DUPLEX ENGINE INDICATOR.

BY MESSRS. SCHÄFFER AND BUDENBERG, MANCHESTER.

(*For description, see page 250.*)

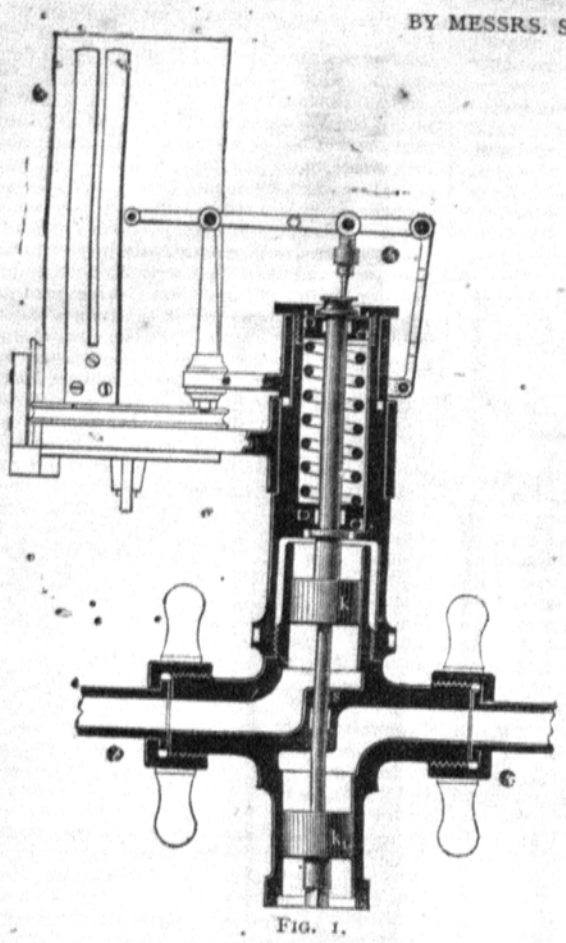


Fig. 1.

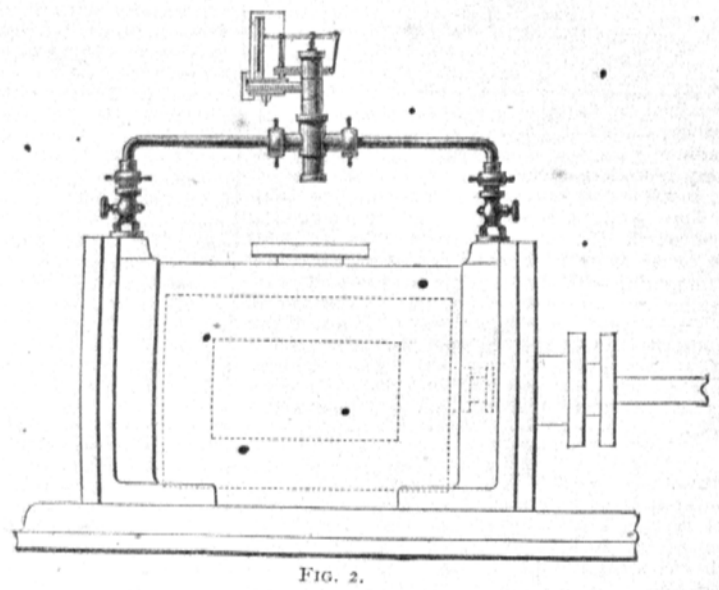
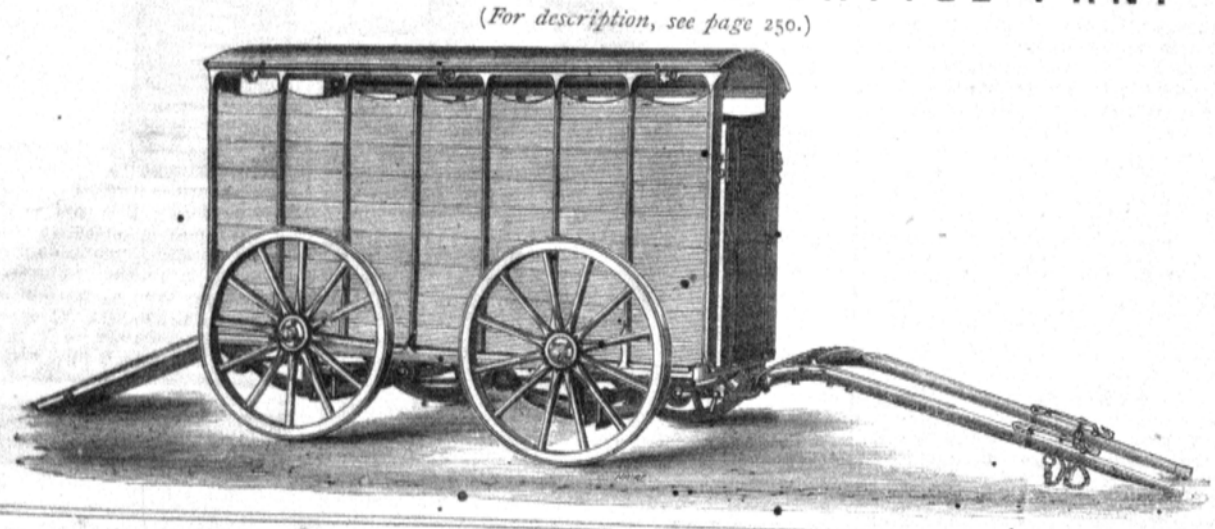


Fig. 2.

MARGETSON AND HEK'S CATTLE VAN.

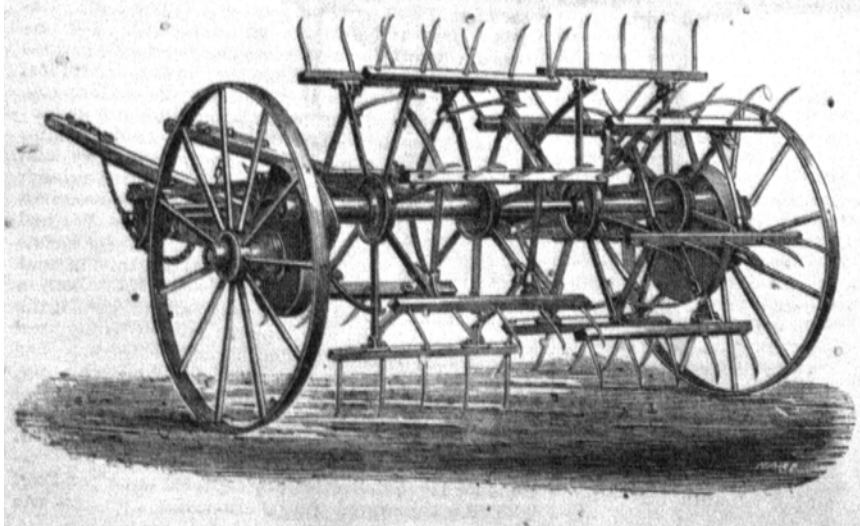
(*For description, see page 250.*)



DOUBLE-ACTION HAYMAKER.

BY THE MALDON IRONWORKS COMPANY.

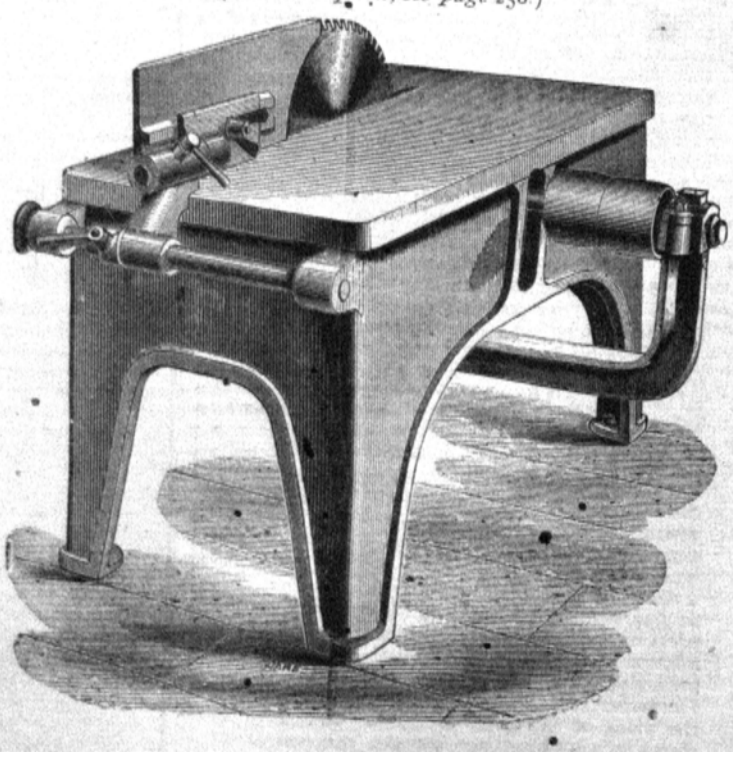
(*For description, see page 258.*)



CIRCULAR SAW BENCH.

BY THE READING IRONWORKS, READING.

(*For description, see page 250.*)



MINERAL STATISTICS OF VICTORIA, 1881.

No. II.

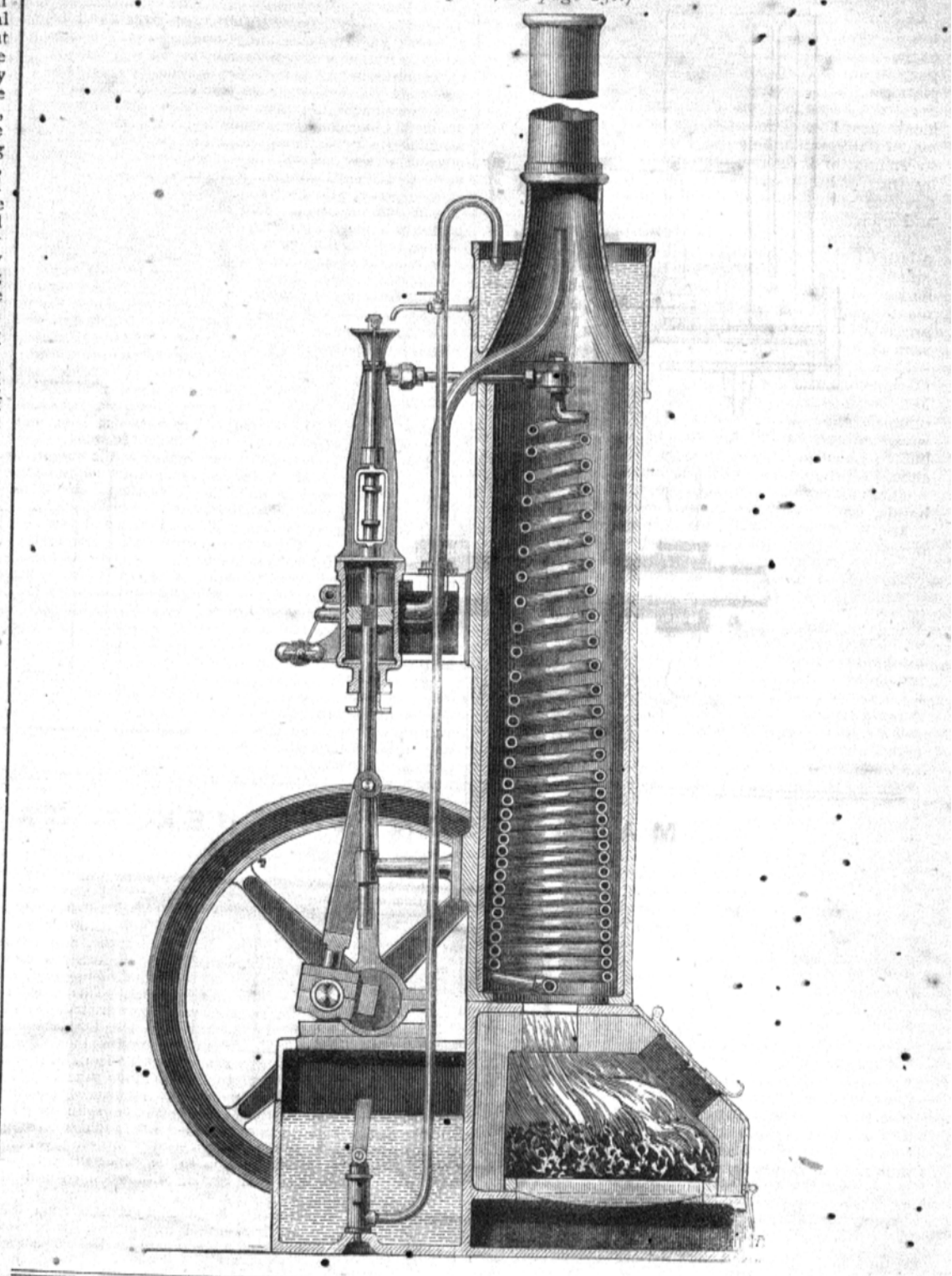
WHILE the chief interest of these statistics centres round the production of gold, the principal features of which were described in our first notice, the information contained in the official report with regard to the minor metals and mineral substances found within the colony is not without its importance, considering the variety of these subsidiary minerals, although individually they might be regarded as rather insignificant. The imports and exports of these miscellaneous metals, ores, &c., show a considerable increase upon those for 1880; the value of the imports for last year being £509,428 against £413,616, for the preceding year, and that of the exports £78,726, in 1881, as compared with £54,881 in 1880. The principal item in the imports is naturally coal, of which, as we shall presently see, Victoria possesses very little of her own. The quantity of coal imported by the colony last year was 302,260 tons, of a value of £313,581; and as regards the other items, it is sufficient to note that there were imported 8787 tons of pig-iron, valued at £78,353; 407 tons of lead ore, and 298 tons of pig-lead, valued at together £10,621; 51,992 lbs. of quicksilver, valued at £5,315; and 910 tons of steel of a value of £16,585. The exports do not present any very remarkable features, except in the case of silver, and it is only necessary to mention here that there were £14,284 worth of antimony shipped; £14,980 worth of copper in various forms; and 15,945 oz. of silver, of a value of £35,387, the last item comparing with none at all in the previous year.

Turning our attention now to the production of these miscellaneous metals and minerals within the colony itself, we find that, in the first place, there was no silver ore raised during 1881. The total production for the year, viz. 20,957 oz., was obtained by the extraction of silver from the gold smelted at the Melbourne Mint. This shows a diminution in comparison with the previous year, when 169 oz. 15 dwts. of silver were obtained from ores, and 23,078 oz. were extracted from gold at the mint. The quantity of tin raised in Victoria is but small; last year it amounted to 120 tons of tin-ore and black sand, which was a slight improvement upon the production of 1880. The high prices commanded by tin in the London market have had the effect of stimulating the mining industry in the colony, and the result would probably have been still more favourable but that the drought hindered the mining operations in this department as well as regards gold. During the year 1881 eleven licences to search for tin, over an area of 4470 acres, were issued. Copper mining was not at all in a flourishing state last year, the quantity of ore raised being only 582 tons, against 3031 tons during the preceding twelvemonths. It would appear that with the appliances for smelting at present available, it is impossible to carry it on remuneratively, and, as a consequence, one important mine was allowed to lie idle all the year. Attention is, however, being directed towards the improvement of the methods of separating gold from the copper, and if the experiments in that direction are successful, and the metal proves as rich in gold as is expected, copper mining would doubtless receive a considerable impetus. The quantity of copper exported shows a very large diminution; in 1881, 61 tons of copper and 71 tons of regulus were shipped, against 262 tons of copper and 17 tons of regulus during the preceding year. In antimony also, which, measured by the total value of the quantity exported since the discovery of gold in Victoria, ranks after gold and tin only as the mineral of which the colony has been most productive, there has been a very marked falling off in the output; for, whilst in 1880 there were 334 tons of antimony ore raised, in 1881 the quantity had dwindled down to 70 tons. Lead mining was a blank last year, as in the preceding year, and indeed the total quantity raised within the colony hitherto has been only 600 tons of lead ore. When we come to iron, however, a very gratifying improvement is noticeable; the quantity of iron ore raised during 1880 was only 97 tons, and the total quantity up to the end of that year 937 tons; but during 1881, 1092 tons were worked, of a value of £3200. Some samples of ore analysed during the year by the analyst to the Department of Mines would seem to indicate that iron of a rich quality is to be found within the colony, one sample showing 58·7 per cent. of metallic iron, and another of hematite ore yielding 70 per cent. of iron. As regards coal, the production of 1881 was *nil*, but efforts are being made to discover any seams of value that may exist. Three leases to mine for coal and nine search-licences were issued during the year, whilst on December 31 there were eight mining leases in force, covering an area of 4938 acres. Little or no interest is attached to the rest of the mineral substances found in Victoria. From what we have said, it will be noticed that there has been a very general decline in the quantities of the secondary metals which the colony produces, and the apparent discrepancy between this fact and the improvement which took place in the exports is attributable simply to the much greater quantity of silver which was exported. Although the quantity raised shows a decrease upon 1880, there were 15,945 oz., valued at £35,387, exported during 1881, against *nil* in the previous year. The total value of all the metals, mineral substances, clays, &c., discovered in Victoria since the first finding of gold up to the end of December, 1881, was £202,437,243, or, deducting the value of the gold produced, £763,125, which shows in a striking manner the preponderance of that precious metal in the mining annals of the colony.

THE SIMPLEX MOTOR.

BY MESSRS. HATHORN, DAVEY AND CO., LEEDS.

(*For description, see page* 251.)



LEES' SELF-FEEDING DRILL.

(*For description, see page* 251.)

MEETING OF THE IRON AND STEEL INSTITUTE AT VIENNA.

THE autumnal meeting of the Iron and Steel Institute began on Tuesday morning, September 19, soon after ten o'clock, in the handsome hall of the Ingenieur- und Architekten-Verein, a striking portrait of the Emperor Franz Josef surmounting the platform.

Herr C. August von Frey, the president of the local reception committee, opened the proceedings by cordially welcoming the Iron and Steel Institute to Vienna, and referring briefly to the efforts made by the committees of Buda-Pest, Leoben, and Graz to afford the members combined instruction and amusement.

The general secretary, M. J. S. Jeans, then read a letter from Mr. Josiah T. Smith, of Barrow, the president of the Institute, stating that his medical man had absolutely forbidden him to attend the Vienna meeting in the present state of his health, and expressing his great regret at being unable to be present on so interesting an occasion.

Under these circumstances, Mr. Fry, M.P. for Darlington, who greatly regretted the sad state of Mr. Smith's health, and wished him speedy recovery, proposed that Mr. I. Lowthian Bell, past-president, whose name was well known, not only in England, but in Austria, and, indeed, throughout Europe, should fill the chair on this occasion.

This motion was carried unanimously by a show of hands, and

Mr. I. Lowthian Bell said that no one regretted more than he did the sad occasion which called him to the chair; it was an onerous duty to preside over such a meeting when taken unawares at the eleventh hour, but he would do his best under the circumstances; and he was glad to see such a goodly number of members present, which proved that the kind efforts of their friends in Austria were well appreciated. He then referred to the three separate high officials who would welcome the institute to Austria and to Vienna.

Two of these gentlemen, viz. the Bürgermeister (Lord Mayor) of Vienna, Herr Edward Uhl, in the name of the city of Vienna and the president of the Austrian Ingenieur- und Architekten-Verein (Society of Engineers and Architects), Herr Charles Prenninger, director of the Southern Railway, then bade the institute a hearty welcome in the German language, which, however, was evidently well understood by a large number of the members present, as the speeches were received with loud applause. The president of the Society of Engineers, indeed, added a few words in English, remarking that the Iron and Steel Institute was a most welcome guest to the Engineers' Society, as both served the same useful purpose.

Mr. I. Lowthian Bell then observed that neither forcible nor eloquent language was needed to return thanks for the hospitality so generously offered. He hoped and believed that the friendly nature of this visit to the Austrian dominions would strengthen the peaceful sentiments existing between the two friendly countries. Science and art knew no boundaries; and the Iron and Steel Institute had fully recognised this by enlisting Professor von Tunner among their number. Mr. Bell concluded in German, expressing the *wärmste danke* of the Iron and Steel Institute for the hospitality extended to them.

Proceeding to business, Mr. Bell then announced that at the council meeting of the previous evening it had been proposed by Mr. Windsor Richards, seconded by Mr. Riley, and carried unanimously, that Mr. Bernard Samuelson, whose high position was well known both at home and abroad, should fill the office of president of the institute for the next two years.

This announcement was received with every mark of approbation by the meeting; and the secretary then read the minutes of the last meeting, which were confirmed and signed by the chairman.

Mr. Daniel Adamson then announced that he should at the next meeting of the institute in May propose a slight alteration in the rules, to the effect that the president be only elected for one year, subject, however, to re-election for that following.

On account of the regretted absence of Mr. J. T. Smith, there was no president's address; so Mr. Bell presented to the meeting his old friend, Professor von Tunner, the most distinguished metallurgist of Europe.

Professor von Tunner excused himself from reading his paper, fearing that his voice was not strong enough, and his pronunciation of English not sufficiently good to be intelligible. Accordingly the secretary read the first paper on the list,

THE IRON INDUSTRY OF STYRIA AND CARINTHIA.

Our distinguished guests from England, the members of the Iron and Steel Institute, on visiting the ironworks of Styria and Carinthia, may possibly be disappointed in their expectations. They may, perhaps, find less progress in the manufacture of iron than they had expected. I thus feel myself in a manner bound to give a short account of the situation occupied by Styria and Carinthia, as a defence for those members of the profession of the land of my birth, to whom neglect and insufficiency might be imputed. It is well known that the Styrians and Carinthians compete for the questionable honour of having made from their iron the nails with which the Divine Founder of our holy religion was crucified. The excellent quality of the Noric iron was known to the Romans, and the iron mountains near Eisenerz and Hüttenberg belonged to the Roman province of Noricum. No doubt both Styria and Carinthia are amongst the oldest iron-producing countries of Europe, their iron mountains being unsurpassed for the abundance and quality of their ores, as well as for their still extant forests. These circumstances would certainly lead us to expect a far more advanced state of the iron industry in the countries in question. This expectation appears to be still more justified when we take into consideration that the government has for years taken active measures not merely to encourage the industry, but also the science of metallurgy. In Styria especially the local legislators did most in this way, and were further encouraged and supported in their efforts by His Imperial Highness the Archduke John whose memory will always be held dear by the Styrians. The province of Styria, more than fifty years ago, took measures to found a perfectly independent school for instruction in the metallurgy of iron. These endeavours were carried out in 1839, when a mining school was opened at Vordernberg, which developed in course of time into the Mining-Academy of Leoben. At this school special importance is still attached to instruction in the metallurgy of iron. The very first school for instruction in iron manufacture was founded at Fahlun, in Sweden, under Professor Sefström, but to my certain knowledge Vordernberg was the second; for in the older schools of Freiberg in Saxony and Schemnitz in Hungary, very little attention was paid to instruction in this branch of learning. We may now well inquire how it is that Austria, and in particular Styria and Carinthia, are so far surpassed by England, Germany, and even by Belgium and France, not merely in the output of iron and the cost of production, but even partly so in quality. Many reasons can be given, but the following are the principal ones:—

(1) It is generally known that the last-named countries have an abundance of first-rate mineral fuel. Delivered to the ironworks at a relatively low figure, this fuel can be used in all reverberatory furnaces with scarcely any preparation, while it can also be used in the blast furnace, either as it comes from the pit, or after being coked at very little cost. On the other hand, the Austrian Alpine districts of Styria and Carinthia are mostly confined to the use of the much more expensive vegetable fuel, spread over a wide area, and in many cases obtainable in a comparatively limited quantity only. It is true, indeed, that Styria in particular possesses a by no means small quantity of mineral fuel. But with the exception of small amounts of impure coal of older formation in the western, and an equal amount of coking coal in its southern districts, it is all a thin sort of brown-coal and lignite. These cannot be used without admixture in the blast furnace; and as regards the reverberatory furnace, such fuels must be prepared, either by a drying process or by being resolved into gas. It must be allowed that Styria has not been inactive in endeavouring to diminish the disadvantages under which it labours as to mineral fuel. In no country have more experiments been undertaken in this direction. The use of brown-coal and lignite for working the blast furnace was actually first carried out in Styria, and also the gasification of brown-coal for melting cast steel in the Siemens furnace, as proved at the London Exhibition of 1862. Both Styria and Carinthia have tried to raise the production of pig-iron by importing coke from Moravia and Hungary. This method of working must, however, be obviously restricted by the high railway freights. Bohemia, Moravia, and Silesia are better situated as to fossil fuel, so that in future the Alpine countries will not be able to compete with them, either in quantity or price, but must try and assert their superiority in the quality of the iron they produce. I am convinced they will assert and maintain this superiority, in spite of the dangerous competition caused by the dephosphorising process now in use by the above-named countries. Within certain limits, however, it is to be expected that the exchange of good ores from Styria, with good coke from Moravia and Bohemia now partly begun, will extend in the future, if the railway authorities take into consideration the general advantage, and indeed their own profits. It is also to be remarked that the inland competition by exchange, so to say, is a great advantage for Austria. It should obviate the necessity of facilitating the foreign competition, to avoid monopoly prices for iron in Austria.

(2) The cost of producing iron in the Alpine districts is furthermore materially increased by the expense of carriage; for quite apart from the high railway tariffs, the cost of transport in those mountainous districts is necessarily very high. On account of the more or less steep inclines of the railway lines and roads, only one-half, and often only one-tenth of the load can be transported with the same power as on level lines. The cost of production in the Alpine countries must thereby be materially influenced. This may be illustrated by the fact that to produce one hundredweight of bar iron, it is necessary to transport ore, flux, fetling, fuel, pig-iron, and other materials to the amount of together five to ten hundredweights on average distances. Another not unimportant cause which raises the price of production in the Alpine districts lies in the relatively high cost of labour, the heavy taxation, and the high rate of interest paid for money. On account of the sterile nature of mountain soil, provisions are expensive, and the fact that the greater part have to be brought from long distances also raises the price of labour. Similar loss is induced by the numerous Roman Catholic holidays and Saints' days, which are not kept, as in other Catholic countries, for twelve hours, but, according to ancient usages, for thirty-six hours, the ordinary Sundays included; and, besides, many of the holidays fall in the middle of the week. The reasons for the high rate of interest paid for money, as well as the heavy taxation, are too well known to need further elucidation, and means to reduce these burthens are not within reach of the ironmasters. I cannot refrain from adding, that in such naturally poor countries as the Alpine districts, the higher the rate of interest, the more difficult and expensive is it to raise capital for reconstructing old works or erecting new ones; and yet, with the immense changes that have succeeded each other during the last twenty years in the manufacture of iron, such alterations were obviously necessary.

(3) One important reason why the manufacture of iron has made relatively so little progress in our Alpine countries lies in the very fact that this industry has existed so many centuries, and has thus consequently become so much divided in regard to the ownership. Owing to this, a great many diverging tendencies and customs injurious to trade have sprung up, which, though antiquated, are difficult to remove. The following personal experience may serve as an illustration. In the years 1830 to 1840 I attempted by my pen, as well as by lecturing, to bring about a combination of the ironworks of Upper Styria. My notion was to erect a rolling mill in common, to be enlarged later on by adding puddling furnaces, with the intention to use the brown-coal near Judenburg for the whole of these works. Whenever the question was debated with the separate proprietors, ever man was in favour of the idea, but as soon as it came to a general meeting, these diverging tendencies prevented a final decision. When in 1840 the government bought up the coal pits at Fohnsdorf, and began to erect large rolling mills and puddling furnaces in the vicinity, it was again the proprietors of the small ironworks round about who prevented them being carried out. They stormed the authorities with petitions not to ruin their interests. The government gave way to them, and transporting to Reschitza, in Hungary, the plant already delivered, they erected the works there. Now that a fusion of the principal ironworks of Styria and Carinthia has taken place under the Austrian Alpine Montane Company, matters will improve; a proper division of labour can take place; a saving in the cost of transport will result; and instead of continual disagreements, the works will help each other. Wherever the necessary natural supplies exist as a basis, it is much easier to erect works in an entirely fresh district than in places where a large industry has existed for ages. A notable example is the flourishing condition of the ironworks of Westphalia, which has been arrived at in a comparatively short period.

(4) Though the Alpine countries are not alone in being affected by the inefficiency of the laws for the protection of the iron industry, still I would also allude to this point. There is no doubt that in the same measure as a too high import duty which excludes all competition is an injury to trade, so too low a duty (if any at all is necessary) prevents any trade from prospering. There is no doubt that not merely the Alpine districts, but the whole of Austria, need protection for their iron trade, and particularly against England and Germany. I am sure that to no Austrian, having the interest of his country at heart, is it immaterial whether it has an iron trade or not; the only question in doubt is the proper amount of protection required. During the last twenty years the iron trade here has not suffered so much by a too low rate of import duty, but rather from the manifold exceptions and evasions that have been made in the protective laws. The repeated changes in the rate of import duty have had the worst possible influence upon trade. They have induced a want of confidence, and capitalists have therefore been afraid of investing. Strong and healthy plants will sometimes thrive on bad land. But in quicksand no plant at all can grow. If the above-named disadvantages with which the iron industry of the Austrian Alpine countries have had to contend are considered, you will perhaps be less disappointed with the state you find it in, and possibly form a more favourable opinion of it. Far from maintaining that the arrangements and working are perfect, I am sorry to say that many an improvement and innovation, the advantages of which were generally acknowledged, could not be adopted from actual want of capital. Some half-finished undertakings near Leoben may serve as an example. Another instance how divided ownership and the accompanying divergence of interests mar all efforts at improvement may clearly be seen in the manner in which the coal is transported at Seegraben, near Leoben. Taking it in a general way, however, the Alpine countries, using vegetable fuel, such as lignite and turf, in their iron production, have attained such a position as enables them to hold their own against any other country compelled to use the same kind of fuel. The mining as well as the transport of the ore on the well-known two large iron mountains in Styria and Carinthia you will find very well organised. You can also convince yourselves how much has been latterly done for the culture of the forests, and that the charring of the wood, at least in the principal places, is done in the best way possible. In no country is the production of charcoal iron carried on either so extensively or so perfectly; and it is only to be regretted that the erection of one large blast furnace, begun at Vordernberg, has not been carried out. The Austrian Alpine countries were also the first to produce ferro-manganese direct from the blast furnace. This was carried out by the Carniola Iron Company. The priority was proved at the Vienna Exhibition of 1873. Many of the old refining works still existing, whose production is confined to a small quantity of steel for special purposes and to refined iron for wire and plates, are worked according to the most perfect principle, with a view to the utmost possible saving in charcoal. In the puddling process the fuel used is lignite, the residue of peat and wood burned upon a step-grate, or is used in different kinds of gas furnaces, which have since served as patterns for other places. On the Continent, Styria and Carinthia were in 1802 the first to adopt and improve the Bessemer process. In connecting it directly with the blast furnace, the Austrian Alpine countries were even before England, though the priority is due to Sweden. To my certain knowledge, also, the use of the Siemens furnace for puddling and welding was first tried in Styria. Cast steel was also first produced from the Siemens furnace at Kapfenberg, in Styria; and I believe that the production of Bessemer metal by direct connection with a Siemens furnace was first carried out at Neuberg in Styria. What is likely to create an unfavourable impression upon the minds of the members of the institute when you visit the Alpine ironworks, and compare them with the extensive ironworks in England and elsewhere where pit-coal is employed, is not so much the size and extent of the works, but the relatively small production. However, this is the consequence of being principally dependent upon vegetable fuel. Wherever such fuel is used, the ironworks are generally so arranged as to make numerous different kinds of iron and steel. Therefore, when you contrast the Alpine ironworks with the ironworks of other countries, I would beg you to compare them with countries which are dependent upon the same kind of fuel.

In conclusion, I would say a word as to the reason why England surpasses the Austrian Alpine countries, even in part, in the good quality of its iron. Before England began to import a large quantity of ores from foreign countries, its

superiority in quality was confined to the better kinds of cast steel, and to particular kinds of soft iron, very uniform in its grain. This could only be attained by using the best Swedish iron, and by the great care observed for many years in the manufacture of cast steel. Add to this also, the excellent quality of the fuel used, whereby the highest temperature can be easily obtained. England has not only gained great advantages, by the magnitude of its production, which allows a thorough method of sorting, but has also been able, by a suitable division of labour, to educate a superior class of workmen. England has also in the course of time introduced certain methods in the fabrication of particular kinds of metal, such as producing a special iron for making a better quality of tinplates; the method used at Lowmoor and Bowling for producing a first-class homogeneous welding iron, &c., &c. Altogether, however, these specialities have been confined to small quantities, and those at very high prices. But since England imports about 2½ million tons annually of the best iron ores from Spain, Algiers, Italy, and Russia, the superiority in the quality of its iron has been increased still further. This is felt all the more, as the cost of the first-rate pig-iron made from these ores in England is about 25 per cent. lower than the price at which it can be produced in our Alpine countries. Apart from the cheapness of the fuel used, the reason of this surprisingly cheap production of pig-iron from foreign ores in England lies in the circumstance that, in spite of the long water carriage, the cost of the ore, delivered to the ironworks, is seldom higher than 9½d. per cwt. With such an immense production, also, as in England, trade expenses, and even labour, are less than in the Alpine countries. No doubt the dephosphorising process will in a measure contribute to the superiority of English iron. However, as England, though using the Thomas-Gilchrist process, instead of importing less, continues to import more foreign ores, and still increases its demand for hematite, although it is so high in price, there can on this account be no great danger for the Alpine iron trade. Through experience we know—and I would particularly refer to the United States of America—that charcoal iron, which is produced at a not too high temperature of blast, is purer and less mixed with foreign substances than iron produced from fossil fuel at a high temperature of blast. Accordingly, for certain purposes there is always a demand for charcoal iron, and it is always worth from sixpence to one shilling more per hundredweight than coke iron. This advantage will, therefore, always remain to the Alpine iron trade. In all sincerity and gratitude, I acknowledge you, our honoured members of the profession from England, as our teachers and masters in iron manufacturing. It would be surprising if such were not the case. England produces about twenty times as much iron as Austria; therefore, it may be assumed that twenty times as much brain-work is employed in the English iron trade as in Austria. Financially and commercially England has certainly more than twenty times the amount of resources to rely upon.

The reading of this paper was received with loud applause, and Professor von Tunner made a few remarks in English, saying that the considerations of the paper must be regarded as taken from a general standpoint, and drawing special attention to certain statistics of production, size of furnace, and percentage of charcoal required to produce a ton of pig-iron, that would be published in a pamphlet to be distributed to members joining the Graz excursion.

The chairman (Mr. Bell), in proposing a vote of thanks to Professor von Tunner, observed that the materials named in the paper were of the very highest degree of excellence; but they were very dear. Styria had taken the lead in producing good iron, and had availed herself of the new inventions; and he considered that this was due in a large measure to the careful study that metallurgy had received at the universities, and in no slight degree to the eminent author of the paper which had just been read.

The secretary then read the second paper, by Professor von Kerpely, of Buda-Pest, on

THE IRON INDUSTRY OF HUNGARY.

The metallurgical industry of Hungary may be said to be quite as old, and, at the present time, at least quite as fully developed, as that of the neighbouring states lying to the west and to the south-west. At a depth of about a foot from the surface of the ground, in the midst of beautiful vineyards, remains of iron slag have been found, which show that centuries ago, and notwithstanding the 150 years' dominion of the Turks, iron was produced in Hungary by the methods then in vogue. Even in the time of the Romans, and in the first century of our era, the excellent iron ores of Hunyad were mined not far from the famous Trajan Road and the Roman colonies lying near thereto. There are, indeed, written descriptions extant of the working of iron mines in Upper Hungary in the years 1326 and 1408, especially in the districts of Gömör and Zips. In the latter year, in mentioning a dispute which broke out, reference is made both to the Dobschau ironstone mines and to the iron works lying along the stream of the Göllnitz as if they had been long known. But the great antiquity of the iron industry in Hungary cannot, of course, be regarded as in any sense a criterion of its subsequent progress and present state of development. On the contrary, we find that the iron manufacture of Asia, which was carried on 1500 years before the Christian era, has, in the subsequent 3500 years, made practically no progress whatever; while the iron industry of Europe, which is of much more recent origin, has, as we may without hesitation affirm, arrived at the highest stage of development. But even in Europe, as we know, this development has not proceeded by regular gradations, but has, in some cases influenced by some sudden or exceptional impulse, made rapid and enormous strides. In countries with more limited means of production and inferior demands, it has not been easy to follow the improvements and innovations that have been made from time to time in the technology and practice of the iron manufacture; and hence, without absolute retrogression, they were in such a position that they could only very gradually avail themselves of such progress. In Hungary, the conditions requisite for the successful prosecution of the iron industry were not always the most favourable, notwithstanding the extensive and excellent deposits of iron ore of which the country is possessed. The difficulties in the way of obtaining the necessary supplies of suitable fuel have in Hungary, as in many other and especially in the neighbouring countries, tended to hinder the development of the iron trade; and although we have now arrived at a knowledge of how to meet our necessities in some degree by the successful use of inferior qualities of fuel, the absence of fuel supplies of a better description still remains a great hindrance to the extension of our iron industry. The largest, if not also the most important section, of the iron trade of Hungary is compelled to use vegetable fuel for the smelting works, of which we have now altogether forty-eight erected, possessing sixty-eight blast-furnaces. Of this number, only one works, Reschitza, uses coke; one other uses coke and coal (Kalán); another uses charcoal and coal (Anina); one uses charcoal and coke in equal proportions (Theissholz); and the remainder use only charcoal, and principally charcoal made of beechwood. The iron ore deposits of Hungary, in regard to their richness, variety, and extent, are not inferior to those of the most highly favoured of neighbouring countries. Spathic iron ore deposits and masses of considerable thickness and extent are found in the districts of Gömör, Zips, Abany, Torna, Sohl, Liptau, and Szörény. The Dobschau iron mountain with its numerous deposits, which, in some places, run to a thickness of 36 metres and even more, yields ores, mainly worked in the open, which contain 2 to 4 per cent. of manganese and 36 to 42 per cent. of spathic iron of great purity and value. On one side of the Dobschau deposit, along the valley of the Sajo, and on the other side along the valley of the Göllnitz, there are numerous spathic and brown iron ore deposits, quite as important as those of the mountain itself, and developed to an even larger extent. Of late years much importance has been attached to the spathic and brown iron ore deposits of the Zips district, especially in the vicinity of Rottenbach, owing to the export trade with Upper Silesia. These deposits likewise furnish to the works in the Trzinyetz district (in the Austrian part of Silesia) the greater part of their iron ore supplies, from their own mines in the Zips district. In the districts already named, and in most of the iron-ore bearing districts of Hungary, there are brown and spathic iron ore deposits, in some cases intermixed with red iron ore. The mine of Gömör near Röcze, which yields porous to friable brown iron ore, containing from 40 to 61 per cent. of iron, has an extent of 4½ kilometres and a thickness of 4 to 37 metres. The Salgó-Tarján Rima-Murány Union, the Montanaerar, Heinzelmann, and several other smelting works of limited extent, have in this district their largest mines. The first-named company will shortly have joined the iron deposit by a rope tramway 15 kilometres in length with its projected new smelting works on the Theissholz Feled Railway, and undertakes to transport the iron ore of the Montanaerar for Theissholz as far as the railway, at moderate charges. Another large deposit of brown and red iron ore, which has not yet been fully opened out, is found in the Bozsoda district, near Telekes and Rudobanga. The iron and steel works of Witkowitz, in Moravia, have joined the deposit, of which it has acquired a lease from the government, by a narrow-gauge railway with the Bánréve Feled Railway at Barczika, and a considerable development of mining enterprise has thus been brought about in this district, 600,000 centners having been worked during five months of 1881. Of greater importance to the iron trade of Hungary than any of those already named are the mines in the Hunyad district, which contain rich deposits of brown iron ore, merging, in some cases, into red. With partial interruptions, their deposits are known to extend for a distance of more than 30 kilometres. At Gyalár, which is the property of the government, the principal deposit attains a thickness of 100 metres. The ore is almost entirely free from impurities, and in the lower deposits it contains from 3 to 8 per cent. of manganese, with 41 to 50 per cent. of iron. It is smelted by the government in Gonasdia in charcoal furnaces. The scarcely less important deposits of the Kronstadt Company, which are worked in the open, belong to the same series, and are smelted partly at Kalán and partly at Ruskitza. Magnetic iron ore, which is found in pockets of large dimensions, is chiefly smelted at Reschitza and the furnaces belonging to it. Ores of this class are also found near Theissholz, in Gömör, near Metzenseifen, in the Zips district, and in the Marmarosch district, partly alone and partly mixed with other ores. Specular iron ore of most remarkable purity is the material chiefly employed in the Dernö blast-furnaces in the Gömör district. Analyses of ores of this class will be found in a work published by the writer in the year 1876, and entitled *Eisenstein und Eisenerzeugnisse Ungarns*. It appears from these analyses that some of the Upper Hungarian spathic and brown iron ores contain copper, but, by a careful separation of the copper contained in such ores, there is no difficulty in using them for the manufacture of pig-iron of high quality; and they are actually so used, more especially when exported. Phosphorus is found only in a few of the Gömör deposits. The greater part of the ore is so pure that it may be used for the production of the best brands of Upper Hungarian iron. Sulphur is present in some of the ores of Hungary, chiefly in the form of barytes, which, whether existing in veins or diffused throughout the mass, may be separated without difficulty.

The smelting works of Hungary are now able to meet the demand for their pig-iron, and are, considering the materials at their disposal, producing iron of a very excellent quality. Seeing that the fuel used, as already stated, consists chiefly of charcoal, the future of the Hungarian iron industry must depend upon the production of iron of superior excellence, all the more so as it is becoming necessary to bring the charcoal from still greater distances to the works, and the cost of production is thus materially enhanced. To the increasing difficulty of procuring supplies of charcoal must be attributed the fact that the export of iron ores from Upper Hungary has greatly augmented, until it has now reached a total of about 2,500,000 centners per annum. The most important smelting works of Upper Hungary, especially those of Count E. Andrássy, with five blast-furnaces, those of the Sárkány family, with three blast-furnaces of their own and two others taken on lease, the two blast-furnaces of Smizsan, and the two blast-furnaces of Krompach, draw a great part of their supplies of charcoal from the Zemplin and even from the Marmarosch districts, the distance varying from 300 to 380 kilometres. For the two government furnaces at Theissholz, in the district of Gömör, a part of the charcoal supplies for the current year will be taken from the Unghe district, a distance of 280 kilometres. To the facilities accorded for the transport of the raw materials required, and the desire of the Hungarian State Railways to facilitate the development of our iron industry, must be attributed the fact that the charcoal can be brought from such long distances with advantage, notwithstanding the relatively low prices of our pig-iron. The State Railways have provided a description of waggon specially adapted for the transport of charcoal, each waggon being equal to carrying 100 metrical centners, and carry it at low rates of freight for long distances, which are not at all beyond the well-known special tariffs of England and Germany. Notwithstanding that the forests in the near neighbourhead of the ironworks are now very much reduced in bulk, and in some cases entirely exhausted, there is not, so far, any reason to complain of the scarcity of charcoal in Hungary; but the distance of the available forests from the centres of the iron trade naturally increases from year to year, and all the more so as the industry becomes more fully developed. In order to give some idea of the extent of forest lands still left in Hungary, I may mention that the state forests alone extend over an area of 1,726,500 hectares. The different forest lands belonging to the church represent a further area of 58,433 hectares. The forests of the State Railway Company in the district of Krassó extend over 88,000 hectares; the forests of the Duke of Coburg in the Gömör and Zips districts extend over 49,500 hectares; the forests of Count Emanuel Andrássy in the district of Gömör cover 19,650 hectares; those of the Salgó-Tarján-Rima-Murány Company, 18,992 hectares; and those of the Nadray Iron Company, 12,058 hectares; while, if the remaining forest lands of the various parishes and private owners are taken at 575,500 hectares, the total extent of woodlands in Hungary will reach a total of at least 2,530,000 hectares. The annual consumption of timber from this area of forest land is 14,000,000 cubic metres, and if only one third part of this total were utilised for metallurgical purposes, it would represent annually a production of ten million centners of charcoal pig-iron. In spite, however, of the enormous resources of our forest lands, in most of the ironmaking districts the scarcity of proximate fuel supplies is becoming more and more felt, owing mainly to the fact that most important and valuable forest lands lie in mountainous districts almost impossible of access, and at a great distance from rivers, streams, and roads adapted for transport. The fact that these forest lands are practically unavailable for the iron industry is a matter of great public importance, and steps have been taken by the Hungarian Ministry of Finance to furnish a proper solution to the problem thus presented. For the supply of two blast-furnaces which are now being built in Vajda Hunyad, the necessary supplies of charcoal will be brought to the furnaces direct from the locality where the fuel is prepared, situate at a distance of 30 kilometres, in the midst of otherwise inaccessible beech forests, by a rope tramway with four stations. We need not enter at length into the advantages to be derived from such a treatment. Suffice it to say that the charcoal will be superior in quality, loss in burning and hauling will be avoided, and consequently forests will be more completely utilised.

The management of the ironworks of Hungary is now, with few exceptions, in the hands of technically trained and practically skilled men. It would not be possible otherwise, at the present day, to meet the requirements of our iron and steel works. The practical results obtained in the carrying on of our chief ironmaking establishments are on this account extremely satisfactory. There are works in Hungary, as, for example, those of the Salgó-Tarján-Rima-Murány Company, which produce 100 kilos. of pig-iron with not more than 4 hectolitres of beech charcoal, being 83 per cent. of the weight of the iron made. The works of Count Andrássy in Gömör produce 100 kilos. of pig-iron with 4·5 to 5 hectolitres of charcoal. The royal ironworks in the Gonasdia-Hunyad district use only 4·5 hectolitres of charcoal per 100 kilos. of pig, and the royal works of Theissholz, in the district of Gömör, consume only 4·6 to 5 hectolitres of mixed hard and soft fuel. The works of Reschitza, again, in the district of Krasso, use only 5·2 hectolitres of beech charcoal per 100 kilos. of iron made. The production of these smelting works varies per blast-furnace from 6000 to 10,400 centners (300 to 520 tons) per month, according to the dimensions of the furnace and the character of the iron being made. These results, highly favourable for Hungary, are owing chiefly to increased height of the blast-furnaces, which are now raised to 14 metres, the widening of the hearth, the belly, and the throat, and the increased pressure and temperature of blast. At the works of Count Andrássy the blast is now heated up to 300 deg. to 400 deg. C. At the royal ironworks of Theissholz two blast-furnaces are now fitting with three Whitwell hot-blast stoves, each 8 metres in height by 5 metres diameter, by means of which the blast is to be raised to a temperature of 500 deg. C., and it is hoped that by the use of these stoves a still further increase of production and economy of fuel will be attained. In all the Hungarian pig-iron works the surplus gases from the furnaces are utilised, and, when water is the motive power used, they are employed for re-heating, and for the raising of steam in the boilers, which have within recent years been erected at most of the smelting works.

At the present time Hungary possess an aggregate of 41 pig-iron works, with 52 blast-furnaces in operation. The yearly production of the whole country amounts to 3,350,000 centners, of which 352,000 centers take the form of castings. These figures are not likely to suggest to English, French, and German metallurgists that our iron industry is one of any great importance. Our trade, in point of fact, is entirely a local one, and does not go beyond the supply of our own everyday requirements, in respect not of crude iron alone, but of railway material and machinery as well, for the manufacture of which considerable contracts have been concluded. The manufacture of finished iron is carried on in Hungary, with but few exceptions, in the ordinary puddling furnace, a fact obviously indicating that very few of our ironworks are engaged in the manufacture of rails, tires,

axles, and other railway material. Most of our works, indeed, have been compelled to direct their attention mainly to the production of such articles as an almost purely agricultural country like Hungary specially requires, and in reference to which they are threatened on all sides by competition. It will be sufficiently manifest that the use of charcoal as a fuel in the puddling process is not likely to assist the iron industry of Hungary, having regard to the conditions of the fuel problem already referred to. The smaller iron works, indeed, where the ordinary system of puddling is employed, subject to these conditions, have been obliged to succumb to the competition of the larger and more important works, which within the last few years have adapted the Siemens regenerative gas furnace to their requirements, and have thus averted a catastrophe which, with the continued use of vegetable fuel, it would otherwise have been impossible to avoid.

The immediate occasion of the introduction of the regenerative gas furnace was the favourable results obtained by the Siemens furnace at the works of Salgó-Tarján in the year 1877 with brown coal of inferior quality. The adoption of the regenerative gas furnace at these works brought about a remarkable economy in the consumption of fuel, the production of the works having more than doubled relatively to the cost of the fuel employed. Nor could the improvement of the product remain unnoticed by manufacturers and others who were interested in the development of the trade. Hence we find that in Brezova (Hungarian Montanaerar), at the beginning of the year 1879, the use of undried, uncut wood was attempted for the regenerative heating of the gas puddling furnace fired with wood. At the present time there are at Brezova, besides a large number of other furnaces, five double gas puddling furnaces, and three regenerative gas welding furnaces in continual operation. At Ferdinandsberg, the property of the Kronstadt Mining and Metallurgical Company, there are five double gas puddling furnaces fired with wood, and three welding furnaces; Bujakova, the property of the Prihradny Iron Company, and Kudsir (Hungarian Montanaerar), have each two double gas puddling furnaces and two gas welding furnaces fired with wood. The timber employed as fuel, mostly beechwood, is introduced into the pit-shaped generators, often directly after felling; but, notwithstanding this, the consumption of fuel per 100 kilos. of iron produced has been reduced at Brezova from 0·6 to 0·7 cubic metre, which was the average of the old furnaces, to 0·25 and 0·4 cubic metre; and in Bujakova the consumption has fallen from 0·41 c.m. in the old furnaces to 0·2 c.m. in the generative gas furnaces now employed. If the iron contains, besides 0·5 to 0·6 per cent. of silicon, very little graphite, the waste is not more, on an average, than 3 per cent., but, if the pig-iron be of a fibrous nature, it is reduced to 1·5 to 1 per cent., and there is often no waste at all. The charge of pig-iron used in Brezova amounts to 550 kilos., and in Bujakova it is about 500 kilos. Six charges may be worked in a shift of twelve hours. The greatest obstacle hitherto met with in working regenerative gas puddling furnaces successfully arises, as is well known, from the frequent and unequal changes of the regenerative chambers, which render it necessary to have many stoppages in order that the chambers may be cleaned out. This difficulty, however, is entirely obviated in the gas puddling furnaces of Brezova, Bujakova, and Kudsir. These furnaces are constructed of exceptional length, instead of being made in the form of a horse-shoe; and to facilitate the operation of puddling, two fire-bridges are provided, at short distances from each other, and so arranged that all dust falling between them will be smelted and can be taken away. The adoption of this simple arrangement has allowed the puddling process to be carried on almost without interruption in the furnaces employed at the three works I have named. As an example of this continuity of working, it may be stated that at Brezova three puddling furnaces were regularly in operation for a period of three months without any necessity arising for cleaning out the regenerators. With the gas welding furnace in Brezova the quantity of wood consumed per heat has fallen from 0·6 to 0·7 to 0·17 to 0·35 cubic metre.

Notwithstanding that such favourable results have been obtained by the use of gas raised from wood in the production of wrought iron, mineral fuel is increasingly employed. The refining works in Reschitza, Anina, Ozd, Diósgyör, Salgó-Tarján, and Kalân use mineral fuel exclusively. At Reschitza and Anina, which are possessed of excellent coal supplies, direct firing is employed both in the puddling and in the welding furnaces, of which there are twenty-five and forty-one respectively. The works of Salgó-Tarján, Diósgyör, Ozd, and Kalân, which have coal supplies of an inferior quality, have changed their furnaces gradually to regenerative gas heating. The achievements of Salgó-Tarján as the pioneer of this movement have been frequently referred to in metallurgical literature, and are, therefore, tolerably well known. The solution of this important question was, indeed, an essential condition of existence, not only to Salgó-Tarján, but also to the other works named, which have each in their way made great efforts to establish the success of puddling by the use of regenerative gas furnaces. At the present time there are in operation the following works using regenerative gas furnaces fed with brown-coal, viz.:—

Salgó-Tarján, with	10	double puddling	and 7	reheating furnaces.
Diósgyör	„ 2	„	4	„
Ozd	„ 11	„	5	„
Kalân	„ 3	„	2	„
Total	... 26	„	18	„

In a shift of twelve hours, a gas puddling furnace will produce six to eight charges of 500 to 600 kilos., with, on an average, from 3 to 4 per cent. of waste, consuming for every 100 kilos. of rails 160 kilos. of brown-coal in the generators, and 99 kilos. under the boilers. In Salgó-Tarján 300 to 350 kilos. are used with direct firing. In localities lying at a considerable distance from the coal deposits, such as the works of Brezova, Kudsir, and Bujakova, they have by improving their direct firing arrangements and by the introduction of coal generators and Bicheront firing, been able to use successfully coal imported from very long distances.

