Brünn, Austria.*) 6*d.*

Instead of the usual hammer the inventor arranges the armature to work on a pivot, and constructs it of two parts, one of which carries the knob and receives its action by means of a lever, anchor, or claw from the other part. By this means the inventor claims to obtain more correct striking without vibration, and louder tone. The battery consists of a zinc rod and a cylinder formed of a mixture of carbon and manganese, to which is added a proportion of iron filings, oxide of iron, or oxide of copper, by means of moulds and pressure. The exciting solution is muriate of soda or salammoniac.

1597. Stoppers and Valves of Syphon or other Bottles, *H. J. West, Southwark Bridge-road.*—1*st April*, 1882. 6*d.*

This relates to a stopper fitted with a valve, which is forced up to its seat by a spring, and also to an opening appliance to force the valve down from its seat and draw off the liquid from the bottle.

1599. Metallic Brushes, &c., *W. F. Bateman, Low Moor.*—1*st April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the manufacture of hair or clothes brushes, each bristle of which consists of a wire of steel permanently magnetised, which magnetised wires or bristles may be used in combination with ordinary bristles.

1600. Electrical Apparatus for Indicating, &c., Fires, *G. W. von Nawrocki, Berlin.*—1*st April*, 1882.—(*A communication from F. Bahr, Warsaw.*) 6*d.*

The expansion or burning of a part of the apparatus causes electrical contact, and actuates a tap so that water is turned on.

1601. Air Economiser for Mixing, &c., *W. Teague, jun., Tincroft, Cornwall.*—1*st April*, 1882. 4*d.*

This relates to the construction of the apparatus whereby the work may be resumed without the delay of filling the reservoirs before having the desired pressure to commence drilling.

1602. Ring Spinning Frames, *A. M. Clark, London.*—1*st April*, 1882.—(*A communication from J. B. Rolland, Paris.*) 6*d.*

The objects are, First, to facilitate the joining of broken threads, avoid twisting, and rendering the working and lubrication of the spindles more perfect; Secondly, to regulate the tension of the thread between the traveller and the feed rollers. The foot of each spindle has the form of a truncated cone with its larger end downwards and rounded. The wharve has a downwardly projecting flange at the lower edge, which surrounds the oil cup, and serves to stop the spindle by applying a brake when required to piece up the thread.

1603. Pianos, *W. Fischer, Dresden.*—3*rd April*, 1882. 6*d.*

This relates to pianos in which the notes are produced by forks of metal or other suitable material, and similar to tuning forks, and the improvements consist in the particular mode of connecting the forks to the sounding board of the instrument, in the means employed for rendering the sound more pure, and in a device by which the strength of the sounds may be modulated at the will of the player.

1604. Vaporising Fluids, *C. Scott, Belfast.*—3*rd April*, 1882. 4*d.*

This consists partly in the employment of a covered bowl or chamber made of iron, tin, zinc, copper, porcelain, or other similar material, and having a funnel or pipe leading to the interior through a suitable perforation, by means of which the fluid to be employed is introduced, and the vapour created by heating such fluid issues for the sanitary or medical purposes intended to be effected.

1605. Manufacture of Washers, *E. I. H. E. and J. T. Whitehouse, Tipton.*—3*rd April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the general construction of machinery for the manufacture of metallic or other washers.

1606. Working the Block System on Railways, *H. J. Haddan, Kensington.*—3*rd April*, 1882.—(*A communication from A. Flamache, Brussels.*) 6*d.*

The apparatus consists of three distinct parts: First, the controlling apparatus; Secondly, the official signalling apparatus, completely independent of the latter; and Thirdly, the indicators which have some points in common with the first and second apparatus.

1607. Door Locks, *J. Mathisen, Christiania, Norway.* 3*rd April*, 1882. 6*d.*

This relates to improvements in the general construction of locks.

1608. Automatic Weighing Machines, *C. Reuther, Hennef, Germany.*—3*rd April*, 1882. 8*d.*

One part of the invention relates to an arrangement of the mechanism for opening and closing the supply of granular or pulverous material from the hopper to the receptacle of the weighing machine. Another part relates to the arrangement of the machine for weighing liquids.

1609. Parquet Flooring, *F. H. F. Engel, Hamburg.*—3*rd April*, 1882.—(*A communication from F. H. Schmidt, Altona, Prussia.*)—(*Not proceeded with.*) 2*d.*

This relates partly to the means of cutting the differently coloured or shaped parts of veneer.

1610. Feeding Wool, &c., to Carding Machinery, *W. Cliffe, near Huddersfield.*—3*rd April*, 1882. 8*d.*

The inventor claims, First, the employment of two or more revolving spiked rollers in combination with a fan or beater; Secondly, the employment of two or more revolving spiked rollers in combination with a travelling apron; Thirdly, the use and employment of a regulating plate or plates when used in combination with a loose bottom.

1613. Taps and Cocks, *F. C. Fleury, London.*—3*rd April*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to produce an efficient waste-preventing tap or cock.

1615. Utilisation of Tides or other Water Power, *E. Davies, London.*—3*rd April*, 1882. 6*d.*

This relates to improvements on patent No. 3012, dated 12th Oct., 1872, and consists in improvements in the construction of the turbines and in obtaining additional work from the reservoirs by use of floating stages or pontoons placed in them to rise and fall with the water, and to make the sluices or equivalent connecting them with the turbines or with each other, self-acting, though they may be operated by hand or otherwise if preferred.

1617. Machines for Cutting Wood Blocks for the Manufacture of Matches, *F. Wirth, Frankfort-on-the Maine.*—3*rd April*, 1882.—(*A communication from G. Sebold, Karlsruhe.*) 8*d.*

One of the improvements consists in imparting to the knife or cutter a motion in the direction of its length at the same time as the advancing motion, in order to obtain a smooth cut surface.

1621. Adjustable Photographic Exposer, *G. L. Addenbrooke, London.*—4*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This consists, First, in the use of a simple clockwork train governed by a fan to regulate photographic exposures, such clockwork train to release both shutters, or their equivalents in other forms of shutter, when the apparatus is wound up, the shutter set, and the fly released. Secondly, the use of a rotating disc with two projections or their equivalent, for the purpose of regulating photographic exposures.

1622. Rock Drilling, *H. D. Pearsall, London.*—4*th April*, 1882. 6*d.*

The inventor claims, First, propelling the piston or plunger of a percussive rock drill by an explosive admitted to and fired in the cylinder of the drill. Secondly, effecting intermediate strokes by the vapour of a liquid admitted to the heated cylinder.

1623. Bicycles, *A. E. Gorse, Birmingham.*—4*th April*, 1882. 6*d.*

This consists in the construction of bicycles in such a manner that the backbone is pivotted somewhat behind the centre line of the front fork.

1624. Machinery for Driving Tunnels or Shafts, *C. D. Abel, London.*—4*th April*, 1882.—(*A communication from F. Rziha, Vienna, and F. Reska, Prague.*) 6*d.*

This relates to an improved construction of machinery for driving tunnels or shafts wherein a revolving bore-head is caused continuously to cut away the face of the rock by means of cutters so arranged that one set thereof cuts a series of concentric circular grooves, leaving annular projecting ridges between them, which are then cut or broken away by another set of cutters, the advance of the bore-head being effected by a cylinder and piston actuated by hydraulic or other pressure.

1625. Recovering Lead, &c., from Furnace Fumes, *E. A. Cowper and T. Sopwith, Westminster.*—4*th April*, 1882. 6*d.*

The fumes are caused to pass through diaphragms of porous woven fabric placed in a horizontal or inclined position, whereby the solid matters are arrested and fall on to the floor of the chamber in which the diaphragms are suspended, and can be removed from time to time.

1627. Separating Metallic and other Bodies from Earth, *B. Tillett, Leytonstone.*—4*th April*, 1882.—(*A communication from E. S. Bennett, Colorada, U.S.*) 8*d.*

The quartz or other earth is placed in a revolving drum of wire or meshed work, and provided with a screw-like blade, or a number of them if desired, in the interior, so that the particles larger than the meshes may pass to the end to be further reduced, the finer particles pass through the meshes and meet with jets of water forced upwards in all directions from nozzles which saturate and partly break up the particles.