Thanks to the improvements and achievements we have now described, not less than to the advantageous rates of freights conceded by the Hungarian State Railways, the iron trade of Hungary has now obtained complete possession of the home market, and it has also been able to make considerable progress in the manufacture of sheets and profile iron. So far as regards the manufacture of steel, it is, as we have already indicated, carried on in Hungary in only very few works, but still in a creditable manner. The steelworks of the Royal State Railway Company in Reschitza, with four converters and two Martin furnaces, occupy, as is well known a respectable position in the steel industry. At these works, during 1881, 610,800 centners (30,540 tons) of steel ingots were produced, of which 390,000 centners were used for rails, 24,500 centners for girders, 8300 centners for axles and plates, and 2900 centners for steel bars and profile steel. The stagnation in railway construction which set in after the year 1873 was not encouraging to those who projected new steelworks in Hungary, any more than in other countries, and it was not till three years ago, when railway enterprise became more active, that it was deemed desirable to commence the construction of steelworks at Diósgyör. Here a Bessemer works answering all modern requirements has just been completed, and will shortly be at work, while two open hearth furnaces have been working for a year past. The pig-iron required for the manufacture of steel is mainly produced in the ironworks of Upper Hungary. To re-smelt the pig-iron required for the Bessemer process, gas furnaces have been erected, as all coke requires to be imported from Silesia and Moravia, while the brown-coal of our own districts, which resembles ordinary lignite, can be used for the gas furnace. The furnaces at Diósgyör have been constructed by the state, and promise to meet the current requirements of the State Railways. They form an integral part of the Staats-Maschinenfabrik at Buda-Pest, whence the bridge-building works will be transferred to Diósgyör. In Brezova there is an open hearth furnace for the production of castings and sheetiron. Of puddled and furnace steel, about 5000 centners are produced yearly in Hungary. Crucible steel is only produced at Kudsir and at Prackendorf; in the former about 500 centners, and in the latter about 200. The crucible furnace at Kudsir was, until recently, supplied with the Ponsard recuperator; but as soft kinds of steel in heating with gas from wood could not easily be made to smelt, it had to be removed, and replaced by a Siemens regenerative furnace. As in countries which are compelled to use vegetable fuel, there are in Hungary a large number of small smelting and refining works in out of the way places, and although a high blooming furnace is still worked with perseverance in a district in Siebenbürgen, I believe I have said enough in this roughly sketched picture of our iron industry to show that we are striving to keep pace with our western and south-western neighbours in the race of progress.

The chairman (Mr. Bell) remarked that English metallurgists were not accustomed to reckon the coal consumed by bulk, and he hoped the author would give some figures of the weight required. They would also like to know how the rate of wages paid compared with those of England. He concluded by proposing a vote of thanks, which was carried by acclimation.

Before sitting down, he conveyed to the members a wish expressed by Herr Bauermann, that they should visit the Hof-Mineral-Akademie, where they would see some of the oldest iron that existed, and also the Geological Institution.

The secretary then reported that all the members proposed for election had passed the ordeal of the scrutineers, and were thus far duly elected. He proceeded to read the third paper, by Herr A. Kurzwernhart, of Teplitz, on—

THE MANUFACTURE OF BESSEMER STEEL WITH BROWN-COAL AT TEPLITZ.

The tertiary deposits of the north-west part of Bohemia, which extend from the Bavarian frontier to the east of the Fichtelgebirge, from the entrance of the Eger into Austria along the rapidly falling south-east edge of the Erzgebirge, are known by the name of the Bohemian brown-coal basin. This basin is divided into several smaller basins, of which the most important is the so-called Aussig-Teplitz-Saza basin, the length of which stretches from south-west to north-east about sixty kilometres, while the breadth varies from twenty-five to four kilometres, and is on the whole larger in the southern than in the northern part. The thickness of the principal deposit varies from ten to thirty metres, and in some places there is a thickness of even thirty-eight metres. The depth of the deposit never exceeds 200 metres, the average being about 100 metres, and in some places it is so near to the surface that it can be easily worked in the open. The quantity of ash contained in the brown-coal varies from 2 to 8 per cent., the content of water ranging from 15 to 20 per cent. About 200 kilogrammes of this brown-coal are equivalent to one cubic metre of soft wood. The price of this coal, on account of the nearness of the deposit to the surface and the thickness of the bed, is very low relatively to that of the mineral fuel raised from the ordinary coal beds in Austria, the average price per ton being 1 to 1·20 Austrian florin (paper currency), that is, from 1s. 6d. to 2s. per ton. The proximity of the river Elbe is attended with much advantage in the working of these deposits. The development of coal-mining operations in this basin is, however, of comparatively recent date. Mining, in the true sense of the word, can only be said to have commenced in the year 1858, but since that date the trade has increased with such rapidity that in the year 1881 no less than 6,000,000 tons were produced, of which by far the larger quantity was transported to Germany, both by railway and by the Elbe. The existence of the brown-coal deposits of this district, and of the means of economical transport of English iron from Hamburg via the Elbe, led in 1873 to the establishment of a Bessemer works and rolling mill near Teplitz, which, since 1881, has carried on the manufacture of Bessemer steel by the basic or Thomas-Gilchrist process. The arrangements of the Teplitz works differ in some particulars from those of other works of the same character, because they have been specially adapted for the use of Bohemian brown-coal as a fuel, and because this point has been particularly kept in view in their construction, so as to enable the use of coke, which is exceedingly expensive in Bohemia, to be entirely dispensed with.

So far as concerns the manufacture of Thomas steel with Bohemian brown-coal, we can only here refer to the modus operandi of dealing with the heating of the metal, as the rest of the process does not differ materially from that usually followed in ordinary Bessemer practice. Our remarks will, therefore, be confined to the arrangements and manipulation adopted in heating the furnaces and converters employed in the heating of the lime and the spiegeleisen, the melting of the iron to be used in the converters, and, finally, with the employment of brown-coal in the raising of steam. In heating the Bessemer converters, and the reheating furnaces, there is one and only one respect in which brown-coal does not answer all the requirements of the process, and here we find the necessity for supplementing the use of brown-coal by a fuel possessed of a larger flame. Brown-coal has the peculiarity of giving up its heat—the least heat at the actual point of combustion—and for this reason a small quantity of coke must be used to aid in heating. It is necessary with the converter to have the interior sufficiently warm directly at the point on which the material rests, and which, on account of the application of the blast, is partly exposed to a cooling influence. Experience has shown that it is not possible by the use of brown-coal alone to get the bottom of the converter sufficiently warm. At Teplitz much value is attached to the duration of the converter bottoms for as long a period as possible, and it is usual after each cast to push out on an average two to six acid tuyeres, which is found to be attended with advantage to the duration of the bottom, as it is thus made impossible for any deep channels to be formed. It will be understood that on this account the top of the converter bottom will become rather cool, as the material that has been introduced, which is generally acid quartz fire-brick, allows the steam to escape when the converter is again heated, thus lowering the temperature of the fuel at the bottom of the mass. The gases produced from brown-coal rise naturally, and are only completely consumed when they reach the highest part of the pile, where they also heat the surrounding walls of the converter, while the lower part, and especially the surface of the converter-bottom, remains cold and almost black. For this reason, after each charge, and after changing the tuyere, 7 to 8 kilos. of coke are thrown into the converter, and afterwards 150 kilos. of brown-coal are added, The coke, which has a short flame, delivers its heat directly on the surface of the converter bottom, and this has the effect of thoroughly drying and burning the mass that has been rubbed round the tuyeres as well as to get the bottom part of the converter to a white heat. With this kind of fuel the converter can, in five minutes' blowing, be made sufficiently hot to commence the treatment of the pig-iron. We do not, however, mean to say that it is not possible, by way of exception, materially to shorten this time, if it is found necessary in practice.

The ordinary method of manipulating the ladle in Teplitz requires some coke to be used also for heating. With one casting ladle in Teplitz, 120 charges, and, under favourable circumstances, even twice that number of charges are cast without changing the ladle. In this way the casting hole is inserted from inside, and the ladle is cooled after each charge with water. This process is effected in the following manner:—The workman throws into the casting hole of the ladle a handful of clay, after which the hollow ladle is filled with water. After the ladle is thoroughly cooled in this way, the new casting hole is put in. It is natural that the porous walls of the ladle should in this way absorb a great deal of water, and the short time which is available to allow of the heat being got up again makes it desirable that the best and most effective fuel should be employed. Hence it is that we always introduce abot five kilos. of coke, along with about two baskets of brown-coal. For every other purpose, however, brown-coal alone is employed. We will now proceed to speak of the method used for the heating of the spiegeleisen and the lime. Both of these operations are carried out at Teplitz at the same time, and with one and the same fuel. The lime is heated only with the surplus heat escaping from the heating of the spiegeleisen. The spiegeleisen is introduced not in a liquid, but only in a very hot condition. We endeavour, as far as possible, to apply the spiegeleisen in a non-liquid state; and with the exercise of a little care on the part of the workman, it need never happen that the spiegeleisen causes any considerable ebullition in the converter; while, on the other hand, the temperature of the spiegeleisen is already so high that it is only a very little short of liquidity. Although the low temperature attained by this mode of working is attended with disadvantage in some respects, it has, on the other hand, the compensating benefit that the whole manganese content of the spiegeleisen is called into requisition. We may add that a highly heated instead of a liquid spiegeleisen tends to further the uniformity of the steel. For the purpose of merely heating the spiegel as described the brown-coal sufficient, without any application of gas fuel, and it even gives a sufficient surplus to bring the lime to a yellow heat. The furnace used to heat the spiegel and lime is generally furnished with a direct step-grate firing, for the heating of which only nut coal is used. This coal costs abont 8 kr. per 100 kilos. at the works. It is necessary to specify here the various kinds of coal used at Teplitz according to their composition and quality. By nut is meant the coal in which the smallest pieces have a content of $\frac{3}{4}$ cubic centimetre, the largest a content of 36 cubic centimetres. The next smallest kind is called *Lösche*, and it contains all that is smaller than nut coal, as well as all the dust that is gathered from the sorting of the coal. After nut coal, the largest is medium coal No. 2, which contains pieces of over 36 cubic centimetres to something under the size of a man's fist. Medium coal No. 1 contains only pieces of the size of a man's fist and over. What is known as *Stückkohle* is not used at Teplitz. The spiegel is heated in a furnace resembling a welding furnace, which ends in a flue. The flue leads into a tower of a square section, in which there are several shelves, one above another on opposite sides, and inclining towards each other, on which the lime is placed. The tower terminates at the top in a firebrick chimney. Directly in the lower part of the chimney the lime is introduced through a side opening, which leads downwards from one shelf to another towards the bottom, and finally covers the whole, so that the surplus heat must rise through

the different layers of lime. As Teplitz does not prepare its own lime, but procures it already burnt, it happens that there is often a great deal of fine slaked lime, in order to prevent which from adhering to the shelves, and thereby diminishing the draught of the furnace, vertical openings are provided in the sides of the tower, through which the surplus heat escapes, if the lime does not allow sufficient scope for this purpose, so that the due amount of draught required for the heating of the spiegel is not wanting. It will be easily understood that in the latter case the lime is not so fully heated as it should be. This arrangement of heating the spiegel and the lime at the same time has given very satisfactory results. A charge of 6½ tons of pig iron—the usual charge for rail steel—requires an addition of 370 kilos. of spiegel and 600 kilos. of lime.

The most important use of brown-coal is that of smelting the pig-iron, for which at Teplitz the Siemens gas regenerative furnace is employed. The usual charge in this furnace amounts to 6½ tons of pig-iron. The length of the furnace is 3·8 metres; the breadth, 2 metres; the extent of the surface available for the bath covers the full breadth of the furnace hearth; but the length is only 3 metres, the greatest depth in the centre of the furnace being 0·3 metre. The gas and air chambers are arranged underneath the furnace hearth, thus giving upright generators. The cubical contents of a single air chamber is 15·5 metres, and those of a single gas chamber 14·5 centimetres. For the reversing valve generally cast iron cross valves are employed. Such a furnace melts in two hours a charge of the proportions already described, so that eight charges in twenty-four hours can easily be obtained, including casting and re-charging. With these furnaces, by the acid process, and with iron tolerably rich in silicon, and with 50 per cent. of steel scrap added, the time occupied in heating a charge was not longer, and the iron ran exceedingly hot from the furnace. The fuel used to raise the heat in this case is also nut coal, but there are two methods of applying the fuel. The gas generators of the old furnaces have generally grate bars, while the new generators are fitted with the step-grates. With the latter it was intended to use nut coal No. 2, which is produced in some districts, and which is between coal dust and nut coal No. 1. The nut coal used with horizontal grates was liable to fall through, whereas with step-grates excellent results are obtained. Endeavours have been made to get up the necessary heat with coal dust with step-grates which on an average only cost 1½ kr. per 100 kilos., and in this direction considerable success was obtained, but the production was sensibly diminished, and for this reason the use of slack has been abandoned. The total extent of grate bar surface in one furnace is 5 to 8 square metres. The layer of fuel has, with generators with horizontal grates a medium height of 0·8 metre, while with the step-grate generators the corresponding thickness is 0·52 metre. The gas collected from the generators is conveyed to a reservoir constructed of sheet iron, which is open towards the bottom, and stands in a cast iron water basin, wherein a great part of the tar, water, and flue dust is allowed to fall. In consequence of the large quantity of water contained in Bohemian brown-coal, such an arrangement for condensation is regarded as necessary. The gas is conveyed direct from the connecting-basin to the gas valve, and the draught is so regulated that the gas in the furnace has a pressure of under one atmosphere, so that the flames are never allowed to appear outside the inspection holes of the furnace; while, on the other hand, air is drawn in from the outside. The furnace is supplied with a very strong draught, which enables the best result to be obtained. If the gas is allowed a pressure, as is the case so generally in the Siemens furnace, it not only does the work of smelting more slowly, but it also threatens to attack the chamber. These furnaces require for 100 kilos. of iron 45 kilos. of nut coal. The smelting chamber is in all parts constructed with Dinos bricks, and the fire-bridges are kept in order during the working of the furnaces as required, loss of time from stoppages being as far as possible avoided. In the same way the side walls of the furnace are repaired. Each furnace will last about 600 charges, but after that time the hearth has become so broken up that a complete and thorough running out of the furnace cannot with safety be attempted. It is, therefore, preferred, after the furnace has stood about 600 charges—that is, after three months of regular wear—to construct a new furnace. In order to heat the iron with advantage, it is necessary to provide a chimney of 1·5 metre diameter and 45 metres high for every two furnaces. According to the character of the heating furnace, the iron heated with brown-coal in the Siemens furnace undergoes some change in its chemical composition. Formerly, while the acid process was in use, one description of iron, introduced into the furnace with about 2·5 per cent. of silicon, was found, after being melted, to have its content of silicon reduced to 2·25 per cent., so that there was a considerable variation in the silicon content. With the basic process the content of manganese is varied in a much greater degree, one kind of iron, which, before being melted, contains 2·0 per cent. of manganese, showing a content of not more than 0·6 as it runs from the furnace.

It may finally be remarked that the total quantity of steam required to be raised on the works is obtained from brown-coal, and for this purpose only coal dust is employed. In the consumption of this fuel, Bolsano's patent shelf-grates are used in part, and partly step-grates, either system being found equally successful. The Teplitz works require for the carrying out of the Thomas process about 20 charges of 6 to 6½ tons daily, about 1320 cubic metres of brown-coal, and 1·6 cubic metre of coke, so that he quantity of coke required is only 0·1 per cent. of the total fuel employed, Brown-coal, therefore, is used almost exclusively for carrying out this process.

Mr. Percy Gilchrist, who was warmly welcomed, being called upon by the secretary, informed the meeting that he and some friends had just gone the round of eight works in Austria, where the Thomas process was in use, and they were glad to find that more basic steel was now being made than was formerly turned out by the old acid process. Three thousand tons per month were produced; and the work would compare favourably with that done in England, although the plant was not so good. One of the most interesting facts was that a bottom lasts sometimes as long as the lining—for forty charges or more. An attempt had been made in England to accomplish similar results, but unfortunately without success, because makers had not gone the right way to work. Mr. Gilchrist gave some details about the construction of the furnaces. The tuyeres were put in in an inclined position; and there were two rows of bricks with the Holley joint, whole bricks being cut instead of half bricks being used. The works used up all the scrap that they made. The composition of the pig was the same in all the eight works that they had visited; and the operation was also the same. Nothing better was found than the Ilsede pig, which was universally approved of. Not only were 110 blows obtained with one bottom when working the acid process, but even the extraordinary number of 120 had been attained, whereas fifteen was considered a good number in English works. The pig used at Teplitz contained ¾ per cent. of phosphorus; but from 2 to 2½ per cent. was preferred. Although it was called "white iron," this was perhaps not quite the correct term. Sixteen cwt. of scrap was charged in cold, and, when melted, was conveyed with the ferro-manganese, or whatever name it was preferred to give this substance, by means of a nice little shoot into the converter while blowing. There was a very good mill for rails and rolled sleepers; and at the works in question rolling only was practised, no hammering. The average content of manganese, he found, was 0·07 per cent., but 0·2 per cent. was liked best. He had been much interested in the very able paper they had just heard.

Mr. Windsor Richards enquired the maximum amount of sulphur in the pig, and took exception to the expression used by Mr. Gilchrist as to a bottom lasting so many charges when the tuyeres were renewed.

Herr Kupelwieser, being called upon by the chairman, and received with loud applause, spoke in English; but his first remarks were not audible except to those quite near him. He concluded by expressing the hope that 30 charges a day would be made by the Thomas-Gilchrist process in half a year's time. In reply to a question from Mr. Bell, he said that they did not charge in so much as at Teplitz, and that about 4 tuyeres were charged ten times.

Mr. Jeremiah Head then said,—I did not intend to speak at all on this subject, as I am rather a learner than a teacher; but, as I have been to Witkowitz for a couple of days through the courtesy of Herr Kupelwieser, I may be able to make a few remarks of interest to some of the members. The basic converters were not at work, owing to a slight accident that had unfortunately occurred; but the rolling mill was at work, and my principal object was attained, viz. seeing how basic ingots behaved when rolled into plates. The ingots for plates are usually made at these works about 4 feet by 18 inches by 12 inches. They are heated in an ordinary heating furnace, receiving nearly the same treatment as iron piles, and being worked indiscriminately with them at the same price and by the same mill hands. After being raised to a welding heat, just as iron piles are, they are taken to a Belgian or universal mill, which converts the necessarily tapered ingots into rectangular blooms. The ingots so rolled or cogged down are then cut by heavy shears to lengths suitable for the size of plates required. The pieces, reheated in the ordinary mill furnace, or "wash-heated," as the term is in England, are brought down by the roughing, and then the finishing rolls to 5 inches, or perhaps 2 inches thick. The engines are of the reversing type, in the proportion of 1 to 2½ or 3, and have plenty of power; they work and reverse very rapidly, the setting-down screws being worked by a pair of small engines, so that the roller has nothing to do but to get the bloom through as fast as possible. There are nine rolls for facilitating the obtaining of a greater number of passes than in the case of iron. The Belgian mill leaves the plates with good edges, so that there is very little shearing, and there are seldom any defects on the surface. The treatment in rolling is similar to that usual for rolling plates, except that a less amount of screw appears to be given at each pass, while the speed of the rolls and the rapidity of the reversing is as great as can be obtained. I carefully inspected several plates, and could not discover any defect of importance. I saw a piece sheared off a plate that was taken indiscriminately from the rest, this piece bent double cold with the grain, and then doubled over again across the grain, also in a cold state, without any sign of crack or failure. Some of the steel was being made into "tube strips," 12 feet by 9 inches by ¼ inch; and these strips, I was assured, were being regularly welded into tubes without any difficulty whatever. Plates thinner than 5 centimetres (nearly 2 inches) are again heated and then rolled down to thinner gauges. I was altogether very favourably impressed with what I saw at Witkowitz, and the impression I received was that there will be little difficulty in adapting the heavy iron plate mills of England to the rolling down of basic steel ingots, without any material change in the appliances they now possess.

Herr A. Kurzwernhart, managing director of the Teplitz Works, stated that sulphur was present in the pig to the extent of 0·2 and 0·3 per cent.; they prefer not to have more than 0·1 per cent., but can work with 0·2 per cent. The forty charges got off one bottom at Reschitza was not an average, 25 to 30 being nearer the mark. If the tuyeres were very good and the bottom taken great care of, as many as 40 might be obtained. On the whole, he should say the average was 30 blows. They began to change two or three tuyeres at the fifth charge, another two at the seventh and eighth charge, and so on. Much also depended on the workman, if he wanted to keep the bottom in case it were good or not. The average was one tuyere for one blow, but that could not be depended upon; and a bottom certainly lasted out seven tuyeres.

The chairman, in conveying the thanks of the meeting to Herr Kurzwernhart, commented on the frank and loyal manner in which he had replied to the questions.

Herr Baumeyer, who spoke in German, did not obtain a fair hearing, for the members now began to thin off, as the hour for luncheon approached.

The chairman then said it gave him great pleasure to be the mouthpiece of the Austrian Ironmasters' Association in presenting Mr. Sydney Thomas with a handsome inkstand, with most elaborate and delicate workmanship, made of Thomas-Gilchrist cast steel, as a token of their appreciation of the services his invention had rendered to their struggling industry.

Mr. Gilchrist, in returning thanks for Mr. Thomas, who was unfortunately too unwell to be present, said that he was sure nothing could give his friend half so much pleasure as this token of good-will that found its expression in a piece of such unequalled work as that on the table, and that he would always reckon it among the most precious of his possessions.

This interesting ceremony brought the day's business to a close, and the members adjourned to an elegant luncheon in the Imperial Volksgarten, to which they were invited by the Austrian Iron Trade Association. After listening to some excellent music by the band of the 34th Austrian Intantry, the party proceeded in omnibuses to the Arsenal, the only object to be visited this afternoon, but which, indeed, contained more than ample material.

On arrival, the members were received by Lieut.-Feld-Marschall Baron Tiller, the commandant, and also by Colonel Streit, Fabriksdirector, under whose guidance they were conducted over the various departments.

EXCURSION TO THE ARSENAL.

This immense pile of buildings, erected from 1849 to 1855, forms a rectangle, measuring roughly on the outside 950 by 600 yards. The four corners, and also the central blocks between them, making eight altogether, constitute barracks, while the intermediate buildings form depots for the storage of war *matériel*. There is also a school for artillery cadets, and a chapel for the 3700 persons inhabiting this vast industrial city. On entering the enclosure formed by the above-named buildings, the members first visited the Waffen-Museum, which contains, on the ground floor, fifty-two white marble statues of Austrian heroes, and on the upper floor historical mementoes relating to the House of Hapsburg. They then inspected an interesting collection of small arms, showing the several stages of improvement, as well as many remarkable specimens of this class of weapon. The building devoted to this purpose has ranged on its outside a large number of cannon taken in war, some presented to the Emperor, and an old piece built up of square wrought-iron bars, secured by hoops of the same metal, while a mortar of the same construction is said to be of Turkish origin.

The portion which chiefly interested the visitors was the second half of the interior buildings, divided into three parts, viz. the manufactory of small arms and repair-shops for the same, the accessories of horse artillery and the cannon foundry. From this last, however, the most interesting of all, where large guns are cast from the famous *Stahlbronze*, or steel gun-metal, they were excluded, as from Krupp's factory at Essen during the Düsseldorf meeting, because everything connected with this operation is kept a profound secret. The time at disposal was so short, and the ground covered by this establishment is so large, that only a cursory run through was possible of the remaining portion that was thrown open; therefore no stay was made in the forge, smithy, and fitting shop. In the erecting shop, however, a new machine was shown at work for boring both the trunnion bearings of a cannon at one operation, thus ensuring perfect accuracy. In the foundry for casting shells a moulding machine for making a large quantity of small parts appeared to afford very good results.

Although there is all the plant necessary for making small arms, they are now almost entirely made by contract outside. But whether made in the Arsenal or supplied by contractors, they are all subject to a minute inspection by officials acting under a committee of reception; and each individual piece forms the subject of a special report. If anything is found amiss, even the colour of the barrel, the arm is sent back for rectification. Besides the persons resident in the Arsenal, there is room for 2500 workmen living outside, although at present only 1200 are employed. These include men who have learnt one of the trades

necessary to the manufacture of small arms, and who are serving in the army; they are taken, sixty or seventy at a time, and kept in the Arsenal until their work comes up to the required standard. They are chiefly engaged in repairs and in the conversion of rifles. The Werndl system has now almost entirely superseded the Wenzl both for the rifles of the line and the carbines of the artillery. A Tighe-Hamilton dovetail-cutting machine is employed in making the packing cases for conveying ammunition, and is thought very highly of for its accuracy and the quantity of work it turns out. In the same department a saw-frame was sawing out to the required arc portions of the felloes of gun-carriage wheels; while another machine, analogous to the wood-planing machine, was shaping the spokes.

In one of the halls about 800 gun-metal Gatling guns were arranged ready for being sent off. By the side of the steel gun-metal cannon of 12 and 15-centimetre (about 4¾ and 6-inch) bore were a few guns of similar type and bore, cast from motives of economy, from Styrian iron; but these latter are not now made.

The preparation of the helical springs for receiving the recoil of large guns was watched with interest. This portion of the works is driven by one of two 16-horse-power horizontal engines on the Wood system, the other being kept in reserve.

The depot of small arms, where 3360 are arranged closely in a single iron rack about 6 yards high and 8 wide, and the total number averages 200,000, brings forcibly to mind Lord Palmerston's famous utterance that the best way to ensure peace is to be prepared for war.

OCCASIONAL NOTES.

IRON SPORTING SHOT.

A COMPANY has been formed in Iowa for the purpose of manufacturing sporting shot from iron. It is stated that the trials which have been made of the shot have proved it to be fully equal and in some respects superior to lead shot. Ovens are now being put up to anneal the shot. The invention is protected by letters patent both in the United States and in Canada. No tower is required, as the shot is made by the process with less than three feet drop. The company are nearly ready to put the new manufacture into the market, and as it can be sold at a much lower price than lead shot, the demand will probably soon assume large proportions. It is stated that the iron shot looks well, and cannot be distinguished from lead shot.

A NEW CURTAIN FOR THEATRES.

Subsequent to the burning of the Ringtheater at Vienna inventive genius has been greatly stimulated in exerting itself to provide for the safety of a theatre-going public. The iron curtain is a most important and valuable arrangement, but it is somewhat cumbersome, and, above all, expensive, and thus only suitable for large theatres. Its unwieldiness has led to the design of an apparatus which may in some instances replace it. The new curtain which we briefly describe is formed of a double layer of canvas, between which a large meshed net of stout cord is placed and quilted to the canvas. If at the moment of danger water is made to flow from a pipe which carries the curtain, the latter, as experiments have shown, remains intact, even if exposed to the greatest heat. One of the principal features of the invention is that, by the weight of the water pouring in, the curtain descends automatically, and thus by simply opening the watercock its descent and incombustibility are ensured, and further danger is at once prevented. The expense for such a curtain, moreover, is, as against an iron curtain, comparatively low, and small theatres are thus enabled to provide an efficient protection against fire.

PROPELLING STREET CARS BY STEEL SPRINGS.

We hear that successful experiments have been made at Philadelphia of propelling street cars smoothly and rapidly by the expansion of powerful steel springs, the difficulty of giving a uniform and perfect temper to the metal having been overcome. The motor consists of six springs coiled upon a cylinder. Each spring will be made of a flat bar of steel 300 feet long, six inches wide, and one-fourth inch thick. These springs are tempered by the new process so uniformly and so delicately that their power becomes tremendous. After first being coiled so that their diameter is 18 feet, they are tempered, and then wound up until the diameter is 7½ feet. In this condition they are placed upon the motor truck, and the appliance is adjusted. A stationary engine at the terminus of the road then winds the springs to a diameter of 40 inches, and it has been demonstrated that the power of the expansion of the six springs from 40 inches to 7½ feet in diameter is sufficient to drive an ordinary street car, full of people, five miles on any track in Philadelphia. The springs are stated to be so entirely under the control of the brakesman that he can use the power of all of them at once or limit the power to one, or in going down a steep grade he can shut them all off. A brake prevents the car from running at a greater rate of speed than nine miles an hour. Should this clockwork arrangement—for that it seems to be—stand the wear and tear of extensive traffic, then good-bye to horse, steam, or compressed-air tramways. The vexing problem of safely and economically propelling tramcars would be satisfactorily solved.

OUR TRADE WITH SPAIN.

Whilst viewing with satisfaction the progress which, in spite of an unfavourable harvest, is being made by Spain, all English merchants interested in Spanish commerce cannot but regret that a satisfactory arrangement has not been agreed as to wine duties that would enable a treaty to be negotiated, placing England on the favoured nation footing. As already shown in these columns, the differences in the tariff now existing is a deathblow to trade in the bulk of British manufactures as far as the Peninsula is concerned. The erroneous statements of the Premier in the House of Commons on the subject of the Spanish wine trade, and the want of consideration shown to Spanish feeling and opinion, has had a further unfavourable effect in Spain and has no doubt aggravated the irritation displayed in the Spanish press as regards the movements and intentions of England in Egypt. It is to be hoped that, attention having been called by the press generally to the unfortunate commercial relations now in force, a speedy remedy will be provided. There is, however, another obstruction to British trade that calls for serious consideration. It not only applies to Spain, but to other countries where the metric system prevails. Much business is lost to England because of the difficulties encountered in assimilating the metric measure to the English inch. It is a matter for surprise, when it is known that so much business is lost on this account to English manufacturers, that some amongst them have not ere now introduced into their manufactures the metric system specially to meet the wants of those countries where it exclusively prevails. It is quite certain such a measure would materially facilitate business and open up a new era in British trade with continental nations.

GERMAN RAIL EXPORTS.

Notwithstanding that less activity has been displayed in the construction of new lines of railways in most countries in recent years, there are, on the contrary, others which are only now being opened up by the laying down of railways. Germany, however, has succeeded in maintaining a large and increasing export of rails. Indeed, the growth of her rail exportation has been somewhat remarkable. In 1860 she exported only 1270 tons; in 1861 her exports of rails had risen to 6780 tons, and in 1868, at a jump (from 4300 tons in 1867), to 28,600 tons. From that time her rail exports rose steadily to 36,000 tons in 1870, 70,700 tons in 1872, 84,900 tons in 1874, 133,000 tons in 1876, and 207,000 tons in 1878. In the following year her exports fell to 164,000 tons of rails, but they speedily advanced in 1880 to 230,204 tons, and in 1881 to 250,709 tons. It will be seen from the above that during less than ten years German rail exports increased by more than 300 per cent. The places of destination have changed considerably, even quite lately. Ruscia has taken less in the shape of rails from Germany, while Spain and South America have had increasing quantities. Among the principal consumers of German rails in 1881, we find Holland with 65,132 tons (of which, it is assumed, a great part went to South America); next the United States, with 45,531 tons; Spain, 34,440 tons; Belgium, 31,523 tons; and Switzerland, with 10,588 tons. Larger quantities have also gone to the East Indies.

CANAL BETWEEN LAKE SUPERIOR AND LAKE WINNIPEG.

A canal connecting Lake Superior with the Red River, Lake Winnipeg, Assiniboine, and Saskatchewan, is being projected. At a convention recently held at Duluth, "the zenith city of the unsalted seas," it was agreed that steps should be taken to have the canal constructed with the least possible delay, and to urge Congress to order surveys and vote a sum sufficient to complete the work. Engineers estimate the minimum cost of the proposed canal to be four million dollars, while the highest calculation places it at ten millions, exclusive of preliminary surveys. By means of about forty miles of canal with suitable locks and dams, it appears to be practicable to utilise 340 miles of deep water lakes and rivers now navigable for steam vessels, lying between Lake Superior and the Red River, and so to make a useful waterway for craft propelled by steam from the Great Lakes to the vast system of water routes in the valleys of the Red River, the Assiniboine, the Saskatchewan, and their tributaries, which reach so large a part of Minnesota, Dakota, Manitoba, and the North-western Territory, and are the natural highways to the richest and most extensive body of contiguous agricultural lands on the American Continent. The construction of the canal, it is claimed, will afford an outlet by a through water route to the Atlantic seaboard for a stretch of arable country equal in dimensions to the entire Eastern and Middle States of the Union. The promoters of the canal project also assert that its completion will bring through the United States the principal traffic of the Canadian North-west, and be a powerful commercial link between the two peoples; and, likewise, that it will practically extend the existing northern water routes from the Atlantic to and through the great lakes to the valleys of the Red River, the Assiniboine, the Saskatchewan, and their tributaries, and cheapen the transportation to the seaboard of their vast products sufficiently to make those lands valuable and the inhabitants of them prosperous. It remains to be seen whether, by voting the funds required, the United States Congress will take the same view of the project as its promoters.

DUPLEX ENGINE INDICATOR.

DIAGRAMS taken by ordinary steam engine indicators only represent the result of one side of the cylinder. In order to obtain the results on both sides a double indicator has been devised by Messrs. Schäffer and Budenberg, of St. Mary Street, Manchester, and is being introduced by them. By means of this instrument, in which two pistons are applied, a combined diagram, giving the result of both sides of the cylinder, or of the one or the other side singly, may be taken on the same paper by merely shutting or opening the steam cocks. In the engravings on page 244, fig 1 shows a vertical section of this indicator, from which it will be seen that two indicator pistons, K and K¹, are applied at the ends of the rod S. If the indicator cocks are open, the piston K is acted upon by the pressure of one side of the cylinder, and K¹ by the pressure of the other side of the cylinder, and they are forced in opposite directions, and they are supporting each other in such a manner that while in the passing of the crosshead of the steam engine in the one direction the piston K is pressed upwards, and in the return stroke the piston K¹ is pressed downwards, the indicator is continually acted upon by pressure only, and accordingly the combined diagram obtained in this manner, represents the positive or true compressions of both ends of the cylinder. The resulting diagram is a line lying partly above and partly below the atmospheric line. The distance from the atmospheric line represents in every case the real pressure acting upon the piston-rod, and while the fully closed curve represents the entire work done during one revolution of the steam engine, the part of the curve above the atmospheric line indicates the work done by the one side of the cylinder, and the part of the curve below the said line, the work done by the other side.

By only opening the one or the other of the two cocks a single or separate diagram may be taken from each end of the cylinder. If the diagrams of the two ends of the cylinder are taken separately, and also the combined diagram upon the same paper, which can be done by operating only with the cocks, the combination of diagrams contains all desired details for calculating the horse-power of the steam engine and the work done by the same. By this means the paper containing the combination of diagrams not only shows distinctly the separate diagrams and the combined diagram, but likewise clearly the influence of the circumstances, and a better and more correct diagram, representing the actual work done by the steam engine, is obtained. Another advantage of the double indicator over all other constructions is the fact that it is not influenced by the rising and falling of the barometer. In all other indicators the piston is exposed to the atmospheric pressure, and influenced by all the varying changes of the same, It is evident that this circumstance is particularly important in mountain locomotives and steam engines working underground and in coal mines. Fig. 2 of our engravings shows the method of connecting the indicator with the steam cylinder.

MARGETSON AND HEK'S CATTLE VAN.

OUR readers have been made familiar through our pages with the ingenious tipping wagons and carts invented by Messrs. Margetson and Hek. We have now to bring before them another invention of those gentlemen which we found at the late Reading show. This is their cattle van, which is a new vehicle, and possesses several advantages over the ordinary vehicles used for this purpose. It is mounted upon four wheels and has a locking carriage at each end, the carriages being connected with each other by diagonal bars. It is very low on the ground, and has good high wheels, the front ones being as large as the back ones. Each end is made to let down, so that cattle can, without difficulty, go in at one end and out at the other. The shafts are removable, and can be fixed to either end of the van. By means of the double-locking carriage it will turn easily in a very small space, and the strain upon the horse is obviously not so great as with a two-wheel cart. An improved arrangement of the springs, working on friction rollers, and not being tied to the body of the vehicle at either end, makes it run exceedingly easy, giving much easier draught for the horses. We may add that the Bristol Wagon Works Co. are the manufacturers of these vans. We give an illustration of them on page 244.

DOUBLE-ACTION HAYMAKER.

A VERY good double-action haymaker was exhibited at the Royal Show at Reading by the Maldon Ironworks Company, of Maldon, Essex, of which we give a perspective view in the engraving on page 244. It will be seen that there is nothing special in the general arrangement; the details, however, are worthy of note. It is fitted with a solid steel axle, and mounted on wrought iron travelling wheels 3 feet 10 inches high. Its extreme width is 7 feet 10 inches, and its working width 5 feet 8 inches. The wheels are constructed on an improved principle, which prevents the spokes wearing loose in the tires. The gearing is all covered in, and is very compactly arranged, thus allowing a maximum working width. It has a very simple reversing motion, and the draught is easy, the implement being well balanced.

CIRCULAR SAW BENCH.

THE engraving on page 244 represents a circular saw bench, in which several improvements have been introduced by the Reading Ironworks, who are the manufacturers. It has been designed to supply the want of a cheap and efficient saw bench. It has a rising and falling spindle, and turn-over bevel fence, and combines steadiness and solidity with a capacity for doing good work quickly. The table and legs are in one casting, having a planed top, and the fence is arranged, both for cutting bevel, and to hinge back off the table for cross-cutting. It can also be adjusted to cut different thicknesses of timber by means of the set screw on the bar for large variations, and by means of the hand

wheel and screw for smaller adjustments. The spindle is raised or lowered by means of a hand wheel, bevel gear, and screw, which is convenient of access, and is so arranged that the spindle has no tendency to move from the position in which it is placed. The bearings are long and made of gun metal, and have oil cups cast on them. The machine is provided with fast and loose pullies, and is fitted with a 24-inch saw. It can be fitted with a 30-inch saw if required. It is well finished, and is worthy the attention of those who require a good and effective machine.

THE SIMPLEX MOTOR.

UPON the occasion of a recent visit to Leeds, we took the opportunity of visiting the works of Messrs. Hathorn, Davey and Co., the Sun Foundry, where, amongst other interesting matters, we found a new and simple motor for small powers. This was the simplex motor, which is the invention of Mr. Davey, and which we illustrate in vertical section in the engraving on page 245. The motor consists of a small steam-engine and generator combined, the generator being a coil of wrought-iron pipe, inserted in the chimney of a small furnace. The piston-rod of the engine is continued through the upper cover, and made to form the plunger of a little pump. Into a funnel containing the suction valve of this pump, is allowed to run a small stream of water from a tank formed at the base of the chimney. During the down stroke of the plunger of the pump, air and water are taken in through the suction valve, and during the return stroke the air and water are together forced, in the form of spray, into the top of the coil generator. This spray courses through the convolutions of the coil until it reaches the bottom, by which time the water is converted into steam. That steam passes immediately into the steam cylinder, and works the engine in the usual way. A throttle-valve is inserted in the steam-pipe, actuated by means of a small governor fixed on the side of the steam cylinder. It will be seen that this coil generator possesses several advantages. In the first place it is very cheap and simple, requiring none of the fittings of an ordinary boiler, and being secure against explosions. There is no reservoir of water in the coil, consequently it is almost impossible to accumulate pressure when the engine is standing. The coil is so arranged that the fire does not impinge directly on the lower portion, and is found not to burn out. These coils have been in use more than twelve months without showing any signs of burning. Should a coil fail at any time, it is replaced at a trifling expense. The coil for a 1 horse-power engine is made of wrought-iron tubing only half an inch in diameter. The motor is made for all purposes requiring small powers, and is specially suited for pumping water for the supply of country houses, or for any purpose requiring intermittent work. The engine can be started in from seven to eight minutes after lighting the fire, and, as it has no delicate fittings about it of any sort, it can be worked by a labourer or gardener. When used for pumping purposes the small feed-tank at the base of the chimney is supplied by means of a small pipe from the pump; but when required for driving purposes, a little pump without valves or stuffing-box is provided in the base of the engine, which forms a cistern. By this arrangement the feed-water tank is automatically supplied. An overflow pipe is provided in the feed cistern to prevent a possibility of its running over. Altogether, the simplex motor appears to be a very desirable apparatus for light work, especially that of an intermittent character.

LEES' SELF-FEEDING DRILL.

IN the engraving on page 245 we illustrate a very useful tool, lately brought out by Messrs. T. and R. Lees, of Hollinwood, near Manchester. This is a self-feeding, portable, hand-power drilling machine, which is intended to —and doubtless will—supersede the old ratchet brace for drilling by hand power in places where the work cannot be done by an ordinary drilling machine. It can also be made to answer the purpose of an ordinary drilling machine when fixed to a bench. The construction of this tool is very simple, as will be seen from our engraving. It is fixed to the bench by means of clamps, as shown at the foot. The arm or cross-bar bearing the drilling apparatus is passed through a socket, in which it can be adjusted so as to point the drill in any desired direction. It is then secured in that position by tightening-up the set screws. The most ingenious part of the machine is the feed, which consists of a clever application of differential gear in a simple form. By lifting the small knob handle at the side of the feed screw, the upper of the two small toothed wheels fixed upon the spindle to which the knob is attached is thrown out of gear from the small toothed wheel fixed on the drill spindle nut. This nut then remains stationary, and a quick motion can be given to the spindle for getting the drill to and from its work. When this small handle is down the toothed wheels are in gear, and the feed motion is self-acting and ready for work. The rate of the feed is so arranged as to be suitable for the average sizes of the holes that the machine will drill. These machines can be prepared for boilermakers' use, or fitted with a clip for drilling pipes when required. With sixty revolutions of the handle per minute, we understand that a No. 2 machine will drill up to $\frac{3}{4}$ of an inch in diameter, and 6 inches deep, the rate of progression being about one inch in five minutes, or fully three times the work of the ordinary ratchet drill. As already observed, it will drill holes at almost any angle; and as the handle can be placed in three different positions for working in a very short time, it will be seen that it is adapted for drilling in the most difficult positions.

THE ANNUAL MEETING OF THE UNION OF GERMAN ENGINEERS.

THIS association held its annual meeting this year at Magdeburg on August 27 to 30. We learn that the attendance was satisfactory as to numbers, and that the proceedings throughout were of an interesting character. The business portion of the programme was disposed of on the 27th ult. at a preliminary sitting, so that the time fixed for the duration of the congress itself (28th to 30th ult.) was free for the discussion of various matters of professional interest.

At the opening sitting on August 28, Herr Wolff, on the part of the government congratulated the union on their assembling for the twenty-third time to discuss matters of interest to the profession. He remarked that in no branch of learning had such progress been made during the last ten years as in engineering, this development having led into new paths many important national industries—amongst them, those connected with mining, traffic matters, and appliances for lighting purposes.

Herr Born (the burgomaster of Magdeburg) in a congratulatory address of welcome to the meeting, referred to the fact that the industrial development of the city had been intimately connected with the progress realised during the last quarter of a century by German engineers. Such progress had, he observed, placed the nation on an equal footing with others, which was not the case at one time.

Herr Dittmar (of Eschweiler), the president, thanked the previous speakers for the sentiments they had expressed, and spoke of the encouragement the union received from the appreciation of their efforts at such a centre of technical industry at Magdeburg.

Herr Peters (of Berlin), the secretary of the union, reported that there were now 4400 members, 74 per cent. of these belonging to local unions, and 26 per cent. being in direct communication with the central body. Out of the entire number, 235 are resident in foreign countries. He alluded to the labours of the various commissions which, during the past year, had been dealing with subjects affecting the interests of members, such as the questions of technical instruction in workshops, and employers' liability for accidents.

The scientific part of the proceedings was opened by Professor Fischer, of Hanover, with a paper on "Warming by the Storage of Heat." His remarks were in some measure only applicable to the system of heating by means of tiled stoves so usual in Germany, respecting which he stated that the comparative thinness of the materials now commonly employed allowed them to give off heat in more or less exact proportion to the rate in which it was supplied to them. In this respect they differed from the old-fashioned stoves. He then alluded to the system adopted in 1843 by Grouvelle, for the improvement of the heating arrangements at the Mazas prison in Paris. Heating by means of warm water had been known for a long time, and where storage of heat was required, had been found to answer the desired purpose, but the want of mechanical power in hot water had prevented its successful application to the heating of large buildings. Grouvelle's principle was the utilisation of the mechanical power of steam in conjunction with the previously known system of heating by means of hot water. The irregularity of the heat thus given off having been found to be a disadvantage, the efforts of those interested in that branch of engineering had of late years been directed to obtaining uniformity in the supply of heat, and according to the professor's theory, this end is best attained by the water reservoir being placed in the cellars, the water being there heated by fire from underneath. The insertion of a stop-cock provides for the supply of the water to the serpentine pipes leading upwards, and for the regulation of the amount of heat. He remarked that it is without any real influence on the heat given off whether water or steam be employed, but he pointed out that with steam heating a comparatively large quantity of steam is used in the first instance, and hence a boiler of somewhat large dimensions is necessary. In conclusion, he stated his opinion that warming by means of the storage of heat is only to be recommended where the mechanical arrangements allow of a uniform heat being maintained if necessary, while also providing for the increase or decrease of the supply, as may be found advisable. He attached particular importance to the storage of heat being arranged in such a way that there should be no difficulty in shutting off the heat from the rooms thus served to any extent which might be found desirable by its occupants, this regulation of the supply of heat being rendered specially necessary by the variable nature of the German climate.

In his paper dealing with "The Technical Application of Electricity," Dr. Zexener referred to the invention of an electrical machine in 1630 by Otto von Guericke, a citizen of Magdeburg, and claimed for him a priority of discovery in this branch of science. With reference to the electric light and its application to domestic lighting purposes, he spoke of the successful attempts of Herr von Hefner-Olteneck to remedy certain imperfections of some systems, such as that by which the extinction of one light used to involve the extinction of the entire circuit of lights. He also spoke of a German invention which permits of the easy renewal of the filaments of carbon in electric lamps, which by their yellowish light seem likely to be more appreciated for many purposes than those which have the white light first known in connection with electric illumination. He dwelt further on the advantages of lighting railway carriages by electricity, on which subject deliberations and experiments are now being carried on by railway administrations at Frankfurt and Strassburg. The lighting of railway carriages by gas caused an unpleasant odour at times in the carriages and on the platforms. By means of the Faure accumulator, there is no danger of the extinction of the light from the stoppage of the train, although the motive force for the electrical apparatus is furnished by the rotation of the wheels. He likewise referred to the trials of transmission of electric force over distances of some magnitude, which will form a feature of the programme at the Munich Exhibition, and which it is expected will be of advantage to the cause of electrical science, particularly with reference to the question of electric railways.

The second day's proceedings were of varied interest, and included papers on "The Most Recent Improvements in Sugar Manufacture," "Progress of Boring Science during the Last Ten Years," and "Salt-mining in the Stassfurt District." In connection with the last-named subject an interesting excursion had been organised to Stassfurt.

On the closing day of the congress a number of interesting matters were brought forward for discussion. Herr Peters (the secretary) proposed that the necessary communications should be entered into between the union and the German government for the establishment of a fixed remuneration, for engineers summoned as judicial experts, on the basis of the scale laid down by the engineers' congress at Gotha. This scale was as follows:—4s. per hour at their own houses, or 5s. per hour out of their dwellings, but in the same town. As to matters which involved travelling, it was suggested that the scale of remuneration allowed to attorneys in similar cases should be made legally applicable to technical experts.

Professor Inze, of Aix-la-Chapelle, spoke of the advantages arising from the adoption of normal models for rolled iron. The same member also referred at some length to the measures which the Engineers' Union was taking in conjunction with the Architects' and Engineers' Union to bring about the rational utilisation of the water-power of the German rivers. The sanitary advantages of the regulation and purification of rivers were dwelt on by him, and the instance was cited that, in a department of France where such measures had been carried out, the mortality sank from 40·5 to 25·4, and the average duration of life increased from twenty-five to thirty-five years, while the number of recruits who were not up to the medical requirements of the military regulations diminished from 52 per cent. to 9 per cent.

We may add that we are indebted for the above excellent report of the meeting to our able contemporary, the *Builder*.

THE LEATHER TRADES EXHIBITION.

THE second leather trades exhibition, last year, was an improvement upon the first, held the previous year. The third, now open in the Agricultural Hall, Islington, shows a decided falling-off, if not in the quality of the manufactures exhibited, at least in the number of exhibitors. It was opened on Friday last by the Lord Mayor in state, and is announced to close to-morrow (Saturday). The display of leather and leather goods is deserving of all praise, and naturally attracts the greatest attention. But as we have less to do with manufactures than with the machinery which helps to produce them, we pass by them, leaving it to our contemporaries of the leather trade to deal with them according to their merit. We cannot, however, pass over without notice the fine display made by Messrs. John Dixon, Sons and Taylor, Manning Street, Bermondsey, S.E., who show a large variety of hides and leather, a number of alligator skins, an elephant hide, &c.; nor that by Messrs. W. Stephen and Son, of Dundee, who have in the hall a trophy consisting of the heads of walruses, seals, a polar bear, and a reindeer, weapons used by hunters and fishers in the Arctic seas, and leather prepared from the skin of a whale, the whole being crowned by the preserved body of a young polar bear. The Eglinton Chemical Company, 29, St. Vincent Place, Glasgow, have also a goodly selection of leather and leather goods.

The machinery shown is limited in number, and presents no striking novelties. Mr. Edward Wilson, of Exeter, has again some very good tanners' machinery. His show comprises two striking machines, as described in IRON of September 30, 1881, one of them at work; a universal roller for offal, bends or butts; a butt roller, a pendulum roller, and a disintegrator; all of the excellent finish for which Mr. Wilson's machinery is known. Messrs. C. Molinier and Co. exhibit their improved small setting-out, striking, shaving, and fleshing machine, and their improved small duplex machine, for treating both sides of sheep, calf, or goat simultaneously. Mr. John Blakey, of Leeds, has a very good show of boot and shoe manufacturing machinery, boot protectors, &c. The collection of tanning machinery exhibited by Messrs. Huxham and Brown, of Exeter, is as good as it is extensive, and is the largest in the hall. It includes a softening machine for curriers, American stoning, re-setting, glazing, and glassing machine, a C roller with adjustable spring pressure to bearings of top roller, a pendulum roller, a scouring machine, a bark mill, tanners' pumps, &c. Mr. J. M. Jones, of Wrexham, again shows his improved fleshing and fluffing machines. Both these machines may be seen in operation. We are informed that since they were exhibited last year, they have met with a steady sale both at home and abroad, including the United States, India, and Australia, while one home firm has purchased two of the fleshing machines, another firm three, discarding all other makes, and six of them are in work at the Cambrian Leather Works, Wrexham. By an attachment for altering the speed, the machine may be adapted for fleshing calf, of which it will do from 40 to 60 dozen per day of ten hours, according to size. For the purpose of scudding and striking out, it may be fitted with an extra knife cylinder with dull edges, the change of knives being effected in about twelve minutes. The quantity of work done in a given time is said to equal that of eight men, while the manner in which it is done gives every satisfaction. The operator has little else to do besides feed the machine, and as the knives rotate towards him, there is no risk of accident. Messrs. W. Reynolds and Co., of Warrington, exhibit their automatic leather and offal rollers; and Messrs. Buchanan Brothers, 104, Temple Street, Bristol, an assortment of their well known boot and shoe machinery. Messrs. Pearson and Co., 9, Acorn Street, Bishopsgate, E.C., display sewing machines used by boot and shoe manufacturers, and other machines employed in the manufacture of boots and shoes. Of other sewing machines shown, we may mention those sent by the Wheeler Wilson and Howe Companies. An ingenious machine in the exhibition is the wire quilting machine of the Wells Wire Quilting and Shoe Tip Company, of Leicester, which in a couple of minutes fills a leather sole with brass or other wire as a substitute for nails.

Mr. E. S. Hindley, of Bourton, Dorset, is the only exhibitor of steam motors. He shows a 10-horse-power horizontal engine combined with vertical boiler. The engine is fitted with a high-speed equilibrium governor, upon which entire dependence may be placed for uniformity of speed; the boiler is multitubular, and there is a water-heater attached. The whole is combined on water-tank foundation, requiring no fitting. Mr. Hindley also exhibits a 4-horse-power vertical engine and boiler on travelling wheels, and a 2-horse-power vertical engine and boiler without wheels. Gas engines are shown by Messrs. H. C. Gros and Co., 11, Great Eastern Street, Shoreditch, E.; Messrs. Pearson and Co., and the Turner Gas Engine Co. Amongst what may be classed as miscellaneous exhibits, the Wilson Engineering

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THE CONTINENT.

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Messrs. WILLMER and ROGERS, Beekman Street, New York, will supply thick or thin paper copies of IRON on application.

Co. and the Eagle Range Foundry Co. appeal to the housewives of tanners and shoemakers by large assortments of cooking ranges. Messrs. D. Hart and Co., of the North London Iron Works, Wenlock Road, N., with their improved patent weighing machines, without loose weights, and adjusted to the standard weights of any nation, deserve commendation. Mr. Maurice Gandy, of 130, Queen Victoria Street, E.C., 5, Ansdell Street, Liverpool, and Baltimore, U.S.A., notwithstanding the old saying that "there is nothing like leather, is not afraid of challenging comparison with his cotton belting, which is made of the best American cotton duck, hard woven, folded and sewn together, after being saturated with a composition to prevent the atmosphere having any effect upon it. This belting may be used for any purpose to which leather is applied; it is stated to be thoroughly waterproof and impervious to climatic influences and the variation of temperature. Moreover, it is said to cling well to the pulleys and to run true, and can be made any length without joints, advantages which will be appreciated by users. It is suitable for any width of pulley, some being made five feet wide—and one end can be tapered, if necessary, to prevent jump in running. Some very severe tests have been applied to ascertain the relative strength and value of Gandy's main driving-belt as compared with leather. At one of these experiments the best quality leather 6 inch belting withstood a breaking strain of 3572 lb. to the square inch of section, while Gandy's 6-inch eight-ply cotton belting withstood a strain of 6811 lb., or nearly double that of leather belting, while the cost of cotton belting is less than one-half that of the other. These results are very remarkable, and it would seem that the stronger and cheaper belting is likely to supersede leather, especially as in these competing times efficiency and cost have to be considered in all commercial matters. The patent belting is successfully used in over 4000 mills and works in this country and abroad, including Messrs John Crossly & Sons, the well known carpet factory, Halifax; Messrs Siemens Brothers, Woolwich; and other eminent firms. At various exhibitions Gandy's patent cotton belting has been awarded first prizes.

NOTICES OF BOOKS.

The Boilermakers Ready Reckoner. By J. COURTNEY. Revised and edited by D. K. CLARK, C.E. London: Lockwood and Co., 1882.

IN order to make this book thoroughly useful to all for whom it is intended, the compiler has included in it all the tables which ought to be in such a ready reckoner. The piecework plater, who is paid by the ton, will find without trouble the weight of his iron when he has the size of it. For smiths there is supplied reliable information as to circumferences of circles in plate iron and angle iron. Riveters will be able to settle the payment of the holder-on from the rivet table. Apprentices are not lost sight of, for they will gain some knowledge of the rules that are to guide them in templating. Among other matter useful to the boilermaker will be found the rules for calculating the tables, as well as some small tables of strengths of ropes and chains. The rules and tables will save many a troublesome casting-up, and at the same time form a reliable guide to the working boilermaker.

The Phynodderree, and other legends of the Isle of Man. By EDWARD CALLOW. With sixty illustrations, drawn expressly for the work, and engraved on wood, by W. J. WATSON. London: J. Dean and Son.

YOUNG and old children will read with avidity the charming fairy tales of the Isle of Man collected by Mr. Callow, and prettily illustrated by Mr. Watson. In no part of these islands has the belief in the existence of fairies retained a stronger hold upon the people than in Mona's Isle. Many legends of good and evil fairies are still related by the country people of the Isle of Man, and Mr. Callow has rendered a real service to our children in rescuing them from oblivion, and presenting them in an entertaining shape. We may add that the publishers have spared no pains in rendering the book attractive.

NEW BOOKS.

Fore and Aft Seamanship for Yachtsmen. C. Wilson.
International Cyclopædia (The). Edited by J. Ashurst. Vol. 2. Macmillan and Co.
Photography at Home: its Appliances and Apparatus. Marion and Co.
Renaissance in Italy. By J. A. Symonds.
Revival of Learning (The.) 2nd Edition. Smith, Elder and Co.
Revival of Learning (The)—The Fine Arts. 2nd Edition. Smith, Elder and Co.
Science in Short Chapters. By W. Mattieu Williams. Chatto
Science Ladders. By N. D'Anvers. Series 1. Nos. 1 and 2. Philip.
Science Ladders. By N. D'Anvers. Series 2. Nos. 1 and 2. Philip.
Science Ladders. By N. D'Anvers. Series 3. Nos. 1 and 2. Philip.
Solution of the Pyramid Problem (The) or, Pyramid Discoveries. By R. Ballard Low and Co.
Story of the Earth and Man (The.) By J. W. Dawson. 7th Edition. Hodder.
Student's Handbook of Philosophy and Psychology. By B. F. Cocker. Hodder
Synopsis of the Classification of the Animal Kingdom. By H. A. Nicholson. Blackwood.
Tables for the Qualitative Analysis of Simple Salts and Easy Mixtures. By J. Barnes. Simpkin and Co.

BOOKS RECEIVED.

Directory to the Iron and Steelworks of the United States. Prepared and published by the American Iron and Steel Association. 1882.
Technologisches Wörterbuch in englischer und deutscher sprache. By Professor Gustav Eger. Part I. English German. Revised by Otto Brandes. Braunschweig: F. Vieweg und Sohn.

SCIENCE AND ART.

CITY AND GUILDS OF LONDON INSTITUTE.—The council of the institute announce that, owing to unavoidable delay in the completion of the workshops and the laboratory fittings, the opening of the Technical College, Finsbury, is postponed until January 1883. Arrangements, however, have been made for carrying on the work of the college during the winter term, in all its departments, in the temporary class-rooms of the institute, Cowper Street, Finsbury.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending September 16, 1882:—On Monday, Tuesday and Saturday (free), from 10 a.m to 10 p.m., Museum, 11,753; Mercantile Marine, Building Materials, and other Collections, 5686. On Wednesday, Thursday, and Friday (admission 6d.), from 10 a.m. to 6 p.m., Museum, 1782; Mercantile Marine, Building Materials, and other Collections, 670; total, 16,891. Average of corresponding week in former years, 18,999. Total from the opening of the Museum, 21,337,387.

THE NORTHERN SANITARY ASSOCIATION.—This association, which has been lately constituted at Liverpool on a basis similar to that of the London Sanitary Protection Society, has now practically commenced its career. At a recent meeting of the executive committee, Mr. Fleeming Jenkin, M. Inst. C.E., professor of civil engineering in the University of Edinburgh, and consulting engineer to the Sanitary Protection Associations of Edinburgh and London, was appointed consulting engineer. Mr. Coard S. Paio, engineering surveyor of Liverpool, acts as resident engineer; and the secretaryship and treasurership is placed in the hands of Mr. J. S. Harmood Banner.

THE NEW LAW ON ANCIENT MONUMENTS.—The act for the protection of ancient monuments, one of the last passed in the recent session (45 and 46 Vict. c. 73), is now operative, and may shortly be enforced. Power is given to constitute the Commissioners of Public Works the guardians, and any owner of an ancient monument may by deed place the same under their guardianship. The commissioners are empowered, with the consent of the Treasury, to purchase ancient monuments, and inspectors of ancient monuments may be appointed. Penalties by fine or imprisonment are to be imposed for injury done to ancient monuments in a summary manner in the United Kingdom. A description of the owners of ancient monuments is given, and a schedule of existing monuments to which the act is to apply, as also two other monuments of which the Public Works Commissioners may become guardians. There are nearly seventy specified in the United Kingdom now to be protected including in England, Arthur's Round Table, Penrith, Stonehenge, and Kit's Coty House, in Kent, as also Old Sarum. They may be now maintained and protected at the public expense.

INTERNATIONAL FISHERIES EXHIBITION.—In the report of the executive committee to the general committee of the Great International Fisheries Exhibition at the meeting on September 7, it was stated that since the date of the last meeting of the general committee the arrangements for the preparation of the gardens of the Royal Horticultural Society for the reception of the exhibition have been greatly advanced. The plans of the proposed buildings have been determined upon, and the details of construction are so arranged as to be economical and effective, and can with ease be extended in the event of more space being required. The total amount of space at present provided for by the existing and new buildings, will amount to 220,300 square feet. A sub-committee has been appointed to superintend the construction of tanks and aquaria, and all the necessary arrangements for the piscicultural department. Since the date of the last meeting the committee have received highly encouraging notices of adhesion from several additional governments and colonies, one of the latest received being a highly satisfactory telegram, through the Foreign Office, from the government of China. From several parts of France also the process of oyster cultivation, carried to great perfection in that country, will be well represented; and the exhibits promised from Hungary, Italy, and Germany, are such as the committee feel will be in the highest degree interesting, whilst from Norway and Sweden, the Netherlands, and other countries, including the Chilian Republic, which enjoy the advantage of local committees sanctioned by the governments, the collective exhibits sent will of course approach perfection. The International Meteorological Committee, who recently held their annual conference at Copenhagen, agreed to forward to the exhibition from their respective countries representations of the system of forecasting the weather. From the colonies, for the most part, very satisfactory replies have been received, and official arrangements have been organised in nearly all the colonies connected in any way with the fishing interest. In the list of special prizes the committee have made large and important additions, notably the prize of £600 for the best life boat, and have received from private individuals donations to cover a certain amount of the expenditure thus involved. Among the subjects for prize essays are the following:—On improved facilities for the capture, economic transmission, and distribution of sea fishes, £100. On improved fishery harbour accommodation for Great Britain and Ireland, indicating the localities most in need of such harbours, the general principles on which they should be constructed, and the policy the state should adopt in aiding and encouraging harbour accommodation for fishing purposes, £100. The best appliances and methods of breaking the force of the sea at the entrance to harbours and elsewhere, £100.

MEETINGS FOR THE WEEK

MONDAY, SEPTEMBER 25.

NATIONAL SOCIAL SCIENCE ASSOCIATION.—Nottingham, address by Professor Bonamy Price. 10 a.m.

TUESDAY, SEPTEMBER 26.

SANITARY INSTITUTE.—Autumnal Congress. Newcastle-on-Tyne. (Five days). Captain Douglass Galton president.
SOCIAL SCIENCE ASSOCIATION.—10 a.m. Address by Mr. G. Aitchison, &c.
LICHFIELD AGRICULTURAL SOCIETY SHOW. (Two days).

WEDNESDAY, SEPTEMBER 27.

SOCIAL SCIENCE ASSOCIATION.—Concluding meeting, noon.
SANITARY INSTITUTE.

THURSDAY, SEPTEMBER 28.

ABERGAVENNY AGRICULTURAL AND HORSE SHOW.
NORTH WESTERN COUNTIES SHEEP DOG TRIAL ASSOCIATION.—Greystoke Park, Penrith.
SANITARY INSTITUTE.

FRIDAY, SEPTEMBER 29.

SANITARY INSTITUTE.

SATURDAY, SEPTEMBER 30.

SANITARY INSTITUTE.

METALLURGY AND MINING.

THOMAS GILCHRIST PROCESS AT CREUSOT.—M. Delafond, the inspector of rails for the French government, has recently reported for the state railways on the basic process at Creusot. His report appears in a late number of the *Annales des Mines*. The following is his summary of the question:—"Summing up, we can say that the problem of the manufacture of steel from phosphoric pig is resolved both for the Bessemer and open hearth processes by the employment of a peculiar lining of magnesian lime. The removal of phosphorous is as satisfactory as possible, that of silicon is almost complete, and a great part of the sulphur is also removed. The series of analyses quoted show that the basic steel is purer than the acid steel and is more uniform in composition. The mechanical tests of tensile strength show that the basic steel is appreciably more regular than the acid. The rails manufactured with the two kinds of steele give equally good results. The State has therefore decided to accept indifferently rail tenders for acid and basic steel. In the Siemens furnace, the Thomas-Gilchrist process is more easily carried out than even in the converter, and the dephosphorisation is more complete."

A NEW INVENTION IN IRON SMELTING.—We learn that an innovation has been introduced in the Scotch iron smelting trade which may be considered the most important that has been effected since the introduction of the hot-blast process. For some considerable time past, experiments on different scales have been made further to utilise the waste gases before burning them, by extracting the tar and ammonia which were found to be present in the gases of all blast-furnaces where coal was used as fuel, and, after much labour, and numerous experiments, Messrs. Alexander and M'Cosh, of the firm of William Baird and Co., Gartsherrie, are stated to have successfully solved the problem, in practical form, of extracting the tar and ammonia, as subsidiary products, from their blast-furnaces without increasing the cost of manufacture, or in the slightest degree disturbing the process of smelting. Some time ago a work on a very considerable scale was erected at Gartsherrie iron-works, and is now said to be in successful operation, recovering the tar and ammonia from blast-furnace gases, which, after passing through the apparatus and parting with their valuable products, are conveyed by piping to different parts of the works for the generation of steam and other purposes. We hear that so successfully have these operations proved that the Gartsherrie firm are now erecting similar apparatus for all the furnaces at their various works in Lanarkshire and Ayrshire.

TESTS OF BESSEMER STEEL.—The Pittsburgh Steel Casting Company, with a view of showing the uniformity that may be attainable in the manufacture of Bessemer steel, have made a series of tests and carbon determinations of their refined Bessemer steel. The result of their tests was as follows:—

No. of Blow.	Elastic Limit.	Elongation in 1 inch at Fracture.	Tensile Strength.
700	Not taken	52 per cent.	61,280
701	32,272	50 "	63 448
702	34,667	62½ "	63,200
703	33,333	50 "	64,800

The mechanical tests, in addition to above, showed the same uniformity, the steel being rolled into boiler plate, flanged, crimped, and then brought down solid, without showing the least fracture in either of the different blows. The carbon determinations of 73 separate blows, where the carbon aimed at was not to exceed 0·10, and to be as near that as possible, proved that this steel can be produced with regularity. The determinations were:—

54 blows below 0·10
14 " 0·10
1 " 0·11
2 " 0·12
1 " 0·13
1 " 0·14

The mechanical tests of these low steels showed that all of them, after working, can be cooled in water, and bent double without showing a fracture, and with but few exceptions will do the same when cooled in a strong solution of salt and water. In spring steel the same uniformity was secured. In 65 blows of this steel, where the carbon aimed at was 0·66, the following were the results:—

5 blows, 0·63
10 " 0·65
16 " 0·66
11 " 0·67
15 " 0·68
8 " 0·69

The average being 0·666.

The above experiments prove that by the use of good material and careful manipulation steel can be produced from the Bessemer converter equal in regard to uniformity to either open-hearth or crucible steel.

ELECTRICITY AND TELEGRAPHY.

THE MUNICH EXHIBITION.—A series of electro-technical experiments on a large scale are now taking place at the electrical exhibition in Munich. Their object is to give government officials and local authorities, as well as the general public, a clear survey of the present state of electricity in its practical shape, more particularly with reference to the transmission of force and sound, as well as the application of electricity to lighting purposes. It is expected that these trials will tend to propagate the introduction of electricity both in public and in private life, to the great benefit of the community at large.

THE ELECTRIC LIGHT AT ALEXANDRIA.—Messrs. Allen Alderson and Co., of that city, who have worked the electric light at Ramleh for the last month, have now received orders to erect another electric light in the Mex forts. This firm was one of the first to resume business in Alexandria, their extensive stores of machinery, which had happily escaped the fires of last July, having been reopened on the fourth day after the bombardment, and have since been of great service in supplying H.M.'s troops with various machinery, tools, &c. The machine used is a Gramme of 5000 candle power. The Servin lamp belonging to the machine being in Cairo, a lantern had to be made by a local maker. It threw a clear light at Ramleh for a distance of over three miles. We understand that the lamp which is now being made for Mex will be ready shortly, and will, it is fully expected, throw a light for at least six miles. The Gramme machine is worked by a portable engine manufactured by Messrs. Ruston, Proctor and Co., of the Sheaf Iron Works, Lincoln. They have also supplied one of their portable engines for pumping out the stale water from the old cisterns, and this little machine of 4 horse-power has likewise been pumping salt water from the sea, near the Ramleh station in town, and forcing the water up to a place close to the Zizinia Theatre for the purpose of flushing the town drains.

RAILWAYS & TRAMWAYS.

THE RAILWAY RATES FOR COAL FROM YORKSHIRE TO LONDON.—The question of the tonnage rates for coal conveyed by Railway from South Yorkshire to London has once more been brought to the front by the coal owners, who for many years have complained bitterly of the rates imposed by the Great Northern Railway Company. The meeting of coal owners held in Sheffield on Tuesday, although private, was specially called by circular issued by an influential firm of Yorkshire solicitors for the purpose of hearing the reports of a deputation who had had an interview with the Great Eastern directors, and with Mr. Noble, the manager of the Midland Railway Company respecting the matter. The rates and the desirability of having an independent route from the district collieries to London, have occupied the attention of coal owners for a number of years. For many years the Great Northern Railway Company, which now carries most of the coal from South Yorkshire, was the largest feeder to the London market; but matters have now changed, and the coal-owners contend that this arises from the high rates charged. It is a somewhat significant fact that when the rates were the lowest, the tonnage of coal was the largest which ever passed over the Great Northern line. The rates from the district are 8s. 3d. per ton, including city dues, whilst those from other districts vary a good deal. For instance, the rate from South Yorkshire—172 miles—is 7s. 2d., without city dues. It is the same from West Yorkshire, although the distance is eight miles further. From Lancashire and Cheshire it is only 7s. 1d., although the distance is 194 miles. The cost of carrying coal from South Wales—204 miles—is only 7s. 4d., and from Durham—260 miles—8s. 7d. per ton. The same seams are worked in South Yorkshire as in Derbyshire, but the latter district is 30 to 40 miles nearer London. Yet the Great Northern charges more per ton per mile for the long distance than the Midland does for the short one. This is seen by the increased tonnage of coal from Derbyshire. At least three-fifths of all the coal sent to London by rail goes from that locality. On the other hand, whereas the Great Northern in 1852 carried more than one-half of all the coal which entered London by rail; in 1872 it did not carry one-fifth of the coal sent to the metropolis.

NAVAL ARCHITECTURE.

LAUNCHES.

ENGLISH.

Adour.—On September 11, there was launched from the yard of Palmer's Shipbuilding and Iron Company, Jarrow, a steamer of the following dimensions:—Length 250 feet; breadth, 33 feet; depth, 16 feet. The engines will also be supplied by Palmer's Company, and will have cylinders of 30 inches and 57 inches respectively in diameter, the piston stroke being 36 inches. She has been built for Messrs. D'Obigney and Co., of La Rochelle, for whom Messrs. Palmer and Co., have already delivered three steamers, and for whom they at the present time have five on hand.

Cornucopia.—On September 18, this steamer was launched from the shipbuilding yard of Messrs. Osbourne, Graham, and Co., North Hylton, built to the order of Messrs. Turnbull, Potts and Co., of the Argosy Steam Shipping Company. The steamer, which has been built for the general carrying trade, is of the following dimensions:—Length, 250 feet; breadth, 34 feet; depth to main deck, 17 feet, and to spar deck, 24 feet; with a carrying capacity of 2200 tons deadweight. Her engines, of 150 horse-power, will be fitted by Mr. George Clark, of Southwick.

Eppleton.—On September 14, there was launched from the shipbuilding yard of Messrs. S. P. Austin and Son, this iron screw-steamer of the following dimensions:—Length over all, 223 feet; breadth, extreme, 31 feet; depth of hold, 15 feet 2 inches; gross tonnage, 990 tons; nett tonnage, about 632 tons. She will be fitted with compound surface-condensing engines of 110 horse-power nominal, and is the second boat built to the order of Messrs. Sharpe and Co., Newcastle on-Tyne, off the same model.

Gardepee.—On September 14, there was launched from the shipbuilding yard of Messrs. Wm. Pickersgill and Sons, Southwick, Sunderland, this screw-steamer, built to the order of Messrs. Morel Brothers and Co., of Cardiff. The vessel is of the following dimensions:—Length, 258 feet; breadth, 36 feet; depth, 18 feet 6 inches. Her engines are to be of 140 horse-power, by Mr. George Clark, Southwick.

Gerarde.—There has been launched from Messrs. C. Mitchell and Co.'s yard, Newcastle, an iron screw-steamer of 2400 tons burthen, built to the order of Mr. Jos. Fawcett, of Sunderland and Newcastle. She is being engined by the the Wallsend Slipway and Engineering Company (Limited).

Lero.—On September 12, there was launched from the building yard of Mr. James Laing, Deptford, this steamer of the spar-deck type, of the following dimensions:—290 by 37 by 27, for Messrs. N. and S. W. Pinkney.

Watlington.—On September 13, Messrs. William Gray and Co. launched from their yard at West Hartlepool this iron screw-steamer, of the following dimensions:—Length, 268 feet; breadth, 35 feet 6 inches; depth of hold, 19 feet 9 inches. She is built to the order of Messrs. R. Ropner and Co., of West Hartlepool, and is intended for the Indian and Mediterranean trade, to carry 2500 tons. Her engines are to be supplied by Messrs. T. Richardson and Sons, of Hartlepool.

SCOTCH.

Aston Hall.—On September 13, there was launched at Dundee, by Messrs. Gourlay Brothers and Co., this steamship for Messrs. Alexander and Radcliffe, Liverpool. Her dimensions are as follows:—Length, 360 feet; breadth, 42 feet 6 inches; depth of hold, 27 feet 7½ inches; gross tonnage 3700. She is fitted up with engines of 330 nominal horse-power; she will be schooner-rigged, and classed 100 A 1 at Lloyd's. She is intended for the Bombay trade.

Beeswing.—On September 15, this vessel was launched from the shipbuilding yard of Messrs. Dobson and Charlton, Grangemouth. She is built of steel and to the order of the Universal Steam Shipping Company, London. Her principal dimensions are:—Length between perpendiculars, 23[illegible] feet; depth of hold, 16 feet. She will be fitted with compound surface-condensing engines of 120 horse-power nominal by Messrs. Hutson and Corbett, of Kelvinhaugh Engine Works, Glasgow.

Bow Fell.—On September 16, Messrs. Murdoch and Murray launched from their yard at Port Glasgow this screw-steamer, of the following dimensions:—Length, 14[illegible] feet; breadth, 22 feet; depth of hold, 10 feet 6 inches. The vessel has been built to the order of Messrs. Hume Smith, and Co., Liverpool, and forms the fourth of their new Fell line. She will be fitted with engines of 65 nominal horse-power, by Messrs. Dunsmuir and Jackson, Govan, Glasgow.

Brier.—On September 14, Messrs. David and William Henderson and Co. launched from their Meadowside Works, Partick, this iron screw-steamer, of the following dimensions:—210 feet by 30 feet by 15 feet 2 inches, and 700 tons. She has been built to the order of the Glasgow and Londonderry Steam Packet Company. The vessel will be fitted by her builders with compound engines of the most approved design and with all recent improvements, her cylinders being 31 and 60 inches diameter by 3 feet 6 inches length of stroke, and a working pressure in the boilers of 9 lb. per square inch.

Florence.—On September 14, Messrs. Thomas B. Seath and Co. launched from their shipbuilding-yard at Rutherglen, this steamship for the west coast of England traffic. The vessel, which has been built to the order of Messrs. J. J. Mack and Co., Liverpool, is of the following dimensions:—Length, 150 feet; breadth, 22 feet; and depth, 11 feet. The engines are compound surface-condensing of 60 nominal horse-power; cylinders, 20 inches and 36 inches in diameter by 27-inch stroke, with a working pressure of 80 lb. The machinery is supplied by Messrs. Wm. King and Co., Glasgow, and it is expected that the steamer will attain a speed of 11 knots an hour.

George Gordon.—On September 14, Messrs. Birrell, Stenhouse, and Co. launched from their yard at Dumbarton this iron sailing ship, of about 1320 tons gross register, built to the order of Mr. G. Cowper, Glasgow. She will be an addition to the fleet of the North British Shipping Company.

Libau.—Messrs. R. Napier and Sons launched from their shipbuilding yard at Govan this iron screw-steamer of about 2000 tons. The vessel has been built to the order of Messrs. Fraissinet and Co., Marseilles, and is intended to inaugurate their Indian and China service from that port. She will be fitted with compound surface-condensing engines of about 2000 horse-power, which have been constructed by the builders at their Lancefield works.

Milton Park.—On September 18, Messrs. A. M'Millan, and Son, Dockyard, Dumbarton, launched this double-bottomed iron sailing ship of 1705 tons, B.M. The double-bottom is constructed on the longitudinal girder principle, and is made to contain 300 tons of water ballast, and is fitted with pumps capable of discharging the whole of it in six hours. She is intended for the East India trade.

Neto.—On September 16, Messrs. Dobie and Co. launched from the Govan shipbuilding yard this iron screw-steamer of about 1600 tons gross, for the Mediterranean trade of Messrs. Strong, Reid and Page, of Liverpool. The machinery is being supplied by Messrs. Smith Brothers and Co., of the Kingston Engine Works.

Ruby.—On September 15, Messrs. John Fullerton and Co. launched from Merksworth building yard, Paisley, this iron screw-steamer of the following dimensions:—125 feet by 22 feet by 9 feet hold, and 300 tons B.M. The vessel has been built to the order of Messrs. Mitchell and Rae, merchants, Newburgh, Aberdeenshire. She will be fitted with a pair of compound engines by Messrs. Lees, Anderson and Co., Clyde Street, Glasgow, of 50 horse-power nominal, cylinders 17 inch and 32 inch diameter and 27-inch stroke, and a working pressure on the boilers of 80 lb. per square inch.

Woosung.—On September 19, there was launched from the shipbuilding yard of Messrs. Scott and Co., this iron screw-steamer of 1800 tons register and 200 nominal horse-power. Her dimensions are:—Length, 272 feet; breadth, 35 feet; depth, 23 feet 6 inches. She is a sister ship to the *Whampoa*, recently launched by the Messrs. Scott. The *Woosung* is built to the order of Messrs. John Swire and Sons, London, and is intended for the China trade.

TRIAL TRIPS.

Rougemont.—On September 12, the screw-steamer *Rougemont*, the latest addition to the fleet of steamers owned by Messrs. John Cory and Sons, of Cardiff, went on her trial trip in the Bristol Channel. The steamer proceeded down Channel to off Lynmouth, where her sea-going capabilities were fairly tested; an average speed of 13½ knots was obtained, with 80 revolutions and 75 lb. of steam. The *Rougemont* is the first steamer of large tonnage which has been built at Chepstow, and has a carrying capacity of 2000 tons. Her engines have been built by Messrs. Black, Hawthorn and Co., of Gateshead-on-Tyne, and are on the compound surface-condensing principle. The cylinders are 28 and 54-inch, with 36-inch stroke, 140-horse power nominal. The boilers are of very large dimensions, and are fitted with Fox's patent corrugated furnaces, which effect a great saving of fuel, and is the first steamer which has been so fitted in the Bristol Channel. Messrs. E. Finch and Co., Chepstow, are the builders of the steamer.

DISASTERS AT SEA.—There were nineteen British and foreign actual shipwrecks reported during the past week, making a total of 979 for the present year, or a decrease of 179 as compared with the corresponding period of last year. British-owned vessels numbered 13, three were steamers (British), with an aggregate tonnage of 1330 tons. Total tonnage lost for the week, 6524 tons; total number of lives lost 13. Seven vessels were wrecked off the coasts of the United Kingdom, six being British owned, and one French. Th[illegible] British vessels sunk by collision.

GENERAL NOTES.

CHANGE OF ADDRESS.—Messrs. James and Shakspeare have moved to 1, Metal Exchange Buildings, Whittington Avenue, Leadenhall Street, E.C.

HAY AND CORN DRYING COMPETITION.—The judges appointed by the Royal Agricultural Society to test the merits of the different appliances adopted by the competitors for a prize of one hundred guineas offered for the most efficient and economical method of drying hay or corn crops artificially, either before or after being stacked, have made their report. There were eight competitors, six of whom employed the "Neilson" system of exhaust fans for drying in the stack; the two remaining competitors using, in one case, hot hair applied before stacking, and in the other a system of ventilation assisted by hot air applied after stacking. All the inventions were tried on hay, but a selected three out of the various adaptations of Neilson's system were submitted to an extended trial both on hay and barley. In the end, however, none of the exhibitors proved that they were able to make good hay in wet weather. In a few instances where fairly good hay was obtained, equally good, if not better, might have been secured without the application of fans. The trials of the three selected fans upon corn were even less satisfactory than those upon hay, none of the machines having succeeded in effectually drying the corn in the stack. Under these circumstances the judges report that they do not feel justified in awarding the prize.

THE TRADES UNION CONGRESS.—The Trades Union Congress opened its fifteenth annual session at Manchester, on Monday. Mr. Birtwistle, chairman of the parliamentary committee, having briefly opened the proceedings, the election of officers was made, and the parliamentary committee's report was read. After paying a feeling tribute to the memory of the late Mr. Macdonald, M.P., reference was made to the unsuccessful efforts to amend the Employers' Liability Act, the payment of wages in public houses, the Factory Acts, land law reform, the depression in the mining and building trades, the Liberty and Property Defence League, and kindred topics. On Tuesday, the president, Mr. R. Austin delivered his inaugural address. He contrasted the improved position of the working classes of the present day with their condition some fourteen years ago, when the congress was established. He pointed to the legislation they had been instrumental in accomplishing, and alluded to several of the seventeen objects on their programme for which they still have to contend. Chief among these is an amendment of the Employers' Liability Act, as it is found that many employers and companies have taken steps to defeat the intentions of the Legislature. Mr. Austin advocated the formation of a fund, by penny weekly subscriptions for the support of twenty-five representatives of labour in Parliament. The congress subsequently passed resolutions in favour of an increase in the number of factory inspectors, and of an amendment of the patent laws. On Wednesday, resolutions were passed in favour of a requirement that all persons placed in charge of steam boilers and engines should possess certificates of competency; that the number of mine inspectors should be increased by the appointment of practical working miners; and that strenuous efforts should be made to remove the permissive character of the Employers' Liability Act, and so render it impossible for employers to contract themselves out of that measure. On Thursday, the first business at the sitting of the congress was a motion by Mr. Sharrocks, of Manchester, protesting against the inequality of the law affecting debtors, and instructing the Parliamentary committee to do its best to have the inequalities removed by a provision in the forthcoming Bankruptcy Act. Mr. Williams, of Manchester, seconded the motion. Several delegates spoke in favour of the total abolition of imprisonment for debt. Mr. Drummond of London, brought forward a resolution in favour of such an amendment of the jury laws as would enable workmen to take their fair share of the duties devolving upon jurymen, and also entitle them to compensation for any loss of time by the performance of such duties. Mr. Jack, of Glasgow, seconded the motion, and after a discussion the motion was carried unanimously. A motion was also passed in favour of extending the Summary Jurisdiction Act to Ireland.

IMPORTED IRON.—Almost unnoticed, a startling change has during the last few years, taken place in the metallurgical world. The iron manufacturers of Great Britain have come to depend in very great degree upon foreign nations for a large part of their raw materials. If we look back twenty years we shall find that the iron that was made in Great Britain was made almost exclusively of that smelted from our own ores; but this is far from being the case now. A few figures will show how great has been the growth of the demand for iron ore from other parts. In 1861 we imported 23,408 tons of iron ore, all, except a few hundred tons, being brought from Spain. Taking the importations in the total for periods of five years from that date, we find that by the year of 1866 the importation had risen to 49,360 tons, and by the year 1871 to 335,033 tons. Again, in 1876 it was 673,235 tons, and in 1881 it was 2,450,696 tons; so that, roughly speaking, it doubled itself in every year named, except that in the last of the periods there was an increase much more than threefold. And it is worthy of note that Spain still supplies the great bulk of the ore thus brought in, for last year 2,227,486 tons were imported from that country, Italy and Algiers sending in the bulk of the remainder. Sweden used to send us large quantities of iron ore, but for the last seven or eight years it has sent us none; and Norway, once a large source of supply, sent us only 118 tons last year; so that it is from the countries of Southern Europe and Spain that our supplies are drawn. This growth of the use of imported ores is due to one cause, —the increase of steel-production. Until the basic process was commenced it was tolerably clear that the great bulk of the iron ores of Britain were not suitable for use in the steel manufacture; and thus as the use of steel grew, there was an inevitable use of ores that were so fit. The rich districts of Furness and that of West Cumberland had ores that were so usable, and that there was a continuous growth of the production of these; but there was a call beyond that that they could supply. And, moreover, many of the works that were on the coast could bring ores from Spain by sea cheaper than they could bring those by land, so that there arose the vast demand for ore that has caused the swelling of the imports shown in the figures above given, and that seems likely to continue, though probably not with such rapidity. There is now a systematic attempt to utilise our own ores by the basic process, and this will allow a portion of the steel that we use to be smelted from our own iron, and thus will at least lessen the rapidity of the growth of the imports of iron. But the fact that we use about 2,500,000 tons of ore from other nations, and that they cost with the carriage probably £1,500,000, is one that should be a very great inducement towards the further development of any and every system that will allow of the increasing use of our own resources, and that would retain a very large amount of money in this country. It is not to be expected that any such change will be very rapid. The imported ore and its product has made itself well known; that made by the basic process from our own ores has yet to win its way in many quarters. But whilst there has been only one large extension, that of Eston, where the process has been in use, there is now in course of construction one that will be equally large, and that will, in the course of a very few months, materially add to the production, whilst in the Shropshire and Staffordshire districts new works are in course of construction or in contemplation, and by these the basic process of steel production will be much extended, and the use of our own ores in the steel manufacture will be extended. It remains to be seen what effect the extension will have on the importation of ores; in the past that importation has been affected by political events in Spain, and that cause alone should induce as much as possible the substitution of our own ores for those the continuance of the supply of which has been broken at times.—*Builder*.

THE HOME IRON AND COAL TRADE.

BARNSLEY AND SOUTH YORKSHIRE.—The district iron trade maintains the vitality referred to in previous reports. Many of the foundries are fairly off for orders, for colliery and miscellaneous castings. There is no falling off to note with respect to the output of pig-iron, Bessemer steel rails, tires, &c., for which a general sale is had. The coal trade, so far as household qualities is concerned, is active, the rumours relating to a general stoppage, having evidently unsettled consumers. Some of the district collieries are full of enquiries for quotations for Lancashire and North Wales where the men threatened to come out. The demand for London and the South has also increased, but the output more than meets the demand. The London traffic is just now large, and would be further increased if the rates were lower. House-coal for Lincolnshire and the eastern counties exhibits an increase, which is causing some of the pits to make full time. It is, however, to be regretted that there is a falling off in the demand for steam coal for export. The quantity sent to the Humber ports exhibit a falling off, and the same may be said with regard to the transit to other places. Should the house-coal continue to improve in demand, some of the pits will experience great difficulty inasmuch as both the hard and soft coal is got from the same seam, and in some instances the steam qualities amounts to fully fifty per cent. of the whole of the seam. The demand for locomotive coal is pretty active, their being some good contracts on hand. As the season progresses, the gas coal trade improves. There is also a very fair demand for engine fuel and slack, chiefly for the Yorkshire and Lancashire manufacturing districts. The position of the coke trade is still good, and all that can be made finds a ready sale. The largest quantity sent out of the district is forwarded to North Lincolnshire, where the iron trade holds well up. Now that the coal trade is improving, collieries are being brought into the market. The collieries belonging to the Dodworth and Silkstone Coal and Iron Company (Limited), at Dodworth and Higham, as well as the Mitchell Main Colliery are to be brought under the hammer at Barnsley in a very short time. There is but little change to note in the position of affairs relating to the wage question.

BARNSLEY, THURSDAY.—Seeing that the Yorkshire Miners' Association, through its officials, took a most prominent part in the Manchester Conference, and the passing of the resolution for demanding a general advance of wages a good deal of interest is being attached to their movements. During the past and present week numerous meetings have been held in various parts of Yorkshire, for the purpose of discussing the advisability of making a general demand, and of sending delegates to a large conference to be held at Rotherham on Monday next. Seeing that there is a good deal of misapprehension relating to the conference called by the Yorkshire Miners' Association, it may not be out of place to say that it is intended to be an open conference to all representatives who choose to attend. Admission will be by ticket, a goodly number of which have already been sent out and accepted. No programme, it is understood, will be drawn up, but the conference will be allowed to choose its own president, secretary, treasurer, and committee for the transaction of its own business. It is expected that there will be a diversity of opinion, inasmuch as there are three associations, one of which has already passed a resolution in favour of 7½ instead of 15 per cent., and whilst deprecating a strike, has offered to submit the matter, in the event of the coalowners not conceding the advance, to arbitration. Some of the men are exceedingly anxious to give in their notices, and would probably strike if they saw any prospects of being supported.

BARROW-IN-FURNESS AND NORTH LANCASHIRE.—The demand for all classes of iron remains very steady, and the only change of moment to record is an improvement in the enquiry on continental account. This is all the more satisfactory because makers already hold very large contracts for delivery during the remainder of the present season to continental consumers of hematite pig-iron. The sales on American account have not been suspended, although the season is not far from its close so far as the shipping business is concerned, but it may be expected that the experience of last year will be repeated, and that to New York and other open ports large cargoes of metal will be shipped during the winter months; this, of course, will more probably apply to merchant steel and steel goods generally. A very large contract has been secured at Barrow for 10,000 tons of steel rails and about 1200 tons of fish-plates, &c., this will not, however, represent more than a fortnight or three week's output of the mills, running as they are at present, night and day. The cogging department is busy, and bloom and ingots are largely enquired for. The value of iron and steel is unchanged, and much firmness is shown by makers and other sellers. No. 1 Bessemer is quoted at 58s. 6d. and 59s. per ton, at works, net, three months' delivery. The business doing in the iron shipbuilding trade at Barrow and in the vicinity is very considerable, and one or two new orders from New Zealand and other colonies have lately been booked. Iron ore is in steady demand at the unchanged value of 14s. to 14s. 6d. per ton at mines. The output of metal is very large and raisers are well sold forward. A good shipping trade is doing.

BIRMINGHAM.—Owing to the sudden termination of the Egyptian war and the suspension of military preparations by the Government, some departments of the local manufacturing industries have been prejudicially affected. Manufacturers who are engaged on army and navy contracts, and who have entered into conditional engagements for the supply of material with other producers in the anticipation of a prolonged campaign on the Nile are now seeking to close their engagements, and they are keenly anxious as to the manner in which their goods will be "dealt" with by the departmental officials on "inspection." So far, there has been no curtailment of production in respect of the requisites for the public services, but increased attention is being paid to the quality and finish of the goods so as to minimise the possibility of rejection. An active enquiry is still experienced for marine tubes and ship fittings for the shipbuilding districts of the North of England and Scotland, and there is also a well-sustained demand for engineering requisites. Heating and lighting appliances are in brisker demand with the approach of the winter season, but there is a slight curtailment of orders for builders' and furnishing ironmongery. Fender and fireiron manufacturers are well employed, and merchants and structural ironfounders continue busy. Mediæval art metal workers are well supplied with orders, and one of the leading Birmingham houses is occupied on a stained glass window for Lichfield Cathedral, in memory of an officer who fell in the Zulu war; on a commemorative window to be placed in Edensor Church to Lord Frederick Cavendish; and on a memorial window of Dublin Cathedral. Altars, lecterns, and other ecclesiastical furniture are in brisk request for home and abroad. Waggon builders keep in steady operation, and there is more doing in the brass and copper wire branch. Horse nail makers are oppressed with orders, but other branches of the nail trade, with the exception of the malleable department, are quiet.

THURSDAY.—The improved tone of the iron market was well maintained to-day, and merchants and consumers were anxious to enter into contracts for forward delivery to cover them against an advance in the prices of crude and finished iron, which must follow an increase in the price of coal. The colliers are pressing for a 10 per cent. advance of wages, and the employers are not unanimous in resisting the demand. Galvanised sheets and steel sheets were in brisk enquiry, the former being 20s. a ton dearer than at the beginning of the quarter.

CARDIFF.—The amount of iron sent away from this port last week was 1838 tons, while iron ore came in from Bilbao and other places to the extent of 4731 tons. Campanil Somorrostro is still quoted at 15s. 3d., c.i.f.; good Rubio, 15s. Carthagena manganiferous ores are firm. Tinplates are in good demand, and prices fluctuate a little, but the tendency is still upwards. Coke-mades are quoted at London and Liverpool at 16s. 6d. to 17s. per box, while charcoal-mades realise from 19s. to 20s.; best stamping, 21s. to 22s. The rapid advance in the price of tin, which now stands at £106 per ton, and bids fair to remain at that figure, if not higher, is an adverse element in this trade; but the works at present going seem fairly active, and business is declared satisfactory by those most competent to pronounce an opinion. The steam-coal trade shows no signs of relaxed activity, while a demand is springing up for household qualities in consequence of the near approach of cold weather. The exports last week amounted to 116,499 foreign and 21,620 coastwise, while patent fuel was sent away to the exent of 2294 tons. The resolution of the North of England miners at Manchester, to strike for an advance of 10 per cent. will have no effect here, as the men are working under the sliding-scale, which has only just been re-signed by the men's delegates at the Conciliation Board, after a dispute between the bituminous and anthracite men. Wages are low, but a rise of 15 per cent. has taken place since 1879, and another may probably be conceded at the next inspection of the books. Two gentlemen from this district, Mr. Whitworth, M.P., of the Tredegar Company, and Sir Henry Tyler, M.P., of the Rhymney Company, have been solicited to form part of the committee of the Steel Railmakers' Association, with the view of "preventing undue competition and the lowering of prices beyond what circumstances appear to warrant."

CARMARTHENSHIRE.—During the past week 1100 tons of pig-iron have arrived at Llanelly from Middlesbrough by steamer, and nearly 200 tons of old iron have also been imported. No iron ore cargoes are reported. In tinplates prices have a downward tendency, 16s. 3d. being mentioned as the best figure realisable for prompt deliveries of cokes. Orders appear to be plentiful, and the different works continue in full swing. Forgemen are still out of work in many instances, and are likely to remain so, owing to the increasing use of steel bars instead of charcoal iron, for best quality plates. Only 14,922 boxes have been shipped for Liverpool in the first three weeks of the current month. Some idea of the price of coal generally will be gathered from the following quotations:—Llangennech, 9s. 6d.; Cwmamman, 10s. per ton, for steam coal, f.o.b.; Gwauncaegurwen (great vein) anthracite, 7s. 6d. at pit's mouth. Mabon, a delegate and unionist, has issued a manifesto to the stone-coal colliers of South Wales, urging unity and combination as the only way of keeping up wages. Many of the works in this county have, during the past week, received offers from electric lighting companies to supply them with all the requisites for the new illuminating agent.

CLEVELAND.—There was a very fair attendance at the iron market at Middlesbrough on Tuesday, but very few ironmasters were present, they having taken advantage of the full state of their order books, and the steadiness of prices to go to the Iron and Steel Institute meeting at Vienna. Scarcely any business was done, and the market altogether was one of the quietest we have had this year. However, as sellers are not in want of orders—for they have sold ahead as far as they consider it prudent to do—prices are well maintained, and there has been practically no change for the last three weeks. The tone of the market may be considered very satisfactory, and is still in favour of the producers. Neither makers or merchants have much iron for early delivery, and as iron is thus scarce the "bears" find they meet with scant success in attempting to force down prices. For some weeks past there has been scarcely any speculative business, the position and prospects of the trade not favouring anything of the kind. On Tuesday, prices of No. 3 G.M.B. for prompt f.o.b. deliveries were firm on the basis of 44s. per ton, merchants and several of the makers asking this figure, while others, the combination makers, hold out for 44s. 6d. per ton. There are orders offering for long forward deliveries, but these are not entertained at present. The decrease of iron in the public warrant stores has somewhat strengthened the warrant market, and 44s. is being asked by some holders of Connel's No. 3 Cleveland, f.o.b., while the realised prices range from 43s. 7½d. to 43s. 9d. Connal's stock on Tuesday stood at 111,231 tons, or 2135 tons less than the previous Tuesday. The shipments this month are enormous, being 66,326 tons up to Wednesday night, as compared with 60,107 tons to the same period in August, thus averaging close on 4000 tons a day. The shipments for the week ending Saturday, September 16, amounted to 25,491 tons as compared with 26,000 tons during the previous week. The inland consumption being also very large, stocks promise to show another heavy decrease. No. 4 foundry iron is 43s. 6d. per ton, and No. 4 forge, 43s. More orders are obtainable in the ironfounding branches, but at no better prices. The finished iron trade is quiet on the whole, though some of the plate-makers have secured more orders during the past week, and manage to keep their prices up to £6 15s. for ship plates, less 2½ per cent. Bar and angle manufacturers are not quite so fortunate, for they have had to submit to lower rates to secure contracts, angles being not £6, and common bars £6 2s. 6d. per ton, both less 2½ per cent., but even less than this is taken when an extensive order is taken. Puddled bars are £4 2s. 6d. net. The prices of Cleveland and foreign iron ores remain unchanged. The coal trade is brisker, and during last week consumers have complained of a scarcity of supplies. Prices are stiffer, and it is expected that an advance of 1s. per ton in house coal will be declared at the close of this month, in fact, that winter prices will be established.

DERBYSHIRE.—The coal trade in most parts of Derbyshire is in about the same state as when last noticed. The pits are not working full time, and should the requirements of the trade demand it the output could be considerably increased. The tonnage rates from Derbyshire and Notts being much more advantageous than from South Yorkshire, a pretty good tonnage of coal is being sent over the Midland and other lines. The position of the district collieries with London may be imagined when it is stated that eleven collieries sent 122,000 tons of coal. The demand for steam and locomotive coal is very fair, but prices do not improve. There is a fair business doing in locomotive coal for railway purposes, but small coal and slack is only in moderate request. A good deal of coke continues to be sent from South Yorkshire to the Derbyshire furnaces for smelting purposes. The wage question has at last cropped up in this district, and the Derbyshire Miners' Association has issued a circular to the men, in which they contend that they are entitled to better wages, and ask them to send delegates to a meeting to be held at Chesterfield to-morrow (Saturday) to decide whether notice shall be given or not. The iron trade continues fairly active, most of the works being kept fully going. There is still a good output of pig-iron, for which a good demand exists. Many of the foundries have of late shown a fair amount of improvement.

DURHAM.—Another quiet week has appeared so far as fresh business is concerned, though trade generally is very actively proceeding in every department. The absence of so many of the leaders of trade at the Iron and Steel Institute at Vienna may largely account for the lull in fresh business, and the comparative absence of demand. This is more particularly shown in relation to pig-iron, though in large measure it also appertains to the finished iron industry. Practically, however, it makes little matter, as both makers of pig-iron and manufacturers have a large stock of orders in hand, and have no need to be anxious for more work just yet. The makers of pig-iron are sold pretty well up to their full make for the next six weeks or two months, and thus they have little iron generally to spare; while, on the other hand, consumers have about as much iron as they need to meet their wants. A quiet condition of trade at the present time is therefore pretty much of a necessity. In various directions, however, work was never brisker. This is more particularly shown in relation to the deliveries of pig-iron, which are going forward on contracts previously entered into. Shipments are very heavy from the Tees for the present month, and promise even to exceed the large shipments made last month. This necessarily exercises a very satisfactory influence on the trade, and helps to maintain prices firmer than they otherwise would be, thus the quotations this week are really better than they were last. They are nominally the same, but are more firmly upheld. The quotations are, on the average, 44s. No. 3; and, though some of the makers ask more, this may be taken as the regular quotation. There have been some more orders placed for ship plates, and £6 15s. to £7 is still the quotation. Large orders can generally be placed at the lower rate. Angle iron and bars are not so much sought after. They range from about £6 to £6 2s. 6d., less 2½ per cent. Puddled bars £4 net. The Auckland Ironworks, which had been stopped through an accident, have again been put into operation. The wages questions are still pending in the finished iron trade, no movement having yet been made towards settling the matter by arbitration. The household coal trade has very sensibly improved, and there is likely to be an advance next month of 1s. per ton on the local depôt trade. Already rates have been rather better for shipment. The manufacturing coal trade has been steady, and prices are firm. Steam coal, no change. Coke has kept pretty much the same in price for some time past; furnace kinds being 10s. to 10s. 6d. at the Durham ovens, and foundry kinds 1s. to 2s. more, according to brand.

EAST WORCESTERSHIRE.—Some good sales in pig-iron are reported, and prices, as compared with other centres, are firm. Quotations range from £3 7s. 6d. to £3 10s. for all-mine, hot-air, pig-iron; £2 10s., £2 12s. 6d., and £2 15s. for part-mine; and £2 to £2 2s. 6d. for common pig-iron. There are few stocks of any kind held in the district; indeed, Northampton and Derbyshire pig-iron is coming in to compete with the output of native crude iron. The condition and prospects of the local finished iron trade continue good, and the district mills and forges are making fair time. Orders continue alike on American and "home" account; in the last respect, especially, an improvement is manifest. Marked bars are £7 10s., with £8 2s. 6d. for the Earl of Dudley's brand. A rise in the price of finished iron is considered a probable contingency at no distant date. Orders continue to be given out for heavy sections, but actual business begins to partake now of a somewhat tentative character, in view of the near approach of one of the most important of the four quarterly meetings in the year. Ironstone (native) is in good sale at firm rates. There is a good supply of oven and gas coke on the market. The coal trade continues to show a steady improvement—the slight impetus in demand manifesting itself not only in forge and manufacturing coal, but in household fuel. Prices seem to have a rising tendency, although nothing positive can be known yet as to the intention of the principal coalmasters in regard to raising quotations. Considerable importance attaches to the actions of the colliers, for undoubtedly they have power to precipitate a grave crisis, which may affect not only their own trade, but all the staple industries of the district. To all appearance, the men are nothing loth to accept the line of conduct marked out for them by the Manchester Conference, for meetings continue to be held calling upon their executive to arrange for a meeting of coalmasters and men to discuss the wages question, and pledging themselves to come out on strike should the desired increase of wages be not conceded. There seems good reason to believe that this is not a mere *brutum fulmen* on the part of the miners, but is meant to be followed up by action. It is, however, to be hoped that the relations between masters and men will continue amicable. The miners may rest satisfied that if the coalmasters believe that the state of the fuel market will stand an advance, they will be nothing loth to raise prices. At present, the "list" rates are upon the basis of 10s. and 9s. 6d. per ton for furnace coal; whilst colliers' wages are 3s. 4d. and 2s. 8d. per day, thick and thin miners respectively.

FOREST OF DEAN.—The position of the crude iron branch has improved, and stocks of pig metal are being rapidly reduced. Under existing rate of diminution local yards will be very shortly cleared. This is an encouraging feature of the iron trade in its application to the Forest, and as quotations are stiffening, prospects appear more hopeful than they have been for many months. The latter becomes all the more encouraging because of the near approach to quarter-day, and the lifting of quotations in more important iron making centres. In the manufacturing department there does not appear to be a corresponding improvement, and some of the works are still hampered by a scarcity of employés in puddling operations. The tinplate branch does not gather the strength desired, and prices are still discouraging. The mineral branch is assuming a degree of activity which encourages the belief that substantial improvement has arisen. In the western districts of Dean Forest there is an important expansion, and quotations for the better classes are given at 12s. per ton at the pit banks. I hear that the mineowners are well served with orders, and that considerable consignments are being despatched, both to South Wales and the Staffordshire districts. The coal trade continues active, and the pits are in full operation. This may, however, appear to be the result of an anticipated advance next month of a shilling per month which has been by the masters determined upon. With the advance of quotations, it is stated to be the intention of Forest masters to give a 5 per cent. advance in wages, which, as it is now 10 per cent. below old rates, will be acceptable. There are substantial reasons for believing that this branch of industry is recovering its former condition of activity, in which case masters will find it difficult to find workpeople, large numbers having during the past few years left the district for other coalfields.

THURSDAY.—I hear that at Forest Vale Ironworks a substantial American order has been secured, which will occupy some time in execution.