1628. Manufacture of Surface Printing Blocks, Dies, &c., *J. Noad, East Ham.*—4*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a mixture consisting of silicate, say, fine sand, 50 parts; clay or brick earth, 50 parts; ground glass, 50 parts; boracic acid, 10 parts; sulphur, 10 parts. These are well mixed, and placed in a crucible or retort and heated until brought to a red heat and stirred. This being carried out, the charge is ground and sifted, and the mixture used as follows: 100 parts are put into a pan and heated to 450 deg. Fah., sufficient sulphur being used till the mixture has become fluid. It is then cast into ingots, which can be melted and used in the ordinary way of stereotype casting.

1629. Shoes for Horses, &c., *W. E. Litt, Shrewsbury.*—4*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This consists in making the shoes of india-rubber, either alone or in combination with gutta-percha, wood, leather, or other material capable of being securely attached to or combined with the rubber.

1630. Obtaining Caustic Soda and Chlorine by the Decomposition of Saline Solutions, *J. B. Spence, London, and A. Watt, Charlton.*—4*th April*, 1882. 4*d.*

The inventors claim obtaining caustic soda and chlorine from the decomposition of saline solutions produced by electricity, being generated by the employment of the hydrogen gas evolved during such manufacture.

1639. Improvements in Electro Depositing Copper, &c., *W. H. Walenn, Islington.*—4*th April*, 1882. 4*d.*

This relates to improvements on the inventor's previous patents No. 1540, 1857, and 3930, 1868, the object of which is to procure absolute adhesion of the electrolytic coating to the metal underneath. To deposit copper so that it may adhere and be in a soft condition the inventor uses the following solution:—32 oz. avoirdupois of cyanide of potassium (70 per cent. real cyanide), and 1 oz. neutral tartrate of ammonium per gallon of liquid—this is charged with copper electrolytically; the solution is then completed by the addition of cupric ammonide as set forth in patent No 3930, 1868. This solution is used at a boiling heat, which softens the coating of copper and increases the rate of deposition. Other parts of the invention relate to the prevention of evaporation of the solution, working copper, &c., solutions in a closed vessel under a known pressure, &c.

1641. Measuring, &c., Liquid, *J. M. Smales, Leavesden, and H. J. Rogers, Watford.*—5*th April*, 1882. 6*d.*

This relates to means and apparatus for measuring and indicating the depths of liquids, semi-liquids and fluids, in seas, rivers, canals, docks, &c., such indications being transmitted to any desired distance.

1643. Buttons, *G. W. von Nawrocki, Berlin.*—5*th April*, 1882.—(*A communication from C. Brandt, Saxony.*) 4*d.*

The object is to enable sewn-on buttons to be easily secured to the fabric, and to be made so that the outer or top portion will entirely cover the thread sewing the button.

1644. Portable Apparatus for Extinguishing Fires, &c., *M. Vinning, London.*—5*th April*, 1882. 6*d.*

The apparatus is constructed for the utilisation of compressed air, which exerts its pressure upon water in a reservoir in such a manner as to throw a stream of the same through a nozzle with considerable force.

1646. Bobbins and Spools, *J. Spence, near Bradford.*—5*th April*, 1882. 4*d.*

The bobbins or spools are made of paper, paper pulp, &c., coated with dissolved shellac, dripping oil, or other suitable varnish.

1648. Vertical Rough and Fine Grinding Mills, *F. V. D. Wyngaert, Berlin.*—5*th April*, 1882.—(*A communication from O. Soldan, Frankfort-on-the-Oder.*)—(*Not proceeded with.*) 2*d.*

This invention consists in forming the grinding stones of rings of stone, a scoop or shovel apparatus regularly feeding the mill at all points.

1651. Fire Escape and Extinguishing Apparatus, *W. R. Lake, London.*—5*th April*, 1882.—(*A communication from L. D. B. Shaw, U.S.*) 6*d.*

This relates to fire escapes in which a telescopic column is employed for elevating a ladder to any required height, and when so elevated to enable the column and ladder to be inclined in any direction.

1652. Curbs of Roads and Footpaths, *J. J. Wheeler, Chelsea.*—5*th April*, 1882. 4*d.*

The object is to use the curb as a means for holding conducting wires for telegraphic or electrical purposes, or even for pneumatic tubes.

1654. Felt Leathers for the Linings of Hats, &c., *C. J. Shaw and E. Nördlinger, Glasgow.*—5*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This consists of an outside band of perforated leather or other like material, arranged next to an inner band of flannel or other absorbing material, with a thin band of waterproof material at the back.

1655. Water-closets, *H. Conolly, London.*—5*th April*, 1882. 4*d.*

This relates to the construction of the water-closet pan so as to prevent the escape of sewer gas.

1656. Wheeled Carriages and Wagons, *H. J. Barrett, Kingston-upon-Hull.*—5*th April*, 1882. 6*d.*

The carriage or wagon is made of detached parts, which may be bolted together or taken to pieces.

1657. Apparatus for Automatically Playing Pianofortes, &c., *W. R. Lake, London.*—5*th April*, 1882.—(*A communication from F. E. Moore, Boston, U.S.*) 8*d.*

This relates to attachments for musical instruments having a keyboard, the said attachments being adapted to be readily secured to, or removed from, the said keyboard, and constructed and arranged to mechanically strike the keys of the instrument, and thereby sound the notes or tones thereof in an order or succession corresponding to perforations in parallel rows in a music sheet, which is caused to travel in proper relation to the operating mechanism of the attachment.

1658. Machinery for Sewing or Rivetting Driving Belts or Straps, *T. Wheelhouse, near Brighouse.*—5*th April*, 1882.—(*Not proceeded with.*) 2d.

The object is partly to cut the belt parallel and straighten the edges thereof, whilst they are passing through the machine to be sewn or rivetted together.

1659. Utilising the Action of Sea Waves for Driving Machinery, *R. J. Scott, London.*—5*th April*, 1882. 8*d.*

The object is to utilise the motion of sea waves by their action on a float which is free to rise and fall within certain limits, whereby through the connection with apparatus or appliances, machinery or mechanism may be driven.

1661. Mills for Grinding Grain or Seed, *W. R. Lake, London.*—5*th April*, 1882.—(*A communication from N. W. Holt and R. K. Noye, Buffalo, U.S.*) 8*d.*

This relates to roller mills, and consists, First, of feed mechanism to regulate the flow of material from the hopper to the rolls; Secondly, of driving mechanism, whereby the rolls are rotated by an endless belt clamped or pressed between two pulleys, whereby it is prevented from slipping, and the rollers thus prevented from changing their speed by frictional contact with each other through the medium of the material passing between them; Thirdly, of mechanism to adjust the rollers to and from each other; and, Fourthly, of peculiar dress ribs or corrugations applied to the rollers.

1664. Distributing and Checking Tickets, *J. Lawson and J. Sirech, Bordeaux.*—6*th April*, 1882. 6*d.*

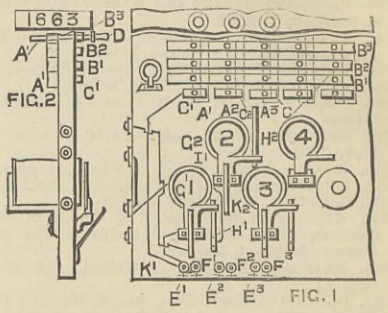
This consists of a box divided into compartments, each containing a column of tickets pressed downwards by a weight so as to force them towards an opening at the bottom, from which they are withdrawn, the position of the weight indicating the number of tickets that have been withdrawn from each compartment. Attached to the box is a numbering or dating mechanism.

1662. Manufacture of the Wheels of Colliery Corves, &c., *R. Hadfield, Sheffield.*—5*th April*, 1882. 8*d.*

The inventor claims, First, the method of manufacturing the wheel or under-frames of colliery corves or wagons by casting the same in steel or malleable iron complete at a single operation; Secondly, the construction and method of fitting such wheel or under-frames when so manufactured.

1663. Improvements in the Arrangement of Circuits and in Apparatus to Facilitate Communication by Telephone, *F. D'A. Goold, Euston-road.*—5*th April*, 1882. 6*d.*

This relates to improvements in telephone switch-boards, &c. Fig. 1 shows the switch-board. The subscribers' lines are connected to A^1 A^2, &c., which are spring strips; crossing these at right angles are bars B^1 B^2, &c. C^1 C^2, &c., are metal blocks, one for each bar A. The connections are made by pegs D D. The normal state of the line is with the peg inserted making connection between A and C. Blocks C^1 C^2, &c., are connected with E^1 E^2, &c., which are battery terminals. The other terminals of the battery F^1 F^2



&c., are connected with the supports to which the armatures and indicators G^1 G^2, &c., are pointed. When the armatures are against the magnets the circuits are through spring H^1 H^2, &c., I^1 I^2, &c., to earth, the return being through subscribers' wire. When the armature has fallen the circuits are by K^1 K^2, &c., and so to earth through the instruments of the attendant at the station. B^1 B^2, &c., are in pairs, and the two bars of each pair are connected with battery terminals, negative and positive. Fig. 2 is another view of the board. The patent also includes improvements in the subscribers' instrument, &c.

1665. Producing Tannin, &c., *E. A. Brydges, Berlin.*—6*th April*, 1882.—(*A communication from A. Mitscherlich, Munden, Germany.*) 4*d.*

The process consists principally in the action of the so-termed bi-sulphite of lime—sulphite of lime dissolved in a weak solution of sulphurous acid—on previously steamed portions of plants or small pieces of wood, the water having a temperature above the boiling point.

1666. Steam Boilers, *G. Stevenson, Airdrie, N.B.*—6*th April*, 1882. 6*d.*

The object is, by improved modes of combining tubes having the water inside of them, with other parts, to form boilers which have extensive heating surfaces, and it also comprises important novel arrangements of the furnaces and flues of steam boilers.

1667. Tricycles and Bicycles, *T. Forshaw, Smalley.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to improvements in the general construction.

1668. Submarine Torpedoes, &c., *General W. N. Hutchinson, near Bideford.*—6*th April*, 1882. 8*d.*

This relates to improvements on patent No. 1866, A.D. 1881, and it consists, First, in giving greater sensitiveness to the touch of any vessel coming in contact with the torpedo by adding to the length of the upper cylindrical part of the head of the air chamber formed of thin metal, and in contracting the said metal part near its junction with the lower part of the air chamber; Secondly, in withdrawing the safety pin by an electric current which destroys the chemically-prepared twine that restrains a spring from withdrawing the pin. Should the torpedo drift, all danger is prevented by interposing another pin between the hammer and the copper cap. By releasing a cork attached by a thin cord to the drifting torpedo, its locality is shown; and Thirdly, in the means for rotating a spiked wheel placed in front of a projected torpedo or arrow.

1669. Tipping Frame for Wagons, *R. Hadfield, London.*—6*th April*, 1882. 6*d.*

The invention consists in casting a tipping frame by preference of cast steel or malleable iron, and affixing the same either by rivets or bolts underneath the wagon body.

1671. Extinguishing Fires, *P. Amjorn, Compte de Sparre, Paris.*—6*th April*, 1882. 6*d.*

This relates to the employment of apparatus for extinguishing fires in which gases are generated.

1672. Manufacturing Cigarettes, *P. Everitt, Queen Victoria-street.*—6*th April*, 1882. 1*s.*

The tobacco is fed through a semicircular trough by an endless band to the first pair of a series of grooved compressing rollers, through the whole of which it passes in succession, and is reduced to a cylindrical compressed form, which is fed on to a narrow web of paper, and carried by it to a tapering open tube, through which it passes, one edge of the paper projecting to receive gum. A roller then folds down the gummed edge, and the roll is cut into the required lengths.

1673. Circular Knitting Machinery, *H. Barratt, Nottingham.*—6*th April*, 1882.—(*Void.*) 2*d.*

The object is to facilitate the production of fashioned fabric by circular knitting machinery, and for this purpose the apparatus is arranged to produce at pleasure circular knitted fabric, and then, as desired, to effect a fashioning of the same. The circular head carrying the needles and the jacks or levers is stationary and the operating parts revolve round it. The jacks operate the needles, and have elongated ends to be operated by suitable surfaces to bring the needles into working position in the order desired. The fashioning movements are brought into operation by a jacquard or pattern surface.

1674. Safety Apparatus for Cages in Mines, &c., *C. D. Abel, London.*—6*th April*, 1882.—(*A communication from F. Pelzer, Germany.*) 6*d.*

This relates to apparatus for maintaining cages in their raised position, and for releasing them when required to be lowered; and it consists in the use of catches mounted on shafts at the opposite sides of the staging, and prevented from turning so as to allow the cage to descend by means of levers and catches, until the latter are released. The shafts are connected to springs, which cause them to turn back into their original position after the cage has descended. Cataracts are used in combination with the shafts and springs to control the motion of the shafts. The retaining catches are disengaged by means of cam surfaces on a spindle which is capable of being turned.

1676. Making Scaleboards, &c., *A. Millar, Glasgow.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This consists, First, in making composite scaleboards of two thicknesses glued together, with the fibre of one at right angles to that of the other; Secondly, in making boxes from the composite scaleboard in the same manner as millboard boxes are made—that is, by "scoring," by which the box is made of one piece and the lid of another; Thirdly, in leaving the boxes flattened out until required, when the corners may be secured by tying, rivetting, or cementing; Fourthly, in corrugating the sheets, so as to increase their strength.

1677. Fishing Tackle, *R. Clark, Edinburgh.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to minnow or parr tackle, the object being to save time in fixing the bait.

1678. Boring Machinery, *J. Orton, Durham.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This consists in making the borers or drills of steel of an oval section, thickest in the middle and tapering to nothing at the sides, and twisting the same with the required number of twists. The drill is carried in a frame adjustable up and down and sideway; according to the requirements of the boring, and the driving may be effected by nut and screw, in which case the nut should be reversible, so as to go into the ends of the driving screw to unloose the drills.

1679. Cleaning and Scouring Rice, &c., *M. Church, Washington, U.S.*—6*th April*, 1882.—(*A communication from D. Lukins, Georgetown, U.S.*)—(*Complete.*) 6*d.*

An inner cylinder is caused to revolve within an outer perforated screen, the surface of the former being preferably part perforated and part full. On the inner cylinder shaft are fitted arms carrying fan blades, provided with brushes, so that currents of air are forced through the cylinder and screen, and through the rice between them, while the latter is acted upon by the brushes.

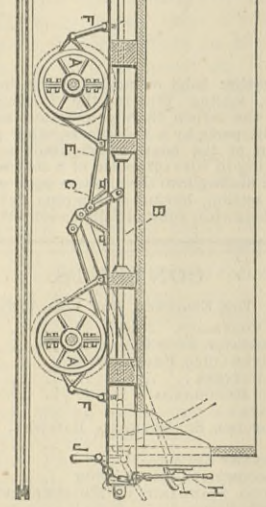
1680. Bicycles, &c., *W. Scantlebury, Lower Clapton.*—6*th April*, 1882. 6*d.*

This relates, First, to the application of a self-acting safety stop or brake to arrest momentum of the rider when the driving wheel comes in contact with an obstruction tending to throw him over the handle, and consists in forming on the head of the fork, towards the front thereof, an inclined serrated surface, which if the backbone is raised is brought to bear on a ball resting freely on the tire of the wheel, which is thus caused to grip the latter. The invention further relates to weighting the rim of the wheel at four equidistant places, so as to impart an additional momentum to the upper part of the wheel. Springs are applied to the head of the fork, and their ends rest on the backbone, so as to tend to keep the front wheel in line with the back wheel.