GLASGOW.—The warrant market remains in a dull, inanimate condition. Very little business is being done, and there seems to be no disposition to operate in either one way or another—each party awaiting the turn of events. All expectation of any renewal of the agreement between the Scotch and Middlesbrough ironmasters may be said to be ended, and it now remains to be seen what the masters will do when left at liberty. It is quite possible in Scotland that two or three furnaces may be put in blast to make special brands, which at present are extremely scarce, makers having no stocks; but the action of the men render it highly improbable that there will be an addition to the production of any appreciable amount. There are a fair number of foreign orders coming to hand, more especially for continental shipment, and the home consumption continues on as large a scale as ever. On Thursday business was done from 50s. 2½d. to 49s. 10d. cash, and 50s. 4½d. to 50s. 1d. one month, next day the price fluctuated between 49s. 11d. and 50s. 1½d. cash, and 50s. 2d. and 50s. 4d. one month. On Monday the market was steady at 49s. 11½d. to 50s. 1½d. cash. On Tuesday there was no change at 50s. 2d. to 49s. 11½d. cash, and 50s. 4½d. to 50s. 2d. a month. On Wednesday a few lots changed hands at 49s. 11½d. and 49s. 11d. cash, and 50s. 2½d. and 50s. 2d. a month. Closing sellers 49s. 11½d. cash, and 50s. 2d. a month. Buyers at 1½d. per ton less. Makers are well supplied with orders, and firmly maintain their prices, which are comparatively higher than warrants. There are now 109 furnaces in blast, against 120 at this time last year. The shipments of pig-iron from Scotland last week were, foreign, 8014 tons; coastwise, 2888 tons; total, 10,902 tons, against 14,449 tons in the corresponding period of last year. The total increase in the foreign shipments for this year is 54,537 tons, while the coastwise shipments show a decrease of 9920 tons. The imports of Middlesbrough iron into Grangemouth last week were 3905 tons, against 2935 tons in the similar period of last year. The total imports till September 16, 1882, are 161,499 tons, against 210,667 tons till September 17, 1881, showing decrease for this year of 49,168 tons. The stock of pig-iron in Connal and Co.'s store is now 627,902 tons, being a decrease for the week of 1453 tons. There is a rather better demand for manufactured iron, and a number of new orders have been placed during the week, and prices are now firm. Common bars are £6 5s., f.o.b. Glasgow, less 5 per cent. The steel works are all very busy, especially on angles and plates. The position of the iron trade in this district continues satisfactory, many engineers and founders being filled up with orders for a long time ahead. All branches of the coal trade show an improving tendency, except that there was some slackness in steam-coal this week. The shipments keep up on a large scale, and the demand for house-coals is increasing; prices are firm. The colliers are beginning to agitate, and a general strike is threatened, unless an advance of wages is given before October 1. Some of the Sale coalmasters are said to be willing to grant some advance to their men.

LANCASHIRE.—Here and there an increased amount of business seems to have been stirring in the iron trade of this district. In one or two cases sellers of district brands, who have been doing very little for several weeks past, have been booking pretty largely during the week at their full rates, and prices generally are firm; but any marked activity in business is very exceptional, and the tenour of reports, as a rule, is still that the actual new orders going out continue very limited in extent. Business, as a whole, seems to be more of a steady, hum-drum character, with very little variation in values. Lancashire makers of pig-iron have during the week received very little new business of importance, and to a large extent they are dependent upon deliveries of iron already sold to keep works going. Their quotations are unaltered, and for delivery equal to Manchester 46s., less 2½, for forge and foundry qualities is still the figure asked; as to whether makers are really firm at this figure there is practically no business doing to afford any actual test, but it seems probable that offers made at a trifle under the full list rates would now stand a chance of being entertained. Transactions in Lincolnshire pig-iron, to a fairly large extent are reported in one or two quarters on the basis of about 47s. to 47s. 6d. up to 48s. 6d., less 2½, delivered equal to Manchester; but merchants, as a rule, are quiet, and do not seem disposed to renew contracts except at 1s. per ton under the above figures; for Derbyshire iron delivered into this district makers are still asking 49s. to 50s. per ton, less 2½. Reports as to the condition of the finished-iron trade vary considerably; merchants do not seem to be doing very much, but makers, as a rule, are well engaged, and in some cases find enquiries coming in more freely with buyers, showing less hesitation about placing out orders. Sheetmakers are fully sold, and bar iron-makers appear to have been doing better. For delivery equal to Manchester quotations are very firm at from £6 7s. 6d. to £6 10s. per ton. Although complaints are still made that new enquiries for engineering work are falling off in most branches of trade, a very fair amount of activity is still maintained. In the coal trade the winter demand for house-fire coal is being hurried forward by the apprehensions of a strike amongst the colliers, and an upward movement in values, and during the past week there has been quite a pressure of orders, which is keeping the pits fully going, and taking away the whole of the present output of the better classes of round coal. The demand for other classes of fuel shows, however, no material alteration, except that perhaps consumers of steam fuel have been rather more pressing for supplies. In the West Lancashire districts there has been a pretty general advance of 6d. per ton on house-fire coals, but the principal Manchester firms do not show any signs of moving until the end of the month, and fuel for iron making and steam purposes has only been put up in exceptional cases. At the pit's mouth, prices average about as under:—Best coal, 9s.; seconds, 7s. to 7s. 6d.; common house coal, 6s. to 6s. 6d.; steam and forge coal, 5s. 3d. to 5s. 9d.; burgy, 4s. 3d. to 4s. 6d.; and slack, 3s. to 3s. 9d. per ton, according to quality. Shipping has been fairly active, but prices are very little higher. Notices for an advance of wages of from 10 to 15 per cent. have now been very generally sent in by the miners throughout the Lancashire coal fields, except in those districts where the sliding scale is in operation.

LEEDS AND WEST YORKSHIRE.—The make of best Yorkshire iron this week has been rather below the average. Two or three of the forges are not working more than three days on boiler plate and railway material. The production of "uses" continues to be on a large scale, owing to the activity among engineers, machinists, and special tool makers. Some forges are experiencing a much better enquiry for best bars, and the orders are accompanied by what upon the whole are satisfactory prices, although no advance upon former rates has actually been obtained. Orders for common iron are placed more largely than was the case a few weeks ago, and the slight improvement in prices which took place last quarter-day is steadily maintained. For bars and angles there are frequent enquiries, and the autumn market for this class of iron promises to be of much greater activity than was expected; but unless the value of raw material keeps hardening, it is scarcely likely that quotations will undergo much alteration. Great pressure is put upon the owners of rolling mills for nail cutters' sheets, and the business in this branch during the next two or three months it is already certain will be unusually extensive. Engineering shows unabated briskness. The hope of better prices in this department is believed to have a really good foundation, and may occur at no distant date if certain foreign orders which are being negotiated about are secured for this district. Engine tools are, as reported last week, in much better demand, especially some of large capacity, and others peculiarly adapted for shipbuilding operations. The West Yorkshire coal trade is a trifle better because of exportation.

and a larger enquiry in the London market. There is no great likelihood of any early improvement in prices.

LIVERPOOL.—The better tone prevailing last week still continues. Tinplates are very steady, and good quantities change hands at 16s. 3d. for the inferior, 3d. more for the better class of brands. The demands for South Welsh iron on Indian account, mentioned in our last, has brought about an advance in the price of Welsh bars. The price of sheet iron remains the same, although the demand for this article is not so marked as it has been for the last few weeks. There is not much call for plates and angles for shipbuilding purposes. Hoops, however, are much sought after, and command a better figure than last week in consequence. The prospect of large American buying during the autumn is still an uncertainty. Since the cessation of the Pittsburgh strike, there is a diminution in the number of orders coming across. Canada continues to take large shipments; and there is also a slight demand for new business from this quarter. The Indian market is still suffering from the effect of the disturbed state of affairs in Egypt. From the Mediterranean and Baltic some good orders are coming to hand. Home trade is more active, but the release of so large a number of vessels recently employed in transport service makes shipbuilders and shipowners somewhat uneasy.

LONDON.—The metal market here remains firm with manufacturers well ahead. Iron.—In pigs prices are uncertain, pending the announcement as to what masters and men intend doing. Scotch warrants, 49s. 11d. Copper strong; spot bars, £69 10s., with an upward prospect. Tin.—There is a very strong market, with rapidly advancing prices. Fine foreign closes firm at £108 5s. cash; English, very scarce; America being large buyers. Tinplates more active. Cokes, 16s. 6d. to 16s. 9d.

NEWCASTLE AND THE TYNE DISTRICT.—Only a moderate amount of business has been done here in pig-iron this week, although exports are fairly well maintained. Prices remain unaltered at 46s. 3d. per ton for Cleveland No. 3 and 45s. 3d. for No. 4 forge quality, delivered to the Tyne, and they are pretty firm at those figures. Manufactured iron is very active, the shipbuilders buying freely, but only for present requirements; these, however, are as great as they have ever been in the history of shipbuilding on the Tyne, if not greater. The quotations are—ship plates, £6 17s. 6d. to £7; angle-iron, £6 5s.; bars, £6 5s.; and boiler plates, £7 17s. 6d., delivered in the Tyne, less 2½ per cent. As regards the iron ore imports from Bilbao, they are only on a moderate scale, and prices are easier; red ore is shipped at Bilbao at 6s. 9d. to 7s. per ton, and the freight to the Tyne is 9s. The remarks made last week as to the shipbuilding trade being likely to decline unless new orders are received more often than they have come to hand of late still hold good. Work in all our Tyne and Wear yards is plentiful, and is carried on with every exertion by the building firms; but there is no blinking the fact that more new business would be acceptable to most of the firms and companies engaged in the trade. Engine manufacturing continues highly prosperous, and, according to the most trustworthy accounts, it is certain that, in this neighbourhood at least, a busy winter will be experienced. The North-east Coast Exhibition at Tynemouth has brought large numbers of gentlemen engaged in steam shipping and engineering into our midst, and it is said that business transactions have been entered into that will materially benefit the engine manufacturing business of the Tyne and Wear. The condition of the foundry trade is good, all classes of work being plentiful; forges, rivet factories, and chain and anchor shops are all remarkably active. The coal trade is steady in every branch; households, which for a long time past have been dull of sale, are fast improving, and better prices are looked forward to. Steam coals of the best quality remain at 9s. per ton, less 2½, with only a quiet trade and short turns, owing to the scarcity of steamers, through detention mostly. Gas, manufacturing, and smithy coals are selling well at recent quotations. The market for chemicals has receded still further, but is now steady; soda ash sells at 1¼d., less 1½ per cent.; soda crystals, £2 10s 6d.; and bleaching powder, £4 2s. 6d. Rouen chalk cliff is taken by chemical manufacturers at 4s. 6d. to 5s. per ton. The firebrick business shows more animation again; Messrs. Cowens' sell at 55s. per thousand; Ramsay's, 45s.; and others at 32s. to 38s. 6d. Cement works are actively employed here; stocks are low, and prices unchanged.

NEWPORT.—The condition of the iron and steel trades in the district continues satisfactory, and, if anything, orders in each branch are more numerous. The upward movement in the prices of pig-iron which we predicted in our last, is now a fact, and quotations show an advance all round of 3d. per ton. Middlesbrough foundry pigs are quoted at 50s. 9d. to 55s. 3d., and other qualities at 49s. 3d. to 56s. 3d. per ton of 20 cwts., delivered ex-ship at Newport. We have no change whatever to record in iron ore. Prices are firm at recent quotations. At present buyers refuse to give higher figures, and although the demand for the next few months is likely to be considerable, we do not expect any advance on current quotations. Enquiries for manufactured iron are fairly numerous, but makers are still very cautious in booking far forward. It is not very probable that prices will decline this year; on the other hand, an advance seems imminent. Sellers know this, and naturally wish to be in a position to take advantage of any rise in the market. Tinplates are in very good demand, but the increase in the price of tin is against the tinplate manufacturer. I. C cokes are quoted at 16s. 3d. to 16s. 6d., and charcoals 19s. to 21s per box. Steel is in active request. Blooms quoted £4 12s. 6d. to £4 15s. per ton f.o.b., and at these prices are firm. Some important orders for steel rails are in the course of negotiation, and the market is decidedly firmer. The foundries and engineering firms are extremely busy, and in some cases completely blocked with orders. One firm in particular have secured orders which carry them towards the close of next year. In the steam coal trade there is still great activity, and although prices have not yet advanced, the tone of the market remains very firm. Small coal keeps in brisk demand and prices are well maintained. Pitwood is again in better request, and quotations are stiffening. The coal clearances for the week, foreign, show a total of 27,792 tons, and coastwise 19,605 tons, as compared with our last returns of 26,907 tons foreign, and 18,116 tons coastwise. Of iron, &c., 1500 tons were despatched to Rio de Janeiro. The imports comprised 4105 tons of iron ore from Bilbao, and 940 tons from other places. Two cargoes of purple ore also came to port. Of pitwood, 709 tons were received.

NORTH STAFFORDSHIRE.—There is a continuation of the improvement in the finished iron trade, which has been noticed during the last two or three weeks. Orders are being distributed more copiously by home merchants, many of whom consider the present a favourable time for making contracts to cover their wants to the end of the year, a fact which shows plainly that they do not anticipate any change in prices during the next three months in favour of buyers. The shipping trade well maintains its activity, good specifications coming in by almost every mail. Business with South America is brisk, and a number of good orders are being received for the United States. Several heavy lots are in the market on account of various foreign houses, a number of them being for Russia. Orders from the colonies are also coming in fairly well. The merchant mills are, as a rule, well off, and at some works pressure is being experienced, a feature which has existed for a considerable time. Plates are showing up rather better, but it is with difficulty that the mills are kept going full time. Hoops are not in urgent demand, but heavy sections are much enquired for, and the mills are generally well employed. Prices, although very firm, are not advancing, as competition is still very severe where orders are wanted. The make of pig-iron is being steadily disposed of, but not so rapidly as to absorb the production, and stocks at some of the furnaces are becoming heavy. Business in ironstone is quiet, but the better qualities find regular customers, at the rates lately quoted. There is a slight improvement in the demand for coal, both manufacturing and domestic descriptions, but prices show no sign whatever of upward movement. In some instances manufacturing coal is selling at figures as low as 5s. 6d. to 6s. per ton.

SHEFFIELD.—There is a healthier look about the Sheffield trades generally than has been observed for at least six months past, especially in the iron department, where most of the mills are running full time. The call is principally for sheets, plates, and bars. Ship and boiler plates in good request. The Bessemer makers of best qualities find a stiffer market on the week, and rates are a little higher than when last given. Billets are, for fixed marks, 2s. 6d. per ton dearer than a fortnight ago, and there is every likelihood of a steady advance to Christmas; but it will be very gradual, owing to the relapse in the rail trade, occasioned by the competition of coast houses. Contracts obtained here for rails are principally for delivery to the central country railway stations for home use. The outlook in the rail trade for local houses is at present bad. Leading makers are pushing special makes in competition with wrought irons and common cart steels with success. This new phase of the Bessemer department is an important item. Converters of finest cast steels are extraordinarily busy, and we note that some of the old houses which have been slack for months have their order books full. The country trade is reviving a little, and the East Indian and Australian houses have good enquiries in. Edge tool and file houses with an American connection are shipping largely, and this will relieve some of the heavy stocks which have been accumulating for several years past for this market. Best classes of cutlery are selling somewhat slowly, owing to the tremendous rise in the value of ivory within the past six months. It is believed that ivory will become still dearer, and that bigger prices will be realised at the next sales. Ebony is cheaper, but bone and horn are still up, and with a short supply. The agitation amongst the colliers for an advance of wages or restriction of the output is spreading throughout the district. Mass meetings on this question are to be held, and the tenor of the addresses delivered to the men by their leaders has an aggressive tone. In the meantime it may be said that coal is almost hawked in the trade by agents, and that at least two-thirds of the collieries in South and West Yorkshire are being worked at a loss. Some thousands of men and boys are either out of work or only employed half time, and the present certainly is a very inopportune time for anything in the shape of a strike in the trade. Fine, open weather, well into the autumn months, and the accumulations of coal stored at the pit banks, will enable the coalowners to take up a strong position, should the agitation on the part of the miners be carried to an extreme. The engineering branches are busier, but this is usually the case at this time of the year. Small firms in this line are complaining, but the large ones are not. The quarter is now closing; and it will be a week or ten days before we have any trade movements of real importance to note.

SOUTH STAFFORDSHIRE.—The end of the war is received with satisfaction by traders doing business with Egypt, India, and the Eastern Mediterranean. The more immediate effect, however, has been to stop summarily negotiations, which the Army Department had begun for placing new contracts for hardwares in this district. But the news did not arrive soon enough to prevent the placing of some good orders for horse nails in various localities, and on these orders the operatives are now busy. The cultivating tool and shipping tackle firms in particular report that the Government Departments are now staying their hand. The more tranquil state of Ireland is leading to an increase of demand from that market, and some travellers, who had postponed their journeys to Dublin and elsewhere, have now resumed the road again. Cultivating tools are going away in large bulk to South America, the Cape, and India, though the Indian demand is not as good as it should be. New orders are badly wanted by the wrought iron tube firms. Some galvanisers report that the past nine months have been, for the extent of activity, pretty nearly the best they have ever experienced in their sheet department. The committee appointed to get out a new price list for galvanised iron hollow wares have met this week in private, but the result of their deliberations has not yet transpired. In the manufactured iron trade prices are stronger all round, in some cases to the extent of 2s. 6d. to 5s. per ton.

SWANSEA.—In the iron trade there is no change, the demand continues healthy. The same general and satisfactory features apply to our steel industries. The past week's iron ore imports are represented by 3134 tons. The steam-coal clearances show an increase of 3184 tons as compared with the preceding week, the respective quantities being 28,332, and 25,148 tons. There is a steady increase observable in our export trade. All the local steam and house-coal collieries are well employed. The enquiry for house-coal is, of course, strengthened by the rapid oncoming of winter weather. The South Wales coal constituencies have no sympathy with the proposal carried at the recent Manchester conference to suspend work throughout the country on the 1st of October, unless a wage advance is meanwhile conceded. The men fully endorse the sentiments of their leaders, and condemn the scheme as chimerical and unpracticable in these and other vast coal fields where sliding-scales are in operation. The anthracite trade is still very dull, and the underground workmen complain that the employers do not carry out the agreement. Of patent fuel 6330 tons have been shipped. The demand for pitwood is sustained. Copper is also in fair request, though prices are but slightly remunerative. Tin is tending upwards, and it is confidently asserted that it will shortly reach £110. Fair prices are given for lead. The Midland Railway have issued notification that they are not prepared to ship coal at their tip in the Prince of Wales Dock. At Neath, in order to facilitate the construction of the docks, electric lights are about to be used. After much ominous complication at Siemens' new steel works, Landore, a settlement has been arrived at which is to be followed by the restarting of the furnaces. The melters have virtually accepted the terms offered by the employers, and the hammermen and helpers for bloom (12 ingots) will be paid at the following reversed rates: 8-inch blooms, 5d., 4½d., 3¼d.; 7-inch, 6d., 5d., 4d.; 6-inch, 7d., 6d., 5d.; 5-inch, 8½d., 7½d., 6½d.; 4-inch, 1s., 10d., 8½d.; 3-inch, 1s. 2d., 1s., 10½d. The management state that these are the prices paid by competing firms in Great Britain, and some of them are contemplating a reduction therefrom. In a few days the works will again be on the full tide of activity, and the manifold miseries inseparable from a strike, which would affect at least 1000 hands, will have been averted.

WEST CUMBERLAND.—No change of movement can be noted in connection with the iron trade of this district, and orders are still being booked both from America and the Continent, while on home account the business doing is quite up to recent averages. A fair tonnage of iron and steel is being shipped from local ports to America and the continent, and there is reason to believe that the trade with the continent will be further augmented during this month. Prices of all classes of iron are steady, and No. 1 Bessemer is noted at 58s. 6d. per ton, at works; No. 2, 57s. 6d.; No. 3, 56s. 6d. net. Forge-iron is in good demand. Steel-makers are very busily employed, and good orders are coming to hand both on home and foreign account. The shipbuilding trade is well employed, and enquiries are coming to hand from all quarters, prices ranging from 14s. to 15s. 6d. for ordinary qualities at mines. The coal and coke trades show no change. There is a good demand for native coal and coke. Shipping is very busily employed all round, and is likely to continue active for a month or six weeks.

SCOTCH PIG-IRON SHIPMENTS.

The table below (copied from the *Public Ledger*) is a comparative statement of the weekly shipments of Scotch pig-iron from the beginning of this year and the corresponding weeks of the previous four years, up to last week. The shipments were:—

Week ending		1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons	1878. Tons.
Jan.	7 ..	3,389	6,182	6,689	6,069	6,085
	14 ..	5,767	6,677	12,288	6,291	4,532
	21 ..	7,742	4,608	7,566	6,331	6,170
	28 ..	8,041	8,906	13,383	4,969	6,550
Feb.	4 ..	12,236	7,226	14,190	6,130	5,637
	11 ..	10,786	10,072	10,612	7,272	5,722
	18 ..	10,528	7,405	15,152	8,996	5,124
	25 ..	10,739	11,266	12,603	8,318	7,836
March	4 ..	12,600	9,900	17,968	13,910	6,816
	11 ..	13,287	8,261	23,985	10,743	8,662
	18 ..	17,544	7,893	20,987	11,167	7,728
	25 ..	12,375	12,262	23,598	9,463	11,499
April	1 ..	10,107	10,421	15,822	15,053	7,448
	8 ..	12,662	10,647	18,309	12,913	9,441
	15 ..	11,694	13,736	15,784	13,228	9,513
	22 ..	14,170	11,492	16,279	11,795	8,382
	29 ..	18,056	13,147	17,749	12,923	8,853
May	6 ..	11,387	9,461	14,799	13,135	9,348
	13 ..	14,982	10,718	13,123	9,919	7,820
	20 ..	12,122	9,532	11,036	11,415	10,742
	27 ..	9,760	11,943	12,819	15,434	7,362
June	3 ..	9,867	14,509	13,198	8,402	7,008
	10 ..	14,270	12,331	11,860	6,156	10,310
	17 ..	15,308	13,537	9,502	7,278	6,326
	24 ..	10,147	10,977	11,514	7,074	7,175
July	1 ..	15,324	13,095	12,527	8,252	7,416
	8 ..	10,474	13,850	10,158	5,619	7,151
	15 ..	13,136	11,118	10,478	9,383	8,104
	22 ..	13,763	12,805	10,815	3,923	5,610
	29 ..	13,116	9,285	10,015	10,670	5,973
Aug.	5 ..	13,579	12,669	12,260	7,504	5,993
	12 ..	13,258	11,700	14,252	8,652	6,162
	19 ..	13,983	10,965	15,870	7,200	8,700
	26 ..	13,191	11,239	13,530	18,312	8,493
Sept.	2 ..	10,076	13,795	15,522	11,795	9,918
	9 ..	10,629	14,812	12,546	11,443	9,792
Sept.	16 ..	10,903	14,079	10,789	15,650	7,956
Totals	..	447,077	402,151	509,577	362,447	286,355

CLEVELAND PIG-IRON SHIPMENTS.

The following table contains comparative statements of the weekly shipments of Cleveland pig-iron from the beginning of this year and the years 1881 and 1880, up to last week, as well as the monthly shipments from January to August of 1882 and the previous four years:—

WEEKLY SHIPMENTS.

Week ending		1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan.	7 ..	14,992	12,331	14,347	—	—
	14 ..	18,128	13,454	21,712	—	—
	21 ..	16,125	10,246	19,384	—	—
	28 ..	18,648	6,890	15,315	—	—

Week ending	1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Feb. 4 ..	14,990	9,761	11,988	—	—
11 ..	15,591	15,635	18,082	—	—
18 ..	14,929	14,681	15,725	—	—
25 ..	16,941	16,116	21,055	—	—
Mar. 4 ..	25,669	19,135	28,546	—	—
11 ..	21,245	13,474	14,322	—	—
18 ..	19,400	17,404	18,295	—	—
25 ..	15.433	19,370	24,241	—	—
April 1 ..	19,850	20,498	12,138	—	—
8 ..	17,530	13,154	22,145	—	—
15 ..	14,934	19,390	18 835	—	—
22 ..	16,406	19,221	17,111	—	—
29 ..	16,286	22 946	20,878	—	—
May 6 ..	14,000	15,537	20,509	—	—
13 ..	16,841	15,395	19,239	—	—
20 ..	17,609	16,480	16,471	—	—
27 ..	16,801	21,426	21,648	—	—
June 3 ..	8,943	17,568	22,400	—	—
10 ..	17,678	19,796	18,368	—	—
17 ..	15,596	21,834	17,078	—	—
24 ..	15,715	21,827	12,312	—	—
July 1 ..	20,803	22,802	24,117	—	—
8 ..	18,473	15,265	18,613	—	—
15 ..	12,349	21,159	19,190	—	—
22 ..	14,218	22,046	17,362	—	—
29 ..	18,477	21,529	17,135	—	—
Aug. 5 ..	22,361	20,983	15,734	—	—
12 ..	21,199	15,982	17,651	—	—
19 ..	20 002	17,980	18,387	—	—
26 ..	18,864	21,923	14,067	—	—
Sept. 2 ..	20,536	15,027	20,609	—	—
9 ..	26,000	22,364	15,375	—	—
Sept. 16 ..	25,491	16,866	14 472	—	—
Totals ..	659,116	646,955	674 856	—	—

MONTHLY SHIPMENTS.

Jan. 31 ..	71,458	47,890	78,941	39,751	47,932
Feb. 28 ..	66,893	58,370	71,573	57,458	51,097
Mar. 31 ..	89,837	81,609	84,375	73,105	61,386
April 30 ..	68,909	78,894	88,018	65,250	69,256
May 31 ..	71,405	75,729	81,829	71,456	74,043
June 30 ..	68,373	91,577	82,186	60.808	68.804
July 31 ..	74,311	87,580	82,306	64,825	78,628
Aug. 31 ..	95,861	84,901	72,665	61,499	73.275
Totals ..	607,047	606,550	641,893	491,152	525,039

THE CONTINENTAL IRON AND COAL TRADE.

AUSTRIA.—The Direction of the Hungarian State Railways has concluded contracts for the supply of (wooden) railways sleepers with the following firms:—S. M. Guttmann, of Gross-Kanizsa, 500,000 sleepers, at 1·50 florin each; Baiersdorf and Biach, of Vienna, 150,000, at 1·37 florin; Ignatz Lederer, of Grosswardein, 240,000, at 1·17 florin; Heim, of Kremnitz, 40,000, at 1·38 florin; Gadeon, of Kaschau, 60,000, at 1·30 florin. The supply of 120,000 sleepers for local railways was contracted for at 70—80 kreuzers each, and that for bridge timber at 22—23 florin per cubic metre.

The Austrian iron market preserves its good tone, and prices are steadily advancing. Pig-iron is firm, and slowly advancing, stocks being gradually reduced. There is great activity in manufactured iron, particularly in merchant iron and joists. A good many orders are expected within the next few months from railways for rails, tires, axles, &c., and both manufacturers and merchants are looking forward to a good autumn business. Quotations, per 1000 kilogrammes, were, on September 16, as follows at works:—

	Florins.
Styrian and Carinthian charcoal pig, white ..	52 — 54
Ditto grey	54 — 56
Ditto Bessemer	56 — 59
Bohemian and Hungarian pig-iron	44 — 46
Moravian and Silesian pig-iron	45 — 47½
Spiegeleisen	64 — 75
Styrian and Cnrinthian bar iron	122½—125
Bohemian bar iron	110 —115
Moravian and Silesian bar iron	112½—117½
Hungarian bar iron	115 —117½
Sheet iron	165 —195
Rolled wire	135 —160
Joists	127½—135
Steel rails	115 —125
Old rails (at Vienna)	87½—105

Greater activity prevails in the Austrian coal market. Sugar refineries are taking considerable quantities; iron manufacturers and engineers are also large consumers, and export is expanding.

BELGIUM.—The Belgian iron market continues firm. Work is abundant, and orders are coming in steadily. Pig-iron is steady. English foundry pig is about 65 fr., while Belgian pig, for which there is a good demand, remains at 75 fr. Forge pig is quoted at from 50 fr. to 60 fr., according to quality, but there is little doing in these descriptions. Athus is very firm at 57 fr. 50 c. Manufactured iron is getting stiffer in price. The base quotations for bars is 140 fr., but sales are still made at 135 fr. and 137 fr. 50 c. Joists are in good request at 145 fr. to 150 fr., and angle iron at 150 fr. to 155 fr. Plates are firm. No. 1 are generally quoted at 190 fr., No. 3 at 210 fr., and fine plates at 280 fr.

BRUSSELS, WEDNESDAY EVENING.—Our iron trade has undergone no great change since last week. Business is quiet in pig-iron, but there is a brisk demand for manufactured iron. English pig is very firm. Prices are the same as last week, but there is no sign of weakness for the coming season. Our last official quotations are:—

	Sept. 13. Francs.	Sept. 20. Francs.
Belgian foundry pig	75 ..	75
Belgian forge pig	65 ..	65
Luxemburg foundry pig	57·50 ..	57·50
English foundry pig	65 ..	65
Bars No. 1	137·50 ..	140
Joists	145 ..	145
Angle iron	150 ..	150
Nailrod	145—150 ..	145—150
T iron	145—150 ..	145—150
Ordinary plates	190 ..	190
Boiler plates	210 ..	210
Sheets	290 ..	290
Steel rails	160 ..	160
Tires	235 ..	235
Axles	245 ..	245

In the coal market, there was to-day, at the Bourse des Métaux, no great animation, since dealers as well as producers are in an expecting attitude, especially as regards the house-coal trade. Large coal for industrial purposes continues very active. Current prices are:—

	Sept. 13. Francs.	Sept. 20. Francs.
House coal	16—18 ..	16—18
Large coal	16—19 ..	16—19
Unscreened coal ..	11·50—14·50 ..	11·50—14·50
Small steam coal ..	10—11 ..	10—11
Small coking coal ..	11 ..	11
Coke	19 ..	19
Half washed coke ..	21 ..	21

FRANCE.—It appears from the July *Bulletin* of the Comité des Forges de France, just received, that the imports and exports of iron and steel during the first six months of this year, compared with those of the same period of 1881, were as follows:—

Imports.

	1882. Tons	1881. Tons.
Pig iron	136 390 ..	129,192
Manufactured iron ..	39 879 ..	33·537
Steel	16 807 ..	9.247
Totals ..	193,076	171,976

Exports.

Exports of all descriptions	53,978 ..	59,050

The imports and exports of iron ore, according to the same source, were:—

Imports.

	1882. Tons.	1881. Tons.
From Belgium	56,640 ..	50,110
Germany ..	186,416 ..	137,886
Spain	241 691 ..	205,356
Italy	49,535 ..	67,563
Algeria	166,208 ..	143,881
Other countries ..	5,529 ..	7,074
Totals ..	706,109 ..	611,860

Exports.

To Belgium ..	31,0153 ..	10,012
Germany ..	20,672 ..	18 937
Other countries ..	5,588 ..	10,601
Totals ..	57,275 ..	39,550

The imports of iron and steel during the first six months of 1882 exceed those of the first six months of 1881 by 21,100 tons, or more than 12 per cent. The decline in exports still continues. The imports of iron ore during the two corresponding periods show a difference of 94,249 tons in favour of 1882; the exports were also higher (by 17,725 tons) than in 1881.

In the French iron market the former activity continues. The forgemasters of the Nord, at their last monthly meeting, held this time, on September 14, at Maubeuge, decided not to sell merchant iron under 190 fr. and plating iron under 195 fr. per ton, at works, excepting for larger contracts. This is actually a reduction of from 5 fr. to 10 fr. per ton, and will fix prices as follows:—

	Sept. 13. Francs.	Sept. 20. Francs.
Merchant bars	190—195 ..	190
Plating iron	200—205 ..	195
Angle iron	200—205 ..	200
Joists	190—195 ..	190
Heavy plates	220—225 ..	220
Ordinary plates	250 ..	250
Boiler plates	280 ..	280

Forges are very briskly engaged in the Nord, the sale of plating iron being well sustained. Many contracts which were on the point of expiring have been renewed at terms varying from six to twelve months. There has been no change in the Haute-Marne, where prices remain on the basis of 210 fr. for rolled coke iron and 230 fr. for mixed qualities. At Paris, a better tone has prevailed during the past week, and sales are now effected to consumers at 200 fr. for merchant iron, 210 fr. for plating sections, and 215 fr. per ton for angle iron. There is a good demand for old rails, which are selling at 125 fr. per ton, delivered at rolling mills.

GERMANY.—The German iron market remains firm. In Westphalia enquiry is maintained to the full extent of previous weeks. The production of blast-furnaces making puddling pig, as well as that of Luxemburg furnaces, is nearly all sold up to the end of the year. Those turning out foundry and Bessemer pig are unable to meet the demand made upon them, and in consequence large quantities of these brands are imported from England. Manufactured iron works and steel works are fully employed. The latter are working upon old orders, but new contracts are impending.

The latest official quotations at Dortmund for iron and steel, per 1000 kilogrammes at works (English descriptions per ton at port of shipment), are:—

	Sept. 11. Marks.	Sept. 18. Marks.
White-grained puddling pig ..	64—66 ..	64—66
Spiegeleisen	76—78 ..	76—78
German foundry pig No. 1 ..	76 ..	76
German foundry pig No. 2 ..	72 ..	72
German foundry pig No. 3 ..	66 ..	66
German Bessemer pig	72 ..	72
English foundry pig No. 3 ..	44—45 ..	44—45
English Bessemer hematite pig .	58—60 ..	58—60
Luxemburg pig	47½ ..	47½
Bar-iron	150 ..	150
Fine-grained iron	170 ..	170
Angle-iron	150 ..	150
Joists	150 ..	150
Boiler-plates	220 ..	220
Boiler-plates No. 2	205—210 ..	205—210
Fine Siegen plates	195—200 ..	195—200
Fine-grained plates	250 ..	250
Charcoal plates	280 ..	280
Low Moor plates	310 ..	310
Bessemer steel rails	160—166 ..	160—166
Bessemer steel rails (defective)	135 ..	135
Bessemer steel pit rails	135—143 ..	135—143
Iron pit rails	135 ..	135

The total quantity of coal and lignite exported by Germany during the year ending with July last was 3,973,057 tons, and the total quantity imported was 4,125,582 tons. Of the exports, a portion was sent away *via* the German North Sea ports; but, in addition, Russia took 178,590 tons, Austria 1,040,061 tons, Switzerland 201,549 tons, France 599,422 tons, Belgium 305,352 tons, and the Netherlands 1,229,728 tons. The imports were received chiefly from Great Britain, the direct imports from that country amounting to 661,413 tons.

Enquiry is growing in the German coal market, and prices have been advanced for nearly all descriptions. Coke is very active, and most coke ovens have disposed of their output for the fourth quarter. At Dortmund quotations per 100 cwt. at the pit's mouth or at coke ovens are as follows:—

	Sept. 11. Marks.	Sept. 18. Marks.
Best coal (Stückkohle)	40—45 ..	45—50
Cobbles	36—40 ..	36—40
Large washed nuts	37½—40 ..	37½—40
Washed smith's coal	30—33 ..	34—35
Screened coking coal	26—28 ..	28—30
Inferior coal	20 ..	20—24
Gas coal	36—37 ..	36—40
Mixed coal	30—33 ..	32—35
Prime coke	65—68 ..	65—68
Patent coke	68—78 ..	70—78
Small coke	42—45 ..	45—50

HOLLAND.—At the recent competition for the supply of rails and permanent way requisites, required by the Dutch State Railways, and divided into two lots, the Bochum Union made the lowest tender for the first lot, consisting of 4000 tons of steel rails, 350 tons of iron fish plates, 81½ tons of iron end plates, and 63½ tons of iron screw bolts, with 78·07 Dutch florins per ton, or 350,954 fl. for the whole lot; while Messrs. Ch. Cammell and Co., Sheffield, made the highest tender, 84·83 fl. per ton, or 379,555 fl. the whole. For the second lot, consisting of 96 tons of spikes, Doppler Bros., of Maestricht, tendered lowest, with 134·40 fl. per ton, or 12,902·40 fl. the whole.

SPAIN.—The prices of manufactured iron, as far as can be ascertained, continue unchanged and steady, and the various centres of this industry are fully employed. The same activity continues in the export of ore from Bilbao at prices nominally unaltered. Coal mining appears to be gradually developing, and the main lines of railway are using more and more native coal, but the inferior quality and cost of transport cannot compete with English coal at the outports, except in the Gijon district, where the rich coal measures of the Asturias are within easy reach of the coast. The lead mining interest, although unfavourably affected by the low prices so long prevailing, continues fairly active, and an association is being formed to establish a lead warrant company in London with the object of promoting the interests of producers, enabling them to obtain advances on stock of the metal, and hold the same for favourable markets. A feature in this department of mining is, in spite of low value, the extension of operations—opening up of new deposits; and it is only lately that the valuable silver lead mines of Horcajo have been bought by the Banque de Paris et Pays-Bas. Copper mining is prosperous, and the provinces of Huelva and Seville continue their large and profitable exports. In Portugal the San Domingo Mine enriches its proprietors; various new undertakings are being talked of, and there is some prospect that the Transtagana Mine, mismanaged and unfortunate hitherto, may pass into strong and capable hands, and the valuable property it really is develop into a second Tharsis or Huelva Company. It is probable that, before the end of next year, the South-Eastern Railway Company of Portugal will have built the pier so much needed at the Barreiro Terminus, opposite Lisbon, and the facilities for the embarkation of minerals thus afforded will, undoubtedly, give an important stimulus to the traffic in the manganese, copper and iron ores abounding in the Alemtijo district. The prosperity of Bilbao and neighbourhood, induced by its abounding mineral wealth extends to the whole province. The success attending the making of the narrow-gauge railway from Bilbao to Durango has brought forth other schemes, and amongst them the projected metre-gauge line of Estella to Durango by Vitoria, with a branch to Arroniz, and Lerin, offers every prospect of profitable enterprise, and will open up a rich wine and agricultural country, containing also valuable mineral deposits, and bring them within easy and direct communication of the busy and thriving Biscayan port on the Nervion.

THE AMERICAN IRON TRADE.

LATEST advices from New York state that the Pennsylvania Ironmasters' Association has finally determined to ask the United States Tariff Commission for the following duties. They ask that the duty upon iron ore be fixed at 85 c. a ton. That upon pig-iron is to be advanced from 7 dols. to 8 dols. a ton; on cast scrap from 6 dols. to 8 dols. The duty on steel rails is to be reduced from 28 dols. to 22 dols. 40 c. a ton. That on steel blooms is to be changed from 40 per cent. to 20 dols. a ton. The convention recommend an increase in the duty on steel wire rods from 30 to 50 per cent. For all other descriptions of steel the duty is to be changed from 30 per cent. to 3 c. a pound. A committee has been appointed to present the new scale to the commission. The New York pig-iron market has been quiet. Consumption at the same time has continued as large, and deliveries on old contracts have been heavy. The business passing in Scotch pig at New York has been of a retail character. Owing to cheaper ocean rates prices have been a little easier, although not quotably lower. Gartsherrie has made 25½ dols. to 26 dols. per ton. Sales of steel rails have been reported at New York to the extent of 3,200 tons at 46 dols. per ton at the mills, and negotiations are stated to be pending for some large parcels for winter delivery. Iron rails have been to a great extent neglected, and prices, in the absence of business, are comparatively nominal. Steel rails have been quoted at the mills at 46 dols. to 47 dols. per ton. The Philadelphia pig-iron market has been rather quiet, but prices at the same time have been well maintained. Steel rails have been dull at Philadelphia, but an improvement is anticipated. The Amalgamated Association has given way, and officially declared the great iron strike to be ended, as the men were returning to work at the former prices despite the association's orders. This formally ends the greatest strike the United States have known. It lasted sixteen weeks. The loss to the labourers in wages is between ten and twelve million dollars. No estimate is made of the manufacturers' losses.

SCOTCH PIG-IRON QUOTATIONS.

(From the *Glasgow Herald*.)

NEW YORK, Wednesday.

	Th.	Fri.	Sat.	Mon.	Tu.	Wed.
Gartsherrie (in yard)	25½	25½	25½	25½	25½	25½
Coltness (at quay) ..	26	26	26	26	26½	26½
Langloan	25½	25½	26	26	26	26
Glengarnock ..	24½	24½	24½	24½	24½	25
Carnbroe	24½	24½	24½	24½	24½	25
Summerlee	25	25	25	25	25¼	25½
Eglinton (at quay) ..	23	23	23	23	23	23
Shotts	25½	25½	25½	26	26	26
Calder	—	—	—	—	—	—
Carron	24¾	24¾	24¾	24¾	24¾	24¾
Dalmellington ..	24	24	24	24	24	24
Kinnell	24	24	24	24	24	24

† None here.

NEW PATENTS.

ALL the patents are placed alphabetically, with the official numbers attached. The new applications range from No. 4323 to No. 4436, being the entries from Sept. 12 to Sept. 18, 1882.

NEW APPLICATIONS.

A Joint for Electrical Lamps.—*W. R. Wynne*, 116, *High Holborn, Middlesex.* [4365

Aerial Navigation.—*U. Green, South Hackney, London.* [4387

Alloys of Gold.—A communication.—*A. Guye, St. Bride Street, London.* [4366

Artificial Leather.—*E. Fischer, Kaltwasser, Wustegiersdorf, Prussia.* [4428

Attaching Screw Stoppers to Bottles.—*A. F. Nicholl, Streatham, Surrey.* [4425

Automatic Regulator.—*E. Wilson, Exeter Devon.* [4415

Base Material for Paint.—A communication.—*G. E. Church, 8, Summer Street, Providence, Rhode Island, U. S. A.* [4436

Bird Cages, &c.—*J. H. Stiles, South Norwood, Surrey.* [4357

Boiler Furnaces.—*J. R. Russell, Glasgow, Lanark.* [4334

Bottles, &c.—*J. H. Drayton, Brixton, Surrey.* [4410

Cans or Boxes.—*J. F. Stoy, Lime Street, London.* [4435

Caustic Alkalies, &c.—A communication.—*W. L. Wise, 7, Whitehall Place, Westminster.* [4364

Chronograph.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [4343

Cleaning Grain.—*J. and R. M. Davison, Newcastle-upon-Tyne, and A. Miller, Gateshead, Durham.* [4372

Combined Clothes Hook and Hat Peg.—A communication.—*G. A. Folker, Wimpole Street, Middlesex.* [4397

Compression Pumps.—A communication.—*C. D. Abel, 28, Southampton Buildings, Middlesex.* [4401

Construction of Walls.—*F. Bander, Venezuela, South America.* [4383

Coupling Carriages.—*T. A. Brockelbank, Shepherd's Bush, Middlesex.* [4400

Coupling Railway Trucks.—*G. Fenwick, Gateshead-on-Tyne, Durham.* [4358

Crayon Holders.—A communication.—*J. H. Johnson, 47, Lincoln's Inn Fields, Middlesex.* [4386

Dispensing Gaseous Liquids.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4398

Distributing Electricity.—*L. Gaulard, Montague Place, Bedford Square, and J. D. Gibbs, Bury Street, St. James, Middlesex.* [4362

Dynamo Electric Machines.—*M. Depres, Boulevard Saint Denis, 3, Paris.* [4370

Dyeing Hanks.—*J. Cowling, Blackburn, Lancs.* [4371

Electric Arc Lamps.—*J. Brockie, Brixton, Surrey.* [4419

Electric Lamp Carbons.—*R. Hammond, and L. Goldenberg, both of 110, Cannon Street, London.* [4344

Electric Lamp Holders.—*J. W. Swan, Newcastle-upon-Tyne, and C. Swan, Cambridge Street, Pimlico, Middlesex.* [4300

Electric Lamps.—A communication.—*H. H. Lake, Southampton Buildings, Middlesex.* [4404

Electric Lighting.—A communication.—*W. Morgan-Brown, 38, Southampton Buildings, Middlesex.* [4367

Electrodes.—*W. Simcock, New Cross Road, Kent.* [4352

Endless Platforms of Binding Machines.—*P. Robinson, Saxby, Lincoln.* [4354

Enlarging or Reducing Maps, &c.—A communication.—*L. A. Groth, 32, Finsbury Pavement, London.* [4324

Fastenings of Ties.—*H. Fenn, Strawberry Hill, Middlesex.* [4433

Feed Motions.—*T. Shanks, jun., Johnstone, Renfrew.* [4365

Frames of Umbrellas.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4392

Friction Clutches.—A communication.—*W. A. Barlow, 6, St. Paul's Churchyard, London.* [4427

Fronts of Shirts.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [4394

Galvanic Batteries.—A communication.—*J. H. Johnson, 47, Lincoln's Inn Fields, Middlesex.* [4407

Galvanic Batteries.—*O. C. D. Ross, 52, Trafalgar Road, Old Kent Road, Surrey.* [4355

Galvanic Batteries.—*S. H. Emmens, and S. Mason, both of No. 8 quare, Middlesex.* [4434

Gaseliers, &c.—*M. Merichenski, Stainsby Road, Poplar, Middlesex.* [4420

Gas Engines.—*J. Atkinson, 47, Marquis Road, Finsbury Park, London, N.* [4398

Gas Engines.—*J. Atkinson, 47, Marquis Road, Finsbury Park, London, N.* [4388

Gas Engines.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [4363

Globe Holders.—*G. H. Nash, Birmingham, Warwick.* [4356

Governor for Steam, &c., Engines.—*A. Berverley, Stanley, and A. Sykes, both of Wakefield, Yorks.* [4336

Grinding, &c., Flat Metallic Bars.—*H. Slack, Sheffield, Yorks.* [4370

Holders for Bouquets.—*C. M. Tate, 35, Store Street, Bedford Square, Middlesex.* [4332

Hydraulic Lifts.—*J. S. Stevens, Queen's Road, and C. G. Major 34, Freke Road, Battersea, Surrey.* [4375

Incandescent Electric Lamp Globes.—*J. Crowder, 99, Summer Street, Southwark Bridge, Surrey.* [4429

Increasing the Illuminating Power of Gas.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [4416

Iron and Steel.—*J. G. Willans, 68, Priory Road, Kilburn, Middlesex.* [4379

Knife Cleaning Machine.—*C. W. Spong, 4, Great Saint Helens, London.* [4433

Knitting Machinery.—*S. Lowe, and J. W. Lamb, both of Nottingham.* [4340

Knitting Machinery.—*J. W. Lamb, and E. Attenborough, both of Nottingham.* [4341

Lanterns.—A communication.—*A. J. Boult, 323, High Holborn, Middlesex.* [4345

Linoleum Machinery.—*D. Hendry, and J. Melville, both of Kircaldy, Fyfe.* [4339

Lock Stitch Sewing Machines.—*L. Silverman, Westminster.* [4377

Locking Points by Electricity.—*S. Brear, and A. Hudson, both of Bradford, Yorks.* [4412

Looms.—*T. Blezard, Padiham, and W. Nelson, Darwen, both of Middlesex.* [4330

Machines for Hulling Grain.—*J. R. Russell, Glasgow, Lanarkshire* [4335

Machines for Making Moulds.—*J. V. Hope, Wednesbury, Staffs.* [4406

Match Boxes.—A communication.—*W. R. Lake, Southampton Buildings,* [4381

Mechanical Pianofortes, &c.—A communication.—*W. R. Lake Southampton Buildings, Middlesex.* [4346

Measuring Woven Fabrics.—*R. Murdoch, Glasgow, Lanarkshire.* [4333

Motors.—*J. Watts, and H. R. Smith, Bristol.* [4418

Nails and Screws.—*T. J. Sloan, St, Maude, 75, Rue de Paris.* [4385

Noble's Wool Combing Machines.—*T. H. Wharton, and R. Smith, both of Bradford, Yorks.* [4360

Opening and Closing Fanlights.—*H. Pearce, 5, Lidlington Place, Harrington Square, London, N. W.* [4353

Ore Crushing Machine.—*S. Wekey, 18, Catherine Street, Strand, Middlesex.* [4397

Pickers used in Weaving.—*I. Sowden, Bradford, Yorks.* [4398

Pipe, &c., Cutting Machines.—*C. Neil, Sheffield, Yorks.* [4395

Plates for Secondary Batteries.—*N. C. Cookson, Queen Street, Newcastle-upon-Tyne.* [4391

Postal Stamps, &c.—A communication.—*S. Pitt, Sutton, Surrey.* [4403

Preparing Cotton, &c.—*T. Berry, Rochdale, Lancs.* [4384

Preservation of Wood, &c.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4423

Preventing the Deposit of Sand, &c., in Rivers.—A communication.—*W. R. Lake, Southampton Buildings, London.* [4424

Production of Chloride Gas.—*A. L. Nolf, Brussels, Belgium.* [4349

Production of Musical Sounds.—*J. Burnet, Slave Island, Colombo, Ceylon.* [4393

Pumps.—*T. Willoughby, 4, Sykes Place, Leeds, Yorks.* [4426

Safety Valve Apparatus.—A communication.—*A. W. L. Reddie, 66, Chancery Lane, Middlesex.* [4342

Screw Propellers.—*F. J. Croft, Birkenhead, Chester.* [4375

Secondary Voltaic Batteries.—*A. Watt, Liverpool, Lancashire.* [4431

Self-Acting Mules.—*J. Drausfield, and J. Isselt, both of Dewsbury Yorks.* [4361

Self-Acting Temples.—*J. Wrigley, Bury, Lancs.* [4408

Separating Tin from Scrap.—A communication.—*C. D. Abel, 28, Southampton Buildings, Middlesex.* [4400

Ships.—*T. Hyatt, 21, Addison Gardens, W., Kensington, London, S. W.* [4374

Stamped Fabrics.—*J. Coates, 38, Gutter Lane, London.* [4331

Starting, &c., Engines.—*W. H. Allen, and R. Wright, both of Lambeth, Surrey, and W. L. Williams, Westminster Chambers, Middlesex.* [4329

Steam Boilers.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4373

Steel Strips.—*C. Baker, 92, and 93, Herbert Street, and G. T. Badcock, 41, New North Road, Middlesex.* [4382

Stoppering Bottles.—*A. J. T. Wild, Arbuthnot Road, Peckham, Surrey.* [4347

Stoppering Bottles, &c.—*J. J. Rawley, St. George Street, Middlesex.* [4389

Supply and Waste Valves.—*S. S. Hellyer, Newcastle Street, Strand, Middlesex.* [4402

Suspending Horizontal Bars.—*G. Welling, Camberwell, Surrey.* [4380

Tap.—*W. Bright, Exeter, Devon.* [4428

Teaching the use of the Rifle.—*W. E. Heath, 176, Camden Road, Middlesex.* [4326

Telegraphic Apparatus.—*A. C. Brown, and H. A. C. Saunders, both of 66, Old Broad Street, London.* [4421

Telephonic Telegraphy.—*C. A. McEvoy, and J. Mathieson, both of 18, Adam Street, Adelphi, Middlesex.* [4422

Thread Winding Machines.—*J. W. Shepherd, and W. Ayrton both of Longsight, and S. Hallam, Manchester, Lancs.* [4337

Transmitting Motion to Sewing Machines.—*W. Beecroft, and J. H. Beecroft, both of Leeds, Yorks.* [4359

Treadles of Bicycles, &c.—*J. Buckland, Taunton, Somersetshire.* [4390

Tricycles.—*E. Marchall, Birmingham, Warwick.* [4414

Utilising Steam, &c., as Motive Powers.—*J. M. X. Terlinden, Brussels, Belgium.* [4351

Valves.—*W. Lloyd, Newport, Monmouth.* [4427

Vegetable Parchment.—*H. Hymans, Stepney Green, Middlesex.* [4383

Venetian Window Blinds.—*G. S. Marshall, Birmingham, Warwick.* [4368

Visually Indicating Electrical Signals.—A communication.—*B. F. B. Mills, 23, Southampton Buildings, Middlesex* [4350

Waterclosets.—A communication.—*J. Imray, 28, Southampton Buildings, Middlesex.* [4410

Weldon's Process.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [4411

Wheels and Axles.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4348

White Lead.—*A. J. Smith, 427, Fulham Road, West Brompton, Middlesex.* [4405

Window Sash Fasteners.—*W. A. MacLeod, Birkenhead, Chester.* [4369

Wire Gard Points.—A communication.—*T. Morgan, 21, Cockspur Street, Charing Cross, Middlesex.* [4339

ABSTRACTS OF SPECIFICATIONS RELATING TO METALS

PUBLISHED DURING THE WEEK ENDING SEPT. 16, 1882.

(Prepared by PHILIP M. JUSTICE, 53, Chancery Lane, W.C.)

Securing Rails to Sleepers.—406 (1882).—*Clark*, communicated by T. J. Bush.—The invention relates to improvements in the method of securing rails to sleepers, or securing two or more blocks of stone or metal together for bridge or ship building. The bolts for the purpose are of any suitable section, provided with notches at the points where they are to cross, thus enabling them to interlock with each other, the bolts being bent near the upper ends, so that they shall project perpendicularly to the face of the sleepers or other surface.

Anvils.—657 (1882).—*E. and O. Wright.*—The anvils are made of wrought iron, and in one solid piece, without weld or joint. A bloom of iron is first heated, then roughly shaped, and afterwards pressed between suitable finishing dies.

Horse Shoes.—709 (1882).—*J. Camp.* Final Specification not filed.—The shoe is constructed in two parts hinged together, and having clips round the edges bent inwards so as to secure the shoe without nails.

White Lead.—731 (1882).—*E. V. Gardner.*—The conversion of the metallic blue lead into white lead takes place in a closed ventilated chamber heated by a steam coil placed in a tank of water. The lead is granulated and placed on shelves in the chamber. Vapours of acetic or nitric acid are then produced, and generated by heat in a properly arranged vessel. Electrical discharges may be employed to accelerate the process, or instead, the lead may be placed on trays arranged so as to bring the lead into action with carbon platinum, or some such electro negative. After forty-eight hours treatment, carbonic acid and air are distributed by pipes into the chamber, the acid vapours being continued all the time. In seven to fourteen days, the blue lead will be entirely or for the greater part converted into white lead.