1681. Brakes and Couplings for Railway Carriages, &c., *J. P. Davies, Chester.*—6*th April*, 1882. 6*d.*

The brake consists of four cast iron brake wheels or pulleys A A, each made in halves and bolted together when upon the axle upon which they are keyed. B are longitudinal rods to which are secured levers C, by which rotary motion is given to a transverse shaft working in wrought iron brackets. Wrought iron or metal brake straps E are fastened to the levers C. Upon the opposite sides of the wheels they are suspended to the framework by links F. The longitudinal rods B are made so as to be coupled with chains, links, or other suitable appliances. The coupling apparatus consists of a lever H working upon a small fulcrum bracket I, links J J connected together with a knuckle joint, from which it is suspended by a short link chain to the end of the lever H.

1681



1682. Apparatus for Working Railway Signals, *J. Harrison, Hackney.*—6*th April*, 1882. 6*d.*

The inventor claims the interposition between a signal lever controlled by interlocking apparatus and its signals of a latch which is disengaged by a passing train (causing the signal to be automatically put on against a following train whilst the signal lever remains in the off position), and which latch re-engages when the signal lever is moved back by the signalman on the "on" or "danger" position of the signal.

1683. Manufacture of the Peroxides of the Alkalies, Alkaline Earths, and Hydrogen; and Application of the same, *L. Mond, Northwich.*—6*th April*, 1882. 6*d.*

This consists partly in the manufacture of barium peroxide from carbonate of baryta in a cupola or continuous kiln, in one part of which the material is exposed to great heat, so as to reduce it to caustic baryta, and in another to the action of hot air to produce the barium peroxide.

1684. Improvements in Telephonic Instruments, *A. E. Dolbear, Somerville, Massachusetts, and London.*—6*th April*, 1882. 6*d.*

This relates to improvements whereby a more advantageous effect of the vibratory action of the sound waves in telephonic transmitters can be obtained. In the inventor's instrument the relative position of the parts is so arranged that the sound waves will act so as to diminish the compression or closeness of contact of the electrodes at that phase at which in other instruments there is the greatest compression. One method of carrying out this principle is shown in Figs. 1 and 2. A is a short tube containing two tongues or electrodes B C formed of thin metal of a width nearly equal to the diameter of the tube, and extending longitudinally from the wire terminals at the other end of the tube; B C are capable of slight movement towards and away from each other, and are in connection with battery wires. A is the mouthpiece, Fig. 1 is a longitudinal section, and Fig. 2 a section of the same on the line X X.

1684

FIG. 1.

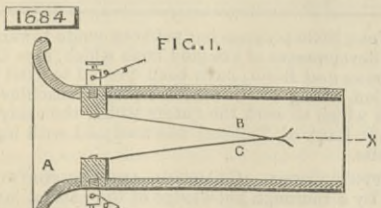
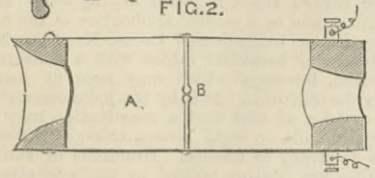


FIG. 2.



1686. Label Holders for Plants, &c., *J. Parker, Woodstock.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a metal sheath to receive a piece of glass, and also a second sheath containing a piece of any suitable material bearing the name of the plant. The glass will prevent the name from becoming effaced.

1687. Motor for Driving Sewing Machines, Lathes, Tricycles, &c., *C. J. Griffith, jun., London.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a pair of gear wheels worked by a weight or spring.

1688. Packing Cases, *D. Nicoll, Strand.*—6*th April*, 1882. 4*d.*

This relates to the construction of light and strong packages to be used especially for the post.

1689. Improvements in Electric Lamps, *G. S. Young, Blackwall, and R. J. Hatton, Stratford, Essex.*—6*th April*, 1882. 6*d.*

The inventors regulate the arc by means of a brake on the feeding carbon, consisting of a chamber containing balls surrounding the carbon, so arranged that the balls are made to jamb equally all round between the inner circumference of the chamber and the carbon, and to move it into the proper position for regulating the arc when the said chamber is acted on by a solenoid or its armature. When the arc is adjusted the chamber is released by the solenoid, the balls being released by coming aginst a stop, such as a tube or ring, connected to the lamp frame.

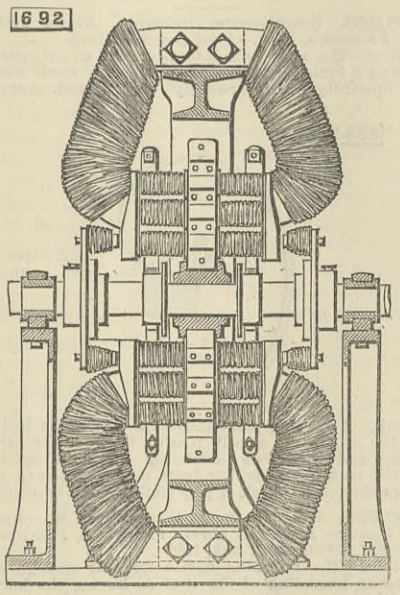
1690. Manufacture of Nickel, *P. C. Gilchrist and S. G. Thomas, Westminster.*—6*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the manufacture of nickel by treating crude nickel pig, in which nickel exists in combination with carbon and more or less iron and other substances, by injecting currents of air into the melted crude material.

1692. Improvements in Dynamo-Electric or Magneto-Electric Machines, *D. T. Piot, Great Tichfield-street, London.*—6*th April*, 1882. 6*d.*

The accompanying figure will explain the construction of the machine. The inventor claims the arrangement of bobbins forming the armatures fixed in radial series and parallel to the axis of rotation, so that such series of bobbins may come between the poles of the magnets. The magnets are placed so that their poles correspond with the radial lines of bobbins.

1692



1693. Checking or Indicating the Periodical Arrival and Departure of Employes, *W. M. Llewellin, Bristol.*—8*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to improvements on patent No. 2472, A.D. 1881; and consists, First, in providing the checking apparatus with shoots, so that the employés leaving or entering by another apartment may pass their checks into the machine; Secondly, in providing the machine with an open circular hopper, so that any number of checks may be passed in at one time; Thirdly, in the mode of supporting the central spindle which actuates the moving parts of the apparatus described in patent No. 1554, A.D. 1855, whereby the box to receive the checks can be withdrawn at will. Other improvements are described.

1694. Cornice Poles, Curtain Suspenders, &c., *C. F. Grimmett and J. Cook, Birmingham.*—8*th April*, 1882. 6*d.*

This relates to improvements in cornice poles and in curtain suspenders, and also in the mode of manufacturing the cornice rings of such suspenders, which mode is applicable to the manufacture of rings, armlets, &c.

1695. Breakwaters, &c., *G. H. T. Beamish, Queenstown, Ireland.*—8*th April*, 1882. 6*d.*

The object is to form breakwaters and other structures so that they are solid and bound together as one mass as far as lateral or side thrust is concerned, but so that any vertical settlement can take place without affecting the other parts; and it consists in the mode of forming the blocks of which the structure is built up with projections and recesses to interlock.

1696. Fishing Bait, *M. Carswell, Glasgow.*—8*th April*, 1882. 4*d.*

This consists in the use of a piece of vulcanised indiarubber, shaped and coloured to represent a worm in the action of moving through water.

1698. Boxes or Cases for the Transmission of Samples by Post, *M. J. Verkouteren, Fenchurch-street.*—8*th April*, 1882.—(*A communication from R. Chapin, Texas, U.S.*) 6*d.*

The body is cylindrical and closed at bottom, and is preferably stamped out of sheet metal. A stem with a screw thread at its upper end is fixed in the centre, and receives a wooden or other cover which screws on to it, so as to close the open top.

1700. Machinery for Galvanising Sheet Iron, *T. H. Johns, London.*—8*th April*, 1882. 6*d.*

The object is to produce a fine finished sheet of galvanised iron without the manipulation hitherto required, and at the same time an improved surface is put on the sheets. The sheets are put in at one end of a flat metal bath containing the coating metal, and pushed forward until seized by a pair of rollers heated by gas, and which feed the sheets through a pair of metal operators or surface dressers, which planish the plates and produce a good surface thereon by equalising the metal. The sheets are then drawn through a pair of hollow rolls which are cooled, and from them the plates may pass to apparatus for corrugating or stamping them as desired.