Furnaces.—737 (1882).—*Johnson*, communicated by E. J. Mallett.—A draught is created by a mechanical appliance, such as a fan or exhauster, instead of by a chimney stack, the fan serving to suck the air through the furnace. As the heated air would soon destroy the fan. A cooling or condensing appliance is interposed between the furnace and the fan. Separate air inlets into the furnace are provided, one admitting air beneath the grate bars, the other admitting heated air at a point where it will meet and mingle with the fuel gases.

Ornamentation of Metals.—739 (1882).—*G. Bower.* Provisional Protection only.—Articles of cast iron having a protective coating of magnetic oxide of iron are submitted to galvanic action in a suitable metallic solution, so that a film or coating of the metal in solution becomes deposited on the surface of the magnetic oxide. The surface may then be rubbed with a brush or device having filaments composed of metals described in Patent No. 2750 of 1881.

Screw Nuts.—763 (1882).—*R. Harrington.*—A strip of spring steel having a V edge, is coiled up into a spiral shape, the V shaped edge forming the thread of the nut.

Preserved Provision Cans.—767 (1882).—*Gates*, communicated by H. K. and F. B. Thurber and Co.—The object is to provide a device for gauging can bodies on the outside to a uniform size, preparatory to soldering the side seam. The gauging clamp consists of a circular head having a flange to gauge and clamp the body of the can, and hold it while being soldered.

Permanent Way.—768 (1882).—*H. T. Grainger.*—The rail is oblong in cross section, and has a groove or flute rolled or formed in the sides. The chairs are rolled in iron and steel into the form of valley girders, and while hot are cut into suitable lengths. The form of the chair gives the rail an elastic bearing

Punching Metals.—771 (1882).—*J. Tushaw.*—The apparatus is adapted for punching hoop iron, punching out the teeth in strips of metal for band saws, &c. The machine is actuated by geared wheels and cams from a main driving wheel, and has appliances for guiding the material, and gauging the distances apart of the holes or indentations.

Recovering Tin.—777 (1882).—*Abel*, communicated by Dr. H. A. Schulte.—To recover the tin from waste metals, alloys, old utensils, cans, &c., a lye is prepared of any desired degree of concentration from hydrate of soda, or potash and water. This lye is heated to a boiling point in a suitable vessel, with addition of a considerable excess of any oxide of lead. This lye will dissolve the tin without attacking any other metal.

Fish Joints.—778 (1882).—*F. C. Winby.* Provisional Protection only.—Along the inner sides of the fish plates, a series of grooves and projections are formed, corresponding grooves and projections being also formed on the web of the rail.

Steel Ingots.—822 (1882).—*J. D. Ellis.*—A feeder composed of fire clay, and of circular or other form, and having a hole at the top for the escape of gases, is fitted into the top of the mould, so that the molten metal as it enters the mould from the bottom as usual, fills the whole of the mould, and the whole or part of the feeder. The molten metal remains in the feeder in a molten condition longer than in the other parts of the mould, and acts as a feed to counteract the sinking of the metal in the centre.

Reducing Metals.—955 (1882).—*Wirth*, communicated by H. Rossler.—In order to reduce and separate gold, silver, copper and lead, air is blown on or under the surface of the molten sulpho-metals which are contained in closed vessels. By this blowing in of air, concentrated sulphurous acid gases are formed which are carried off and transformed into sulphuric acid, while the volatilised metal particles are collected in condensing apparatus.

Locomotive Wheels.—1084 (1882).—*J. Brandon*, communicated by A. Cottrau.—The wheel described has two pairs of tires of different sizes firmly secured together, the smallest tires or wheels being outside, separate rails being provided for each.

LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

Metal Market, City, Thursday Afternoon, 4 P.M.

(*September* 21, 1882.)

METALS AND ORES.

	Sept. 14.		Sept. 21.	
	£ s.	£ s.	£ s.	£ s.
Copper (per ton)—				
Chili, for 96 per cent.	68 0/	68 5/	69 10	—
Wallaroo	73 0/	—	73 0/	—
Burra Burra	72 0/	—	72 0/	—
English Tough	71 0/	72 0	71 0/	72 0/
English Ingot, best	73 0/	74 0/	73 0/	74 0/
Sheets sheathing and rod	76 0/	—	76 0/	—
Bottoms	8 0/	—	8 0/	—
Ore per unit	—	—	—	—
Phosphor Bronze				
Special Bearing Metal (p tn)	117 0/	—	117 0/	—
Other alloys (per ton	125 0/	140 0/	125 0/	140 0/
Tin (per ton)—				
Straits (Cash)	106 2/6	—	106 2/6	—
No. for arr.	—	—	—	—
Billiton	—	—	—	—
Banca	—	—	—	—
English Ingots	—	—	—	—
Do. Bars	109 0/	110 0/	110 0/	—
Do. Refined	110 0	111 0/	112 0/	—
Australian	111 0/	112 0/	113 0/	—
Tin Plates, per box, I.C.	106 2/6	—	111 0/	—
coke f.o.b. London	0 16 9	0 17/6	0 16 6	0 17/6
IX. do.	0 21/6	0 23/6	0 21/6	0 23/6

	£ s.	£ s.	£ s.	£ s.
I.C. charcoal	0 20/	0 22/	0 20/	0 22/
I.X "	0 25/	0 27/	0 25/	0 27/
Red lead	16 10/	—	16 10/	—
White	21 10/	—	21 10/	—
Patent shot	17 10/	18 0	17 10/	18
ZINC (per ton)—from No. 6 Gauge.				
Sheets, rolled	19 15/	—	19 15/	—
Do., foreign	19 15/	—	19 15/	—
LEAD (per ton)—				
Soft English pig	14 5/	14 10	14 5/	14 10
Do. W.B.	—	—	—	—
Spanish soft	14 0/	—	14 0	—
Do. with silver	—	—	—	—
SPELTER (per ton)—				
Silesian, com	17 10/	—	17 10/	—
Rhenish	—	—	—	—
English	—	—	—	—
QUICKSILVER, bot	6 0/	-	6 0/	—
ANTIMONY ore (per ton)—				
Australian	—	—	—	—
Spanish	—	—	—	—
French Star	5 [illegible]	55 0/	0/	55 0/
Regulus—				
Crude (per cwt.)	1 [illegible]/	—	1 14/	—
NICKEL (per lb.)	0 3/3	—	0 3/3	—
BRASS (per lb.)—				
Sheets, 48×24	0 0/8	—	0 0/8	—
Tubes	0 0/11	0 1/	0 0/11	0 1/
Wire	0 0/8½	—	0 0/8½	—
Yellow metal	0 0/6	0 0/6	0 0/6	0 0/6
ASBESTOS (per lb.)	0 0/3	0 0/6	0 0/3	0 0/6
PLUMBAGO (per cwt.)—				
Ceylon lump	1 2/	1 5/	1 2/	1 5/
Do. chip	0 10/	0 14/	0 10/	0 14/
Do. dust	0 10/	0 12/	0 10/	0 12/
COALS (per ton)—				
East Hartlepool	1 2/	—	1 2/	—
Lambton	1 4/	—	1 4/	—
Tees	1 4/	—	1 4/	—
Hartley	1 2/	—	1 2/	—
Hetton	1 4/	—	1 4/	—
Hawthorn	1 3/	—	1 3/	—
Tunstall	1 2/	—	1 2/	—

OILS, CHEMICALS, &c.

	SEPT. 14. £ s.	£ s.	SEPT 21. £ s.	£ s.
OILS (per ton)—				
Olive, Galloli	—	—	—	—
Do. Gioja	—	—	—	—
Do. Levant	36 0/	37 0/	36 0/	37 0/
Do. Seville	—	—	—	—
Do. Corfu	—	—	—	—
Seal, pale	35 0/	35 10/	35 0/	35 10/
Sperm head	74 0/	75 0/	74 0/	75 0/
Cod	31 10/	32 10/	31 10/	32 10/
E.I. Fish	—	—	—	—
Rape, English, brown	29 0/	30 10/	29 0/	30 10/
Do. refined	—	—	—	—
Foreign Refined	—	—	—	—
Ground nut and Gingelly Madr.	—	—	—	—
Palm oil, fine	35 0/	36 10/	35 0/	36 10/
Palm nut oil	—	—	—	—
Linseed oil	22 15/	23 5/	22 15/	23 5/
Cot onseed (per ton).				
Crude	22 15/	26 0/	22 15/	26 0/
Refined	28 10/	29 0/	28 10/	29 10/
Hull	25 15/	—	25 15/	—
Lard, English	60 0/	62 0/	60 0/	62 0/
Cocoanut, Cochin	35 0/	36 0/	35 10/	36 5/
Do. Ceylon pipes	29 5/	29 15/	29 5/	30 10/
Sydney	—	—	—	—
OIL CAKE (per ton)—				
Linseed, Lndn.	8 5/	8 10/	8 5/	8 10/
American barrels	8 12 6	8 0/	8 12/6	8 0/
Do. bags	—	—	—	—
Marseilles	8 5/	—	8 5/	—
Rapeseed	5 12/6	6 0/	5 12/6	6 0/
Cottonseed	5 15/	5 17/6	5 15/	5 17/6
TALLOW—PYC. old (per cwt.)	51 0/	53 6/	51 0/	53 6/
S.Americn. Beef	—	—	—	—
N. American "	—	—	—	—
Australian Beef (fine) (per cwt)	0 /42	0 43/6	0 41/	0 45/0
Do. Sheep " (per ton)	0 45/6	0 46 0	0 45 6	0 46 0
PETROLEUM OIL—(per gal.)	0 0/5½	0 0/5⅝	0 6⅛	0/6⅛
Refined coal oil	—	—	—	—
Naphtha	0 0/6½	0 7/¾	0 0 6½	0 0/7¾
TURPENTINE—(per cwt.)				
French Spirits	—	—	—	—
American do.	—	—	—	—
WHALEFINS (per. ton)—				
Davis' Straits	800/	900/	800/	900/
Arctic	800/	900/	800/	900/
BRIMSTONE (per ton)—				
Rough 3rds	6 15/	—	6 15/	—
Roll	10 15/	12 10/	10 15/	12 10/
Flour	10 15	12 10/	10 15/	12 10/
ACID, (per lb.)				
Acetic	0 19/	0 26/	0 19/	0 26/
Second quality (per gal.)	—	—	—	—
Citric (per lb.)	—	1/11½	—	1/11½
Muriatic (sp. salts per cwt.)	0 4/6	0 7/6	0 4/6	7/6
Nordhausen 50 per cent.	0 45/	0 50/	0 45/	0 50/
Nitros	0 0/2½	0 0/4½	0 0/2½	0 0/6
Oxalic (per lb.)	0 6½	0 6/	0 /6½	—
Sulphuric, white	—	—	—	—
Do. Brown	0 0/0¾	0 0/1	0 0/0¾	0 0/1
Tartaric Crystal	0 1/8½	0 1/7	0 1/8½	0 1/7
Do. Powdered	—	—	—	—
AMMONIA—				
Carbonate, per lb	0 0/6¼	0 0/6¾	0 0/6¼	0 0/6¾
Sulphate, Best White (per ton)	20 5/	21 0/	20 5/	21 0/
ARSENIC—White Lump (per cwt.)	0 24/6	0 25/	0 24/6	0 25/
Powdered do	0 10/6	0 10/9	0 10/6	0 10/9
Bleaching f owder 35 %	0 2/6	0 5/	0 2/6	0 5/
BORAX, Rfc., Eng.	0 60/	0 63/	0 60/	0 63
COPPERAS, green, tierces (ton)	0 45/	—	0 45/	—
PORTLAND CEMENT—				
1st quality in casks 400 lb. gross, including casks, f.o.b., Thames, per cask	0 9/	—	0 9/	—
Do. in sacks, 200lb. net (per ton)	2 0/	—	2 0/	—
Sacks extra, 2/6 each.				
Charlton White Paint (per cwt.)	1 12/	—	1 12/	—
Calley's Torbay Paint, Br wn	0 30/	—	0 30/	—
Do. Red	0 34/	—	0 34/	—
LEAD, Sugar, Eng., white	0 33/0	0 36/0	0 33/0	0 36/0
Brown	—	—	—	—
Red (per cwt.)	—	—	—	—
White, ground	0 16 6	0 17/0	0 16 6	0 17/0
LITHARGE (pr cwt.)	0 21/	0 21/6	0 21/	0 21/6
LIME (per ton)—	0 17 6	0 21/6	0 17 6	0 21/6
Acetate, Brown	12 5/	12/ 0	12 5/	12/ 0
Distilled	18 5/	18 10/	18 5/	18 10/
POTASH—				
Bichromate (lb.)	0 0/5¾	6 0/	0 0/5¾	0 6/
Chlorate (pr. lb.)	0 0/5⅝	—	0 0 5¾	—
Pruss. Red (lb.)	1 10/	—	1 10/	—
Do. Yel, lb	0 10/	0 10/	0 10/	0 10/
Sulphate 80% (per ton)	8 1/ 9 10/		8 1/ 9 10/	
SALTPETRE (per cwt.)—				
Engl. refnd. kgs.	0 26/	0 27/6	0 26/	0 27/ 6
Do. barrels	0 27/	0 20/	0 27/	0 29/
Do. Bengal	0 10/6	1 1/6	0 10/6	1 1/6
SODA, Acetate (per cwt.)	0 26/	—	0 26/	—
Bicarbonate	0 0/6	—	0 [illegible]/6	—
Caustic 60 to 62 %	0/0	11/0	0/0	11 0/
Crystals grw.hts,exship(prton)	3 2 6	3 6/3	3 2/6	3 5/6
Nitrate	13 /42	13 6/	13 /42	13 6/

PRICE LIST OF IRON AND STEEL.

PREPARED BY

MESSRS. BOLLING & LOWE,

2, LAURENCE POUNTNEY HILL, LONDON, E.C.

STAFFORDSHIRE.

List Brands at Works. Per Ton.

BARS—
½ in. to 3 in. rounds and squares £7 10 0
1 in. to 6 in. flats 7 10 0

Rounds and Squares.
3½ in., 10s. per ton extra.
4 in., 20s. "
4½ in., 40s. "
5 in., 50s. "

Rounds only.
5½ in., 70s. "
6 in., 90s. "
6½ in., 110s. "
7 in., 130s. "

Round and Squares,
7-16 in., 10s. "
⅝ in., 20s. "
⅞-16 in., 30s. "
¼ in., 40s. "
3-16 in. 70s.

HOOPS—
1 in. to 6 in. wide by usual guage £8 0 0
¼ in. wide up to 20 w. g., 20s. per ton extra.
⅜ in. wide up to 20 w. g., 40s. per ton extra.
½ in. wide up to 20 w. g., 80s. per ton extra.
½ in. wide up to 20 w. g., 120s., per ton extra.

PLATES—
To 15 feet long by 4 feet wide, not exceeding 4 cwt. £9 0 0
4 to 5 cwt., 20s. per ton extra.
5 to 6 cwt., 25s. "
6 to 7 cwt., 50s. "
7 to 8 cwt., 75s. "
8 to 9 cwt., 110s. "
9 to 10 cwt., 120s. "
10 to 11 cwt., 140s. "
15 to 20 ft. long, 20s. "
20 to 25 ft. long, 40s. per ton.
4 to 4½ ft. wide, 20s. "
4½ to 5 ft. wide, 40s. "

SHEETS—
Singles 11 to 20 gauge, £9 0 0
Doubles, 30s. per ton extra.
Lattens, 60s. "

ANGLES—
1 in. by 1 in. to 8 united inches £8 5

TEES—
1 in. by 1 in. to 8 united inches £8 10
For each inch above 8 united inches 10s. per ton extra.
Best, 20s. per ton extra.
Best, best, 40s.
Treble best, 60s.

STAFFORDSHIRE, MIDLAND, &c.

Ordinary Brands (at Works).

	£ s. d.	£ s. d.
Bars	6 10 0 to 7 10 0	
Hoops	7 0 0 to 7 10 0	
Plates	8 0 0 to 8 10 0	
Sheets	8 0 0 to 8 10 0	
Angles	7 0 0 to 7 10 0	
Tees	7 0 0 to 7 10 0	

Best, 10s. to 20s. per ton extra.
Best, best, 20s. to 30s. "
Treble best, 40s. to 60s. "

CLEVELAND AND NORTH OF ENGLAND BRANDS (at Works).

	£ s. d.	£ s. d.
Bars	6 2 6 to 6 5 0	
Ship Plates to 8 cwt.	6 15 0 to 7 0 0	
Angles	6 2 6 to 6 5 0	

Best, 10s. per ton extra.
Best, best, 30s. "
Treble best, 50s. "

SCOTCH (at Glasgow).

	£ s. d.	£ s. d.
Bars NB crown	7 0 0	
Hoops	7 10 0	
Ship Plates	8 0 0	
Boiler "	8 0 0	
Angles	7 10 0	

Best, 10s. per ton extra.
Best, best, 30. "
Treble best 50s. "

WELSH (Newport and Cardiff).

	£ s. d.	£ s. d.
Bars	5 10 0 to 5 15 0	
Plates	7 0 0 to 7 10 0	

Best, 10s. per ton extra.

BELGIAN, (f.o.b. Antwerp).

	£ s. d.	£ s. d.
Bars	5 12 0 to 6 10 0	
Hoops	6 10 0 to 7 0 0	
Plates	7 10 0 to 8 10 0	
Sheets	8 0 0 to 10 0 0	
Angles	6 0 0 to 7 10 0	
Nail rods	6 10 0 to 7 0 0	

IRON ROLLED GIRDERS—
Narrow flanges 6 0 0 to 7 10 0
Wide flanges 6 10 0 to 8 0 0
STEEL ROLLED GIRDERS, ANGLES and CHANNELS at proportionate differences.

BEST YORKSHIRE (at Works).

BARS—

	£ s. d.
To 3½ cwt.	19 0 0
3½ to 5 cwt.	20 0 0
5 cwt. and upwards	22 0 0

BOILER PLATES—

	£ s. d.
To 2½ cwt.	22 0 0
2½ to 3 cwt.	23 0 0
3 to 3½ cwt.	25 0 0
3½ to 4 cwt.	27 0 0
4 to 5 cwt.	30 0 0
5 to 6 cwt.	33 0 0
6 to 7 cwt.	36 0 0
7 cwt. and over	39 0 0

Plates over 6 feet to 8 feet wide, 40s. per ton extra.

	£ s. d.
Sheets	24 0 0
Angles and Tees	22 10 0
Tyres to 4 cwt.	19 10 0
4 cwt. to 5½ cwt.	23 0 0
5½ cwt. and over.	26 10 0
Axles to 5 cwt	19 10 0
5 cwt. to 6 cwt.	22 10 0
6 cwt. and over	25 10 0

RAILS (at Port nearest Works).

	£ s. d.	£ s. d.
Heavy iron	5 5 0 to	5 10 0
" Steel	5 5 0 to	5 10 0
Light iron	5 12 6 to	5 17 6
" Steel	5 15 0 to	6 0 0

Steel Mining Rails, 10 to 15 lb. per yard, £6 5/0 to £6 15/.
Fish Plates, heavy, 20s. per ton above rails.
Fish Plates, light, 60s. to 80s. per cwt. do.

BOLTS AND NUTS, for fishes—

	£ s. d.	£ s. d.
Heavy	16 0 0 to	20 0 0
Light	26 0 0 to	28 0 0

SPIKES—

	£ s. d.	£ s. d.
Heavy	14 0 0 to	16 0 0
Light	16 0 0 to	18 0 0

PIG-IRON.

Scotch Wrrnts (Glasgow) 50s. 0d.
Cleveland Warrants No. 3 (Middlesborough) ... 43s. 10½d.
Cleveland No. 1 (Tyne or Tees), G.M.B. ... 48s 0d

CASTINGS

(f.o.b. Shipping Port).

SOCKET PIPES (for gas or water)—

	£ s. d.	£ d.
1½ to 2 in.	5 10 0 to	6 0 0
2 to 3 in.	5 5 0 to	5 15 0
3 to 8 in.	5 2 6 to	5 12 6
8 to 20 in.	5 0 0 to	5 10 0
20 to 48 in.	4 17 6 to	5 7 6
Chairs	4 15 0 to	5 0 0
Girders	5 15 0 to	8 0 0

SCRAP—

	£ s. d.	£ d.
Old rails, D.H.	3 10 0 to	3 15 0
Do. flange	3 0 0 to	3 5 0
Engineers' heavy scrap	2 18 0 to	3 0 0
Light do.	2 0 0 to	2 5 0

WIRE.

Rolled Fencing Wire (at Works)

	£ s. d.	£ s. d.
Nos. 0 to 4	7 0 0 to	8 0 0
5	7 10 0 to	8 10 0
6	8 0 0 to	9 0 0

Galvanized.

	£ s. d.	£ s. d.
Nos. 0 to 4	11 0 0 to	11 5 0
5	11 10 0 to	11 15 0
6	12 0 0 to	12 5 0

Drawn Fencing Wire.

	£ s. d.	£ s. d.
Nos. 0 to 6	9 0 0 to	9 10
7	9 10 0 to	10 0 0
8	10 0 0 to	10 5 0
9	10 10 0 to	11 0 0
10	11 10 0 to	12 0 0

Galvanised.

	£ s. d.	£ s. d.
Nos. 0 to 6	13 0 0 to	13 10 0
7	14 0 0 to	14 10 0
8	14 15 0 to	15 0 0
9	15 0 0 to	15 10
10	16 0 0 to	16 10 0

Drawn Bright Wire.

	£ s. d.	£ s. d.
Nos. 1 to 6	11 0 0 to	11 10 0
7	11 10 0 to	12 0 0
8	11 15 0 to	12 5 0
9	12 5 0 to	12 15 0
10	13 0 0 to	13 10 0

Drawn Bright Steel Wire.

	£ s. d.	£ s. d.
Nos. 1 to 6	12 5 0 to	12 15 0
7	12 15 0 to	13 5 0
8	13 0 0 to	13 10 0
9	13 10 0 to	14 0 0
10	14 10 0 to	15 0 0

Galvanised Fencing Strand (B.B)

	£ s. d.	£ s. d.
7 wires.		
No. 0	17 0 0 to	18 0
1	18 0 0 to	18 10 0
2	18 10 0 to	19 0 0
3	19 0 0 to	19 10 0
4	19 10 0 to	20 0 0
5	21 0 0 to	21 10 0
6	21 10 0 to	22 0 0
7	22 15 0 to	23 5 0
8	24 10 0 to	25 0 0
9	24 15 0 to	25 5 0
3 wires.		
No. 0	16 10 0 to	17 0 0
1	16 15 0 to	17 5 0
2	17 10 0 to	18 0 0
3	18 0 0 to	18 10 0
4	18 5 0 to	18 15 0
5	18 10 0 to	19 0 0
6	19 5 0 to	19 15 0
7	20 0 0 to	20 10 0
8	20 10 0 to	21 0 0
9	22 0 0 to	23 0 0

STEEL (at Works).

Siemens-Martin or Bessemer.

	£ s. d.	£ s. d.
Plates	10 10 0 to	11 10 0
Sheets	11 0 0 to	14 0 0
Bars	9 0 0 to	10 0 0
Angles	9 10 0 to	11 0 0
Tees	10 0 0 to	11 10 0
Spring Stl.	12 10 0 to	14 0 0
Cast Steel for Tools	40 0 0 to	60 0 0

GALVANISED IRON ROOFING SHEETS (at Liverpool).

CORRUGATED SHEETS 5, 6, 7, 8 feet long.
Gauges 16, 18, and 20, £14 0s. to £15 0s.
22 and 24 gauge, £15 0 to £16
26 gauge, £17 10 to £18 10s.
28 gauge, £19 10s. to £20 10s.
Sheets 8 to 9 feet long, 20. per ton extra.
Sheets 9 to 10 feet long, 40s. per ton extra.
Sheets 10 to 11 feet ong, 60s. per ton extra.
Sheets 11 to 12 feet long 80s per ton extra.

PRICES CURRENT OF MANUFACTURED GOODS OF BIRMINGHAM AND DISTRICT.

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The quotations given are manufacturers' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

September 20.

The iron market maintains a firm tone, and unmarked bars are quoted 2s. 6d. to 5s. per ton more than a week or two ago; but as yet prices of manufactured hardware generally remain much the same. Buckets and other galvanised hollow ware will shortly be advanced, the principal manufacturers having resolved to make one general list, as in the case of tubes; but underselling is likely to take place, as there are so many small makers engaged in this industry.

ABRIDGED LIST.

AMERICAN WIRE HOBS, 1 lb., 42/6; 1½ lb., 36/6; 2 lb, 3/6; 2½ lb., 31/6; 3 lb., 30/6 per cwt.

ANCHORS, common, 1 to 10 cwt. 14/ per cwt.

ANVILS (Common), 16/0 per cwt.: Best anvils, not warranted 20/ per cwt.; Best warranted anvils (bick tied in 1 to 5 cwt.), 21/6 per cwt.

AUGERS (shell), ½ inch to 2 inch, 11/ to 44/ per doz., less 57½%; (screw), ½ inch to 2 inch, 26/ to 64/ per doz., less 57½.

AXES, ship carpenters', /4½ to /5½ per lb.; Kent and house carpenters' ditto, /4 to /5; ditto, steel polished, 5 to 6, felling axes, /4½ to /4¾; bright and blued, solid steel, /7 to /8. American felling or wedge axes, steel, polished, /11 per lb.

AXLE PULLEYS, iron, 8/ to 26/6, 1½ inch; Brass face ditto 26/6 to 46/6, 1¾ inch.

AXLES, 35 to 45%

BASINS.—Bright tinned, shallow, 8 inch, 2/6; 9 inch, 2/9; 10 inch, 3/4; 11 inch, 4/; 12 inch, 4/6; 13 inch, 5/; 14 inch, 6/; 16 inch, 8/6 per doz.; galvanised ditto, 8 inch, 2/3; 9 inch, 2/6; 10 inch, 3/; 11 inch, 3/9; 12 inch, 4/3; 13 inch, 4/9; 14 inch, 5/9; 16 inch, 7/9 per doz.

BASTARD BELLOWS, 52½ %; best extra nailed bastard bellows, 47½%; best improved long Bristol, 42½%; common smiths' bellows, 62½%; best warranted extra double nailed, 45 to 50%; ditto, with movable pipe for shipment, 52½%.

BELLS.—House brass, rough, /8 to /10 per lb.; turned edge, 8½ to /10½ per lb.; turned and lacquered on edge, 1/5 to 1/10 per lb.; cattle and sheep bells, with brass loops, 1/1 to 1/3 per lb.; clock bells, 1/5 to 1/6 per lb.

BELL STAPLES (fine tinned) ½ inch, /1½; ¾, /1¾; 1, /2¼; 1¼ /3½; 2, /5½; 2½, /6¾ per gross.

BED SCREWS, London, black heads, 6, and 7-16, and ¾ inch, 8/6 to 10/6 per gross; London heads, with bright turned collar, 6 and 7-16, and ¾ inch nuts, 11 9 to 12/0; black welded heads, 8/3 to 9/3; common slit heads, 6, and ¾, and 1 inch, 8/9 to 9/9; bright turned notched heads, 6, and 7-16, and ¾ inch, 12/3 to 13/3; black notched heads, 10/ to 11/ per gross. Bedsteads, cheap stump, 6 feet by 3 feet 6 inches, 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches.

BOLTS.—Solid end tower, 72½ to 75%; ditto, solid end barrel, 67½ to 70%; best solid tower bolts, 75%; japanned Scotch tower bolts, 55%. Bolts and nuts, black, ¼, and 5-16 to 2 inch and under, 3/6 and 4/1, ⅝ 5/6, 7-16 6/7 per gross, ½ and 9-16 8½, ⅝ and 11-16 21/, ¾ to 1¼ inch, 20/ per cwt.; 2¼ to 3 inch, ¼, 4/, 5-16 4/7, ⅜ 6/6, 7-16 7/10 per gross; ½ and 9-16 21/, ⅝ and 11-16 19/, ¾ to 1¼ 18/ per cwt. Square heads, round necks, square nuts, bright engineers hexagon heads, 2½ to 3 inch, ¼ 22/, 5-16 24/, ⅜ 27/ 7-16 31/ ½ 45/ 9-16 51/ ⅝ 67/ ¾ 69/ ⅞ 126/ inch 184/ per gross. Bright engineers hexagon nuts, ¼ 10', 5/16 12/, ⅜ 14', ½ 20/, ⅝ 25/, 1 inch 36/ per gross. Black nuts, square, blank, 3 inch 16/6, ¾ 14/9, 1 inch 14/6, 1¼ inch 16/6 per cwt. delivered.

BRASS HEAD NAILS, 57½ to 65%; star head, 50%; brass plated countersunk head, 30 to 35%; blacksmith's tongs, 23/ per cwt.; real fine wrought box irons, 20 to 25%; fine cast, 60%; middle cast, 50 to %; Victoria charcoal box irons, 45 to 50%; ordinary charcoal ditto 0 65%; brushes, painters', 50 to 75%; best ditto, 15 to 50%; brass rolled, 2 to 12 inches wide to 30 W.G., /7 per lb. Brass sheets, 24 and 28 inch, 8 lb. and upwards, or 27 W.G., /8 per lb.; ship and turret bells, 1/4 per lb. Battery kettles, 125/ per cwt.; brass jelly pans, with bails, /9½ to /9¾; without bails, /10½ to /10¾; Maslin kettles, cast, 4 to 10 inch, /9 to /9¾ per lb. Brass shoe bills, /9 per lb.; brass scale pans, 1/6; brass toddy kettles, 15 to 20%

BRASS CORNICE POLE RINGS, light, middle and strong, 45%.

BRASS WIRE, /7½ per lb. up to No. 20 W. G.; back bands, 3 lb. and larger, 16/9 per cwt.; ditto, smaller, 2/ per cwt. extra; double swivel ditto, 1/ per cwt. extra.

CART TRACES, 9 to 12 links to foot, 16/3 to 18/9 per cwt.

CHAIN, machine made, Wire, single link, "Iron," 55%; double link ditto, 55%; machine-made Wire Chain, single link, "Brass," 55%; registered ditto, 55%; close link brass chain, 55%; oval link brass chain, 55%; brass clock chain, 55%; short link tested (rigging) chain, 3-16 inch, 19/9; ¼, 17/; 5-16, 15/3; ⅜, 15/; 7-16, 13/6; ½, 12/9; ⅝, 12/; ¾, 11/6; 1 inch, 11/ per cwt.; well chain, twisted or straight link, ⅛ inch, 25/3; 3-16, 18/; ¼, 16/; 5-16, 14/9 per cwt. delivered.

CHAIR NAILS (brass), lacquered or gold colour, No. 1 to 12, 2/ to 7/6 per 1000; machine polished, 1/9 to 7/3 per 1000; lacquered or gold coloured, 2/ to 12/ per lb.; discount per 1000, 57½%; per lb., 2%, delivered.

CHIPPING CHISELS, solid cast steel, /6 per lb.

COACH BOLTS AND NUTS, round or cheese heads, square necks and nuts, black, 3 inch by ¼, 4/1; 3½, 4/5; 4, 5/1 4½, 5/7; 5 inch, 6/1 per gross. Bright, 3 inch by ¼, 4/9; 3½, 5/3; 4, 5/9; 4½, 6/3; 5 inch 6/9 per gross. Black, 3 inch by 5-16, 4/9; 3½, 5/3; 4, 5/9; 4½, 6/3; 5 inch, 6/9 per gross. Bright, 3 inch by 5-16, 5/6; 3½, 6/; 4, 6/6; 4½, 7/; 5 inch, 7/6 per gross delivered.

COACH SCREWS.—Patent bright pointed, 2 inch and under, ¼ inch, 3/1; 5-16, 3/5; ⅜, 4/6; 7-16, 5/4 per gross; ½ inch, 26/; ⅝ inch, 23/; ¾, 22/ per cwt.; 4½ to 6 inches long, ¾ inch, 26/6; 7-16, 25/; ½, 21/; ⅝, 19/; ¾, 18/ per cwt.; above 6 inch, ⅝ inch, 25/6; 7-16, 24/; ½, 20/; ⅝, 18/; ¾, 17/ per cwt.; 1/ per cwt. extra for hexagon heads, delivered.

COACH SPRINGS, 40%.

COCKS.—Brass range cocks, ½ inch, 30/; ¾, 42/; ¾, 53/6; 1, 64/; inch 75/ per doz., less 30% discount; brass racking cocks, fast key, 1¼ inch, 11/; 5-16, 13/; ⅜, 15/; 7-16, 18/; ½, 23/; 9-16, 34/; ⅝, 38/; ¾ 45/; ⅞, 59/; 1 inch, 66/ per doz.; loose key, 1/ to 18/ per doz. extra; discount, 60%.

COFFIN FURNITURE, registered, 50%; ditto, common, 75%.

COPPER BOAT NAILS, ⅛ inch to 2 inches and above, 1/6 to /10½ per lb.; copper boat roves, 3-16 to ½ inch and above, 1/7½ to /11½ per lb.; cut copper nails and tacks, ⅛ inch to 1 inch and above, /10½ to /9½ per lb.

COPPER WIRE, /9½ per lb. up to No. 20, W. G.

CUT NAILS.—Clasp, rose, and clout, 3 to 5 inch, 8/9; 2½ and 2¾ inch, 9/3; 2 and 2½ inch, 9/9; 1¾ inch, 10/3; 1½ inch, 10/9; 1¼ inch, 11/9; 1 inch 13/9; ¾ inch, 16/ per cwt.

DISH COVERS, blue japanned wire, 3/3 to 5/6 per set of 6.

DOOR SPRINGS, X, 85%; XX, 77½%; XXX, 72½%; XXXX, 65%; brass circular and iron circular, 55 to 65%; brass reliance, 10 to 20%; climax, 20%; universal, 55 to 60%; paragon, 20%; O'Connor's patent lever hinge springs, 10 to 20%. O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass 10 to 20%.

FILES, 55% the list.

FLOOR BRADS.—2 inch, 9/3; 2½ inch, 9/; 2½ inch, 9/; 2¾ inch

FRY PANS, 7½ inch to 17 inch, oval, bright, 12/ to 55/ per

doz.; tinned, 14/ to 60/ per doz.; fry pans, 5½ inch to 10 inch round bright, 10/ to 26/ per doz.; tinned, 21/6 to 29/ per doz.; fry pans, 10½ inch to 15 inch round, bright, 30/ to 60/ per doz.; tinned, 33/ to 64/ per doz.. all fry pans 72½% and 5% delivered. Fire-irons, kitchen, in sets, 1/ to 6/ per lb.; tongs, /5½ to /6; pokers, /4½ and /5; fishhooks, best, 40 to 45%; common, 60 to 65%; light kitchen fenders, 5 inch, assorted, 2 feet 6 inch to 3 feet 6 inches, black fronts, 28/ to 30/ per doz.; bright fronts, 31/6 to 34/. Manchester pattern kitchen fenders, 5 feet, 1 inch top, black front, 2 feet 9 inch to 3 feet 3 inch, 37/6 to 40/ per doz.; 3 feet 1 inch to 3 feet 9 inch, 42/6 to 47/6 per doz.

KNITTING PINS, iron, /2½ to /3 per lb.; steel ditto, 15 to 18 W.G., 2/8 to /9 per gross, brass ditto, 1/ per lb.; keys and blanks, 50 to 65%; extra strong plate, 30 to 37½%; extra strong Banbury pinned keys, 35 to 40%; brass shutter knobs, 55%; brass cupboard turns, 55%; brass draw knobs, 55%; brass ashpan knobs, 55%; brass range knobs, 40 to 45%; lock furniture, brass, 67½%; chain lock furniture, 37½ to 45%; ebony lock furniture, 2½ inch, Wilkes' spindles, 18/ per doz. sets; sham ditto, 8/ to 9/ per doz. sets; Norfolk latches, common, 82½%; Suffolk latches, 75%; best ditto, 55%, and larger, 67½ per cwt.; brass head nails, 62½%.

GALVANISED BUCKETS, 12 inch, 38 lb. to the doz., 6/; 11 inch, 5/3; 10 inch, 4/6; 13 inch, 7/3; 14 inch, 8 9; 12 inch, 42 lb., 7/; 10 inch, 5/3; 11 inch, 6/; 13 inch, 8/; 14 inch, 9 6.

GALVANISED WASHING TUBS, oval, 22 inch, 27/; 24 inch, 30/; 26 inch, 34/.

GALVANISED WIRE NETTING, 1½ inch mesh and larger, 67½%; 1 inch mesh and smaller, 72½%, delivered.

GIMP PINS.—Best black iron wire, ⅜ by 18, ½ by 18, ⅝ by 18, all /5½ per lb.; 19 gauge, /1 per lb. extra; coloured, /1 extra; best bright iron panel pins in 1 lb. packets, ½, ⅝, and ¾ by 17 inch, /3½; 1 and 1¼ by 16 inch, /3½; 1½ by 15 inch, .1 per lb.; tinned, /1½ per lb. extra; brass panel pins, /9½ per lb., all sizes; copper ditto, 1/1 per lb. all sizes; brass escutcheon pins, ⅜ by 16, ½ by 15, ⅝ by 15, ⅝ by 14, ¾ by 14, 1¼ by 13 inch, /9½ per lb.; brass gimp pins, 19 gauge, 2/ per lb.; ditto, 18 gauge, /11½ per lb.

GRID IRONS, London pattern, fluted, 70%; light ditto, 77½%; hanging round bar, 60%; doublet, 45%; round bar, /1½ per bar, 67½%; best fluted bar, 67½%; flat bar, 67½%; common flat bar, 67½%; common gridirons, /1 /1½ and /2 per bar less, 65 to 75%; gimblets, 50%.

HAMMERS.—Cast steel stone breaking and quarry, per cwt.; soli cast steel engineers' hand, 1½ lb. each and above, /8 per lb.; solid cast steel boiler makers' hand hammers, 1½ lb. each and above, /8½ per lb.; iron and steel boiler makers' sledge hammers, 6 lb. and above, 17/ per cwt.; iron and steel sledge hammers, 6 lb. and above, 18/6 per cwt.; solid cast steel sledge, 28/ per cwt.; platelayers' keying, 28/ per cwt.; holdfasts, japanned, 18/ to 20/ per cwt.; common Kent hand hammers, 55%; patent hasps and staples, 20 to 25%.

HOLLOWARE.—Best, 45%; common, 55 and 50%; enamelled ditto, best, 30%; common, 35%.

HORSESHOES.—Fullered fore, 16/ to 18/; fullered hind, 17/ to 19/; stamped fore, 16/6 to 18 6; hind, 17/6 to 19/6.

IRONFOUNDRY, GENERAL.—Ash grates 7/9 to 9/ per cwt., air bricks, 2/9 to 3/6; half-single, 3/3 to 3 6; double, 5 6 to 6/; bars and hearers, 7/3 to 8/3; barrow wheels, 8/; bake pans, 8/6 to 9/6; camp ovens, 6/; cooking stoves, 9/ to 12/6; cellar grating, 8/6; clock weights, 7/6; Dutch stoves, 8/6 to 10/; dumb bells, common, 7/ to 9/; best best japanned, 15 to 17/6; furnaces up to 50 gallons, /3½ to /4; galvanised ditto, /7 to /9 per gallon; furnace doors, 9 6 to 12/; furnace grates, 8/6; heaters for box irons, 6/6 to 7 6; heaters for urns, 8/6 to 9/6; oven doors and frames, 8/6 to 10/6; three legged pots, Danish and plumbers' 9/; plumb bobs, 10 6; pudding pans, 10/6 to 11/6; pump spous, 10/6 to 13/; sash weights, 4/6; ditto, with pulleys, 7/ to 8.6; shoe anvils, 8/6; Italian irons, 50%.

MELTING LADLES, 2 inch to 8 inch, 2/ to 16/ per doz., less 15%; Pitch Ladles, 3 inch to 6 inch, 3/6 to 12/ per doz., less 10%.

NAILS.—Patent forged nails, "Iron or Steel." Strong rose flat points), 1 inch, 4 lb., 45/6; 1½ inch, 6 lb., 38/; 1½ inch, 7 lb., 36/; 1¾ inch, 8 lb., 34/6; 2 inch, 10 lb., 32/6; 2½ inch, 12 lb., 31/; 2½ inch, 17 lb., 28/6; 2¾ inch, 20 lb., 28/; 3 inch, 23 lb., 27/6 per cwt. Fine Rose (flat points), 1 inch, 2½ lb., 52 6; 1½ inch, 3½ lb., 58/6; 1½ inch, 4 lb., 54/6; 1¾ inch, 5 lb., 48/6; 2 inch, 7 lb., 43/6; 2½ inch, 8 lb., 41/6; 2¾ inch, 10 lb., 39/6; 2¾ inch, 14 lb., 34/; 3 inch, 17 lb., 32/ per cwt. Coopers' rose (sharp points), 1½ inch, 7 lb. per m., 2/4; 1¾ inch, 8 lb., 2/7; 2 inch, 10 lb., 3/; 2½ inch, 12 lb., 3/5; 2½ inch, 17 lb., 4/3½; 2¾ inch, 20 lb., 5/1; 3 inch, 23 lb., 5/11 per m. Fine Clasp (sharp points), 1½ inch, 4 lb. per m., 2/1; 1¾ inch, 5 lb., 2/4; 2 inch 7 lb., 2/10; 2½ inch, 8 lb., 3/03; 2½ inch, 10 lb., 3/58; 3 inch, 14 lb., 4/43 per m. Best Canada (sharp pointed), 2½ inch, 4 lb. per m., 2/2 inch, 7 lb., 2/9; 2½ inch, 8 lb., 3/04; 2¾ inch, 12½ lb., 4/04; 3 inch, 14 lb., 4/43 per m. Pound Nails, 6dy, 2½ inch, 28/6; 8dy, 2¾ inch, 27/; 10dy, 3½ inch, 23/6; 20dy, 4 inch, 23/ per cwt., discounts 52½% off iron, 47½% off steel. Nails, cast lath, 9 per cwt.; wall nails, cast, 8/6 per cwt.; cast headed bills, ⅞ by 8 oz., 12/ to 14/; fine round cast bills, ⅞ inch, 11/ to 45/; strong round ditto, ⅞ inch, 12 6 to 14/; cast slate pegs, 10/ to 12/; black coffin nails, 55 to 60%; white ditto 45 to 55%; black coffin bullens, 50 to 55%; white ditto, 40 to 45%.

PICKS, iron and steel excavators, /3 to /5 per lb.

PLANKS, 45% off the list.

PLOUGH TRACES, 9 to 12 links to foot, 17/ 19/9 per cwt.

RAILWAY BEATER PICKS, /3 to /5 per lb. delivered in London or Liverpool. Rakes, light garden, 50 to 60%; light solid end rakes, 47½ to 52½%; bolstered teeth garden rakes, 50%; solid end bolstered teeth garden rakes, 40 to 45%.

RATCHET BRACES, improved, 8 inch, 20/; 10 inch, 22/; 12 inch, 24/; 14 inch, 28/; 16 inch, 32/; 18 inch, 36/; 20 inch, 40; 22 inch, 44/; 24 inch, 48/ each, less 65% off list; ditto, with eccentric levers, 8 inch, 22/; 10 inch, 24/; 12 inch, 26/; 14 inch, 28/; 16 inch, 30/; 18 inch, 33/; 20 inch, 36/; 22 inch, 39/; 24 inch, 42/ each; drills for above, 15 per doz., less 40% eccentric lever braces.

RIDDLES, common, 8 inch by 18, 21/ per doz.; do foundry or gravel, 8 by 18, 27/ per doz., less 55%.

RIVETS.—Copper hose, ⅞ by 8 and above, 1/10½ per lb.

RIVETS, Machine-made Wire, No. 6, 18/ per wt.; iron boo rivets, 23/6 to 24/6 per cwt.; brass ditto, /8½ per lb. Ship, tank and girder Rivets, ½ inch, 17/; ⅝, 13/6; 7-16, 13; ⅜ inch, 12/6 per cwt.; Best Boiler Rivets, 2/ per cwt. extra. Ship scrapers, black stee blades, 50 to 55%; bright, 47½ to 52½%; cast steel black, 47½ to 52½%; bright, 42½ to 47½%; best cast steel black, 40 to 45%; bright, 30 to 40 p.c.; sash chain, copper, 53 p.c.; zinc, 55 p.c.; iron prepared ditto, 50 p.c.

S&D IRONS, common, 7.6 to 8/ per cwt., delivered; best japanned, 12/6 to 13 6 per cwt.; best best opanned, 15/6 to 18/6 per cwt

SCALES, copper, 72½ to 77½%.

SCREWS, iron wood screws, 70% brass ditto, 62½; copper wood screws, 35%; stove ditto, 65%; do wel ditto, 70%; brass headlock screws, 40%.

SCREW STOCKS and DIES, 57½ off list.

SHOE BILLS, in 2 and 3 lb. parcels, extra strong, and strong, 9 to 13 W.G., 11/; middle, 14 W.G., 12/3; fine, 15 W.G., 12/3; extra fine, 16 W.G., 12/3 per cwt Shoe heel, York, No. 1, 2/6 to 2/9 No. 1.1 to 3/3; No. 3, 6/9 to 7/6 per gross net; Dundee hot turned, 4/9 to 7/3 bright edge imperial or solid Scotch, 8/ to 8/9; bright York, 61 lb, 6/9 to 7/3; bright solid, 6/3 to 6/9 toe plates, 8/3 to 8/9 per gross.

SHOVELS, common iron, round back, dust, 4 inch to 8 inch, 1/9 to 6/ per doz., less 25%; socket handles, 1/ per doz. extra; Bell mouth Shovels, 7 inch to 10inch, 2/ to 4/ per doz., net; ditto, japanned with wood handles, 3/4 to 5/6 per doz. net. Shovels, all steel, crutch handles, No. 2, 17/ No. 3, 18/3; No. 4, 19/9 per doz.; No. 5, 20/9 per doz.; eye-handles; 1/ per doz. extra; riveted ditto, 2/ per doz extra; Spades and hovels, common, 62½%; second, 52½%; best, 42½% discount off the list.

SOFA SPRINGS, "Bright," 8 by 5 inch, 10/8; 8 by 6 inch, 10/9 8 by 7 inch, 12/6; 8 by 8 inch, 13/6; 8 by 9 inch, 15/3; 8 by 10 inch 18/ per gross, less 15 per cent. "Coppered," 1/ per gross extra in to 8 by 8; all above 1/6 per gross; coiled, /6 per gross extra.

SPLIT COTTERS, 67½ off list. American Wire Tacks, 75% off list.—**W. Gorse and Son**, Icknield Square, Birmingham.

SPOKES.—Steel bicycle and perambulator, tinned, cut to lengths, and headed, No. 6, 29/9; 7, 30/3; 8, 30/6; 9, 31/; 10, 31/6; 11, 32/; 12, 32/9 per cwt. Bright, 9/ per cwt. less.

STAIR RODS, turned ends, 85%; ditto, solid fancy ends, 85%.

STAPLES, Wire fencing, 13 to 9 inch, No. 6, W.G., 12/; No.

STEEL TOYS, 10 to 30% off the list.

STEELYARDS, 65%.

TACKS, fine cut, in 1 and 7 lb. parcels, ½ inch, 20/6; ⅝ inch 28/6; ¾ inch, 19/9; ⅞ inch, 18/3; 1 inch, 17 6; 1¼ inch, 16/9; 1½ inch, 16/9 per cwt., tinned, 8/ per cwt. extra; in ½ cwt. bags, 1/ per cwt. less.

WIRE.—Iron, bright, 0 to 6, 10/; 7, 10/6; 8, 10/ 9, 11/3; 10, 11; 12/3; 12, 13/; 13, 13/6; 14, 14/; 15, 14/9; 16, 15 6 17, 16/; 18, 17/; 19, 18/ per cwt.; galvanised, 0 to 6, 1/3 per cwt. extra; best annealed drawn fence wire, oiled, 0 to 6, £9 5/; 7, £9 15/; 8, £10 9, £10 10/ per ton; galvanised, 0 to 6, £12 10/; 7, £13; 8, £13 10/ 9, £14 per ton. Steel fence wire, round or oval, £2 per ton extra

IRON EXPORTS.

COMPARATIVE EXPORTS of Pig, Merchant, and Railway Iron for the Last Twelve Months.
(*Specially prepared for* IRON.)

PORT.	1881 Sept.	1881 Oct.	1881 Nov.	1881 Dec.	1882 Jan.	1882 Feb.	1882 March.	1882 April	1882 May.	1882 June.	1882 July.	1882 Aug.
(PIG IRON.)	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Ardrossan	805	120	1,940	300	645	848	1,090	1,810	1,915	933	260	3,180
Barrow-in-Furness	19,294	15,747	3,900	8,946	7,931	3,600	7,310	6,068	6,170	17,613	18,128	27,887
Borrowstoness	—	—	—	—	—	200	500	1,410	1,050	380	1,616	2,785
Cardiff	—	600	—	—	—	—	500	2,715	1,109	350	—	1,183
Dundee	—	—	—	—	—	—	—	—	—	—	—	500
Glasgow	17,682	14,289	13,584	11,481	11,647	13,060	17,628	13,956	20,324	24,245	17,225	24,834
Goole	100	110	—	—	—	—	31	—	—	442	624	210
Grangemouth	5,140	1,265	2,265	2,351	800	800	4,762	6,160	1,960	4,218	4,880	3,318
Granton	15	350	75	—	—	—	31	50	35	—	10	300
Greenock	200	75	1,570	164	500	1,258	540	2,535	45	1,353	85	3,680
Grimsby	142	252	1,162	171	225	112	197	698	927	763	1,861	1,619
Hartlepools	3,751	2,134	3,195	2,000	1,865	1,308	4,740	3,032	4,468	1,945	6,588	9,530
Hull	2,160	1,490	2,177	1,645	786	1,111	1,744	1,859	1,248	2,331	776	1,925
Liverpool	20,716	11,490	11,391	10,911	11,550	13,403	22,481	28,823	23,896	15,654	15,958	13,530
Middlesbrough	38,154	46,975	37,483	19,216	24,388	31,778	53,262	38,576	42,010	41,617	39,385	58,450
Newcastle-on-Tyne	9,665	12,892	6,145	3,025	6,013	3,605	8,998	8,029	9,383	11,908	9,422	12,018
Newport	70	—	400	3	1,055	—	1,390	1,460	679	—	—	—
North Shields	300	—	—	2,950	1,500	—	—	20	—	1,000	2,410	1,950
Port Glasgow	—	—	550	50	—	—	—	250	—	—	—	—
South Shields	1,300	75	60	530	2,250	50	420	30	201	55	—	800
Stockton	1,295	1,420	540	300	1,390	1,310	2,501	520	2,442	835	3,310	1,965
Sunderland	—	—	40	—	—	—	30	75	25	—	150	—
Swansea	—	—	25	—	50	—	—	—	—	—	—	30
Troon	200	570	150	200	910	1,120	—	1,720	—	680	1,920	1,860
Whitehaven	3,238	3,550	5,230	1,891	6,185	4,010	5,160	4,170	2,930	4,350	11,084	14,155
(MERCHANT IRON.)												
Ardrossan	—	—	—	—	—	—	—	—	—	—	—	1,150
Barrow-in-Furness	—	393	—	—	—	—	5,144	—	—	—	—	201½
Blyth	—	—	—	—	—	—	—	—	—	—	4	—
Cardiff	35	2,683	1,535	1,846	6,023	5,582	1,105	1,528	1,146	3,911	925	2,054
Glasgow	891	1,320	536	428	670	711	980	310	1,084	782	472	1,026
Goole	2	—	—	—	—	—	—	—	—	—	—	—
Grangemouth	—	—	—	—	—	—	—	—	—	—	—	—
Granton	—	180	—	—	—	—	—	5	64	38	—	—
Greenock	—	—	—	—	—	—	—	—	—	143	—	—
Grimsby	23	101	13	21	69	282	165	343	15	116	45	28
Hartlepools	1,192	314	148	1,237	519	329	719	412	630	319	814	442
Hull	1,625	1,297	1,165	1,552	1,312	1,046	1,235	1,151	1,155	2,012	627	2,413
Liverpool	13,420	16,730	15,302	13,475	13,215	12,604	15,011	12,633	15,501	13,128	13,526	16,105
Middlesbrough	444	549	985	170	212	152	36	320	364	622	794	2,213
Newcastle-on-Tyne	480	540	627	528	594	1,207	578	925	1,121	1,030	225	710
Newport	2,671	34	260	—	—	110	1,123	48	1,813	—	500	4,634
North Shields	—	—	—	—	2	—	—	—	44	—	12	—
South Shields	73	77	113	66	—	28	26	51	30	201	75	182½
Stockton	399	543	—	1,137	505	337	43	816	56	—	—	—
Sunderland	109	—	—	39	—	—	283	44	—	—	21	10
Swansea	212	538	342	190	707	42	43	611	158	78	634	75
(RAILS - IRON AND STEEL.)												
Ardrossan	—	—	—	—	—	—	—	—	—	3,150	—	5
Barrow-in-Furness	3,769	6,976	4,536	1,360	5,285	2,208	—	1,075	2,651	6,488	11,171	14,978
Borro estoness	—	—	—	—	—	—	—	466	—	—	—	—
Cardiff	6,918	5,458	3,838	7,238	3,752	4,812	8,279	3,566	4,173	9,500	6,229	6,854
Glasgow	—	—	—	218	—	—	—	—	—	—	—	—
Grimsby	—	1,905	—	—	—	4,240	—	1,330	—	1,803	—	—
Hartlepools	19	1,090	450	1,256	1 000	1,200	4,461	1 300	6,255	21	2,100	—
Hull	15	126	10	1,406	—	—	—	1	200	36	—	27
Liverpool	15,877	28,668	11,469	10,089	14,818	9,471	11,933	20,687	17,285	25,914	16,750	19,868
Middlesbrough	10,725	9,353	10,288	3,718	15,512	10,949	9.757	9,674	10,851	8,411	6,884	6,029
Newcastle-on-Tyne	—	—	28	—	4	5	47	37	3	5	25	37
Newport	13,072	24,531	4,791	10,912	16,186	18,011	5,982	12,421	11,905	8,420	12,320	10,248
North Shields	—	—	—	—	9	—	—	—	—	—	399	—
Port Glasgow	—	17	—	—	—	—	—	—	—	—	—	—
South Shields	1	—	5	—	—	—	—	—	—	—	—	—
Stockton	—	—	—	—	—	—	—	—	—	—	—	—
Sunderland	169	—	—	—	—	—	—	—	—	—	5	68
Swansea	12	—	—	250	—	—	—	299	—	—	—	250
					254	—	203	717	335	173	—	2

Black rolled fence wire, 4 or 5, £7 per ton. Tinned bottling wire, No. 22, 31/; 23, 33/; 24, 35/ per cwt., cut in lengths and made up in 7 lb. parcels. Fine galvanised iron wire, No. 23, 4/3 per stone of 14 lb.; cast steel wire, /5 per lb.; charcoal iron wire, 4/ per cwt. extra; tinned ditto, 9/ per cwt. extra, delivered in London; 5/ per ton less in Liverpool.