1703. Projectiles for Ordnance, *E. Palliser, West Kensington.*—8*th April*, 1882. 6*d.*

This consists in the use, in combination with projectiles for ordnance, of a jacket or casing fitting with an internal surface of tapering diameter upon a correspondingly tapered surface of the projectile, so that on the projectile striking an armour plate, a projecting shoulder on the jacket will cause it to be stripped off the projectile.

1702. Rotary Motors, *W. J. Gurd, Canada.*—8*th April*, 1882. 6*d.*

This relates to rotary motors in which the pressure of any fluid acts upon a series of sliding buckets confined in a circular casing, and produces direct rotary motion.

1704. Rowlocks, *E. J. Robertson, Ipswich.*—8*th April*, 1882. 4*d.*

This relates to the construction of rowlocks so as to enable them to be shipped and unshipped without detaching them from the socket by which they are secured to the gunwale of the boat, and it consists in forming the socket with an enlarged recess to receive and retain a ball formed at the lower end of the stem of the rowlock, while the upper side of the socket has a recess to receive an enlargement at the top end of the stem of the rowlock; by lifting the rowlock so as to disengage the projection from the socket it can be allowed to fall inwards.

1706. Distillation, Boiling, &c., Fats, Oils, &c., *C. M. Pielsticker, Kilburn.*—10*th April*, 1882. 6*d.*

This consists, First, in the continuous distillation of fats, oils, glycerine, resins, and hydrocarbons by forcing an intimate mixture of the same and steam through a coil, pipes, or retort connected with a condenser and kept at the distilling point of the material under treatment; Secondly, the continuous production of gas by forcing an intimate mixture of steam and hydrocarbons through a coil and retort, the latter filled with incandescent coke; Thirdly, the continuous boiling of linseed and other oils, by forcing an intimate mixture of the same with steam and air through a coil in a boiler kept at a temperature a little below the distilling point of the oil; Fourthly, the continuous saponification and acidification of fats and oils for the production of fatty acids and glycerine by forcing an intimate mixture of fat or oil and alkaline solution, or of sulphuric acid instead of the alkaline solution, through a coil or retort at an elevated temperature; Fifthly, the continuous saponification of fats and oils to produce soap by forcing a mixture of steam, fat, or oil, and alkaline solution in the proportion to form a neutral soap through a heated coil or pipe into a closed boiler; and Sixthly, in apparatus to carry on the operations.

1709. Steering Gear, *T. Britton, Sunderland.*—11*th April*, 1882. 6*d.*

The object is to distribute the wear and tear and strain over the whole machine by arranging the gearing in such a manner as to reduce any vibration and noise to a minimum, and constructed in such a manner that it can be changed from steam to hand power instantaneously without the necessity of setting the engines or gearing to a particular position as is now usual. It consists, First, in the use of double-cylinder engines capable of working independently, and also of being connected and working in unison; Secondly, in dividing the crank shaft at the centre and connecting it by a clutch which is loose when the engines and gear are in working order, but can be tightened to allow the engines to assist each other; Thirdly, in the employment of two worms, one on each end of the crank shaft, gearing with worm wheels on countershafts at right angles thereto, and communicating motion to the spur wheel on the main shaft by spur pinions, thereby actuating the sheaves around which the rudder chain passes; and Fourthly, in regulating the valves automatically by the rotation of the main shaft and the actuation of the same by a hand wheel above, the spindle of which works the starting and regulating lever and passes through, and around which works the hand gear, the regulating lever being capable of adjustment to suit various lengths of tillers.

1710. Ordnance Machine Guns and Small-arms, *R. S. M. De Ricci, Piccadilly.*—11*th April*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to better enable guns to withstand the prolonged strains set up within them under the present system of gradual ignition of the charge, and also to produce such weapons more expeditiously and economically, and it consists essentially in steeling the interior face of the gun barrel tube or lining after the gun has been bored and rifled.

1711. Bleaching Vegetable and Animal Matters, *E. and R. Jacobson, Berlin.*—11*th April*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to substitute for the peroxide of hydrogen (used for bleaching purposes) baths which are obtained by mixing the solutions of certain salts with peroxide of barium.

1714. Steam or Air Whistle, *J. Cran, Leith.*—11*th April*, 1882. 6*d.*

The object is to enable steam or compressed air to sound a variety of notes, and it consists in arranging the tube of an "organ-pipe whistle" so that the length of the part exposed to the action of the steam or compressed air, which issues from the slit or slits formed by the tongue, can be varied and the notes thereby changed. A piston is fitted in the tube and can be adjusted by a hand lever fitted with a pointer moving over a dial on which the different notes are marked.

1715. Hydraulic Engines, Capstans, &c., *B. and F. W. Walker, Leeds.*—11*th April*, 1882. 8*d.*

The improved engine consists of four similar single-acting cylinders arranged in pairs face to face. In each pair of cylinders a double ram works, and a forked connecting-rod, embracing one of the cylinders, connects the ram with a crank, the two cranks being set at right angles on the shaft. Each double ram has an arm connected by a rod with a lever fixed on a spindle, which enters the valve-box containing the valves which actuate the rams. Each valve has three ports, each end one communicating with one of the two opposite cylinders, and the middle one communicating with the return water.

1716. Washing Coal, *T. Bell, jun., Saltburn-on-the-Sea, Yorkshire, and W. Ramsay, Fursdale Colliery, Durham.*—11*th April*, 1882. 6*d.*

This relates to improvements on the apparatus for washing coal described in patent No. 2356, A.D. 1881, and it consists in the use of a trough placed in an inclined position and receiving the coal at its higher end while a stream of water is directed along it. Arms or stirrers are carried by a shaft partially rotating, so as to cause the arms to oscillate and agitate the coal. Ledges are formed at the bottom of the trough and prevent the heavier matters passing onwards, and beneath them are flexible flaps which prevent impurities passing down beneath them to the washed material.

1718. Drying Machines for Use in Dressing or Finishing Fabrics, *A. M. Clark, London.*—11*th April*, 1882.—(*A communication from La Compagnie General de Teinturerie et Appréts, "System André Lyon," Paris.*) 2*d.*

The machine consists of a steel-drying cylinder heated interiorly by the circulation of steam, and an endless web which carries the fabrics round the cylinder.

1720. Files or Cases for Letters, &c., *W. P. Thompson, Liverpool.*—11*th April*, 1882.—(*A communication from G. W. Nauerth, Cincinnatti, U.S.*) 6*d.*

This relates to paper files, and consists of a kind of tray in which a series of index leaves are placed to receive the papers to be filed between them. A cover is placed on top of the index leaves, and projections thereon take into racks let into the sides of the tray.

1721. Lead Peroxide, &c., *F. M. Lyte, Savile-row.*—13*th April*, 1882. 4*d.*

This relates to the manufacture of metallic peroxide, and especially peroxide of lead, from soluble salts of the metals, and in the case of lead especially from chloride of lead, and it consists in the use of a solution or cream of bleaching powder, to which has been added some quicklime, or hydrate of lime, so as when added to the metallic salt solution to prevent the hydrochloric acid formed during the reaction from attacking the peroxide after it is made and the liberation of free chlorine.

1723. Tube Expander, *G. Lohf, Berlin.*—12*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a tube expander, the main body of which does not serve to hold the rollers, but only to guide the conical spindle, and ends with a flange to which the roller holders are pivotted.

1725. Manufacture of Soap, &c., *F. C. Glaser, Berlin.*—12*th April*, 1882.—(*A communication from Dr. O. Liebreich, Berlin.*) 4*d.*

This consists in producing soap from oleaginous fruits or seeds by treating the same, either in their natural state or after previous drying or roasting, and after reduction to small fragments, with alkaline lyes, and then separating the saponified parts from those not saponified by pressing and filtration.