SOUTH WALES COAL SHIPMENTS, AUGUST, 1882.

The following is a summary of the foreign coal shipments from Cardiff, Newport, Swansea, and Llanelly, during the month of August 1882:—

	Tons.		Tons.
Aden	10,668	Malta	66,726
Algiers	311	Maranham	1,036
Alicante	4,248	Marseilles	18,058
Amsterdam	1 352	Martinique	5,758
Ancona	7,254	Mataro	422
Bahia	1,845	Mauritius	3,667
Barcelona	15,989	Messina	2,528
Bayonne	533	Monte Video	6,680
Bergen	725	Nantes	3,272
Bilbao	7,259	Naples	11,526
Bombay	14,983	Odessa	12,360
Bordeaux	12,105	Oporto	993
Boulogne	398	Oran	6,385
Brest	626	Palermo	5,785
Brindisi	10,511	Para	2,039
Buenos Ayres	8,269	Patras	1,641
Cadiz	3,225	Pernambuco	1,828
Caen	8,586	Philippeville	351
Calcutta	1,642	Piræus and Athens	3,982
Caldera	578	Port Said	37,632
Cape of Good Hope	12,842	Rangoon	3,467
Cape de Verde	15,254	Riga	989
Carloforte & Cagliara	850	Rio de Janeiro	16,186
Ceylon	12,354	Rio Grande	211
Charente	1,196	Rivers	1,348
Constantinople	10,043	Rochefort	10,348
Copenhagen	440	Rouen	17,767
Coquimbo	581	Salonica	1,904
Corfu	1,093	Santander	639
Cronstadt	9,345	Santos	3,122
Dantzig	269	Savona	16,665
Demerara	1,827	Seville	664
Dieppe	10,781	Shanghai	967
Fécamp	1,176	Singapore	20,788
Galatz and Danube	6,728	Smyrna	3,010
Genoa	19,573	Stockholm	439
Gibraltar	25,451	St. Malo	3,712
Guadaloupe	535	St. Nazaire	32,652
Hamburg	1,411	Syra	1,030
Havanna	3,595	Tarragona	964
Havre	19,592	Teneriffe	4,247
Hong Kong	1,218	Trieste and Ragusa	400
Java	5,657	Trouville	2,570
La Rochelle	10,152	Valencia	959
Leghorn	800	Valparaiso	2,800
Lisbon	9,611	Venice	1,491
Madeira	7,645	Yokohama	2,000
Malaga	430		
Other French ports	26,621		

COAL AND COKE EXPORTS

To Foreign Parts from the Principal English Ports in the Months of August 1881 and 1882.
(*Specially prepared for* IRON.)

PORT.	Coal. Aug. 1881.	Coke. Aug. 1881.	Coal. Aug. 1882.	Coke Aug. 1882.
	Tons.	Tons.	Tons.	Tons.
Alloa	12,289	—	13,300	—
Amble	9,087	—	7,552	—
Ardrossan	8,980	—	5,852	—
Ayr	1 554	—	2,582	—
Blyth	10,379	—	10,785	—
Borrowstoness	24,807	—	40,271	—
Cardiff	183,020	226	185,296	1,485
Dundee	6,066	—	6,176	—
Glasgow	44,083	494	26,025	124
Goole	28,833	—	29,031	—
Grangemouth	10,652	200	27,722	—
Granton	17,185	—	23,331	—
Greenock	14,074	—	21,747	—
Grimsby	34,401	—	52,348	—
Hull	59,939	89	54,286	79
Irvine	950	—	340	—
Liverpool	62,629	433	48,745	455
Llanelly	5,300	—	6,079	—
Middlesboro'	1,476	1,917	3,014	5,802
Newcastle	146,620	20,413	120,089	28,245
Newport	105,401	287	119,411	367
North Shields	24,438	—	42,975	50
Port Glasgow	—	—	—	—
Seaham	2,629	—	3,541	—
South Shields	42,056	—	54,078	—
Stockton	—	—	—	—
Sunderland	130,091	1,566	116,939	3,140
Swansea	62,013	1,194	91,765	1,078
Troon	8,254	—	7,518	—
West Hartlepool	68,993	2,496	56,045	1,840

SHIPPED for English Ports from the undermentioned places in the Months of August 1881 and 1882.

PORT.	Coal. Aug. 1881.	Coke. Aug. 1881.	Coal. Aug. 1882.	Coke Aug. 1882.
	Tons.	Tons.	Tons.	Tons.
Alloa	1,030	—	744	—
Amble	4,092	—	8,695	—
Ardrossan	11,029	—	7,985	—
Ayr	31,900	—	33,391	—
Blyth	3,959	—	2,256	—
Borrowstoness, including Charlestown, Inverkeithing, & St. David's	4,608	—	3,680	—
Cardiff	81,460	68	92,816	—
Dundee	290	—	80	—
Goole	8,145	—	8,477	—
Granton	4,797	—	2,081	—
Grimsby	1,570	—	2,014	—
Hartlepool	40,954	—	42,278	—
Hull	3,663	—	3,808	—
Irvine	7,333	—	7,634	—
Liverpool	36,576	100	55,202	110
Llanelly	11,527	—	11,595	—
Middlesboro'	2,261	—	541	—
Newcastle	191,008	112	212,120	470
Newport	70,940	—	81,341	—
North Shields	700	—	—	—
Seaham	54,458	—	52,018	—
South Shields	8,834	—	10,998	—
Stockton	40	—	—	—
Sunderland	164,065	—	188,834	—
Swansea	92,769	255	67,562	20
Troon	27,307	—	23,211	—
Whitehaven	19,584	—	16,874	—

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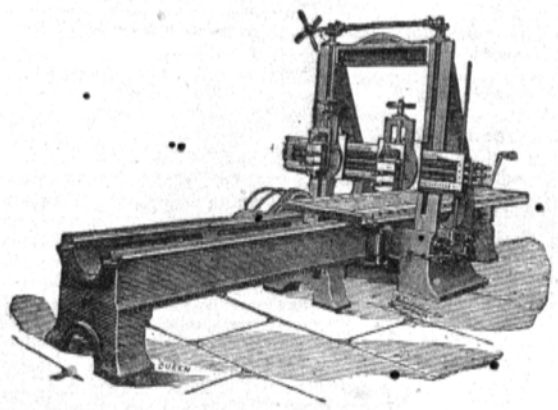

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"I herewith certify that the Rangoon Engine Oil manufactured by Messrs. Charles Price and Co. is free from any materia which can produce corrosion of the metal work of machinery. It is calculated indeed to protect metallic surfaces from oxidation, and from its peculiar character is not liable to lead to the spontaneous combustion of cotton waste or any similar material which might become imbued with it, as is the case with Rape, Gallipoli, and Olive oils. The lubricating power of this Oil is equal to Sperm or Lard oil." T. W. Keates, F.C.S., &c., &c., Consulting Chemist to the Board of Trade.

Extract from Mr. Baxter's speech in the House of Commons, May 31st, 1870. Chas. Price and Co's. Rangoon Oil: "A vastly superior article" (speaking of Gallipoli at £72 per ton) "was obtained for from £40 to £45 per ton."

CYLINDER OR VALVE OIL, for use in high-pressure cylinders, a pure Hydro-carbon, warranted not to decompose nor injure the plates of Boilers.

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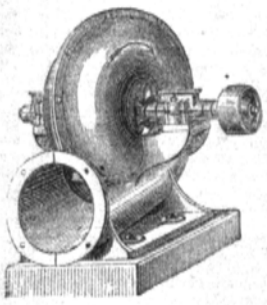

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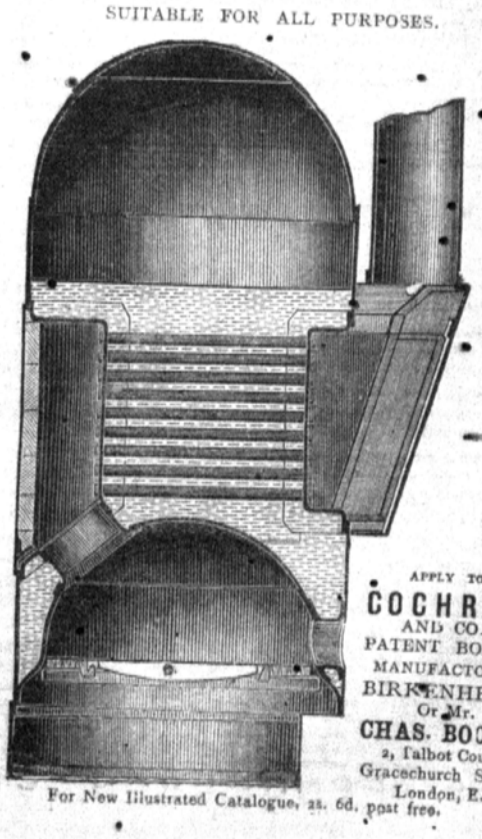

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NEW COMPANIES.

"Brighouse" Steamship Company, Limited.—This company was registered on the 11th inst., with a capital of £13,000, in £25 shares, to purchase the steamship *Brighouse*.

British Coal Company, Limited.—This is the conversion to a company of the business carried on at Paddington and Bristol by the British Coal Company and Alpheus Smith and Sons. It was registered on the 7th inst., with a capital of £10,000, in £5 shares.

Caribbean Steamship Company, Limited.—Incorporated on the 6th inst., with a capital of £45,000, in £1 shares, to carry on the business of shipowners.

Chemical Fire Engine Company, Limited.—Upon terms of an agreement of the 9th inst., this company proposes to purchase from Henry Lewis Rocca, of 3, Mayor Street, Manchester, the letters patent taken out by John Kissack Joshua Foster, for the manufacture and construction of chemical fire engines, and the business of manufacturing the same carried on by Mr. Rocca at Bolton. It was registered on the 7th inst., with a capital of £50,350, in 10,000 ordinary shares, of £5 each, and 150 deferred shares of £1 each.

Cornwall Steamship Company, Limited.—Registered on the 12th inst., with a capital of £25,000 in £50 shares, to acquire a steamship to be called the *City of Truro* of the Port of Falmouth.

Gelly Colliery Company, Limited.—Incorporated on the 12th inst., with a capital of £40,000, in £100 shares, to acquire and work the Gelly Colliery, in the county of Warwick.

Improved Gas and Oil Burners Company, Limited.—This company proposes to acquire and work the patented inventions of James Nicholas Douglass, relating to improvements in oil and gas burners. It was registered on the 9th inst., with a capital of £50,000 in £5 shares.

London and Singapore Anti-Fouling Paint Company, Limited.—This company was registered with a capital of £25,000, in £1 shares, to acquire and work the letters patent No. 3751, dated 29th August 1881, granted to Arthur Bernard Rodyk for improvements in paints or compositions for coating ships' bottoms and other submerged surfaces, to prevent fouling, and for preserving iron, wood, and other matter from the effect of exposure to salt water, damp or atmospheric influences, a communication from abroad by Nicolas Belfield Denys, of Singapore, police magistrate. Also to acquire similar privileges for the use of the invention in France, Germany, Italy, and the United States of America, and to take over and carry on the business of the Singapore Patent Paint Company.

Sailing Ship "Aigburth" Company, Limited.—Incorporated on the 8th inst., with a capital of £3,400, in £100 shares, to purchase, own and work an iron sailing ship in course of construction by Messrs. Williamson and Son, of Workington, of 1800 tons.

Tynedale Steamship Company, Limited.—Registered on the 6th inst., with a capital of £1350 in £100 shares, to purchase the steamship *Tynedale* of Cardiff.

West Indian Ice Company, Limited.—This company proposes to manufacture ice in the West Indies, under the patent No. 3503, A.D. 1875, known as the Stanley Reece Patent Ammonia Process. It was registered on the 7th inst., with a capital of £30,000 in £2 shares An unregistered agreement of the 31st ult., regulates the purchase.

METROPOLITAN BOARD OF WORKS.

Return *of the Testings made at the Gas Testing Station during the Week ending September* 19, 1882.

Company and District.	Illuminating Power.* (In standard sperm candles.)			Sulphur. (Grains in 100 cubic feet of gas.)			Ammonia. (Grains in 100 cubic feet of gas.)			Sulphuretted Hydrogen.	Pressure.†
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.		
Gas Light and Coke Company.											
Notting Hill ..	17·2	16·8	17·0	12·5	8·0	11·0	0·1	0·0	0·0		
Camden ..	17·3	16·6	17·1	12·0	9·8	10·6	0·3	0·0	0·1		
Dalston ..	18·4	17·1	17·4	14·3	8·3	11·4	0·0	0·0	0·0		
Bow† ..	17·7	17·0	17·3	13·9	11·8	12·7	0·8	0·0	0·5		
Chelsea ..	17·3	16·7	17·0	11·6	10·3	11·1	0·3	0·0	0·1		
Kingsland Rd.	17·7	16·9	17·1	12·0	8·0	10·5	0·0	0·0	0·0		
Westminster (cannel gas)..	22·2	21·3	21·6	8·6	6·7	7·7	0·4	0·2	0·3	None in excess.	
South Metropolitan Gas Company.											
Peckham ..	16·9	16·5	16·6	11·2	8·2	9·6	0·6	0·0	0·4		
Clapham ..	16·5	16·0	16·1	11·2	8·3	10·1	0·5	0·2	0·3		
Tooley Street ..	17·0	16·3	16·6	11·0	8·7	9·7	0·6	0·2	0·4		
Commercial Gas Company.											
Old Ford ..	17·5	17·1	17·3	8·4	6·0	7·3	0·2	0·1	0·1		
St. George-in-the-East ..	17·2	16·6	16·9	5·7	4·2	4·9	0·3	0·1	0·1		

W. J. DIBDIN, F.I.C., F.C.S.
Consulting Engineer and Superintending Gas Examiner.

* The standard illuminating power for common gas in the metropolis is 16 sperm candles, and for cannel gas 20 sperm candles. Sulphur not to exceed 17 grains in the 100 cubic feet of gas. Ammonia not to exceed 4 grains in the 100 cubic feet of gas.

† Pressure between sunset and midnight to be equal to a column of one inch of water. Pressure between midnight and sunset to be equal to a column of six-tenths of an inch of water.

‡ Meter under repair.

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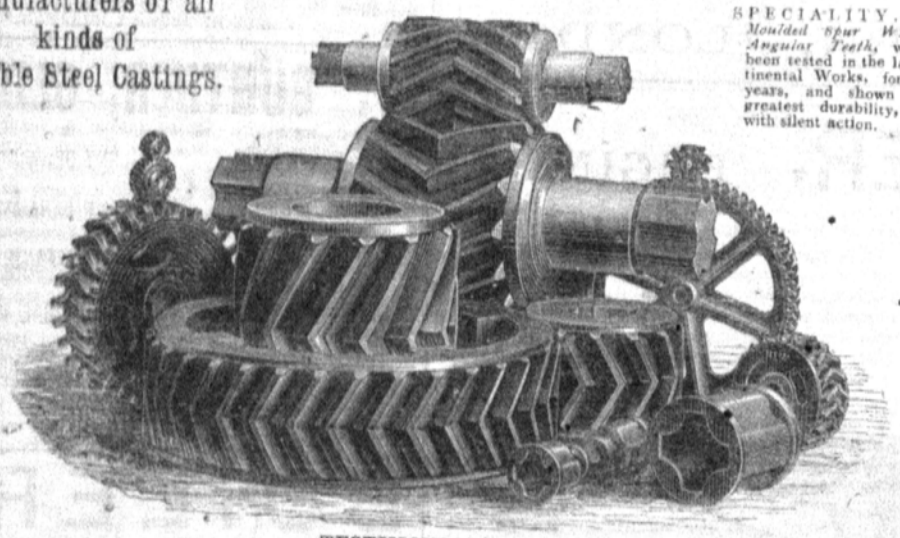

SPECIALITY.—*Machine Moulded Spur Wheels with Angular Teeth*, which have been tested in the largest Continental Works, for about two years, and shown the very greatest durability, combined with silent action.

TESTIMONIALS

Dear Sir,—We have had sufficient trial of the Pinions to be able to judge by comparison, and are thoroughly satisfied with them. Warrington, June 23, 1881.
Mr. Hermann Wedekind. MONKS, HALL and CO. (Limited).

Messrs. SANDERSON BROTHERS, Sheffield, write on April 28, 1881:—
We have had them at work twelve months, and can with confidence recommend them. Speed, 425 per minute.

DARLINGTON IRON COMPANY (Limited), Albert Hill and Springfield Ironworks, Darlington, June 28, 1881.
(Signed), ROBT. MALBY.

Hermann Wedekind, Esq., 158, Fenchurch Street, E.C.
Dear Sir,—In reply to your inquiry respecting the Steel Pinions, I have great pleasure in stating that the 22in. angular cog Pinions you supplied us with are working very satisfactorily.

P.S.—We will thank you to quote us your lowest price for two more sets of 22in. Centres, and stating earliest delivery, and delivered here or free on rail Middlesbrough or Hull,
Yours faithfully, C. THOMPSON, per A.M.

Hermann Wedekind, 158, Fenchurch Street, London, E.C. Sheffield, June 28, 1881.
Dear Sir,—Your favour of the 22nd inst., to hand, for which we thank you. The Pinions supplied to us by the "Hagener Gusstahl-werke" have given us every satisfaction.
Yours truly, pro W. Cooke and Company (Limited),
(Signed), H. GREENFIELD.

Mr. Hermann Wedekind, London, E.C. Stockton-on-Tees, January 20th, 1882.
Dear Sir,—In reply to your inquiry respecting the Steel Pinions, I beg to inform you that the 22in. angular cog Pinions, which you supplied for our reverse plate mill, are working in a highly satisfactory manner.
The BOWESFIELD IRON Co., Limited.

Mr. Hermann Wedekind. West Bromwich, April 20th, 1882.
In reply to yours of yesterday, we have put the Pinions to work, and they give every satisfaction. We are not wanting any more at the present time; when we are we will ask you to quote us your lowest price.
JOHN DAWES and SONS.

Messrs. The Hagen Cast Steelworks, Hagen. Newport Wire Mills, Middlesbrough, April 27th, 1882.
We have the pleasure to inform you that the Crucible Steel Pinions with angular teeth you supplied us several months ago have given us great satisfaction, and we shall continue to use the same.
Yours truly, RICHARD HILL and Co.

Messrs. The Hagen Cast Steelworks, Hagen, Germany. Middlesbrough, April 29th, 1882.
Dear Sirs,—We have very much pleasure to inform you that the Crucible Cast Steel Pinions, with angular teeth, which we have had from you are giving very great satisfaction at our Erimus Steelworks. We had been very unfortunate for some time at first with iron pinions, after that with ordinary steel Pinions, we had so many breakages and stoppages; but since we introduced your Pinions we have never been stopped an hour. They are working smoother than the ordinary pinions, and the present ones have been in use for five months.
Yours truly, The Erimus Steel Co., C. E. MULLER.

Mr. H. Wedekind. Portobello Steelworks, Sheffield, April 21st, 1882
Dear Sir,—Yours of the 17th inst. was duly to hand. We are quite satisfied with the cast steel angular teeth Pinions, and do not think we shall use the metal ones any more. Just now, however, we are not wanting any pinions: will ask for your quotation when we do.
Meanwhile, we remain yours truly, S. and C. WARDLOW.

In reply to your letter of the 17th inst., we beg to say that the set of steel Pinions you supplied to us continue to give complete satisfaction, but we have not at present any need of further supply. If any necessity arises we shall certainly apply to you. Wolverhampton, April 24th, 1882.
E. T. WRIGHT and SON.

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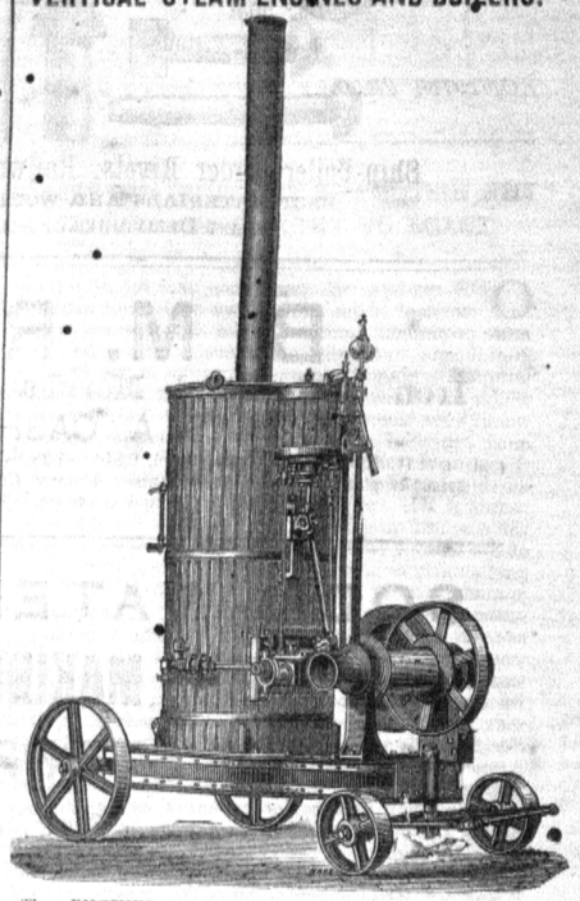

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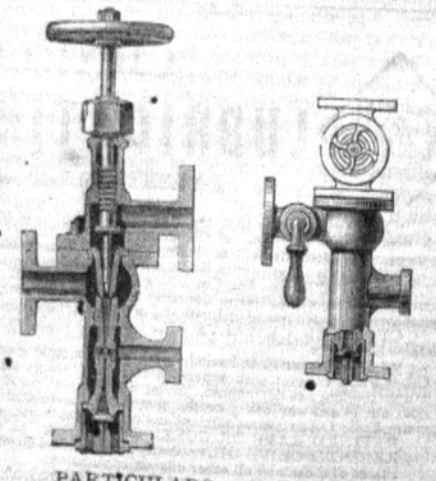

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IRON.

No. 507.

LONDON, FRIDAY, SEPTEMBER 29, 1882.

THE HISTORY OF THE IRON AND STEEL TRADE OF THE UNITED STATES.

No. III.

OUR readers will remember that in our former notices* of this subject, we have dealt with the more prominent incidents of the development of the metallurgic industries of America rather than attempted to give a minute description of the steps by which they have been built up. Such a description would have been impossible within the limits of even a more extended series of articles than these, and at the same time would have possessed but little interest on this side of the Atlantic. In this, the concluding notice of Mr. Swank's carefully compiled account of the rise and progress of the iron and steel industries of the United States, and in which we purpose more particularly to refer to the establishment of the steel manufacture in that country, we shall follow the same method. The chief interest in this matter centres itself naturally within comparatively recent years, for, like other countries, America owes the vast extension which has taken place recently in its steel production to the development of the Bessemer process, the establishment of which, as Mr. Swank justly remarks, "is regarded as constituting a much more important revolution in the production and use of iron and steel than had been created by any preceding influence or combination of influences in any age of the world's history."

Steel was made in the United States from an early period, but the quantities produced were trifling, and it was not until the beginning of the present century that the manufacture began to assume any considerable proportions, and even then it was confined to the production of the commonest quality made, such as was used for rough agricultural purposes. Down to as late a year as 1860 little or no success was achieved in the manufacture of the finer qualities of steel, as best blister steel, shear steel, or crucible cast steel. This would appear to have been due partly to the hold which English steel of these qualities had obtained in the country, and partly to the difficulty of securing raw material of the necessary quality; while in the case of crucible cast steel many of the failures resulted from the want of proper clay to make the crucibles. In 1850, the production of steel in Pennsylvania amounted altogether to 6078 tons, of which only 44 tons were cast steel. After many attempts, which met with varying success, the manufacture of this quality from American iron was completely established between the years 1860 and 1862, so that we are thus brought down very close to the advent of the Bessemer steel era. As so often happens when new inventions are about to be given to the world, while Sir Henry Bessemer in England was perfecting his discovery, an iron manufacturer in Kentucky, of the name of Kelly, was also prosecuting a series of experiments in the same direction. In his own words, he "conceived the idea that, after the metal was melted, the use of fuel would be unnecessary; that the heat generated by the union of the oxygen of the air with the carbon of the metal would be sufficient to accomplish the refining and decarbonising of the iron." This, it will be perceived, is just the essence of Sir Henry Bessemer's process, but, although Mr. Kelly succeeded in obtaining a patent in the United States for it in preference to the English inventor, the fact remains incontestable that Sir Henry Bessemer made his invention a magnificent success, while his American rival was unable to bring his conception to perfection. By the aid of machinery of his own design the former accomplished the manufacture of steel in large quantities and with the least possible expenditure of time; but Mr. Kelly only succeeded in producing refined iron of good quality, and even that not expeditiously nor in large quantities. The patents granted to Mr. Kelly were taken over by a company which proceeded to erect works at Wyandotte, Michigan, and the first Bessemer steel made in America was produced at these works in the fall of 1864. This was not accomplished, however, without the infringement of Sir Henry Bessemer's patents, since the machinery employed was that which he had invented. The control in America of the Bessemer patents was secured by two or three gentlemen, and ultimately an arrangement was come to by which the various conflicting interests were reconciled, and the different patents connected with the Bessemer and the Kelly processes consolidated and vested in trustees. Later on, the ownership of these patents was transferred to the Pneumatic Steel Association, and eventually they became the property of the Bessemer Steel Company, Limited. Under these arrangements the extension of the manufacture of Bessemer steel was rapid, and attention was soon directed to the rolling of the metal into rails. The first of these were made in May 1865, but they were only an experimental lot. In 1867, however, the Cambria Iron Company commenced the manufacture of steel rails to order. Last year the United States possessed thirteen Bessemer works, employing thirty converters, to which five more were in course of being added; while there were two new works in process of construction, which, when completed, would increase the number of Bessemer converters in America to thirty-nine. The following table shows the stages by which the production of Bessemer steel rails in the States has advanced, the weight being given in net tons of 2000 lb. each:—

Year.	Tons.	Year.	Tons.
1867 ..	2,550	1874 ..	144,944
1868 ..	7,225	1875 ..	290,863
1869 ..	9,650	1876 ..	412,461
1870 ..	34,000	1877 ..	432,169
1871 ..	38,250	1878 ..	550,398
1872 ..	94,070	1879 ..	683,964
1873 ..	129,015	1880 ..	954,460

The manufacture of steel by the open-hearth or Siemens-Martin process has also become extensively established in the United States, the expansion of this branch of the industry having been particularly rapid of late years. The first Siemens-Martin furnace which was erected in the States was put into operation in December 1868, but by 1874 the quantity of ingots produced throughout the country amounted to only 7000 tons; by 1877 it had increased to 25,031 tons; in 1879 the output was 56,290 tons; while in 1880 the trade received such an enormous impetus that the production increased to 112,053 tons. The number of open-hearth furnaces in the United States at this period was thirty-seven. In that country, as at home here, they are found very useful adjuncts to the Bessemer works, from their peculiar adaptation for the utilisation of the crop-ends of rails and other scrap which accumulates about the former, but we are unable to trace in what form their produce is most extensively used. The quantity of open hearth steel manufactured into rails would appear to be but small, while, owing to the contracted nature of the shipbuilding industry in America, there cannot be anything like the demand for steel plates which exists in this country. Another industry which consumes no inconsiderable quantity of steel made by this process in Great Britain, viz., tinplate manufacture, may be regarded as wholly wanting in the United States.

In 1880 the United States ranked as the second largest iron-producing country of the world, being outdistanced only by Great Britain. Of the 17,688,596 tons of pig-iron which were made throughout the world that year, Great Britain produced 7,749,233 tons, and America 3,835,191 tons; while, according to Mr. Swank, the latter country stood first in the manufacture of Bessemer steel, having turned out 1,074,262 tons, against 1,044,382 tons made by the mother country. Owing, however, to the greater quantities of other kinds of steel produced here, the total steel manufacture of this country was in excess of that of the United States, or 1,415,382 tons against 1,247,335 tons. The estimated world's production of steel was 4,343,719 tons, so that Great Britain made almost 33 per cent. and the United States almost 29 per cent. of the whole quantity manufactured. In considering these figures there is one significant fact which ought to be borne in mind, and that is that the exports of iron and steel from the United States are virtually *nil*, and that the whole of their large production, to say nothing of the quantity imported, is consumed by the country itself. There is no parallel to this in the world. Considering the imposts which the ultimate consumers have to bear in the shape of the greatly increased cost on account of the high duties, we wonder more than ever at the remarkable prosperity which has rendered such a state of things possible. It is not a little curious, however, to find Mr. Swank lamenting the additional cost entailed by the great distances which the finished goods have often to be transported before they reach the consumer, as well as by the distances which sometimes separate the raw materials, while he totally ignores the much more serious tax upon the resources of the country which the high tariff forms. In themselves the rates of freight compare very favourably with the charges of the railways in this country, and even if they were much more onerous, the manufacturers could well afford to bear them in consideration of the bounty which, in reality, the high protective duties levied puts into their pockets. One or two dollars extra freight on the raw materials is not of much consequence when they are able to obtain some twenty eight dollars more for their products than would be the case did the United States admit foreign iron and steel manufactures free of duty.

* See *antè*, pages 97 and 201.

IRON TRADE SUMMARY.

THE tone of the English iron market continues very firm, and the satisfactory though gradual improvement to which we have had to refer for some weeks past has been fully maintained since our last report. Pig-iron has been better than for a little time back, and the reaction caused by the collapse of the agreement between the Scotch and the Cleveland ironmasters appears to have given way to a much more hopeful feeling. In Glasgow prices have been a good deal firmer, and the closing quotations for the week are about 1s. 3d. per ton above those of the previous Wednesday. The improvement would seem to be due to an increased demand, and also, in a measure, to the fear that the production may be interfered with by strikes, as the workmen are agitating for higher wages. At Middlesbrough the feeling has also been considerably better, partly in sympathy with the Scotch market, and partly owing to the continued large shipments from the district, which it is supposed will cause a reduction to be shown in the stocks when the next returns are issued. Up to Tuesday last the total quantity of pig-iron shipped from Middlesbrough this month amounted to 84,196 tons, against 78,971 tons during a similar period in August. Prices also show a slight advance, but not to the same extent as at Glasgow. From Cumberland we receive very encouraging reports, hematite pig-iron meeting with a ready sale where makers are disposed to enter into fresh contracts. The Continent is taking a large proportion of the iron exported from this district and from Lancashire. Prices of hematite remain very firm, and there are not wanting indications of an improvement in the near future. Steel rails are being largely turned out, and the mills find full employment. Although the end of the quarter is close at hand, business at Sheffield presents a very encouraging appearance, and there have been heavy orders booked in the cutlery line, although the troubled state of affairs in the East has checked almost all business with that quarter. The steel rail trade presents an exceptionally dull appearance in this district, as makers are evidently unable to compete with more favoured localities, but there are signs of a better state of matters even here for the future. In other branches of the Bessemer steel trade in Sheffield things are in a much better condition, while good qualities of iron are in demand. On the Tyne, manufactured iron is rather weaker, the powers of production having been so greatly increased that the consumption can hardly keep pace with it, but prices show no material alteration since last week. The engineering trades are better off, and so are the minor branches of the iron industry. Some additional furnaces have been blown in in the East Worcestershire district, where local pig-iron is in good demand, and considerable quantities of foreign stuff are being brought from other localities. The nail trade is looking better, on account of government orders recently received. From Derbyshire encouraging accounts come to hand, while in South Staffordshire a very marked improvement is to be noticed. Buyers complain of difficulty in obtaining prompt execution of their orders for sheets, which have risen some 5s. during the month, and in the hardware line matters continue in a very promising state. In Leeds and West Yorkshire there is not much change to report, although an improved demand is noticeable in some lines. Reports from Lancashire indicate that the better feeling is experienced there also, although the local engineering trade does not partake of the improvement; but waggon and railway carriage builders are receiving good orders. The steel rail trade in Wales maintains the improvement already noted, and prices are inclining upwards, while in bar iron there has been a very substantial rise from the lowest point touched during the summer. Crude iron in the Forest of Dean is hardening on account of the reduction which is taking place in stocks. Tinplates are fairly active, but the much-desired rise in values is slow to come, while the increasing dearness of the raw materials is making the cost of manufacture more. The coal trade generally continues active, while still higher prices are anticipated, and these will certainly be seen if the men persist in their demand for higher wages.

THE VORTEX TURBINE.

WE recently had occasion in our report of the Royal Show at Reading, to notice the Vortex Turbine, and we now purpose placing full particulars before our readers. This useful motor was invented some years since by Professor James Thomson, and it is now in extensive use in practice on falls, ranging from 3 feet to 400 feet. The vortex consists of a movable wheel with radiating vanes, which revolves upon a pivot, and is surrounded by an annular case, closed externally, but having towards its external circumference four curved guide-passages. The water is admitted by one or more pipes to this case, and issuing through the guide-passages acts against the vanes of the wheel, which is thus driven round at a velocity depending on the height of the fall. The water having expended its force, passes out at the centre both above and below the case. Amongst the numerous purposes to which the Vortex Turbine has been adapted by its manufacturers, Messrs. Gilbert Gilkes and Co., of the Canal Iron Works, Kendal, the most recent is that of driving dynamo machines for electric lighting. One of the first to adopt this turbine for that purpose, was Sir William Armstrong, the current for the electric light in his house at Craigside being produced by the aid

THE VORTEX TURBINE.

By MESSRS. GILBERT GILKES AND CO., KENDAL.

(*For description, see page 263.*)

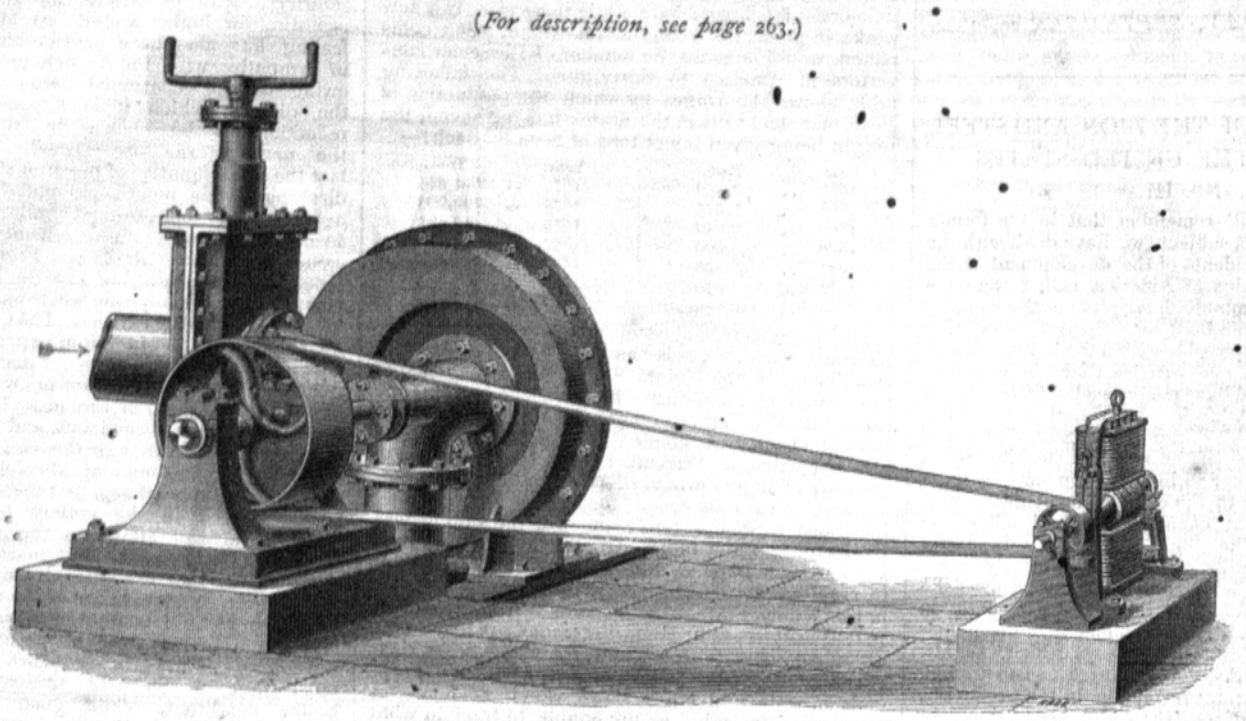


Fig. 1.

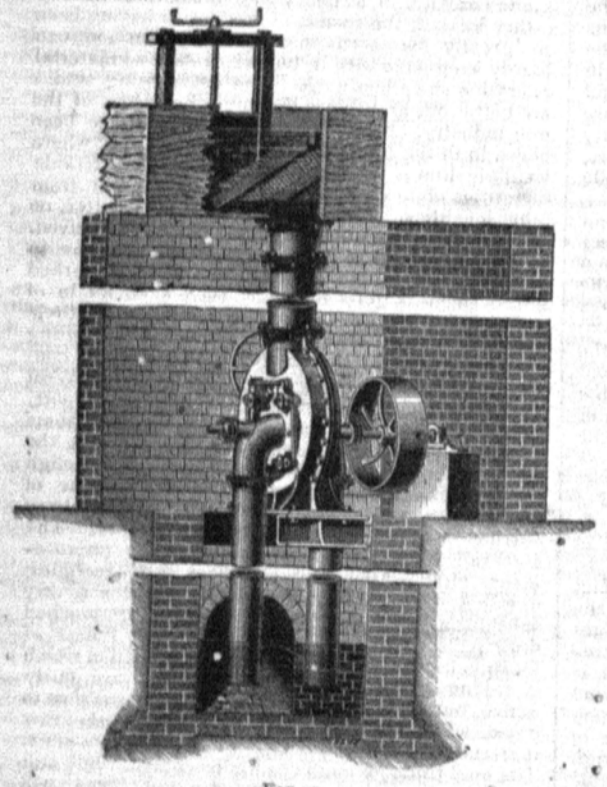


Fig. 2.

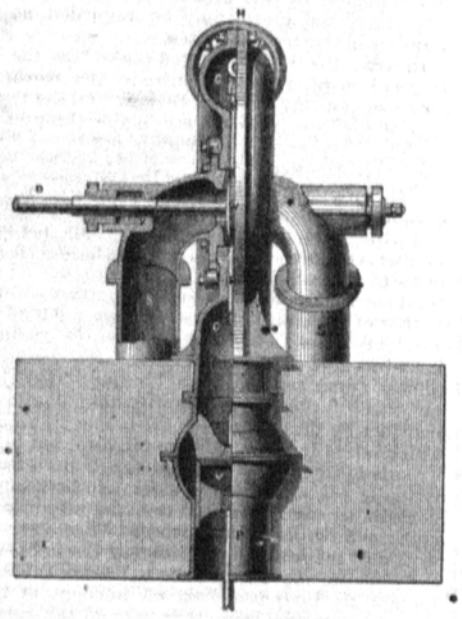


Fig. 3.

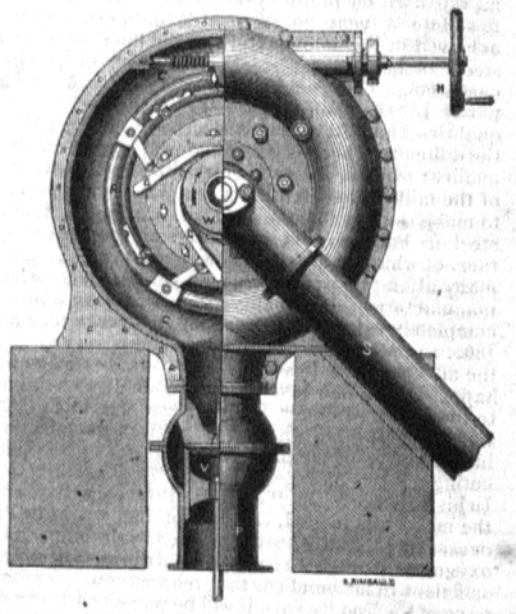


Fig. 4.

of a vortex machine. An arrangement for this purpose is illustrated in fig. 1 of our engravings. The Vortex Turbine is there shown applied to a small dynamo machine. By means of suction pipes continued below the level of the revolving wheel, the turbine can be placed at any height—up to 25 feet—above the level of the tail water, the full height of the fall being utilised with the same certainty and effect as if the wheel were placed horizontally at the bottom of the fall. All bevel gear is dispensed with, and the dynamo machine can be driven direct from a pulley on the turbine spindle. When the fall is a high one, the speed of the vortex wheel can be made identical with that required for the spindle of the dynamo machine, and if coupled to it on the same line, it is found that all loss in the transmission of the power is avoided. In fig. 2 of our engravings the position of the turbine is more fully illustrated. The vortex is shown in a vertical position, as in fig. 1, and it may be thus placed at any height not exceeding 25 feet above the tail-water. The water, after it leaves the vortex, passes by two pipes into the tail-race, and by suction in these pipes the fall below the wheel is utilised. The vortex stands upon two beams placed across the pit or well leading to the tail-race. The shaft is horizontal, and passes through stuffing-boxes in the bends of the suction pipes. The power is taken from the pulley which is shown upon this shaft. It may be observed that it is not necessary that the supply pipes should be vertical. They may be brought at any convenient angle and enter the case at the side.

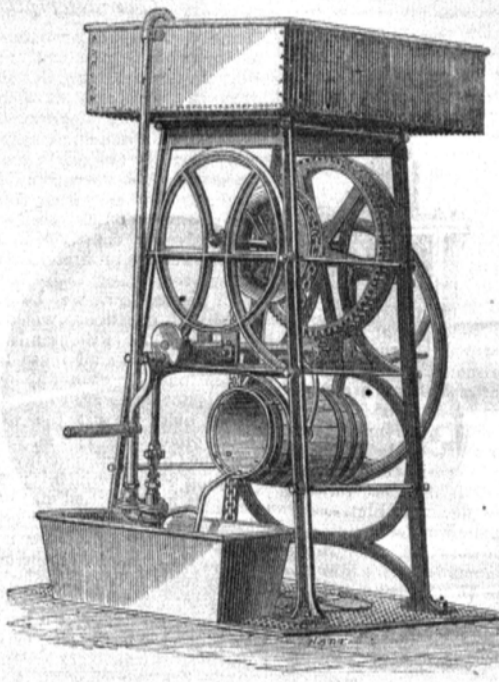
Proceeding to larger examples of this motor, we now refer our readers to figs. 3 and 4, which represent respectively end and side views in part section of a vortex turbine of 60 horse power for a fall of 250 feet. To resist the great pressure of this column of water, the case of the vortex is made very strong, and is held together by an extra number of bolts round the circumference, and by tie-bolts within, the latter being so placed as to avoid obstruction to the water. The channels formed by the guide-blades being of very small area, and the water moving through their narrowest parts with a velocity of upwards of 80 feet per second, it is desirable that the surfaces exposed to it should be perfectly smooth, and in order that corrosion may not take place, the interior of the guide-blade chamber and the guide-blades are made of brass. The vanes and covers of the revolving wheel are also of sheet-brass, fixed upon a tinned wrought iron centre or boss-plate. It will be seen that the vortex is placed upon foundation stones, and stands within the mill. The supply pipe P passes under the floor, and the water enters at the bottom of the vortex case. V is an equilibrium sluice-valve, which is worked by a rod passing out below, and is intended to shut off the water. C is the supply-chamber or exterior case, from which the water is conveyed to the guide-blade chamber, GG are the guide-blades forming the channels by which the water enters the wheel. These guide-blades are movable, and are connected by links near their outer ends with a ring R. The ring when moved round gives motion to the guide-blades, and thus the entrance orifices at their points are varied as required. The ring is worked by a screw and nut from the hand-wheel H outside the case, the connecting spindle passing through a stuffing-box, which prevents the escape of any water. W is the revolving wheel, keyed upon the shaft D, from which the power is applied; this shaft passes through a stuffing-box in the suction bend-pipe on one side, whilst on the other side is an adjusting screw for preventing end motion of the shaft. SS are the suction-pipes which take the water from the central orifices of the wheel into the tail-race.

We may observe that the Vortex Turbine possesses important practical advantages peculiar to itself, and has a high degree of efficiency. In any application of water-power, there are certain losses of effect which are unavoidable; but in the vortex, by various improved arrangements and adaptations, the amount of these losses is materially reduced. The power is obtained with a slower velocity of the water than in ordinary turbines. This is effected by a peculiar balancing of the centrifugal force of the water in the revolving wheel against the pressure due to half the

head, so that only one-half of the fall or head is employed in giving velocity to the water, the other half acting simply in the condition of fluid pressure. Hence the velocity of the water in no part of its course exceeds that due to one-half of the fall, and the loss from fluid friction and agitation of the water is thus materially less than in turbines where the water requires to act at much higher velocities. From the principles of injection of the water from without towards the centre, which is adopted in the vortex, there results another saving of effect, since it admits of the use of long and well-formed channels, by which the water is made gradually and regularly to converge in passing from the outer chamber (where it is comparatively at rest) to the point of entrance to the wheel-chamber, where its velocity should be greatest. Further, from the same principle of injection towards the centre, there is an accordance between the velocities of all parts of the moving wheel and the proper velocities of the water in its passage between the points of entrance and discharge. The water when it has its greatest velocity is admitted to the circumference of the wheel, which is the most rapidly moving part, and when it is, as far as possible, deprived of its velocity, leaves at the central part of the wheel, which has the least motion. The water enters from the guide-passages, with the velocity at which the outer circumference of the wheel is moving and without change of direction, so that there is no loss from impact. The steadiness and regularity of the motion of the vortex are remarkable, consequent upon the action of the centrifugal force of the water, which on any increase in the velocity of the revolving wheel, increases, and so checks the supply entering from the guide-passages; and on any diminution of the velocity of the wheel, diminishes and admits the water more freely; thus counteracting, in a great degree, the irregularities of speed arising from variations in the work to be performed.

DOUBLE-ACTION WELL MACHINERY.

(*For description, see page 274.*)



MEETING OF THE IRON AND STEEL INSTITUTE AT VIENNA.

THE proceedings were resumed on Wednesday, about half-past nine, in the hall of the Ingenieur- und Architekten-Verein, the acoustic properties of which are perfect. Mr. I. Lowthian Bell again occupied the chair, being supported by Mr. Windsor Richards, of Middlesbrough; Mr. Snelus, of Workington; Mr. Daniel Adamson, Mr. James Kitson, jun., Mr. Wm. Whitworth, Mr. Horton, and Mr. J. S. Jeans, the general secretary.

Dr. Hermann Wedding, Geheimer Bergrath, of Berlin, read an English translation of his paper on "The Royal Prussian Institutes for Testing Materials," which is as follows:—

THE ROYAL PRUSSIAN INSTITUTES FOR TESTING MATERIALS OF CONSTRUCTION AT BERLIN.

The controversies between the claims of producers and consumers of manufactured products are in no case more severe, than in that of the materials of construction, even should there be no doubt as to the existence of the best and most honest purpose on both sides.

The producer will always choose the cheapest and best mode of manufacturing in order to get a material which answers the purpose of its application, whilst the consumer, who mostly bears a considerable responsibility for the safety of the public, is indifferent to the method of production, and only cares that the quality of the material be equal to all requirements, even under the most unexpected conditions.

It has therefore always been necessary, to make a compromise between the two parties, which enables the producer to employ rational processes and gives to the consumer a full warrant for all probable requirements. On the basis of such a compromise, all conditions concerning the delivery of materials for purposes of construction are founded, and on the same principles prices are also calculated and arranged.

It would be easy to judge whether the conditions which are thus imposed are fulfilled, if every single piece could be tested for its purpose. If, for example, a tire were not accepted until it had run over 75,000 kilom., nor a rail until it had been used for ten years, nor bridge-iron before it had been in use for 30 years, nor an armour plate until the enemy had bombarded it without success nor a brick until the whole weight of a house had rested on it, it would only be necessary in all these cases to agree on the mode of payment; but because any system of that kind is impossible, and in no case more than for materials of construction, a different method of examination must be sought for.

If a tire gives way, or a rail breaks, or a bridge-girder tears, or an armour plate is shot to pieces, or a brick-wall crumbles, damage is done which can be compensated by payment or repair, but hundreds of lives may be lost through.

Hence it is absolutely necessary to find a means of obtaining a certain judgment on a large quantity of articles or materials by the test of a single piece, or even only parts of single pieces, supposing that the method of production was quite the same for the whole bulk.

It is clear that those tests mostly have only to prove that the mechanical qualities of materials of construction respond to the requirements which are imposed upon them in a practical use; for it is rare in practice, as, for example, with tanks for acid water, that the chemical quality is considered; but it is of the greatest interest to the producer, who makes the material by chemical processes to know how far the chemical constitution influences its mechanical properties, and so to be certain that if a piece of a certain chemical composition answers the test imposed by the consumer, all others of the same chemical composition will do the same.

These circumstances furnish the reason why, during the last ten years, institutes have been established which examine all such questions and give final decisions in cases of doubt or difficulty. It is clear that such institutes can only be properly controlled by government, for then only is there a guarantee of entire impartiality and disinterestedness, and an assurance that in each test the interests of the producing and the consuming parties are equally regarded; and there can be no doubt that it is right to make a certain, if only a very small part of the general taxes of the people pay for the expense of tests which are undertaken for the general welfare.

As I myself, more than ten years ago, influenced by the excellent investigations of Mr. Wöhler, gave the first impulse to the erection of state institutes for testing materials, I may state, that at the outset I found a very unfavourable field to work in. At that time, it will be remembered, there reigned with us the principle of the abstention of government from any interference with the iron and steel industries, then enjoying the full flood of prosperity. These then could dictate the conditions of contracts and affected to see in the proposed examination of materials an encroachment on their rights.

Now-a-days these relations are quite changed. The system of protective duties, meanwhile introduced, has in itself the character of a state aid; the increasingly depressed state of trade obliged the producers to come to terms with the consumers; but the greater understanding of the latter as regards processes of manufacture made them use their powers within proper limits, and the consequence has been a gradual compromise; this was essentially promoted by the transference of railways to the hands of the government, by the introduction of the manufacture of armour plates into the country and by similar changes, which have finally brought about an acknowledgement of the necessity for accurate experiments by state institutes.

The elements for the establishment of these institutes so far as they already existed were then organised and their constitution was laid down by the law of January 23, 1880.

At the present time, three such institutes are in existence, two of them being occupied with mechanical, and one with chemical tests.

The institute for mechanical tests has the duty of examining the strength of iron and other metals, timber, &c.; the institute for the testing of building materials has the same duty for bricks, cement, lime, &c; while the chemical institute makes assays and analyses in both directions.