1727. An Automatic Current Director for Electric Machines, *W. Fisher, Birmingham.*—12*th April*, 1882. 6*d.*

The object of this invention is to prevent the current from dynamo machines passing in the wrong direction, and has special reference to electrotyping and plating processes. It consists in a permanent magnet suspended between two electro-magnets in such a manner that it is attracted by one or the other according as the current passes one way or the other through the coils of the electro-magnets. The permanent magnet throws into circuit one of two other electro-magnets, the armature of which carries with it the connections in such a manner that the current must always pass in the same direction through the external conductors.

1728. Processes of Manufacturing Glycerine from Soap Liquor, *B. J. Young, Manchester.*—12*th April*, 1882.—(*A communication from J. P. Battershall, New York.*) 4*d.*

The invention consists partly in the process of separating glycerine from waste soap liquor by the neutralisation of the alkalies therein contained, evaporation, the addition of certain chemicals, the removal of fat and rosin by suitable means, the use of the centrifugal machine, and distillation.

1730. Manufacture of Red and Yellow Colouring Substances, *J. Wetter, New Wandsworth.*—12*th April*, 1882.—(*A communication from O. Bredt and Co., Unter-Barmen, Germany.*) 2*d.*

The inventor claims the manufacture of red and yellow colouring matters by treating the hexachlorides of hexazo-compounds of naphthalene-benzol, and other aromatic hydrocarbons with naphthol, resorcin, and other phenols, and the sulphonic acids of the same.

1731. Machinery for Bevelling Glass, *T. Parsonage, Barnsbury.*—12*th April*, 1882. 6*d.*

This consists in the application of a new feeding mechanism whereby the travelling table, after travelling the required distance in either direction, has its motion automatically reversed.

1732. Sectional Warping and Beaming Machines, *J. C. Sewell, E. Hulton, and J. Bethel, Manchester.*—12*th April*, 1882. 6*d.*

The object is the attainment of a uniform speed for the yarn while it is being wound upon the section, and the prevention of injury to the yarn by the presser.

1736. Looms, *T. Blackhurst, Preston.*—12*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the dobby or jacquard mechanism, and consists in the employment of a novel arrangement of apparatus more particularly applicable for producing the cross borders of pocket handkerchiefs, table-cloths, or other such-like articles.

1739. Portable Spring Attachments for Baths, *W. P. Thompson, Liverpool.*—12*th April*, 1882.—(*A communication from W. H. Seymour, New York.*)—(*Not proceeded with.*) 2*d.*

The principal parts are a bath of usual construction, hot and cold water faucets, spray attachment, consisting of a hollow tube, having one side shaped concave, with the said concave surfaces perforated with small holes.

1742. Preparation of Creams or Beverages, *F. P. Beck, Brussels.*—12*th April*, 1882. 4*d.*

This relates to the preparation of syrups, and their combination to form creams or beverages.

1743. Apparatus for Manufacture of Compressed Fuel, *J. Lilley and F. Morris, Swansea.*—12*th April*, 1882. 6*d.*

This relates to the filling into moulds, cooling and compressing thereof, and also of providing simple and efficient apparatus to effect the same.

1744. Sewing Machines, *A. Guillaume and A. Lambert, Belgium.*—12*th April*, 1882. 6*d.*

The invention consists, First, in replacing the cops or spindles and small shuttles, which contain only a small quantity of lower or under cotton, by large cops, spindles or bobbins and shuttles; Secondly, a combination in a sewing machine of a shuttle, a guide, a frame, a ring-shaped looper, with a toothed rim, and their accessory parts; Thirdly, an arrangement of mechanism for forming the stitch; Fourthly, the combination of a tension lever with the needle carrier and the upper thread.

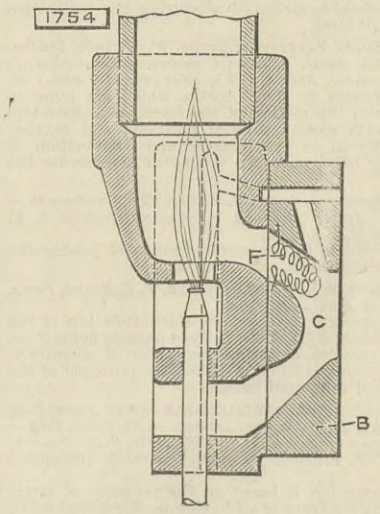
1751. Window Cleaning Chairs or Fire-escapes, *W. P. Thompson, Liverpool.*—13*th April*, 1882.—(*A communication from A. Dormitzer, New York.*) 6*d.*

The invention consists of an improved clamping device for securing the chair and fire-escape to a window sill, and of a simple, safe, and readily manipulated fire-escape combined with and secured to the chair.

1754. Ignition Apparatus of Gas Motor Engines, *F. Anderson and F. W. Crossley, Manchester.*—13*th April*, 1882. 6*d.*

The invention consists in the use of a coil or bunch of wire F in the ignition cavity C of the slide B of a gas motor engine, in combination with a gas jet supplied from the main.

1754



1755. Apparatus for Ascertaining the Gradient of any Internal or External Surface, &c., *P. Jensen, London.*—13*th April*, 1882.—(*A communication from E. F. Macgeorge, near Melbourne.*)—(*Complete.*) 4*d.*

The inventor claims the method of ascertaining the

gradient of any internal or external surface, together with the magnetic bearing of such gradient, viz., by means of vessels containing a fluid which will solidify, and also of a compass card and needle floating on top of such fluid, such vessels being conveyed to the position to be tested, allowed to remain there until the fluid has ceased to be fluid, and then withdrawn.

1766. Finishing the Ends of Metallic Tubes, *S. Fox, Leeds.*—13*th April*, 1882. 6*d.*

The finishing or trimming is effected by the use of a suitably driven circular saw, in conjunction with an adjustable cradle furnished with slides and rollers (or their equivalent), upon which the tube to be operated upon is mounted in such a manner that the said rollers in the case of a corrugated tube take into the hollows of the corrugations thereof, and in the case of a plain tube bear against the outer periphery of the same, and that the tube when so mounted is capable of being rotated on the rollers.

1768. India-rubber Springs for Railway Buffers, &c., *R. Jahns, Cologne.*—13*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the size of the annular staying plate, so as to avoid all cutting action of the plate on the india-rubber.

1769. Improvements in Secondary Batteries, *J. H. Johnson, Lincoln's-inn-fields.*—13*th April*, 1882.—(*A communication from C. A. Faure, Paris.*) 6*d.*

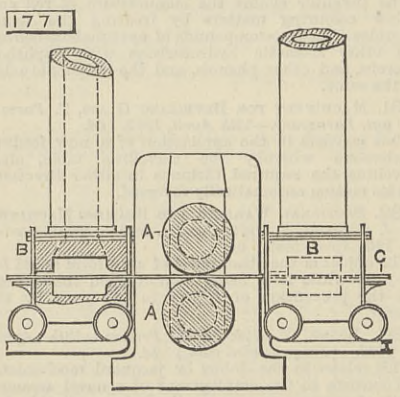
This relates to a vessel to hold the liquid of secondary batteries. The inventor constructs the main body of the vessel of metal, Portland cement, or other similar substance coated with varnish, and then covered with asbestos, felt, canvas, wood, or paper pulp. Other modifications of this method are also described and claimed, as well as a mode of supporting the electrodes.

1770. Metallic Baths, *W. H. Luther, Glasgow.*—13*th April*, 1882.—(*Not proceeded with.*) 2*d.*

The invention consists in the peculiar application, shaping, and jointing of thin sheets of iron or steel as the material of which to construct the baths.

1771. Manufacture of Steel, &c., *S. Fox and J. Whitley, Leeds.*—13*th April*, 1882. 6*d.*

According to one arrangement shown in the drawing A A are the rolls of an ordinary mill in elevation. B B are portable furnaces, and C is the metallic substance under treatment. This substance is passed



through the furnaces B, by which not only is the original heat retained, but additional heat available in its continued reduction is communicated to it, thus avoiding its removal to a furnace for reheating.

1774. Improvements relating to Electrical Circuits, &c., *A. Muirhead, Westminster.*—14*th April*, 1882.—(*A communication from J. A. Briggs and F. Kinsman, Bombay.*)—(*Not proceeded with.*) 6*d.*

The object of the invention is to enable two or more circuits to be carried on the same supports, to obviate induction effects, and increase the capacity of the supports for carrying wires. The invention is carried out by the use of various forms of insulators of porcelain, &c.

1775. Bleaching Hemp and Flax for Paper-making, *A. C. Henderson, London.*—14*th April*, 1882.—(*A communication from A. Deineurs, Huyssinghen, Belgium.*) 4*d.*

The invention consists in suppressing the bleaching by gaseous chlorine, which follows the reduction of the rags to half-stuff, by substituting for it a solution of chloride of lime.

1776. Sewing Machines for Ornamental Stitching, *J. T. Glasier and A. R. Briggs, Southport.*—14*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to improvements in sewing machines for producing ornamental stitching of the hems or folded edges of fabrics, and also the peculiar stitch called herring-bone.

1779. Crushing Oleaginous Seeds, &c., *H. Holt, Hull.*—14*th April*, 1882. 6*d.*

The invention consists in subjecting the seed to a crushing or bruising strain by passing it first between rollers placed one above the other, the top roller being subjected to an elastic pressure.

1781. Road Vehicles, *J. Wetter, New Wandsworth.*—14*th April*, 1882.—(*A communication from D. Meurisse, Marly-les-Valenciennes, France.*)—(*Not proceeded with.*) 2*d.*

This relates to the fore carriages of road vehicles, and has for its object to increase their durability by making them of steel cast in one piece.

1782. Instruments for Measuring the Inclination of Planes, *G. Grütter, Berlin.*—14*th April*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to means of measuring the inclination by a spirit level.

1786. Ships' Sleeping Berths, *W. R. Lake, London.*—14*th April*, 1882.—(*A communication from J. Alexander, Boston, U.S.*)—(*Not proceeded with.*) 2*d.*

This relates to ships' berths which are hung to swing with the motion of the vessel, so as to retain under such motion a level position; and consists essentially in an arrangement and combination of fastening bolts, and of a weight or weights for the berth.

1789. Boots and Shoes, *J. Wetter, New Wandsworth.*—15*th April*, 1882.—(*A communication from S. K. Hindley, U.S.*) 4*d.*

This consists in the peculiar mode of joining the upper to the insole and outer sole.

1801. Motive Power Apparatus, *T. C. Boutet, Paris.*—15*th April*, 1882. 6*d.*

The apparatus is based on Marriotte's law of the "compressibility and elasticity of gaseous fluids;" on Pascal's principle of the "transmission of pressure in all directions;" and on Archimedes' principle of the "theory of immersed bodies."

1817. Obtaining Crystallisable Sugar from Raw Sugar, *J. H. Johnson, London.*—17*th April*, 1882—(*A communication from A. Wernicke, Halle, Prussia, and W. Pfitzinger, Prague, Austria.*)—(*Complete.*) 2*d.*

The invention is based on the property of acetic acid being a solvent of all foreign matter contained in raw sugar, in saccharine juices, in syrup, and in molasses, while crystallisable sugar is absolutely insoluble therein.

1929. Socket Slides for Supporting Shop Window Arms, &c., *W. Randle, Birmingham.*—22*nd April*, 1882. 6*d.*

This consists in manufacturing the socket slides from a cylindrical tubing of brass or other ductile metal or alloy by a drawing process, the drawn or shaped tubing being cut transversely into lengths, and the said lengths converted into socket slides,

2142. Ploughs, *C. A. Snow, Washington, U.S.*—6*th May*, 1882.—(*A communication from J. Quin, Wakeman, U.S.*) 6*d.*

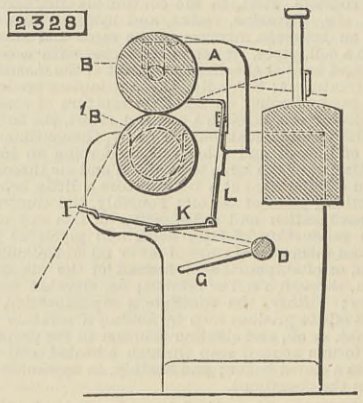
This relates partly to a novel method of laying out and constructing mould-boards.

2240. Locks, *M. Gilmour, Paisley.*—11*th May*, 1882. 6*d.*

The lock consists of a stamped plate which holds together the whole of the locking mechanism, so that the said mechanism and plate can be separated from the stock as one piece.

2328. Doubling Cotton, &c., *F. J. Smith, Heywood.*—18*th May*, 1882. 6*d.*

The invention consists of an apparatus for raising each of the top rollers and holding it out of action whenever its particular end or thread breaks. Between the roller stand A which carries the top roller B and the roller beam is mounted a rocking shaft D, running the entire length of the frame and actuated by an excentric on the bottom shaft (or by any other convenient means). Upon this shaft is fixed a series of light arms or projections G, one to each end or



thread. Between the rollers B B^1, and the thread board is arranged a series of eyes or twirls I, through which the ends pass, and which are held up by the tension thereof. Each of these eyes is at the end of a small hinged piece K, connected to a sliding frame or support L, so that when a thread breaks and its eye or twirl I is released the hinged piece K falls and comes into contact with one of the arms or projections G on the shaft D, which arm as the shaft rocks lifts the hinged piece K and its sliding support L; and as the top roller B rests on this support, it is lifted thereby from the bottom roller B^1 and prevented from drawing off any more thread.

2352. Perambulators, *J. Preston, London.*—18*th May*, 1882. 6*d.*

The essential features are the jointing of the back irons and mode of attachment of the same to the body of the perambulator; Secondly, the attachment of the front wheel so that it may be brought under the body of the perambulator.

2885. Electric Machines, *J. A. Berly, London.*—19*th June*, 1882.—(*A communication from M. F. V. Maquare, Paris.*) 6*d.*

This machine has the armature arranged in sections, for convenience of renewal.

2921. Preparation for Masking the Nauseous Taste of Medicines, *W. H. McLaughlin, San Francisco.*—20*th June*, 1832.—(*Complete.*) 2*d.*

This relates to a preparation to be chiefly useful to disguise the bitter nauseous taste of quinine and other bitter alkaloids, and it consists of a peculiar aqueous fluid extract of a herb commonly known as yerba santa.

3039. Improvements in Galvanic Batteries, *C. P. Nézeraux, Paris.*—28*th June*, 1882. 6*d.*

This consists in certain structural and other improvements in the Planté and Faure secondary batteries. The inventor uses ebonite, enclosing the polar plates as an insulator and to obtain rigidity. When adapted for indirect discharge he uses powders or oxides of lead previously peroxidised and reduced a number of times by a current, finally reduced as to one part and finally peroxidised as to the other part. Such oxides or powders are first prepared and afterwards revivified when exhausted by a special process consisting of the use of acid or alkaline baths. Other improvements are also described and claimed.

3041. Internal Stoppers for Bottles, *W. Froggatt, Nottingham.*—28*th June*, 1882. 6*d.*

This relates to the combinations of internal cylindrical stoppers, conical piston rods, and india-rubber washers.

3178. Manufacture of Bone Tooth-brush Handles, &c., *W. R. Lake, London.*—5*th July*, 1882.—(*A communication from A. C. Estabrook, Florence, U.S.*)—(*Complete.*) 1*s.* 6*d.*

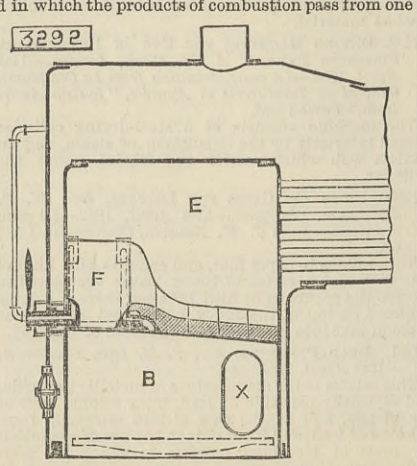
This relates to the employment of machinery for the production of handles of absolute uniformity of contour.