The separate apartments are managed by directors* who again are superintended by a commission under the presidency of the Under Secretary of State for trade and commerce, viz. the head of that department whose duties are devoted to the equable†, development of all branches of industry. Two technical members of the ministry of public works, for the department for mines, smelting works, and salt-works‡, and the department of railways and architecture‖ represent producers and consumers respectively; the third member is deputed by the ministry of culture §, as the authority for technical education

The superintendents have full freedom in the carrying out of the experiments, whilst the commission preserves the harmony of the three institutes, and gives impulse and direction to them.

It may be well not to forget here, that the well-known Association for the Development of Industry¶ has essentially supported the commission by indicating the proper direction of the work to be undertaken.

Regarding the work of the institutes, two groups may be distinguished, the first of which embraces the tests ordered by the state authorities or by private individuals. These are made on payment, and to a great extent cover the cost of carrying on the institutes.

Work of this character cannot be dispensed with. Its value seems at the first blush only to extend to the individual person ordering it, and it might seem to some as if this labour would be better done if left to private enterprise; but bye and bye a system is built up out of the thousands of results, which is of the greatest value in solving problems of general interest, and which can be attained in no other way.

The second group embraces the examination of whole series of assays for the purpose of solving the question, how the quality of the whole bulk can be ascertained with sufficient reliability from the examination of a small part of a material.

It embraces, therefore, experiments which are not connected with single cases of ordinary practice. The results here obtained fill up the voids, which inevitably remain in the results of the first group and give the scientific connection between the methods of production and the quality shown in use, a connection which really is the great end and aim of the institute.

In the prosecution of these series of experiments really consists the most important work of the commission

In the last-mentioned direction, the work done can be ranged under the following four divisions.

1. What must be the condition of the sample to allow of a true conclusion as to the nature of the material from which it is taken?

2. In what manner must the sample be tested, in order to give a result which is, under given circumstances, always certain?

3. In what connection does the chemical constitution stand to the mechanical qualities, and what is relation of the different mechanical qualities amongst each other?

4. What differences, chemical as well as mechanical, are found in the qualities of test pieces of a material, which in practice has not met the demands of the consumer.

I. CONDITION OF SAMPLES.

The delivery of good samples is necessary, to permit of true conclusions from the results of the tests. The acknowledgement of this principle has led to detailed specifications, which will be found in an appendix.

As regards the samples for chemical examination particularly, care in selecting them stands in the first place and therefore the delivery of larger pieces is demanded, as well as if powdered average samples, so that the latter may be checked as far as possible.

The judicious selection of samples from such pieces, the mechanical qualities of which can be judged of only by their chemical composition is of the greatest importance; as an instance: armour plates often show a difference of chemical composition in the second decimal, accompanied by an essential difference in their resistance to the action of projectiles.

It is clear that the smallest remainder of gunpowder in a shot hole whence the sample is taken, gives an essential difference in the content of carbon, not to speak of the smallest particle of straw.

The surest way is always to take the sample, if it cannot be done in the institute, under the survey of an officer of the institute.

In quite another direction the selection of samples for the testing of resistance, &c., is difficult.

It is true that under equal circumstances the dimension of the cross section of a sample has only a small influence on the tensile strength, the contraction, and the elongation; but the great difficulty lies in the creating of such equal circumstances. The ingot iron, or steel, which is at present mostly used for purposes of construction, frequently shows blisters, which interfere with the homogeneity of the material, and the same material, if produced with the addition of spiegeleisen or ferro-manganese, and not very carefully mixed, shows even greater want of homogeneity than welded or puddled iron.

The producers of railway-material have, with good right,

*Chemical Institute Prof. Dr. Finkener, Building materials Dr. Böhme, Mechanical Institute now the same, formerly Professor Spangenberg, now deceased.
† Unterstaats-Secretär Dr. v. Müller.
‡ The Author.
§ Geheimer Ober-Baurath Schwedler.
‖ Geheimer Ober-Regierungsrath Dr. Wehrenpfennig.
¶ Verein zur Beförderung des Gewerbefleisses zu Berlin.

opposed stipulations which are founded on a system of sampling the very foundation of which seems so uncertain, that two pieces of iron taken from the immediate neighbourhood of each other in the same bar give quite different results.

It may be remarked that in this direction the transition of the Prussian railways from private control to the hands of the government has produced a favourable influence, the great majority of Boards of Railway Directions having thus agreed upon the conditions which should be adopted in specifying for the delivery of railway material.

Notwithstanding this agreement, however, there have still been many differences to reconcile in the dimensions of the specimens adopted for the purposes of tests, and the Royal Commission for the control of the institutes therefore, have carefully considered the best forms of specimens suitable for testing, and have arrived, with the aid of a commission of experts appointed by the German railway association,* at specifications which are now examined by the Royal Railway Board in pursuance of an order of the Minister of Public Works. The dimensions specified will be found in the table attached hereto.

It is hardly necessary to observe that the manner in which the iron out of which the samples are taken has been worked is also a matter of vital importance, as the beautful experiments of Mr. Brauns, of Dortmund, show conclusively. These experiments prove that a smaller contraction results from a more thorough working of the iron in consequence of which two pieces of iron, alike in chemical composition may give quite different results on being tested with reference to their tenacity. The experience gained on this subject ought to have an important influence on the work of the institute dealing with the mechanical tests.

With regard to the samples of building materials in compact pieces, the perfect parallelism of the surfaces, which are pressed, is the principal condition demanded, and, if not so delivered, grinding with diamonds in the institute itself is resorted to. The necessary size of grain of powders, &c., is easily provided for in the institute.

2. METHOD OF TESTING.

In all cases and in all the institutes the mode of testing the samples is such as to obtain results as certain as possible. The methods of analysis are therefore controlled continually in the Chemical Institute, and these, as well as the apparatus employed, are corrected and improved as occasion arises. The sources of errors, as well as their possible extent, are determined accurately.

The determination of single elements, such as carbon, phosphorus, sulphur, &c., is improved in different directions, and the superintendent of the institute, Professor Dr. Finkener, has, with indefatigable zeal, found out the smallest sources of error.

The cost of apparatus and of re-agents is not of much importance, but it is necessary, to seek for methods which enable determinations to be made with sufficient quickness to keep abreast of the requirements of practice.

Referring to mechanical testing, the first care is, that the machinery, which is used for the determination of tensile strength, contraction, and elongation be in itself sufficiently accurate to exclude any liability to errors, and particularly that the experiments are made under equal conditions. With these objects the machines employed (those of Werder and Wedding) are continually improved and perfected.

To make sure that the bars which are to be tested are accurately held in position, Dr. Böhme has introduced couplings by the use of which the strain must take the difection of the axis of the bar; models and drawings of them are shown. The weight is applied equally and the time of the trial is regulated; apparatus designed to furnish self-registered diagrams, are in course of construction, after the system of Prof. Tetmajer of Zurich.

In the testing of building materials, the method of examing cements is brought by Dr. Böhme to a high degree of exactitude—as a specimen of the form employed will show—so that different samples can be compared with certainty and it is thus easy for the consumer to give well-defined specifications to the producer and to ascertain whether a cement suffices for his requirements.

3. CONNECTION BETWEEN THE CHEMICAL AND MECHANICAL QUALITIES AND THE RELATIONS OF THE LATTER.

If the solution of the two first named questions is, on the whole, empirical, the solution of the third question is based on more theoretical speculations.

It is, for instance, prescribed that an armour plate shall have a certain amount of carbon, not more than a certain amount of phosphorus, &c., but the practical requirement is its power of resisting the entrance of projectiles. It is prescribed that a rail shall show a certain measure of contraction or of elongation, but the business of the producer is to supply a rail which will bear ten years of constant use without breaking or bending or excessive wear.

These are seemingly quite different requirements, but numerous and careful examinations have demonstrated with certainty that a certain connection does exist, upon which such conditions for delivery can be based, and a method of manufacture can be found, which makes it possible, from the ascertained quality of small samples to draw a conclusion as to the quality of the bulk.

We are, however, far from certain as to a final conclusion. The question, for instance, whether it be better to stipulate, in addition to a certain tensile strength, the contraction or the elongation, or in the latter case, if it be not more just, to take as measure only a part of the elongation, can be answered at the hand of theory only after a large series of careful experiments, and an even more extended series of experiments is demanded by the problem of the connection between chemical constitution and tensile strength, contraction and elongation.

In this direction the institutes follow three methods. First: from all bars, &c., which show strikingly abnormal mechanical qualities, samples are taken, and preserved for analysis; secondly, examinations are made on the influence of single elements when the composition of the material is otherwise the same.

I may assume that you are aware of the experiments on the influence of manganese upon iron, made in consequence of the action of the Association for the Development of Industrial Progress in Germany.

Finally, and this brings us to the 4th class of researches, experiments are made on

4. DEVIATION FROM THE QUALITIES DEMANDED IN PRACTICE

in both a chemical and a mechanical direction, as for example, experiments on materials, which have not met all the requirements of practice, and have been broken, crushed, &c. In this field the Prussian Minister of Public Works deserves a great amount of credit, inasmuch as he has provided that all the departments of the government for the supervision of buildings, railways, mines, smelting and salt works shall be obliged to send to the institutes samples of materials which have failed in service, particularly should fatal accidents have been caused thereby, and also that in all cases, where doubts arise as to the suitability of certain materials for constructive purposes, that the institutes should act as arbitrators between the producer and the consumer.

In this manner, we hope, it will be possible to bring important questions, which are of great moment to the health and life of thousands of men, to a happy solution and finally to obviate all those terrible disasters, the causes of which too often cannot be investigated at all.

It is not necessary to mention that the duties enumerated do not quite exhaust the work of the Royal Institutes in every direction. You may know, for instance, that at the present time a series of investigations is in progress on the welding of iron, which is nearing a conclusion, while another series is being carried on to determine the conditions of the rusting of iron; it is, besides, very likely that other institutes will be affiliated to those now existing, in order to experiment, for example, on the construction of prime movers and other subjects of mechanical technology, on the qualities of lubricants, &c.

Above all things, it is necessary that the institutes should be protected from being used for advertising purposes. The certificates which are given, show therefore only the result, which is obtained with the sample examined, and no expression of opinion as to its quality or applicability is added. This must be formed by the public, by combining numerous results without the aid of the superintendents or the commissioners.

The constitution of the several institutes appears in the tables given in the appendix, from which you can also see the number of orders received and of experiments carried out, including as far as possible those made during the time when the institutes were not under the control of the government.

You will perhaps be disposed to speak of the work done as small, but you ought not to forget, that the institutes are young, and that they work fields which only a few years ago were quite undeveloped, and partly even a complete *terra incognita*.

In closing my paper and referring you for details to the appendix, I have only now to thank you, Mr. President, for the honour, which you have done me, or rather through me the Prussian Government, by desiring me to write this paper, and admitting it to your programme.

I could wish that the result might be the formation of an international commission of experts of all iron producing nations, who should agree upon the conditions which should everywhere be employed in testing materials of construction, and I should be happy, if you, Mr. President, would adopt that idea as a proposal emanating from the Iron and Steel Institute.

On the chairman inviting comments by the members, Professor Kennedy, of University College, London, said that he believed the principle of government regulation of testing, which was the one which Dr. Wedding described in so interesting a fashion, and advocated so ably, was not one suited for our country, where the relations of the government to trade were so different to those existing in Germany, and where there was not the justification for official interference which might perhaps be argued from the heavy protection existing in Germany. The gentlemen who formed the German commission on the subject, were very distinguished and in every respect highly capable, but then they personally would not superintend the actual experimental work, and there was no reason for supposing that the under officials who really did so, would be gentlemen of better standing or more experience, or less open to influence than those who undertook such work in this country. He believed that it was more importance who really conducted the experiments, than whose name only stood at the head of them. This was certainly the view of Mr. Kirkaldy, whose individual exertions had done far more to inaugurate the present system of testing than those of any other man, who, indeed, might be called the father of systematic testing. He (Professor Kennedy) believed that this view would be that of the majority in England.

As to the form of specimens, method of holding them, amount of finish given to them, and so forth, he said that, from the many thousand experiments he had made, he had come to the conclusion that as long as there was nothing distinctly irrational about the form, &c., then differences did not cause anything like the variation in result which necessarily accrued on account of the inevitable want of uniformity in the material. So it was quite possible to push these matters too far, unless, indeed, when the experiments had for their object something much more extended than the mean determination of limit of elasticity and breaking load, and contraction of area. In reference to the latter point, he had seen with great interest the collection of tested specimens shown by Bauschinger, at Nuremberg, just now. The way in which the contraction was influenced by slight inequalities in structure, or almost invisible defects, while the strength remained nearly unchanged, was very strikingly marked.

In conclusion, he expressed the great interest with which he had listened to Dr. Wedding's paper, and the indebtedness which all would feel to him for the valuable information he had given, and the concise way in which it was put. Whether or not we quite agreed with all his conclusions, we recognised the great value of the work he had done, and would certainly try to provide by his experience to the utmost possible extent.

Mr. Snelus, of Workington, considered Dr. Wedding's paper a very important one. He quite agreed with Professor Kennedy that considerable differences would be found in testing samples from the same bar or plate; it was, therefore, very necessary to draw deductions from a large number of tests. He was glad to find that Dr. Wedding proposed to couple with the mechanical testing investigations into the chemical composition. A neglect to do this was, he considered, a great drawback in the experiments of Mr. Kirkaldy, than whom no one could work more conscientiously, as he knew from experience that that gentleman personally superintended and recorded the results of his tests. Moreover, besides the mechanical tests and the chemical analysis, he thought it highly necessary to investigate all the chemical properties. The International Commission proposed by Dr. Wedding was a very good idea; and if a uniform length of sample as well as uniformity in conducting the operation of testing could be agreed upon, a great point would be gained.

Mr. Bauerman, of London, pointed out that there might not be so much difference between the results obtained by Professor Kirkaldy personally and by Dr. Wedding's assistants, because the latter would soon become expert at their work so as to do it in the same way; and then the same objection—if, indeed, there were one—would apply equally in both cases. He thought that valuable results might be obtained by the co-operation of well-trained crystallographers, and that uniformity in testing machines was desirable. He would ask Dr. Wedding if the new analytical methods he alluded to as being in use in the institution at Berlin were made public.

Mr. Daniel Adamson observed that testing should be divided into two principles, the permanent set, and the maximum carrying power, after which, the second series of considerations arise from the ductility of the metal, and the specimen indicating local elongation with considerable reduction of sectional area as elongation takes place.

Mr. Jeremiah Head said the question was whether tests should be carried out by the government, or by private persons who would devote themselves to the matter, and who alone would be responsible in the event of failure. This testing was a sore subject to producers generally. In England the tests were imposed by civil engineers, and varied so greatly as to favour the supposition that a considerable portion of those imposing them did not know, so well as the producers, the capabilities of the metal desired. It was very desirable that there should be some public testing-house in one form or another. Mr. Kirkaldy lately showed him various samples sent by engineers' inspectors to be tested that were highly unsuitable to the purpose, on account either of being defective, or of being badly cut. Indeed, he positively refused to test them, saying that the results would be unfair to the makers, and misleading to all concerned. It was perfectly natural that the producers of a material should know what that material would stand, and what it would not, better than those whose energies are chiefly directed to using it up; and no one had a greater interest than the producers of a material in having a place where it could be intelligently and honestly tested. At the same time he would not urge that this should be undertaken by the government, the English Government, at any rate, simply because it had shown itself scarcely able to keep pace with duties of a more important character. Let engineers state their requirements, asking the producers to supply a table of tests and results of analysis that they can readily fulfil. Besides, if producers can make different qualities, let them give an idea of what these are, and at what difference of price they can be produced. The engineers could then select from this table what qualities they desired, knowing that the tests could be practically fulfilled, so that the head draughtsman could work to them with confidence. Then, if the material should fail, the engineer can retort that they are the manufacturer's own tests that were applied; and a great source of bitterness between engineers and producers would cease. It was a valuable suggestion of the author of the paper that an international committee should be appointed, and, he asked, was not the Iron and Steel Institute as good a body as could be found for the purpose?

In support of his argument that iron and steel makers should be invited to specify their own tests rather than that they should be imposed by civil engineers, he would say that, if the specifications of the latter were often absurdly high and unreasonable in some respects, they were often ridiculously low and indefinite in others. For instance, there was nothing more important than the elastic limit. Iron was necessarily used within that limit; and it was, therefore, of the greatest importance that that limit should be high, or at any rate as high

* Verein für Eisenbahnkunde zu Berlin.

as possible consistently with the leaving of sufficient margin between it and the breaking limit to prevent any risk of sudden rupture. Nevertheless, it was rare for engineers to specify or take notice of the elastic limit. Again, although the extension was frequently specified, the length of the test piece within which it was to be ascertained was rarely fixed. It was well known that the main extension took place near the point of fracture; consequently, the results would differ according to the length of sample adopted. Again, the tensile strength, the extension and the contraction of area varied according to the work put upon the iron; and this in turn, varied with the amount of rolling in different directions, and with the thickness of the plate. It would differ greatly with different plates made in the same way but of different dimensions. Nevertheless, engineers usually required that a maker should undertake that all plates fulfil the same maximum tests, while at the same time he could not know the shape that would be specified for the plates. If a technical committee of the institute be appointed, they could take all these matters into consideration, and would be able to inform civil engineers what they might and what they might not expect. He would question the desirability of two great stringency in enforcing tests on any material used for constructive purposes. There were many purposes for which a low quality of material would answer every purpose; and it would be a great misfortune to the community if there were any obligation to use, and therefore pay for a higher quality of metal than that necessary for any given purpose. Thus, he attributed a great deal of the success of iron shipbuilding and ship owning in Great Britain to the fact that Lloyd's surveyors have not drawn too hard and fast a line. Practically, they accepted any iron that was good enough to pass the tests necessary for constructing the ship, knowing that if the material once passed these it would withstand any subsequent tests except collision or striking on a rock; and no material, of any quality whatever, was proof against such accidents. Had Lloyd's regulations been as stringent with respect to iron plates as they now are for those of steel, they could not possibly have been made for anything like the price at which they have hitherto been obtainable, and, with an advanced price of iron, the enormous development of shipbuilding and ship owning in Great Britain would have been impossible.

Dr. Wedding replied, in English, upon the discussion. Referring to one objection, he was far from discrediting, or wishing to detract from the importance of the researches of practical men; but he thought much better results would be arrived at by a public department of the government. If, for instance, a railway accident should happen, the company would hesitate to send broken parts and models to private individuals; and it was very important that railway companies should be obliged to send specimens to state institutions, to which the public attach greater importance than to private individuals, however eminent. Some of the speakers had observed that it was not necessary to have uniform dimensions of test pieces, and not to have the same testing machines; but he considered that there were sufficient difficulties attending the testing of metals by any one system of machinery, and that these need not be added to by using different systems. The state, therefore, should adopt one uniform system of machines. It was also impossible to obtain uniform results if uniform dimensions of test pieces be not agreed upon. To Mr. Bauerman, who asked if the methods of analysis and improvement adopted in Berlin were kept secret, he replied that this was by no means the case, and he would be very glad if members would go to Berlin and see the whole operation. One of the improvements was to exclude all sources of error in quantitative analysis for carbon, these sources of error arising from the carbonic acid gas due to any other source than the iron. He thanked the members for the interest they had taken in his paper, and sat down amid loud applause.

Mr. I. Lowthian Bell, in conveying the thanks of the meeting to Dr. Wedding for his paper, said, with regard to Mr. Adamson's observations as to testing, that that gentleman, so far from considering identity in the mode of procedure an advantage, he even thought it the reverse, because of the opportunity afforded of checking the results obtained by one method with those arrived at by another. If these observations applied to measurements, he was not prepared to agree with these views. It was very embarrassing for any one accustomed to read the tensile strain given in tons per square inch of sectional area, to have to consider this tensile strain expressed in kilogrammes as applied to square millimetres. It was therefore highly desirable that some uniformity should be arrived at for comparing results. The molecular structure of iron and steel was greatly affected by the mode, and also by the rate of cooling. Referring to the late Mr. Menelaus' opinion that rails were affected by continued percussion, Mr. Bell observed that the North Eastern Railway Company, with which he was connected, had regular analyses made of the rails taken up after long use, and registered the results, and he would be very happy to furnish data for comparison to any technical committee appointed by the institute.

The secretary then read a translation of M. Pourcel's paper on the "Manufacture of Solid Steel Castings," which is as follows:—

NOTES ON THE MANUFACTURE OF SOLID STEEL CASTINGS.

As is well known, the Terre-Noire process is being successfully applied in England, Sweden, and America. The studies still continued at Terre-Noire are now being directed to two points in the process—1. The manufacture of large castings. 2. The methods of annealing and tempering to be applied to the metal, in order to give it all the mechanical properties corresponding to its chemical composition. The end in view is the substitution of steel for cast iron in all pieces of mechanical construction. But the final solution of this problem is still a long way off. The production of castings of any form and of any dimensions in steel of a well-determined chemical composition, combining the resistance and rigidity of steel with the smooth surface and homogenity of iron castings, is a very complicated problem, and one which presents material difficulties of more than one kind. The last progressive step made at Terre-Noire is worthy of notice. An engineering firm in Paris required some cylinders of cast steel, having a diameter of 2·04 metres, and a height of rather more than 2 metres, with a uniform thickness of metal of 50 mm. These cylinders were to support an internal hydraulic pressure of forty-five atmospheres, without showing any sign of percolation. The annealed metal was to have a minimum resistance of 50 kilos. per square millimetre, and a minimum extension of 8 per cent. Of these cylinders six have already been cast. The external surfaces of the castings are quite as smooth as if made of cast iron, and yet the metal is comparatively soft. It contains on the average—carbon, 0·65 per cent.; manganese, 1·00 per cent. to 1·20 per cent.; and silicon, 0·25 per cent. to 0·30 per cent. It is, in fact, the quality demanded for rails by one of the French companies. The flanges of the cylinders, after turning, took a very fine polish, even at the gits, and were free from any defects. The metal is cast in moulds of loam, pierced with numerous holes to allow the gases to escape, and dried with great care. It is run in at the top of the mould, and not at the bottom, the time occupied in casting being less than two minutes. This particular point should be noticed. But it would not be out of place to ask my friend Mr. James Riley for some information on the manufacture of steel castings by the Terre-Noire process, which was introduced by him at the fine works at Hallside in 1878. In the hands of skilful and intelligent moulders such as the English, and in a works commanding such technical ability as those of Hallside, some progress must have been achieved in the manufacture of steel castings which would certainly be as interesting and valuable to the Iron and Steel Institute as the very modest details which I have just given. The second point upon which the experimental studies of Terre-Noire are being directed comprises the various methods of annealing and tempering, applied for the purpose of assuring the molecular transformation of the metal, and of establishing the equilibrium of the molecules of a casting of prescribed form, and consequently of enduing it with the highest mechanical qualities corresponding to the chemical composition of the metal. We have here to conquer difficulties, not only purely mechanical, but others which are inherent in the solution of every problem pertaining to the domain of physics. You may make lots of experiments and possess numerous results, but it would nevertheless be imprudent to formulate a law which would not be, as every physical law should be, the synthetical expression of the deductions obtained from a very large number of concordant facts. It may, however, be of interest to the Institute to learn the practical results obtained in what is considered an extremely delicate manufacture, that of hoops (frettes) for cannon. More than two years ago Terre-Noire supplied to the French Navy a considerable number of hoops for guns of 10 centimetres. To-day we are working on an order for hoops of the same type, the specifications for which are more severe. I am only speaking of round hoops, which are of the following dimensions:—

External diameter	..	360 millimetres.
Internal diameter	..	246 ,,
Thickness of metal	..	57 ,,
Height		265 ,,

These hoops are cut out of a round ingot of 385 mm. diameter, cast solid in an iron ingot mould, each ingot furnishing several hoops. The method followed in this class of manufacture is that illustrated at the Paris Exhibition, and consists in casting an ingot, having pretty nearly the external form of the finished casting, and then cutting out the surplus metal by means of powerful mechanical tools, in order to give the piece its definite form. In most cases, the rough casting would possess the dimensions of a rough forging; more metal is, however, generally left to be removed in the lathe. The metal in the head of the casting is of course not here taken into consideration. A hoop is chosen from each ingot, sometimes from the top, sometimes from the bottom, and sometimes from the middle, from which are taken the samples for drop and tensile tests. This test-hoop is given rather more height than the others, viz., 310 mm. instead of 265 mm. The test-hoops are treated in the same manner as all those of the cast to which they belong, *i.e.*, they are heated and tempered in oil according to a definite formula, and the test cylinder (rondelle d'essai), about 40 mm. high, is then cut in the lathe, and forwarded to the Government works, where it is prepared for and subjected to the drop and tensile tests, a summary of which follows. I will pass over the very minute tests to which each hoop is subjected, my wish being merely to place before you the intrinsic quality of the metal.

1. The bar to be subjected to the drop test is of square section, 30 mm. + 30 mm., and 180 mm. long. It is placed on two supports or knives 160 mm. apart; the anvil weighs 350 kilos. and the monkey 18 kilos. This bar must stand without breaking fifteen blows at least of an 18-kilo monkey falling from a height of 2·75 metres.

2. The bars to be subjected to tensile tests have a diameter of 13 mm. and a net length of 100 mm. The minimum conditions to be fulfilled are—

Limit of elasticity	..	30 kilos. per square millimetre.
Breaking strain	..	56 ,, ,, ,,
Extension measured after rupture	..	14 per cent.

Between two bars from the same hoop a variation of 6 kilos. per square millimetre is allowed in the limit of elasticity, and 7 kilos. in the breaking strain. The following table contains a certain number of results obtained at Terre-Noire with cast steel hoops made during the present year:*—

Nos.	L	R	a	$\frac{S}{S'}$	N	F
1.	39·4	66·0	16·6	0·74	24	31·0
2.	39·0	65·5	16·8	0·72	29	31·8
3.	41·8	67·5	15·6	0·715	29	31·4
4.	40·3	66·7	14·9	0·66	29	31·6
5.	36·1	61·7	17·9	0·55	29	32·8
6.	39·3	66·3	15·4	0·70	36	31·0
7.	37·2	63·6	18·3	0·56	34	32·0
9.	38·5	65·2	17·3	0·64	35	32·0
8.	38·0	64·8	20·1	0·52	45	31·8
10.	40·0	66·7	17·6	0·55	42	31·0
11.	38·9	65·1	18·1	0·54	41	31·7
12.	39·3	65·9	17·3	0·54	36	31·6
13.	40·8	68·0	13·2	0·68	45	31·0
14.	39·8	65·6	18·0	0·55	47	31·5
15.	38·3	64·5	17·2	0·53	36	33·0
16.	37·5	63·1	16·1	0·68	28	32·5
17.	37·4	62·6	14·9	0·64	26	33·0
18.	38·5	64·2	14·4	0·72	27	36·0
19.	37·9	63·0	16·7	0·52	42	?
20.	36·0	56·6	24·2	0·50	25	40·0

Each of these figures represents the mean of two tests, in which the differences observed in the limit of elasticity and the breaking strain varied from 0·1 kilo. per square millimetre to 1·6 kilo. Tests Nos. 9, 10, 11, 12 are those of hoops which had been tempered three times in oil. No. 13 has a somewhat low extension but a high breaking strain. A charge is occasionally produced giving a breaking strain of 70 kilos. or more, and an extension of less than 13 per cent. In this case the series of hoops to which this tested hoop belongs are again heated and tempered in oil at a temperature lower than that at which they were previously tempered. By this means the extension is considerably increased, without diminishing the breaking strain too much. On the other hand, when the breaking strain is too low and the extension high, the new tempering is effected at a higher temperature than the preceding one. In regular working, all the hoops are heated to a yellow oxidising colour (couleur du jaune oxydant), and at that temperature are plunged into a given weight of oil in the direction of their axes. They are allowed to cool in the oil, and are reheated at a temperature varying from bright cherry-red to a dull cherry colour, according to the chemical composition of the metal, and then tempered again in a bath of oil, in which they are allowed to cool. The first tempering transforms the crystalline grain of the metal into a fine homogeneous grain, the second determines the molecular equilibrium of the casting which corresponds to the chemical composition of the metal, and should be more or less intense, according as the metal contains more or less than 0·3 per cent. of carbon and 0·5 per cent. of manganese. The chemical composition of the metal suitable for this delicate manufacture is comprised between narrow limits. The carbon varies from 0·28 per cent. to 0·32 per cent., the manganese from 0·60 per cent. to 0·45 per cent. The sulphur can scarcely be detected, and the silicon is pretty nearly constant between 0·15 per cent. and 0·20 per cent. I have no wish to enter into any theoretical consideration of the tempering in oil. I will merely observe that the word tempering (trempe) which I use does not imply the idea of a hardening action; consequently, to speak more correctly, I should say immersion. Moreover, from a theoretical point of view, I share the opinion of my valued friend, Mr. Akerman. But when facts speak for themselves, any one is at liberty to draw his own conclusions in explanation thereof; that in no wise disturbs the facts. A more serious objection that might be taken, and to which no direct reply can be made except by well-established facts, is the question whether hoops of larger calibre, manufactured in the same way as the preceding, would yield equally good results. It may be admitted that hoops for guns of 42 centimetres can be made successfully by the Terre-Noire process, since the experiments made in 1878, specimens of which were shown at the Paris Exhibition, were perfectly successful. But can the methods of heating and immersion in oil, applied to hoops of 10 centimetres, be equally well applied to guns of greater calibre? I firmly believe that they can. In fact, when steel hoops or coils are forged under the steam-hammer, the hammers used for 42-centimetre coils are relatively much larger than those used for coils of smaller calibre. There is a greater expenditure of heat and mechanical force. Well, then, to effect the molecular transformation of a hoop of large calibre in cast steel, and to reduce its molecular condition to as perfect an equilibrium as possible, it is evident that two immersions in oil, under the conditions above mentioned, will not be sufficient. It will probably be found necessary to immerse them two or three times at a yellow oxidising heat, followed by one or two others at a lower temperature, either cherry red or dull cherry-red. A formula has to be determined for various thicknesses of metal, but the solution of this problem, I repeat, need frighten no one.

Here ends the short statement of the progress recently made at Terre-Noire in the manufacture of solid steel castings, and which the council of the Iron and Steel Institute have done me the honour of requesting me to write. This brief account, written with the diffidence of an author

* L represents the limit of elasticity.
R ,, the breaking strain.
a ,, the extension.
S being the original section, and
S′ the section after rupture, then
$\frac{S}{S'}$ represents the contraction.
N ,, the number of blows required to effect rupture by the drop test.
F represents the deflection in millimetres measured at the fifteenth blow.

N.B.—The contraction is usually estimated in England by $1 - \frac{S'}{S}$.

speaking of his own work, if it does not awaken the false idea that the days of the steam-hammer are numbered, at least serves again the important fact, that steel can acquire all its mechanical properties by other means than by hammering. I will not close my paper without risking a few words on the famous question of blowholes in steel, which remains, so to speak, a permanent order of the day in the proceedings of the Iron and Steel Institute. I mention, simply as a reminder, that solid soft steel castings are obtained by means of alloys of silicon, manganese, and iron, with a minimum of carbon. Alloys which fulfil that very essential condition of containing but a minimum of carbon, are those in which the silicon and manganese are found in the proportion of their chemical equivalents.* It is very difficult, if not impossible, to attain this with mathematical regularity. I have, however, succeeded, after numerous observations, starting with a burden calculated to a very great nicety, in producing these kinds of alloys of the desired formula, containing up to 13·5 per cent. of silicon and 18 per cent. of manganese. These alloys are added at a red heat to the bath of metal (Siemens-Martin process) immediately before casting. The process is, in fact, the same as obtains in the manufacture of soft metal with ferro-manganese. But the addition of ferro-manganese to a bath of soft metal is followed by a more or less violent reaction, accompanied by a disengagement of gas. With the addition of the alloy or silicide of manganese, on the contrary, the intermolecular reaction is calm. All ebullition is instantly arrested; the surface of the bath becomes quiet and no gas rises through the slag. It is universally admitted that the gas disengaged from a bath of metal in the middle of the refining period is carbonic oxide. Well, the addition of three or four thousandths of silicon, in the form of silicide of manganese and silicide of iron, is sufficient to instantly arrest this disengagement of carbonic oxide gas. The sample of metal taken before the addition of the silicon is full of blowholes; that taken after is compact and homogeneous. Is this a purely physical action? Is it a sufficient explanation to say that the silicon has determined the solution of the hydrogen in the metal? But, in any case, it is carbonic oxide that is evolved before the addition of the silicon, and little or no hydrogen, according as the manganese is present in small proportion in the bath of steel, or is entirely absent. What is the gas which is evolved in abundance from the moulds when the steel is on the point of solidifying? Sir Henry Bessemer answered that question nearly twenty years ago. It is carbonic oxide, or at least in a great measure. The experiments made at Denain in 1877 by M. Harmet, and others more recently by Mr. Stead, have confirmed this fact. The metal to which silicide of manganese has been added does not give off any carbonic oxide at the moment of solidification, but emits flames of hydrogen, which burn on the surface at the time of casting. These flames of hydrogen gas are more or less abundant in direct proportion to the percentage of manganese. But if the silicon is added in the form of silicide of iron and the steel contains only traces of manganese, there is no disengagement whatever of gas, no matter how hot the metal may be cast.

In both cases, however, a steel is obtained free from blowholes, compact and homogeneous. I wish to call attention to this phenomenon, because it seems to contradict the theory of blow-holes in steel enunciated by Professor Dr. Friedrich C. Müller, of Brandenburg. Dr. Müller, who by the rather severe manner in which he has treated, or, rather ill-treated, what he calls my carbonic oxide theory, has given my views a notoriety for which I cannot but thank him—affirms, as is already known, that the blow-holes are avoided by previously effecting the disengagement from the metal of the hydrogen gas which it holds in solution. Now in the example I am quoting, neither the metal which on solidifying emits hydrogen gas, nor that which does not, has any blowholes. This fact may be easily confirmed by any person who desires to do so, and has perhaps already been observed frequently in works, where the properties of silicon are applied to the manufacture of castings. Is it not also well known that the addition of silicon to the steel not only diminishes the solubility of hydrogen, but almost annuls it, when only traces of manganese are present? Thus we have several samples of steel containing the same quantity of carbon, the same quantity of silicon, *i.e.*, from 0·4 to 0·5 per cent., but in which the proportion of manganese varies between 0 and 2 per cent. All these samples of steel have a compact but crystalline grain, and their fractures do not reveal any apparent cavities. They contain, however, gas, both hydrogen and nitrogen. But, strange to say, the silicon steel with but traces of manganese only contains a very small volume of gas, in which the proportion of hydrogen is very limited; while steel with 0·5 per cent. of manganese contains a very considerable quantity, which goes on increasing in the other samples *pari passu* with the percentage of manganese, until we reach a steel with 2 per cent. of manganese, which contains the largest amount of gas, with the largest proportion of hydrogen. When I first called attention to these anomalies of the theory of the hydrogen blow-holes in steel, I was met with the objection that the samples of metal which I had tested were, if not honeycombed, at all events porous, and that steels carefully hammered, which are neither honeycombed nor porous, only yield infinitely small quantities of gas. My answer to this objection is the fact that, in the first place, a metal containing traces of manganese and made with silicide of iron yields no more gas than an ordinary hammered steel; and secondly, the not less important fact, that without having recourse to hammering, cast steels of the composition I have indicated do not yield more gas than hammered steels, when they have lost their crystallisation, and have been reduced by reheating and tempering in oil to a state of perfect molecular equilibrium. One would say, perhaps, that the metal acquires all its mechanical properties by losing the hydrogen which it contains in combination or solution. Metal made with silicide always remains brittle under drop tests, and gives but low extensions under tensile strain, with a low and variable breaking load. These bad qualities come to light in forging. The metal cracks under the blows of the hammer, whilst metal made with silicide of manganese behaves in a much more satisfactory manner. I will not refer to the explanation of this phenomenon, which I have given before. M. Gautier has repeated it very often at the meetings of the Institute. I should, however, wish to state that I have never offered the opinion that by intermolecular reaction silicon decomposes carbonic oxide gas, to give rise to free carbon. Mr. Windsor Richards has already been good enough to re-establish the truth on the subject, and to explain my opinion, which has never varied, viz., "that in the presence of silicon no reaction is possible between carbide of iron and oxide of iron; it is the silicon which is oxidised, and carbonic oxide cannot be formed; and it is a silicate that is the result of the intermolecular reaction." That is what I stated. I will now close my plea of extenuating circumstances in favour of hydrogen. Dr. Müller, in his researches as to the causes which give rise to blow-holes in steel has drawn a purely judicial conclusion. He found hydrogen in the ingots which he tested, therefore "Is fecit cui prodest." Hydrogen is the culprit; hydrogen causes the blowholes. But is it proved that the proportion of hydrogen increases with the blowholes? Not yet. On the contrary, solid steel contains sometimes as much hydrogen as if it were riddled with the blow-holes. And how about the nitrogen? It is innocent. As for carbonic oxide, an *alibi* is pleaded. It certainly exists in the molten steel, and it is again met with when the steel solidifies, and in great abundance when the metal boils in the ingot moulds. Then it disappears. It is not again discovered in the ingot; therefore it is innocent of the blow-holes found in the steel. I believe, however, that this judgment is subject to revision.

* Taking the equivalent of oxygen, according to the old scale, at 100, and silica = SiO_3.

When the reading of M. Pourcel's paper had been concluded, the time had arrived for the members to leave for the excursion to the top of the Kalenberg, on the invitation of the city of Vienna. They were therefore conveyed to the steamboat pier, where they embarked on board two steamers, and proceeded through the Danube Canal to the Danube, where the two parties were transferred to a large saloon steamer. The Bürgermeister and the chief officers of the city of Vienna accompanied the party, which were conveyed over the newly-regulated Danube to Nussdorf, where they landed. From thence they proceeded by the mountain railway to the top of the Kalenberg. The line is constructed, like that of the Rigi, on the rack and pinion system, a cogwheel working into a central toothed rail. The railway ascends on gradients varying from 1 in 10 to 1 in 20, and is three miles and a quarter in length. The summit, which is at an elevation of 1400 feet above ground level, was reached in about half an hour, and from it an extensive view of Vienna and the surrounding country was obtained. Arrived at the top, the visitors partook of the hospitality of the city of Vienna, luncheon being provided in the Kalenberg Hotel. The party returned to the city by rail and boat after a most enjoyable excursion. A military band accompanied the visitors to add from the Kalenberg.

Thursday.

The business of Thursday was commenced by Mr. Bell, who again occupied the chair, announcing several invitations to visit different institutions in Vienna, and also the arrival of a telegram from Mr Samuelson, conveying his thanks for his election as president for the ensuing year.

Mr. Windsor Richards, in opening the discussion on M. Pourcel's paper on the manufacture of solid steel ingots read the previous day, said he would be glad to know how that gentleman got off the gas. He then proceeded to describe an experiment of his own in this connection, which proved that the hydrogen was due to the decomposition of water. He suspected there was something wrong in the system of testing, and would like to know how M. Pourcel avoided a similar error. Solid steel ingots were due to accidental discovery; but all honour was due to M. Pourcel for throwing more light upon the matter.

Mr. Snelus said this subject was one of the utmost importance, as every Bessemer manager knew the difficulty of ensuring the steel's setting quietly in the mould. Sometimes it would lie still, but at others it would boil over; and then a cover and wedge were required. It was found that when the steel boiled over, the ingot was more honeycombed than when the metal was dead. He knew M. Pourcel's process, but had not yet been able to apply it invariably to rail ingots, although he had been able to do so in the case of special steel castings. M. Pourcel's theory as to the cause of unsound steel was accepted by the members, it being quite correct that the carbide of iron does not suffer decomposition. That gas was assuredly dissolved in steel just as carbonic acid gas is in champagne; and means must be taken to prevent this gas, which is developed in the metal, from forming a spongy mass. He was interested to hear Mr. Windsor Richards' explanations, and was glad to find that the gas comes from the water and not from the steel. There was little difficulty in making sound castings while adopting M. Pourcel's process; but there was a difficulty with the ordinary Bessemer practice.

Mr. Webb, of Crewe, had lately been making a number of steel castings of the same shape as ordinary castings, including some waggon wheels cast on a revolving turn-table, so as to make the castings sound by driving off the gases by centrifugal action. They were as clean as could be desired; and, when turned on the rim, showed themselves to be perfectly sound. For castings from the Siemens-Martin furnace, siliceous pig from Dowlais was used; but now they were getting ferro-manganese with more silicon, and hoped to obtain better results. He said he would be happy to show members the process as carried out at Crewe; and, in reply to a question, said that the spoke wheel was the type adopted. He hoped shortly to be able to cast the tire on, and when that was worn turn it off and shrink a separate one on. The skin of the castings was quite as smooth as if they were cast of iron.

Professor Chandler Roberts said it was admitted that the question of the occlusion of gas by metal was of the most vital importance, and it is very remarkable, therefore, that the evidence on which it rests has hitherto been so vague. The late Professor Graham showed that the gas occluded by iron, in preference to other gases, was carbonic oxide. He had always considered that the hydrogen found by Dr. Müller in his celebrated experiment, if it came from the iron, could be merely entangled and not occluded in the mass. It was true that iron can occlude hydrogen, but it gave it up again at a very low temperature. It seemed to him that the only method for ascertaining what was the amount and nature of the gas really occluded by the iron or steel consisted in heating the metal strongly in vacuo, and he believed that it was the amount of gas firmly held by the metal, as distinguished from that which was merely entangled, that exerts so marked an effect on its physical properties.

Dr. Wedding would state a few facts, which, he hoped, would tend to clear up the influence of silicon on carbonic oxide. Professor Finkener at Berlin had conducted some synthetical experiments, which showed that if pure iron, carbonic oxide and silicon were heated together, silicate of iron was obtained, and also carbon which unites with the iron, supposing there is less carbonic oxide than was necessary to saturate the iron with carbon, and no free carbon, as was the case in the blast-furnace where the silicon is reduced. It followed that silicon reduces carbonic oxide. It might be doubtful whether it were better to have a low tensile strength and a dense ingot, or to obtain a higher tensile strength and a honeycombed ingot. The practice of adding silicon might be good for some purposes; but for others it was decidedly preferable to employ compression, a method by which the blow-holes are not avoided but reduced in size and spread over the whole mass.

Mr. Bauerman then said that with reference to hydrogen gas in steel, the fact should not be overlooked that attention was first called to the subject by Mr. Parry, or at any rate he was among the earliest discoverers. There was a good deal to be said for hydrogen after all.

M. Pourcel, on being called upon by the chairman to reply on the discussion, said, in a remarkably forcible speech, that the process was that which formed the subject of a pamphlet on the occasion of the Paris Exhibition of 1878, and it might be described in a few words, as follows:—To a sufficiently soft bath, whether in the Bessemer converter, the Siemens-Martin furnace, or any other appliance, an addition was made, in predetermined quantity, of an alloy of silicon, iron, and manganese with a little carbon. And this was done in the same way as rich ferro-manganese is added; that is to say, not melted, but simply at a red heat. On the addition of ferro-manganese being made, the soft metal thus obtained bubbles in the mould, and this metal generally turned out very spongy. Sometimes it might be quieted by superheating, if the operation were performed in the Siemens-Martin furnace or any kind of open hearth. In such a case, the reaction between the carbon in the iron and the silicates contained in the lining of the retort or in the cinder produces an indefinite quantity of silicon. A contrary effect was produced by the addition of a compound alloy of silicon, manganese, iron, &c., no violent reaction taking place, and a very mild steel, perfectly free from blow-holes being the result. In reply to the question of Mr. Snelus, whether the silicide of manganese decomposes the carbonic oxide in solution in the bath, he would say that there was undoubtedly such a reaction, as had been confirmed by the experiments of Dr. Finkener described by Dr. Wedding. It followed that the addition to the Bessemer bath, of a silicon and manganese alloy, would yield solid ingots. But it was more difficult to obtain a metal of predetermined chemical composition by the Bessemer process, because, in the majority of operations, the quantity of carbonic oxide in solution is not determined. With the Siemens furnace, on the contrary, great regularity could be obtained, and the difficulty of securing regularity in a process was soon overcome by intelligent practicians. If a little too much silicon were allowed to remain in the steel, it would only be present in very minute quantities; and, as silicon has a coefficient of hardness scarcely one-fifth that of carbon, the presence of one, or even two thousandth parts of this substance could scarcely affect the metal's softness. This fact had been abundantly confirmed by the experiments of Professor Mrazek, and by the practical results obtained at Terre-Noire. M. Pourcel concluded by saying that, as regards the theory of blow-holes, he only wished to raise the question, leaving each one to form his own conclusions on the subject.

The chairman, Mr. Lowthian Bell, said they were glad to welcome foreign members, especially when

so well qualified as M. Pourcel to speak on the particular subject that was before the meeting. After commenting shortly on the views expressed by some of the speakers, he proposed a hearty vote of thanks to M. Pourcel for his paper, which was not only useful itself, but had also led to a very prolific discussion. This was carried by hearty acclamation.

Mr. James Kitson, of Leeds, then took the chair while Mr. Bell read his paper on "Comparat Blast Furnace Practice," which is as follows:—

ON COMPARATIVE BLAST FURNACE PRACTICE.

Many of the members of the Iron and Steel Institute will doubtless avail themselves of the courteous invitation of the ironmasters of the Vordernberg Valley to visit the works of that district.

Our hosts do not possess the means of presenting for our inspection blast furnaces of the colossal dimensions of the modern class, or of showing us appliances for heating the blast up to 1500 deg. to 1600 deg. F. (865 deg. C. to 920 deg. C.); we shall, nevertheless enjoy the opportunity of seeing iron made with what, at first sight, may appear an almost incredibly small quantity of fuel, in furnaces containing only about 2250 cubic feet, blown with air at 392 deg. F, 200 deg. C.).

I would only remind you of the costly plant by which we have been able, in Great Britain, to bring down our consumption to something like one ton of coke per ton of metal. Furnaces of 12,000 to 40,000 cubic feet have been erected, or heaters are employed, which, from their construction and size, raise the temperature of the blast pipes to a red heat. Sometimes, indeed, the same plant embraces both these advantages, *i.e.*, it consists of immense furnaces fed with superheated air. In Styria and Carinthia you will find pig-iron made with from 12 to 15 cwt. of charcoal, notwithstanding the smallness of the plant and the comparatively moderate temperature of the blast employed.

One marked difference between the practice of the Austrian ironmasters and our own, is in the quality of the fuel, theirs being charcoal, and ours in Great Britain coke or raw coal; and although the metal produced is white iron, the quantity of combustible just named may seem a surprisingly low one.

When my attention was first directed to a study of the operations of the blast furnace, I was greatly impressed with the dissimilarity of the results apparent in smelting iron with charcoal and with coke. This was so striking that I was at first induced to believe that there was a virtue in charcoal not possessed by mineral fuel, and, if I recollect rightly, this opinion was shared by my friend Professor Ritter von Tunner, whose able work twenty-two years ago on the subject I recommend to everyone interested in the subject.

Under these circumstances it occurred to me that the action of the blast furnace, considered, to a certain extent, in a comparative fashion, might possess some degree of interest upon the occasion of our being assembled in the capital of the Austrian dominions.

To some it may appear rather a waste of time to devote any of our attention to a communication dependent more or less for its interest on the use of charcoal in the blast furnace. In Great Britain, as we all know, the process is almost as little known as is the antiquated Catalan fire; but we must bear in mind that in other parts of the world charcoal pig iron continues to be made on such a scale that it has been computed that two million tons, or about one tenth of the world's make, are still produced by means of fuel derived from the forests of those countries where this most ancient mode of making pig-iron is still practised. It is, however, a branch of industry which ultimately, in many districts, is more or less of a temporary nature for it must, generally speaking, recede as population advances and timber disappears. Nevertheless, I consider charcoal smelting offers sufficient interest to warrant my asking for a few minutes of your time, not only because you are about to visit one of its most famous seats, but because an examination of any branch of blast-furnace work always helps to elucidate the general principles which underlie all.

It would not be easy to single out any manufacturing operation which is carried on under a greater variety of conditions than those which accompany the smelting of iron. Flux and fuel, ore and air, and finally the pig-metal itself, differ so much in character as greatly to modify the results obtained in the operation of producing it.

Limestone, the usual flux of the earthy constituents of the ore, sometimes contains as much as half its weight of carbonate of magnesia. Although not without its use in promoting fusion of foreign matter in the ore, magnesia is comparatively inert as regards the important function of removing sulphur from the iron. Hence a very considerable excess of limestone is employed when magnesia is present in large quantity, to neutralise the evil consequences attending the presence of this metalloid. The carbonic acid given off by the latter earth causes a considerable expenditure of fuel, because it dissolves carbon, involving a loss instead of a gain in a calorific point of view. To show how large a quantity of fuel may be absorbed in the formation of slag, I have estimated that out of 21 or 22 cwt. of coke employed in smelting a ton of Cleveland iron the following quantities are connected with the use of the flux when only using 11 cwt. of limestone per ton of pig-iron produced:—

	Cwt. of Coke.
Expulsion of carbonic acid from the limestone ..	1·536
Decomposition of carbonic acid by carbon	1·594
Fusion of about 28 cwt. of slag	5·794
	8·924

The necessity of avoiding the use of a comparatively neutral substance like carbonate of magnesia is sufficiently conspicuous from these figures, and, at the same time, it is obvious that a rich ore, requiring a less weight of limestone and producing a reduced quantity of slag, means a corresponding saving in fuel. To such an extent may this occur, that in certain cases only about one-sixth of the quantity of fuel just named is required in connection with the presence of carbonate of lime and fusion of slag in smelting some ores of iron.

The fuel at one time is charcoal, at another coke or anthracite, and at another raw coal, and even here different specimens of the same kind of combustible vary in the amount of ash and other foreign matter they contain. They also differ in the facility with which they are attacked by carbonic acid, produced during the process of reduction, or expelled from the limestone.

The ore not only requires a varying amount of heat, and consequently of fuel, according to its content of iron, but demands for its treatment a larger or smaller furnace, according to the readiness with which the mineral parts with its oxygen. One kind of ore, like that of Cleveland, is most economically smelted by being exposed for sixty or seventy hours to the reducing influence of the gases, whereas other descriptions, like the spathose ore of Eisenerz, pass through the furnace in periods varying from five to six hours.

The atmospheric air fluctuates in the quantity of moisture it contains. Sometimes the blast as it enters the furnace may carry with it 1 per cent. of hygrometric moisture, to decompose which, if 140 units of air are consumed per 20 units of iron, 5270 deg. C. calories are absorbed. Reckoning each unit of coke burnt to the state of carbonic oxide, with air at about 538 deg. C. (1000 deg. F.) to give 2650 deg. C. calories, this quantity of moisture represents close on two units of coke per 20 of pig-iron. The case just quoted is an extreme one, firstly, because the atmosphere does not usually contain much above half the above named weight of moisture; and, secondly, 100 units of air instead of 140, is a fair allowance in modern furnaces. With these two corrections, about one-third of the heat just mentioned usually suffices for decomposing the watery vapour entering at the tuyeres. It will, however, be observed that the fluctuation in the quality and quantity of air is such as to involve a difference on the heat required varying from about one-third of a unit to 2 units of coke per 20 units of pig-iron produced.

Lastly, the metalloids, exclusive of the carbon in the metal, are occasionally as low as 0·2, while sometimes they reach 3 per cent. This may mean that 1·3 units or more of coke are required per 20 of pig in the latter, against about 0·1 unit in the former case.

When the able article by Ritter von Tunner first attracted my attention, I was unable, from want of the necessary opportunity, to compare the behaviour of a furnace using charcoal with that of one using coke or raw coal. During my visits to the iron districts of Lake Superior, Virginia, Alabama, and Georgia, some years afterwards, I was able, from personal observation and from the information kindly afforded me, to institute those comparisons between vegetables and mineral fuel which, under other circumstances, would have been laborious and difficult.

It may be well at this point to remind you that all kinds of carbon no not appear to yield exactly the same quantity of heat. The diamond is said to afford 7770 Centigrade calories for each unit burnt to the state of carbonic acid; native graphite, 7797; and the hard lustrous carbon deposited on the inside of gas retorts, 8047 calories. Wood charcoal varies from 7900 to 8080 calories per unit burnt. After consulting many authorities, I have adopted 8000 calories as the co-efficient of carbon in coke; so that, according to this view, vegetable carbon cannot be said to possess any advantage, in a heat-producing point of view, over that obtained from mineral coal.

At one time I supposed it possible that the greater richness of charcoal as compared with coke in alkaline matter which accumulates in a blast furnace might, by promoting the fusion of the earths, or by its conversion into cyanides, which possess a certain amount of reducing power, account in some measure or the small quantity of charcoal required in the Vordernberg furnaces, and elsewhere in the Austrian dominions.