3283. Reducing, Cleaning, and Degerminating Wheat, *S. Pitt, Sutton.*—11*th July*, 1882.—(*A communication from C. L. Gratiot, St. Louis, U.S.*)—(*Complete.*) 6*d.*

The object is to remove the germ, fuzz, and other impurities contained in the crease of the kernels, and it consists in breaking the kernels longitudinally through the creases and removing the germ, &c., by rubbing or wearing them off without crushing or grinding the germs or the half sections of the grains. The grain is subjected to the action of a frustrum-shaped roll with furrows provided with rounded ridges and extending from top to bottom of the roll, in a direction diagonal to its axis. The roll revolves within a case formed with furrows running in the opposite direction; and the grain when split is subjected to the action of gravity and centrifugal force in the case, and the impurities thereby thoroughly removed.

3292. Steam Boiler Fire-boxes, *W. R. Lake, London.*—11*th July*, 1882.—(*A communication from R. L. Walker, Boston, U.S.*)—(*Complete.*) 6*d.*

This relates to fire-boxes divided into compartments, and in which the products of combustion pass from one



compartment to another on their way to the chimney, and the objects of the invention are to prevent smoke by causing the gases from fresh fuel to come in contact with highly heated surfaces; to ensure proper circulation in the water leg dividing the fire-box longitudinally; to prevent the damper and its supports from being injured by the heat; to connect the damper covering the outlets from the compartments by a self-packing water-tight joint to the water leg; and to cause all flakes, cinders and the like carried by the draught from one compartment to be arrested and consumed in the other. The top of the compartments is of fire-brick, and they communicate with each other through opening X in the water leg B. A damper F is caused alternately to cover the outlets of each compartment to the combustion chamber E, and so cause the gases from the fresh fuel in one compartment to pass over the incandescent fuel in the other, and come in contact with the fire-brick roof of the other compartment.

3319. Treatment of Hides or Skins, *W. R. Lake, London.*—12*th July*, 1882.—(*A communication from J. Rowe, jun., Ballardvale, and C. F. Perkins, Brookline, Mass, U.S.*)—(*Complete.*) 4*d.*

This relates to the treatment of raw hides of various animals to obtain therefrom sheets of uniform thickness, and strips of uniform width and thickness throughout. The hides are first treated to remove the hair and other impurities, and then allowed to dry whilst keeping the hides stretched, after which they are reduced to uniform thickness by any suitable means, and then cut into strips of uniform width if required. The strips can be coated with shellac or varnish, and used instead of cane to form the seats of chairs.

3362. Combs Employed in Twist Lace Machines, *W. Spowage, Nottingham.*—15*th July*, 1882. 4*d.*

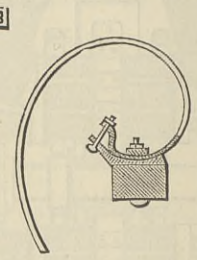
The improvement consists in forming a tab or projection on the under side of the comb blades nearest the bars carrying the threads on one or both sides, the thickness of the gate when the blades are placed together, and the metal cast on them; the projections form a solid rib or comb underneath the nose, and hold them (the blades) firm. By this means the carriages travel safer from one comb bar to the other, and also tend to prevent wrong gating.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

266,348. Spring-tooth Harrows, *Hiram Cobb, Kalamazoo, Mich.*—*Filed June 28th*, 1881.

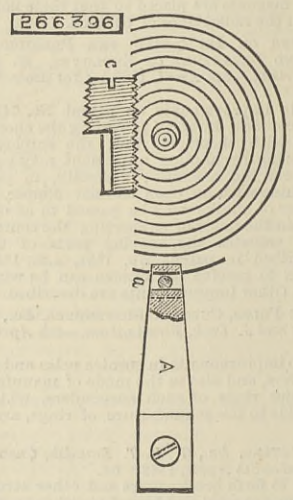
Brief.—The tooth seat is formed with an extension having a funnel-shaped orifice, and the tooth with an upwardly and rearwardly curved and slotted



shank. A binding plate and bolts secure the tooth to the seat, and a bolt passing through the said orifice and slot assists in binding the tooth rigidly to the seat. The binding bolts may be loosened to allow the tooth to rock or play slightly in its bearings.

266,396. Balance-spring Holder for Watches, *Theodore Smith and Merritt P. McKoon, Franklyn, N.Y.*—*Filed April 28th*, 1882.

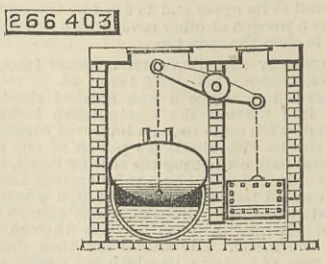
Claim.—The fastening device for hair springs of watches, consisting of the stud A, having the horizontal transverse aperture *a* through one end, one side of said aperture being rounded or convexed, and of



the partly cut-away or reduced screw *c*, working in a screw-threaded aperture intersecting the horizontal or transverse aperture *a*, and having an overhanging portion ranged above the transverse aperture *a*, the said reduced or cut-away side of the screw being also rounded or convexed, as shown and described, and for the purpose set forth.

266,403. Flood Gate, *Heinrich Voelmi, New York, N.Y.*—*Filed April 24th*, 1882.

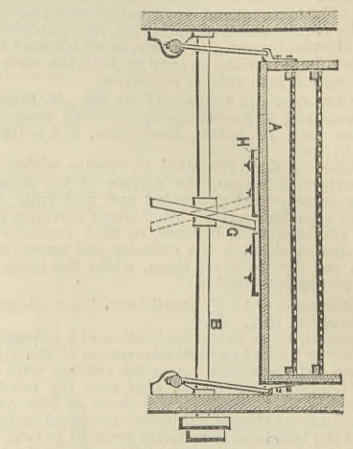
Brief.—Sewer pipe enters one of two compartments separated by a partition and connecting at bottom, and is closed by a valve controlled through chains and lever by a float in the smaller compartment operated by the rise and fall of water therein as received through the outlet pipe. *Claim.*—An apparatus to



prevent the flooding of sewer pipes during flood tide, consisting of sewer pipes, two adjoining apartments, side by side, divided by a partition having an opening at its lower part for a free passage of water between the apartments, a float which rides upon the surface of the water, a chain connecting the float to a lever fulcrum transversely to the partition, and a valve hinged to the top of the sewer pipe and connected by a chain to the lever, substantially as described.

266,424. Grain Separator for Thrashing Machines, *Cephas W. Brackett, Jordan, N.Y.*—*Filed July 13th*, 1882.

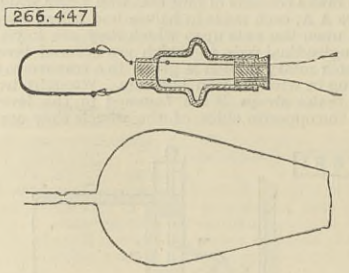
Claim.—In a grain separator, the laterally vibrating



shoe A, the separate wooden blocks H H, having slots and bolts, in combination with the staggering wheel or cam G and cross shaft E, as herein shown and described.

266,447. Electric Incandescent Lamps, *Thomas A. Edison, Menlo Park, N.J.*—*Filed April 26th*, 1882.

Claim.—(1) The method of manufacturing incandescent electric lamps, substantially as set forth, consisting in forming the inclosing bulb or globe directly from molten or pot glass, forming separately



the supporting tube or neck for the incandescent conductor, sealing therein the leading-in wires, attaching the carbon thereto, and then hermetically uniting the parts by a welding together prior to the exhaustion of the lamp, substantially as set forth. (2) A leading-in wire composed of a central platinum section for sealing into the glass an outer section and an inner section, having a clamping device formed integral therewith, substantially as set forth.

CONTENTS.

Very little progress has yet been made towards the development of the gold reefs which, says the *Colonies and India*, have been proved to exist in Ceylon, owing to the want of proper machinery with which to work the quartz which the assayer of the Bank of England has analysed with high results.