I was never able entirely to satisfy myself on even the partial soundness of this explanation, and when I found in the first charcoal furnaces visited in the United States, all things considered, that they were consuming about as much fuel as we were doing of coke, I ceased attaching much importance to the presence of cyanogen compounds. On this question I shall, however, say a few words at a later period.

A convincing proof of the close correspondence of the action of the two kinds of fuel was afforded me in West Virginia, where I found a furnace in which the same quality of ore had been smelted at one time with charcoal and subsequently with coke. Making allowance for the difference of conditions, such as richness of ore, &c., the results afforded by the two kinds of fuel agreed as nearly as could have been expected.

In some localities in the United States the social changes already alluded to as being unfavourable to the production of charcoal iron have led to the abandonment of many works. The timber-producing powers of North America are, however, still so large that in other places furnaces have been built so that the make in 1881 exceeded that of any previous year. Ten years ago, viz., in 1872, the production was 506,587 tons, and in 1881 it rose to 638,838 tons.

The importance of this branch of the American trade has led to the founding of the United States Association of Charcoal Ironworkers, in whose Transactions are many papers of high excellence. One by Mr. John Birkinbine, the secretary of the Institution, gives at considerable length some very interesting results of certain trials at the Pine Grove Furnace in Pennsylvania. In it, using an ore yielding about 40 per cent. of metal, with 11 to 12 cwts. of limestone per ton of pig, they consumed from 22·59 to 23·66 cwts. of charcoal for grey iron, varying from No. 2 to No. 2·40, with a production of about 100 tons per week. The furnace is only 36½ feet high, with boshes of 9 4, blown with air at 600 deg. F. (315 deg. C.)

Having regard to the temperature of the blast, and, above all, to the size of the furnace, this is no doubt very fair work—very much better than the same furnace was able to do with mineral fuel. When coke was employed instead of charcoal, the fuel rose to 31·19 cwts., the limestone to 23·00 cwts., while the weekly make fell to 70 tons of No. 3 quality. In using anthracite the consumption was 34·56 cwts. with 24 94 cwts. of limestone, the production falling to 58 tons of No. 3.

Speaking roughly, the larger quantity of carbonic acid in the limestone, when using coke or anthracite, would carry off about 1½ cwts. of carbon, while the decomposition of the limestone and fusion of the slag would account for about 3 cwts. more than when using charcoal. We may therefore approximately estimate the addition to the fuel from these two causes to amount to 5 cwts. on each ton of iron. The greater volume of the escaping gases, when using fossil coal, would carry off sufficient heat to account for the remainder of the fuel expended, as compared with that carried off in the case of charcoal.

By the kindness of my friend, Professor Akerman of Stockholm, I have been favoured with the particulars of the performance of twenty-seven charcoal furnaces in Sweden, and from these a average of the whole has been compiled.

Particulars of Twenty-seven Swedish Furnaces working with Charcoal.

	Dimensions in English Feet.		
	Minimum.	Maximum.	Average.
Height	30·3	54·6	45·8
Diameter of boshes ..	6 8	10·6	8·8
Cubic capacity in feet, roughly estimated ..	600	2400	1400

From the information contained in the tables furnished to me, an estimate of the average heat required in smelting in these twenty-seven charcoal furnaces has been made. Alongside of it, for purposes of comparison, I have placed a similar statement showing the calories necessary in smelting iron with coke. In each case 20 units of pig-iron are taken.

	Swedish Furnaces.	Cleveland Furnaces.
	Calories.	Calories.
Evaporation of water in fuel ..	1,631	324
Reduction of iron from ore ..	31,761	33,108
Carbon impregnation	1,920	1,440
Expulsion of carbonic acid from limestone	1,421	4,013
Decomposition of carbonic acid from limestone	1,472	4,160
Decomposition of moisture in blast	1,360	2,444
,, phosph and silicic acids	522	4,174
Fusion of pig iron	6,600	6,600
,, slag	8,270	14,520
Transmission of heat through walls, supposed	2,543	3,658
Carried off in tuyere water	1,109	1,818
,, escaping gases ..	6,913	7,542
	65,522	83,801
Estimated development of heat based on the composition of the gases and fuel consumed along with that due to temperature of the blast	63,635	84,772

The fairly close approximation of the two sides of the account, viz., heat produced and absorbed, is a voucher for the approximate correctness of the account taken as a whole. From this statement it will be perceived that fully 30 per cent. more heat is required for smelting the Cleveland ironstone than is needed for that obtained from the richer hematites of Sweden.

The consumption of fuel, &c., was as follows:—

	Swedish.	Cleveland.
Cwts. of fuel per ton of pig ..	19·48*	20·40
Cwts. of limestone per ton of pig .	3·84	9·38
Cwts. of ore .	39·56	46·92
Temperature of blast ..	412° F. = 211° C.	1045° F. = 563° C.
Temperature of escaping gases ...	552° F. = 289° C.	504° F. = 262° C.

The heat computation was obtained by the following method:—

	Swedish.	Cleveland.
Cwts. of fuel per ton of iron ..	19 48	20·40
Less water, &c.	3·02	—
	16·46	20·40
Less ash, &c., and in case of charcoal carbon already combined with oxygen ..	2·12	[illegible]
	14·34	18·77
Less dissolved by carbonic acid in limestone	0·46	1·12
Leaving carbon to produce heat†	13·88	17·65

* As nearly as I can make out, twenty furnaces making iron for Lancashire fires, white and mottled, have an average capacity of ... ... 2150 C. feet,
Charcoal consumed per ton of pig-iron ... ... 18·45 cwts.
Seven furnaces making Bessemer, average capacity 2085 C. feet,
Average consumption of charcoal per ton of pig ... 20·50 cwts.

† Including the carbonic oxide generated by the action of carbonic

		Calories.		Calories.
Carbon burnt to CO	53·88 × 2,400 =	33,312	17·65 × 2,400 =	42,360
Carbon of this CO burnt to CO_2	4·85 × 5,600 =	27,160	5·48 × 5,600 =	30,688
Heat in blast ...		3,163		11,724
		63,635		84,772

It is needless to say that, keeping in mind the much larger quantity of heat which accompanies the conversion of carbon into carbonic acid than into carbonic oxide, the larger the quantity of the former compound we have in the gases as they leave the furnace the better.‡

As is well known, the source of the oxygen which has to convert the carbonic oxide into carbonic acid is contained in the ore. Besides the acid thus formed, there is a certain quantity given off by the limestone, and a further amount evolved by the dissociation of carbonic oxide, by which two equivalents of this gas are resolved into one of carbon and one of carbonic acid ($2\,CO = C + CO_2$).

The moment, however, that the carbonic acid, from whatever source it comes, exceeds a certain limit, it is, at the temperature, and in presence of other conditions where its liberation takes place, resolved into carbonic oxide by an action the reverse of that just stated, *i.e.*, by it carbonic acid attacks the carbon of the fuel, as is expressed by the formula $CO_2 + C = 2\,CO$.

Speaking again from results obtained in using Cleveland stone, to which my attention has been chiefly directed, I am inclined to believe that the limit in question is reached when one-third of the carbon, at the outside, in the gases is in the form of carbonic acid, and the remaining two-thirds is found as carbonic oxide. In practice, however, this proportion appears to be seldom reached, 1 to 2·1, or 1 to 2·2, or even more, being a more usual ratio between the two, while in furnaces of insufficient capacity it often is as 1 to 3, or even more than 3. The figures given in the ascertainment of the heat produced, do not exhibit the whole of the carbonic oxide, because there is that due to the action of the carbonic acid of the flux on carbon. With this correction in the two examples selected for illustration, the ratio is as follows:—

Swedish
furnaces, 1 of carbon as carbonic acid, to 2·05 as carbonic oxide.
Cleveland
furnaces, 1 do. do. 2·52 do.

In a recent number of the "Oest. Zeitschr. für Berg- und Hütt. Wesen," is to be found an admirable paper by M. F. Friderici, containing some important information on the subject of smelting iron by means of charcoal at Vordernberg. I shall offer no apology for inserting some of the facts contained in the communication in question, with a view to compare the results with those obtained in Cleveland when using coke.

Vordernberg Furnaces.	Furnace 2.	Furnace 3.
Total height in English feet ..	35·49	53·13
Diameter at bosh ,, ...	7·87	12·42
Cubic capacity ,, ...	1126	3696
Weekly make white iron (tons) ..	105	269½
,, ,, per 1000 cubic feet of capacity	93.2	73·0
Consumption of charcoal per ton (English cwts.)	14·8	12·6

In order to ascertain the circumstances which enable the charcoal smelters of Vordernberg to produce a ton of iron with so small a quantity of fuel, I propose examining the heat produced at the two furnaces in question, and comparing the product with that of a Cleveland furnace, using a very much larger quantity of fuel in the form of coke.

	Vordernberg 2.	Vordernberg 3.	Cleveland.
Weight of fuel consumed per 20 units of pig-iron	14·80	12·60	22·32
Temperature of blast	572°F 300°C	842°F 450°C	905°F 485°C
Temperature of escaping gases	343°F 173°C	446°F 230°C	630°F 332°C

The heat produced in the furnace per unit of fuel as charged, was as follows:—

	Furnace 2.	Furnace 3.	Cleveland.
	Calories.	Calories.	Calories.
Combustion of the carbon	3602	5726	3656
Contained in the blast ..	277	393	534
	3886	4119	4190
Carried off in the gases .	222	281	508
Accounted for in the furnace	3664	3838	3682
Difference from Cleveland	−12	+156	

acid on the minerals, I find the ratio of carbon as carbonic acid to that as carbonic oxide is as follows:—

	As Carbonic Acid.	As Carbonic Oxide.
Average of sixteen furnaces making mottled and white	1	2.10
Average of six furnaces making Bessemer iron	1	4.37

‡ One unit of carbon into carbonic oxide gives 2400 calories, whereas one into carbonic acid affords 8000. In the statement just given the carbon is supposed first burnt into the oxide and then this oxide passes into the condition of carbonic acid, by which we get the 5600 calories (8000 − 2400).

Thus, according to this statement, the heat obtained from the coke is about equal to that obtained from charcoal in the furnace which works less economically, and about 4 per cent. less than what the unit of charcoal produces in the larger furnace. This difference is particularly striking when we consider the very different value, in a calorific point of view, of the two kinds of fuel; for, while coke contains from 90 to 92½ per cent. of fixed carbon and carbon as combustible gases, charcoal has only about 86½ per cent. Indeed, after making allowance for the combined oxygen it contains, it will not be safe to reckon it as affording more than 85½ per cent. of carbon available for heat purposes.

To obtain the heat-producing power of each variety of fuel an allowance must be made for ash, moisture, &c.; and then a deduction made for carbon carried off by carbonic acid liberated from carbonate of lime.

	Furnace 2.	Furnace 3.	Cleveland.
Carbon delivered to furnace per 20 units of iron, after allowance for ash, &c. ..	12·61	10·74	18·76 × 2400 = 45,024
Carbon in carb. acid in flux or ore carrying off carbon without affording heat ..	0·71	0·43	6·32 × 5600 = 35,512
	11·90	10·31	
The heat evolved is as follows:—			
C. burnt to C.O.	11·90 × 2400 = 28,560	10·31 × 2400 = 24,744	81,536
C. of this to $C.O_2$.	4·438 × 5600 = 24,853	3·964 × 5600 = 22,204	11,919
	53,413	46,948	93·455
Calories in blast	4,103	4,952	11,356
	57,516	51,900	82,099
Calories in gases, including those in ore..	3,295	3·540	
	54·221	48,360	

The heat afforded per unit of pure carbon is in—

Furnace 2	54,221	12·61	= 4300
,, 3	48,360	10·74	= 4503
Cleveland	82,099	20·40	= 4024

The product in calories consists of—

	Combustion of Carbon.	In Blast.	Total.	Less in Gases and Hot Ore.	Absorbed in Furnace.
Furnace 2 . Calories	4236	325	4561	261	4300
,, 3 . ,,	4371	461	4832	329	4503
Cleveland . ,,	3997	584	4581	557	4024

These figures indicate a greater loss per ton of Cleveland iron, arising from more carbon being carried off by the action of carbonic acid on the fuel, as well as from the greater volume and higher temperature of the escaping gases than in the Vordernberg furnaces. On the other hand, each unit of carbon usefully burnt in the Cleveland furnace is accompanied by a much higher amount of heat in the blast. The difference between these two items does not affect the account to any serious amount; for we have per unit of carbon:—

	Heat in Blast.	Heat in Escaping Gases.	Useful Balance.
Furnace 2	325	261	64
,, 3	461	329	132
Cleveland	584	557	27

The superior results afforded by charcoal, in the cases we are considering, are due to the higher state of oxidation of the gases. In the calculation of heat evolved already given, the carbonic oxide generated by the action of carbon on carbonic acid is excluded, but in estimating the composition of the gases, it is necessarily brought into the account.

Analysis showed the following to be the composition of the gases—

	Weight.	Carbonic Acid.	Carbonic Oxide.	Carburetted Hydrogen.	Hydrogen.	Nitrogen.
Furnace 2 ..	100=	22·37	23·81	0·37	0·09	53·33
,, 3 ..	100=	24·93	23·13	0·32	0·09	51·53
Cleveland ..	100=	17·30	25·20	—	0 10	57·40

In these the carbon as carbonic acid to carbon as carbonic oxide is

	As Carbonic Acid.	As Carbonic Oxide and Carburetted Hydrogen.
Furnace 2	1	1·72
,, 3	1	1·49
Cleveland	1	2·28

In all my experiments on Cleveland iron, and, indeed, in furnaces smelting red and brown hematite, I have rarely, if ever, found the ratio of carbon as carbonic oxide to that as carbonic acid to reach 2 to 1, and I was therefore greatly surprised at the results just mentioned. At first I was induced to ascribe the difference to the analysis not representing an average composition of the gases; for, as is well known, it often happens that an excessive quantity of carbonic acid is given off for a short time from a furnace, particularly immediately after charging, but I consider the excess of heat so generated is almost entirely useless, being for the most part carried off in the escaping gases. The unusual proportion of the higher oxide of carbon appearing in both these cases as well as, besides in others, in one expressly made for me by Professor Tunner some years ago, compels me to regard the occurrence as not being one of an abnormal character. To satisfy myself on this point I have examined the performance of the furnace, and so far as I am able to judge, in order to provide the heat required all the carbonic acid stated to be present in the gases seems to be necessary.

It may be useful to supplement the extracts taken from Mr. Friderici's paper by quoting the results obtained by observations made at my own request to my friend Professor von Tunner about fourteen years ago.

Upon that occasion 20 units of pig iron (white) were alleged to be made with 13·20 units of charcoal burnt with air at 400 deg. C. (752 deg. F.).

In order to estimate the heat in the same way as that already adopted, it is assumed that 10·68 units of pure carbon were serviceable; calculated as follows:—

Weight of charcoal delivered to furnace	13·20
Less foreign matter 1·98 and C. removed by CO_2 0·54 = ...	2.52
Total	10·68

The total weight of the carbon contained in the escaping gases is equal to—

That contained in the charcoal = 13·20 − 1·98 = ..	11·22
That contributed by the limestone	0·54
	11·76
Less that combined with the pig-iron ..	0·60
	11·16

The carbon of the escaping gases, viz., the sum of that contained in charcoal (11·22) and limestone (0·54) less that combined with the pig iron (0·6), amounts to 11·16 cwts., of which 4·05 are present as CO_2 and 7.11 as CO; besides they contain 0·44 $CH_4 + H$, so that their reducing power may be roughly represented by 7·11 + 0·44 = 7·55, in which case the ratio of C as CO_2 may be taken approximately to that as CO as 1 to 1·87.

The heat evolution amounts in all to 51,891 calories, and each unit of carbon therefore developed 51,891 ÷ 11·22 = 4624.

The composition of this sum and the net useful effect obtained in the furnace were as follows:—

Due to combustion of carbon	4220
Contained in blast	404
	4624
Less carried off in gases	294
Total	4330

It is always satisfactory in such calculations as the present to have the heat evolution checked by the heat absorption. In applying the same figures as those employed on many former occasions, making, of course, proper allowance for altered conditions as to slag, &c., the heat required comes out to 56,895 calories, showing a difference of (56,895—51,891) 5004 calories. Admitting for a moment that the larger number (56,895 calories) was required, an addition of 1·26, making in all 14·46 units of charcoal per 20 of pig, would suffice for its supply. It has to be remembered, however, that the iron made in the Vordernberg furnace is white iron, whereas we are in the Cleveland furnace comparing it with grey foundry pig.

Now the difference between my figures representing the absorption of heat for foundry iron and those which appear as being required is 5004 calories, equal to 9·6 per cent., which is by no means greater than might, under the circumstances, be expected for the two kinds of metal.

We are still left to reconcile the different ratio of carbonic acid and carbonic oxide found to obtain in these Vordernberg furnaces as compared with those in Cleveland.

As already intimated, my observations on the conduct of furnaces smelting the ore of the last-named locality have led me to conclude that when the ratio is 1 volume of CO_2 to 2 of CO the mixture of gases ceases practically to act on Cleveland ironstone. The largest proportion of CO_2 I have found was represented by the proportion of 1 volume of CO_2 to 2·09 vols. of CO. As a rule, fairly good working is obtained when the ratio is 1 vol. of CO_2 to 2·20 of CO.

In the three examples of charcoal furnaces referred to in this communication, we have 1 vol of CO_2 accompanied by 1·49, 1·72, and 1·87 vols. of CO.

It has to be borne in mind in stating that certain mixtures of these two gases at a given point become exhausted in their reducing power,* it is not to be understood that

* In a furnace of 17,000 cubic feet, 80 feet high, the proportions of carbonic oxide and carbonic acid are as 100 vols. to 45, but as we descend the CO_2 rapidly disappears.

carbonic oxide cannot under certain conditions rob an ore of more of its oxygen even when the resulting gas, which has effected the deoxidation, is charged with carbolic acid to the extent just named.

Suppose a small quantity of the oxide of carbon to be passed through a large excess of ore, there is no difficulty in converting the *whole* of the gas made use of into carbonic acid. This, however, is not the reduction of the oxide of iron to the metallic state; it is the mere separation of the first, and what may be considered the most loosely united, portions of the combined oxygen of the ore.

As illustrating the subject under consideration, I found in the laboratory that a mixture of 100 vols. of CO and 50 of CO_2 only separated 2·10 per cent. of the combined oxygen in calcined Cleveland stone, at a temperature of 417 deg. C. 782 deg. F. in 5½ hours, and 10·04 per cent. in 11½ hours.

At the furnace itself, the results obtained indicated a very languid action when the ratio of the two oxides of carbon approached that just named. Thus 100 vols. of CO with an average of 40 to 45 of CO_2, at an average temperature of 312 deg. C. 594 deg. F., in 24 hours only separated 3.72 per cent. of the oxygen combined with iron in calcined Cleveland ore.

As an instance of the want of power of certain mixtures of the two gases in question to produce metallic iron, a mixture consisting of equal volumes of CO_2 and CO was passed over iron ores of different kinds, and over pure spongy iron at a bright red heat.

As soon as the oxide of iron lost one-third of its oxygen, becoming protoxide, all further action ceased. At the same time the pure iron was oxidised, having also passed into the state of protoxide.

Now, when we compare the ratio in which the carbonic acid, the oxidising gas, and the carbonic oxide, the reducing element, is found at different levels in a furnace working in the Vordernberg Valley and in Cleveland, the difference, according to the analysis of Professor Richter and M. Tunner, is remarkable.

	Vordernberg 2400 cub. ft.	Cleveland, 6000 cub. ft.
Escaping gases contain per 100 vols. CO	95 CO_2	28
About 18 feet from top ..	76	2
,, 28 ,, ..	70	5
At the tuyeres	12	trace

No doubt the interior of a furnace presents very different conditions from the laboratory experiment already alluded to, or even from the trials in the furnace gases themselves. In both the last two solid carbon is absent, whereas in the furnace it exists in great abundance.

In the furnace itself, however, the same law holds good as where carbon is absent, although it is modified. Thus certain mixtures of gases are unable to withdraw above a certain quantity of oxygen from an ore. In like manner certain mixtures of carbon and gases, the latter in certain relations to each other, as to quantity, may separate a certain proportion and no more of the combined oxygen.

In both cases such mixtures might be unable to produce any metallic iron, in others a smaller or larger quantity of the metal might be reduced, leaving a larger or smaller proportion of unreduced oxide to be carried off in the slag. This is what in point of fact happens in the two cases we are discussing. The slag from a Cleveland furnace contains often as little as 0.25 per cent. of protoxide of iron, whereas in that run from the Vordernberg furnaces 3·25 per cent is found.

In the experiment of equal volumes of CO_2 and CO a position of static equilibrium is reached when iron is reduced to the condition of protoxide. In the Vordernberg furnace a similar state of things obtains when all the iron is reduced to a metallic condition, except that portion which is found in the slag as protoxide.

Allusion has already been made in this communication to the existence of cyanogen compounds in the blast furnace. The occurrence of these substances has been the subject of frequent enquiry at the works under my control.

I will give in a few words the results of some experiments bearing on this question, setting forth the extent to which alkaline cyanides were found in the gases of a furnace smelting Cleveland ironstone with coke.

Quantity of potassium and sodium in combination with carbonic acid, oxygen, or cyanogen found in one cubic metre of the gases of a furnace of 17,500 cubic feet, 80 feet in height; ascertained upon six consecutive days at a point 8 feet above the tuyeres.

Potassium and sodium—46·69 30·17 33·15 21·09 31·65 11·83 average 29·11 grammes.

Cyanogen present—19·00 12·93 17·32 11·34 20·61 9·16 average 15·06 grammes.

There is no doubt that as the gases ascend, more or less loaded with this alkaline vapour, a considerable portion of the latter is condensed by the cooler solids fillling the interior of the furnace. The condensed matter is carried back to the inferior zones, which gives rise to the accumulation in point of quantity perceptible in the gases at the lower levels of the furnace.

Besides this cause of disappearance of the cyanogen itself in the higher parts of the furnace, it would seem that some reaction takes place during the ascent of the gases, because the relation between the alkali metals and the cyanogen suffers a material change. Thus on the six days upon which the specimens above mentioned were operated on, the escaping gases were found to contain:—

Potassium and sodium—11·20 15·30 8·68 5·89 4·29 average 60.7 grammes.

Cyanogen—4·00 6·60 3·57 2·91 1·79 average 3·77 grammes.

The figures in the two examples indicate that 65 per cent of the enumerated substances have disappeared from the gases between the two points of observation, and that while cyanogen in the first series bore a relation of 61 to 100 of the potassium and sodium, in the second it exists only to the extent of 41 to 100 to these metals.

Believing that cyanogen, from the carbon vapour it contains, must be a powerfully deoxidising agent, the following experiments were tried. Different mixtures of cyanogen and carbonic acid were passed over oxide of iron at different temperatures. The results are contained in the subjoined table:—

Mixture. Vol. Cy.	Mixture. Vol. CO_2	Duration of Experiment.	Temperature.	Exposed Oxide contained per 100 of total Fe present. Fe as Metal.	Fe as Oxide.	O with Fe.	Carbon Deposited.
1	6	2¾ hrs.	698° C.	56·3	43·7	9·10	28·50
1	6	3·1 ,,	bright red	22·7	77·3	17·4	13·8
1	15	2½ ,,	806° C.	6·5	93·4	32·20	1.30
1	30	3 ,,	775	0·9	99·0	33·82	2·52
1	15	2·8 ,,	bright red	none	100·0	28·90	0·52

By experiment it was found that carbonic oxide and carbonic acid in equal volumes actually converted metallic iron, at a red heat, into protoxide of iron. The same mixture, when passed over iron ore, produced at various temperatures no deposited carbon.

From what has preceded, we may infer that free cyanogen, at all events is, as might be expected, a very much more powerful reducing agent than carbonic oxide, the carbon of which, from the composition of the gas, has its avidity for oxygen already partially satisfied.

In the Cleveland furnaces, particularly those having a height of 75 or 80 feet, the gases are remarkable for the small quantity of carbonic acid they contain, when taken below a certain level. The following examples are illustrative of this assertion obtained from a furnace of 17,500 cubic feet capacity:

Point of Sampling.	Vols. of CO_2 per 100 of Gases.	Vols of CO per 100 of Gases.
At tuyeres.	0·0	35·4
Do.	0·0	34·4
Do.	1·5	36·5
Do.	0.0	34·8

Escaping Gases.	1st Experiment. Vols. of CO_2.	1st Experiment. Vols. of CO.	2nd Experiment. Vols. of CO_2.	2nd Experiment. Vols. of CO.
16½ feet from top ..	2·22	34·08	2·25	33·31
20 ,, ..	0·67	35·11	0·73	34·84
39 ,, ..	1·09	34·96	1·00	35·08
52¼ ,, ..	1·51	35·24	—	—
65 ,, ..	0·50	35·92	0·49	36·03
70½ ,, ..	0·00	36·63	0·00	37·60
At tuyeres ..	0·81	37·70	0·73	37·86

Against these figures I have placed the composition of the gases of an Eisenerz charcoal furnace which has a height of 52 65 English feet and a capacity of 3592 cubic feet:—

	Vols. of CO_2.	Vols. of CO.
Escaping gases, average of two trials ..	16·02	17·87
18 feet from throat	14·86	19·39
25½ ,, ...	13·93	18·77
28 ,, ...	13·87	19·69
32 ,, ...	12·35	20·46
34½ ,, ...	2·98	38·56

Whether the fact of the produce of the Vordernberg furnaces being white iron, and the ore not being so completely reduced as when grey Cleveland iron is sought for, may permit the presence of a greater quantity of an oxidising gas such as CO_2 at the tuyeres, is a question I have not yet had an opportunity of solving. Another question for consideration is the amount of assistance, if any, which a possibly larger quantity of cyanogen compounds, produced from a fuel a richer in alkaline matter than coke, may afford in neutralising the prejudicial effect of so large a quantity of CO_2 in the hearth as obtains in the Vordernberg furnace.

Some light, it may be observed, would be afforded if the Styrian ironmasters would communicate to the meeting the quantity of charcoal required when their furnaces are making grey foundry iron.

I would venture to recommend further enquiry into this branch of blast furnace chemistry to the attention of those ironmasters of the Vordernberg Valley who have in past times enabled our venerable honorary member the Ritter von Tunner to render great service to the science of iron-making.

I trust that in any discussion with which this communication may be honoured we shall hear whether Styrian or Carinthian practice has demonstrated the inadvisibility of heating the blast beyond the very moderate temperature usually employed in these provinces.

I have already compared the constitution, so to speak, of the heat coefficients usefully employed in the charcoal furnaces described by M. Friderici and that of a Cleveland furnace using coke.

In the paper by Professor Ritter von Tunner already referred to, the blast was only heated to 200° C. (392° F.), but in his later experiments of 1871 the temperature had been raised to 400° C. (752 F.) In M. Friderici's paper the blast is quoted as having been heated to 300° and 450° C. in the two furnaces, while the Cleveland furnace was blown with air at 485° C. (905° F.)

In my comparative statement just alluded to, I calculated that the heat actually absorbed in the furnace was, per unit of fuel consumed, as follows:—

	Charcoal Furnace 2.	Charcoal Furnace 3.	Cleveland Furnace.
	Calories.	Calories.	Calories.
Combustion of Carbon	3609	3726	3656
Contained in blast ..	277	393	534
	3886	4119	4190
Carried off in gases ..	222	281	508
Coefficient	3664	3838	3682

By raising the temperature of the blast by means of brick stoves to 700° to above 800° C. the following coefficients per unit of coke have been obtained:—

Height of furnace (feet) ..	55	76	90
Capacity of furnace	10,300	20,642	35,016
Weekly make, tons per 1000 cubic feet	38	—	13
Coke per ton	—	—	—
Temperature of blast° C. ..	718°	780°	819°
Temperature of escaping gases° C	248°	412°	222°
	Calories.	Calories.	Calories.
Combustion of carbon ..	3527	3442	3551
Contained in blast	671	747	793
	4198	4189	4344
Carried off in gases	283	464	189
Useful coefficient	3915	3725	4155

An important item in the evolution of heat by the fuel is the extent to which the carbon is burnt to the state of carbonic acid. There is no doubt that in this respect the charcoal furnaces greatly exceed that of any coke furnaces I have had an opportunity of examining. I annex a synopsis of the relations of carbon in the two conditions of oxidation, carbonic acid being taken as unity:—

	Charcoal F 2.	Charcoal. F 3.	Cleveland.	Cleveland.	Cleveland.	Cleveland.	Cleveland
Blast° C.	300°	485°	485°	522°	718°	780°	819°
CO_2 ..	1	1	1	1	1	1	1
CO ..	1·72	1·49	2·28	2·09	2·53	2·89	2·28

It needs no figures to prove that with gases equally saturated with oxygen gas an elevation of temperature in the blast must be attended with an economy in the fuel consumed.

Whether from some difficulty connected with the conduct of furnaces under 25,000 cubic feet of capacity, I am unable to say, but my own enquiries have led me to infer that in furnaces receiving their blast at the high temperatures supplied by firebrick stoves, the gases have not proved as rich in carbonic acid as those fed with air at more moderate temperatures. As a consequence of this state of things, and in spite of receiving so much more heat through the blast, there has, according to my experience, been little, if any, economy in the use of superheated air, always, be it remembered, comparing furnaces in good working order.

These observations apply to the smelting of Cleveland ironstone, but I have recently examined the results obtained in smelting hematite ores at four different works for the production of Bessemer iron:—

	A.	B.	C.	D.
Height of furnaces, feet ..	60	60	70	70
Stoves, metal, or firebrick	FB	FB	M	½M ½FB
Coke, per ton	20·56	20·60	20·33	20·35

In some cases, no doubt, the results may be affected by differences in the quality of the minerals, but in the case D. I have separated the consumption of the two descriptions of furnaces, two of each, all using the same kind of minerals. They were:—

From metal stoves	20·54	
,, ,, ...	20·55	
		average 20·54
,, firebrick stoves ..	19 97	
,, ,, ...	20·37	
		,, 20·17

It may be, as would appear to be the case from a recent paper by Mr. Charles Cochrane, that superheated air requires a much larger furnace in order to realise the full benefit it is capable of affording.

According to his figures, Cleveland iron is being smelted with something under 19 cwt. of coke, which is about ½ cwt. less than I have met with under the most favourable circumstances. In this instance, however, having regard to capacity, the produce was only half that of furnaces driven with air at about 560° C. (1040° F.).

An estimate of the heat developed for each unit of coke consumed at this furnace, one 90 feet high with a capacity of 35,000 cubic feet, estimated on analysis of the gases at the throat was as follows:—

Temperature of the blast	819°C.
Temperature of escaping gases	222°C.
Heat from combustion of one unit of coke ..	3551
,, contained in blast	793
Total calories	4344
Less carried off in gases	189
Useful coefficient	4155

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This figure is undoubtedly one of high excellence, and is, in point of fact, the best one I have met with in my experience with British furnaces.

There is but one other point to which I would ask your attention, viz., the great make of many furnaces using charcoal as their fuel. The usual produce of a coke furnace smelting Cleveland stone is about 30 tons of grey iron per 1000 cubic feet of capacity per week. The Luxembourg furnaces, using ore of the same geological position as those of Cleveland, run as much as 50 tons of white iron per 1000 cubic feet of capacity, and this up to 55 tons is about the rate of working on English or Spanish hematite. It will be observed, however, in the two Vordernberg charcoal furnaces we have a make of 73 and 93½ tons of white iron per week per 1000 cubic feet of capacity, and I have met in America charcoal furnaces running 100 tons of grey metal per 1000 cubic feet.

It is clear that the facility with which an ore is acted on by the reducing gas in the furnace must necessarily affect the rapidity with which the furnace can be driven. By actual experiment I ascertained that at a temperature of 410° C. (770° F.), when exposed to carbonic oxide, while calcined Cleveland stone lost about 20 per cent. of its combined oxygen, Lancashire ore parted with 2½ times this quantity. Under such circumstances it is not surprising that charcoal furnaces using rich hematites should make much more iron than coke furnaces using clay ironstone. As a rule, however, up to a certain date the make per 1000 cubic feet was notably larger in charcoal furnaces than in those using coke, even when smelting the same class of ore.

I have elsewhere endeavoured to explain a circumstance which seemed to rest on a fairly sound foundation, but I fancy my explanation must be abandoned as an attempt to account for what in reality may have no substantial existence.

I have recently learnt that the furnaces at the Edgar-Thompson Works near Pittsburg, 80 feet with a capacity of 15,000 to 16,000 cubic feet, are producing fully 100 tons per 1000 cubic feet per week of rich Bessemer iron.

There is no question whatever that driving furnaces at any such rate leads to their rapid destruction, so that three years is a pretty long life for one which is turning out so large a quantity, whereas a furnace making a third of this produce, even from the poorer Cleveland iron, lasts three or four times as long.

Now, when it is remembered that blowing engines, hot-air apparatus, indeed, almost every expense attending the cost of manufacturing iron except the mere furnace itself, bears a direct proportion to the quantity of iron produced, it seems doubtful whether there is any saving in these extraordinary rates of production, which necessarily entail blowing out, and standing three months every third, instead of every twelfth year.

Professor Ritter von Tunner, who spoke in English, said he had not had the paper a sufficient time to study it so as to reply; but he would send a written reply. The members would have an opportunity of studying the mode of operation described, and judge of the comparative quantities of coke and charcoal for making grey and white iron.

At this stage of the proceedings, Herr Hofrath Wex, late Director of the Danube Regulation Works, gave some particulars as to what the members saw during the previous day's excursion on that river.

The chairman, Mr. Jas. Kitson, resuming the previous subject, remarked that the paper must be studied, as Professor von Tunner had said; and when the members saw Styria, the visit to which place was much looked forward to, they would compare their own observations with the statements made. At the same time, he hoped a few members would make some observations.

Mr. Wm. Whitwell, of Stockton, said that the large profits made in America induced the iron-masters there to drive the furnaces as long as possible without stopping for repairs; but in England a more economical method had been adopted. As a maker of pig-iron, he should like to observe the practical character of Austrian blast furnace plant. He said he hesitated to speak of firebrick stoves, because, as was well known, he was executor to his late lamented brother, Mr. Thos. Whitwell; but, on being encouraged by members, he said the firebrick stove undoubtedly possessed great advantages, whether the temperature required were high, low, or intermediate; and if it were advantageous to have a high blast, that could also be obtained. They all knew how curious was the working of the blast furnace, and how contradictory it often was. He had no doubt Mr. Bell's statistics were correct, and he paid a high tribute to that gentleman's contribution.

Mr. James Kitson said it was very satisfactory to those who, like himself, were large consumers of a high quality of steel, to know that pig-iron could be smelted with so small a quantity as 12 cwt. of charcoal; and it was very important to English iron and steel makers that Swedish pig of high quality should be continuously imported at moderate prices. This led him to remark that the manufacture of charcoal pig and iron and steel of a special quality was not necessarily antagonistic to new and cheaper products in iron and steel, experience having taught that new productions find fresh markets; and the world was wide enough for all these various manufactures, without these changes necessarily leading to the extinction of old processes. They were all glad to acknowledge that Mr. Bell's early contributions to the transactions of the Iron and Steel Institute were regarded all over the world as standard works on the subject; and he had little doubt that this paper would prove of equal value, owing to the discussions to which it would hereafter give rise.

Mr. Bell, having resumed the chair, briefly returned thanks for the great attention paid to his paper.

Mr. G. J. Snelus then read extracts from his paper on the chemical composition and testing of steel rails.

A most valuable paper to the steel trade was next read by Mr. Gjers (of Middlesbrough), who described a new method of dealing with ingots directly after they go from the Bessemer converter, whereby the labour and the cost of reheating in the costly furnaces are obviated and a great economy in production is thereby attained.

After a few explanations from Mr. Bell about prospective arrangements, Mr. Snelus opened the discussion on Mr. Gjers' paper, observing that he was glad to testify to the value of that gentleman's discovery. It so happened that a strike of "heaters" or furnace hands took place in West Cumberland when Mr. Gjers most opportunely sent him word as to his method. He, the speaker, immediately went to Darlington, saw what was being done, and then put up some soaking pits. He did not then know that the walls were subject to so much attention in putting in and taking out the ingots, and that large fire-blocks should be used. That, however, had nothing to do with the process, which was perfectly satisfactory. He had put 15,000 tons of ingots through the soaking pits, and not into a furnace at all; they were put in with the crane standing upright in the holes, and again taken out with the crane. The process was, as yet, too young to permit of any details being given as to saving; but that must be considerable. The saving in waste was also very great, as it was found that fewer short lengths were made with the soaking-pit process than in going through the furnace. Though the arrangement of his works did not permit of Mr. Gjers' method being carried out in its entirety, he had done 2000 tons a week, and should be disappointed if he did not get more the present week.

Mr. W. Richards had no personal experience of the process, but he had seen it carried out at Mr. Gjers' works, where ingots were taken out of the pits, cogged, and then rolled off into rails, and Mr. Hugh Bell named an instance in which this practice was followed regularly.

Mr. Snelus here explained that they had not yet rolled the ingots off into rails at one heat, as his plant would not admit of this, but that was the fault of the plant, not of the process.

Mr. Whitwell, on being called upon by the chairman, said that he had been invited to go and see the process, but had been unable to do so at the time named. He had arrived one morning quite unexpectedly, and had seen double-headed North-Eastern rails, weighing 84 lbs. to the yard, rolled off direct. During the time he was there, about 80 per cent. of the rails were rolled off successfully without re-heating, being well finished in all respects. He did not see any flange rails rolled, but he had no doubt whatever that, with larger ingots and a mill of sufficient strength, such rails could be rolled off in two or three lengths. The process seemed exceedingly simple, the saving of waste being self-evident; and he thought the invention would prove a great benefit both to himself and all the world.

Mr. Jeremiah Head said it was hardly necessary to add his testimony, but he could entirely confirm all that previous speakers had said as to the Darlington Ironworks. He had seen the ingots stripped, put into the soaking pits, taken out, bloomed and finished into double-headed rails of the N.E.R. section, and their heat appeared greater when taken out than when put in. He noticed that the men put a piece of coal into each pit; and he would ask the reason of that proceeding, since combustion could not go on, no air being present. The pits at Darlington were heating 10 tons per pit per shift; and probably Mr. Snelus was getting better results as he was putting in larger ingots. This was a most valuable and opportune invention, because heaters were now very difficult to get in England, and probably it was the same in other countries.

Mr. Cooper had little to add; but he had been permitted to see Mr. Gjers' process in its earliest stage. The arrangement consisted in making a nest of about six soaking pits under a small crane in the Bessemer house. He saw upwards of a dozen ingots put into the pits, and after remaining there for about 15 or 20 minutes, they were conveyed to the cogging mill, a distance of some 200 feet, and although the circumstances were unfavourable, they were all rolled into blooms in a very successful manner. At a later visit, about a fortnight ago, he found they had made a much better arrangement, a series of soaking pits having been prepared quite close to the cogging mill, in such a way that a crane commanding them can take out the ingots and place them on the live rollers in front of the rolls. At the time of this second visit, they appeared to be dealing with the whole of their make in this manner. Although, as remarked in the paper, the principle was known and attempts had before been made to carry it into practice, he thought every one who had seen Mr. Gjers' plan would admit that it would be difficult to hit upon a simpler one.

Mr. Gjers briefly replied, saying that his plan applied to looms; but, if the plant permitted of it, the rail might be rolled off direct. The small piece of coal was put into the pit to generate gas and cool it, because the pits sometimes got inconveniently hot. The lining required the best firebricks to stand the high temperature, for the pits were constantly receiving an accession of heat.

A vote of thanks proposed by Mr. Bell was carried by acclamation.

A little discussion arose as to whether Mr. Thos. Massick's paper on "The Massick's and Crooke's Patent Hot Blast Stove" should be taken as read, or left over till next meeting, and the last course was adopted. Herr Paul Kupelweser's paper on "An Improved Travelling Crane for Steel Casting" having been taken as read, there remained altogether the last four papers on the list to be left over to the next meeting.

This ended the regular business, and it was arranged that the votes of thanks to the various bodies and individuals who had contributed to enhance the interest of the meeting, or were going to do so, should be proposed and seconded by members from various countries, so as to give the most international character possible to the meeting. Thus, Mr. I. Lowthian Bell proposed, and Mr. Jeremiah Head seconded, a resolution conveying the thanks of the members to the Statthalter of Lower Austria, His Excellency Ludwig Freiherr Possinger von Choborsky for welcoming the institute in the name of the Austrian Government, and to the Bürgermeister of Vienna, Herr Edward Uhl, for the reception accorded by him in the name of the city authorities.

Mr. W. Richards proposed, and M. Pourcel, of Terre-Noire, France, seconded, a vote of thanks to the Vienna Local Committee and its President, C. August von Frey, General Director of the Austrian Alpine Montangesellschaft in Wien.

Mr. Snelus moved, and Mr. Bauerman seconded, the 3rd resolution, conveying the thanks of the members to the Municipality of Buda-Pesth for arranging the reception in that city, and which was yet to come, a worthy sequence, as Mr. Bell remarked, to the proceedings at Vienna.

Mr. Kitson moved, and Mr. John Gjers (of Swedish nationality) seconded, a vote of thanks to the Austrian Staats-bahn for running through trains at nominal fares to the various places to be visited.

The 5th resolution, expressive of gratitude to the ironmasters and others from whom the invitation to Vienna originated, and also to the owners of the works thrown open, was proposed by Mr. Daniel Adamson, who said that this would make us all

better friends than before, and seconded in German by Dr. Wedding in a speech, terminating with the expressive words, "Angenehm zu machen."

Mr. Whitwell proposed, and Mr. Hugh Bell seconded, a proposition conveying the warmest thanks of the members, not only to the city authorities for their organised hospitality, but also to every inhabitant of Vienna for the invariable courtesy shown to their guests.

The last resolution, that conveying the thanks of the institute to the Austrian Ingenieur- und Architekten-Verein, with its president, Herr Charles Prenninger, director of the Southern Railway, for the use of their handsome premises during the meeting, was proposed by Mr. Horton and seconded by M. Noblet, member of the Liége Engineers' Association, who concluded by observing that when scientific associations assert themselves by such magnificent buildings, they give evidence, not only of a powerful organisation, but also of the influence which they exert on the scientific and industrial progress of their country.

It is needless to say that these several votes were all carried unanimously and with the heartiest enthusiasm; and a cordial vote of thanks to Mr. I. Lowthian Bell for undertaking *impromptu* the arduous duties of presiding over the meeting, proposed in German by Professor von Tunner, seconded by Mr. W. Richards, and duly acknowledged, brought the meeting to a close.

The members then proceeded to the Imperial Volks-Garten, where, as on Tuesday, an elegant luncheon was served through the hospitality of the municipal authorities of Vienna. After listening to some excellent music by the band of the 34th Austrian Infantry, the members, their friends and hosts split up into several parties, some visiting the Imperial Summer Palace at Schönbrunn, others following some of the leading architects of Vienna, who were good enough to act as *ciceroni* over the splendid Houses of Parliament, the Town Hall, and University, all new and magnificent buildings.

A considerable section of the party proceeded in cabs to the Wiener Locomotiv Fabriks Actien Gesellschaft at Floridsdorf, where 1200 men turn out a hundred locomotives in the year. Met by the director, Herr Bernhardt Demmer, the members first inspected the erecting shop, where sixteen out of sixty powerful passenger engines for the Paris, Lyon, Méditerranée Company, were seen in various stages of progress on the pits, while eight more were being erected without pits. Not only are there many points of novelty in the workshop practice, but these locomotives also possess many special features, so that even Mr. Webb, of the London and North-Western Railway Works, was heard to acknowledge that he had picked up a wrinkle or two.

The engines have outside cylinders of the large diameter of 21½ inches, with 2 feet 1½ inches stroke of piston, working on to four coupled wheels of 5 feet diameter. Additional pairs of wheels at the leading and trailing ends bring up the wheel base to the large dimension of nearly 19 feet. The axle-box brasses of these latter have a lateral movement in the boxes for easing the passage round curves; and the trailing axle has its axle-boxes outside of all, thus allowing the ash-pan to clear in going round curves, and possessing the additional advantage of keeping the bearings as far as possible from the heated ash-pan. The fire-boxes are very long, for giving a large heating surface, being intended to burn briquettes, or patent fuel, the calorific power of which is not so great as that of coal. There is an arrangement of dropping the fire bars by means of a shaft and lever worked by a rod from the foot-plate. All the holes in the boiler plates are drilled; and the Floridsdorf and the Guss-stahlwerk Annen, in Westphalia, are the only works where the holes are drilled for the large cross-stays above the firebox crown. Tweddel's hydraulic riveter was adopted at once for riveting the boiler shell; and no difficulty whatever has been experienced with it, for the simple reason that great care is taken to make the rivets of the exact length. The boiler is cleated with brass plate, which, strange to say, is afterwards painted. The valve of the saddle sand-box is worked by a rod and lever from the foot-plate. The boiler is fed with a single Giffard injector with P. L. M. modifications and no pump, this company being the only one that thus relies implicitly on injectors. The buffer-beams consist of wrought-iron boxes with laminar springs inside, to take the thrust of the tender buffer heads.

The cylinders, which weigh nearly a ton and a half, are very difficult to cast, and yet they are remarkably clean and well executed. They are cast of a very hard mixture of iron, which has been charged several times in order to get it right. The mixture now adopted is:—

Grey Styrian pig	230
White Styrian pig	175
And old castings	95
	500

At first, 5 per cent. of spiegel was added by way of experiment; but it did not give a sufficient amount of resistance, which is specified to be 18 kilometres per square millimetre. The piston-rod cross-heads are forged, with oil-cups complete, by the Haswell press in Alsatia, and were admired by practical men as being a remarkably good job.

The engines are provided with steam reversing gear like the steam steering gear of vessels, an arrangement that the P. L. M. Company are now adopting on all their locomotives; it is very simple and acts well, the driver being able to reverse with two fingers. The reversing-rod is, on account of its extreme length, guided by a slotted bracket and anti-friction roller. The tenders are arranged for carrying a new type of Westinghouse brake exercising an equal pressure on both sides of the wheels; or in other words, all the brake-blocks exert equal pressure on the wheels, notwithstanding an unequal wear of the tires. There was also in the shops a small locomotive of 31 inch gauge for the open workings of a colliery at Breunberg, on the Hungarian frontier.

Having lingered long over these interesting engines, the party proceeded to visit the other departments of the works, and noticed that the men had a remarkably good physique. The forgemen are generally Styrians; and all the rest Bohemians. The works have only been started twelve years; they are, therefore, fitted up with the most modern appliances. In the boiler shop is a 25-ton travelling crane, worked by an endless rope, while another, on the same principle, travels over and across it in the contrary direction. This latter picks the boiler tubes and flues up vertically for the Tweddel hydraulic riveter. A 5-ton steam-hammer, made at the works and erected four years ago, is built up of ⅝-inch wrought-iron plates and Bessemer steel girders. There are a great many machine tools by English makers, including a triple slotting machine for locomotive frames, made by Fairbairn, Kennedy, and Naylor, which is capable of slotting a foot deep. This was also one of the first firms that adopted emery machinery; and they have, for the last few years, used emery wheels for finishing work to gauge, especially the slide-valve gear and axle-boxes. There is an emery wheel fitted to a planing machine for planing the edges of a plate, because, being case hardened, it cannot be touched by even a fine file.

The tool-making department is very complete and well arranged, the best men being employed here, and special tools are only given out from the store in return for a check. A complete set of Whitworth gauges is here used solely for making duplicates as they are required. The joints of all boiler fittings are made of spherical or dished-form, and these can only be prepared by corresponding gauges. The working of a special lathe for turning oval, conical, and eccentrical objects and making taps, was watched with great interest. In the first of these operations a lateral movement is given to both headstock and puppet, and in the second to the headstock only.

A compound horizontal engine, combined with boiler, has been erected for driving some of the machines, and also to serve for experiments to decide how far the compound system can be applied to locomotives. The boiler pressure is 180 lb. per square inch; and the first shaft runs at 130 a minute. The cylinders are not jacketed; but a live steam jacket is provided for an intermediate receiver placed between them. The live steam passes through this jacket to the small cylinder, and is exhausted therefrom into the receiver, where it is reheated before entering the large cylinder. The exhaust from this latter passes through a feed-water and is then condensed, so that the utmost value of the fuel is obtained.

In concluding our notice of the Vienna portion of this the fourth autumn meeting that the Iron and Steel Institute has spent away from home, we would refer with pleasure to the humanising influence exercised on the men of iron mould by several ladies who were present by express invitation of the local committee; and we would bear special testimony to the unwearying exertions of the general secretary, Mr. J. S. Jeans, in a very arduous position. We shall describe separately the various excursions to Gratz, Leoben, Buda-Pesth, Reschitza, Salgo-Torian, &c., in succeeding numbers.

OCCASIONAL NOTES.

TUNNEL AND ELEVATED RAILWAY AT HAMBURG.

THE senate of Hamburg have had under their consideration a scheme, proposed by Herr Westendarp, an engineer, for constructing a tunnel under the Elbe, and an elevated railway in Hamburg. The construction of a bridge, instead of the tunnel is out of the question, owing to the width and crowded state of the harbour; and the tunnel must be laid deep enough not to interfere with the passage of deep draught vessels. The author of the project has designed the tunnel of such dimensions as would provide both for vehicular and foot passenger traffic, and a double-track railway for goods and passengers. This he proposes to effect by building the tunnel of two stories—the road for vehicles and pedestrians to be in the upper, the line of railway in the lower story. The crown of the tunnel for a length of 656 feet (the width of the navigable channel of the Elbe), is to be 20 feet below the new, or about 30 feet below the old low-water mark. Separate openings are provided for railway and roadway, the ascent to be very gradual, 1 in 35. The tunnel is to be an iron cylinder lined with brickwork, the upper story resting upon columns placed between the two lines of rails. The latter would be in continuation of the track of the elevated railway in the city, which is to be of a decorative ironwork, and similar to that of the New York Elevated Railroad. Three stations are provided—at the Exchange, the Fischmarkt, and the St. Annens-Platz, where elegant pavilions are to be erected in the level of the line for taking up and putting down passengers. The tunnel is to be lighted by electricity, and ventilated and drained by powerful machinery; provision is also made for taking through the tunnel gas and water pipes, telegraph and telephone wires, a pneumatic post, &c. The estimated cost of tunnel and railway is 26,000,000 marks (£1,300,000), and they are to be completed in 5½ years. As it is of the greatest importance to the city of Hamburg to connect the territory of the projected free port on the left bank of the Elbe direct with the city, that expense will not stand in the way of carrying out the stupendous undertaking.

PRICES OF STEEL RAILS IN AMERICA.

Readers of IRON will have noticed how much prices of steel rails in the United States have recently fallen. According to the latest advices they have still further receded, and now stand at about 45 dols. per ton, a remarkably low figure indeed. Even at this, however, the manufacturers of the United States should be able to make a fair profit, in spite of the heavier cost to them of wages and raw material, since it is quite £3 per ton above what our makers are able to sell their rails at. Most of our manufacturers would be very well satisfied if they could obtain £7 per ton steadily for their produce; but American makers, even at the present extremely low prices, are getting £9 per ton. The relapse in prices may be partly due to the conclusion of the iron strike in America, but we believe it will be found to be in a measure owing also to a determination on the part of the manufacturers of the United States to prevent the importation of foreign rails even at the sacrifice of a portion of their own profits. The shipment of steel rails from this side is quite impossible at the present time, for considering that they have to bear 28 dols. import duty, there are only 17 dols., or about £3 8s. per ton left to pay for the manufacture and delivery of them. Fortunately our steel rail makers, as we have seen from late Board of Trade Returns, are becoming more and more independent of the demand from the United States.

BURNING OF THE SYDNEY EXHIBITION.

A brief telegram in the daily papers the other day announced the total destruction by fire of the fine building which was erected for the International Exhibition held at Sydney during the winter of 1879-80. The loss is variously estimated, one computation putting it down at half a million sterling, but even allowing for the natural tendency to exaggerate in matters of this sort, there can be no doubt that the colony of New South Wales, and, indeed, the whole Australian continent, are heavy losers by the catastrophe. The building, which was erected within the short space of eight months, was in the form of a Latin cross, the nave being 800 feet long, and the transept 500 feet. The intersection of the nave and the transept was crowned by a magnificent dome, the cupola of which was 200 feet from the ground. Some idea of the vastness of the dome will be gained when we state that its diameter was 100 feet, or only 8 feet less than that of the dome of St. Paul's. The whole building gave a floor area of about 7½ acres. Since the close of the exhibition the structure had been used for the accommodation of the School of Mines, and the Technological Museum, amongst other useful purposes, and its destruction is all the more to be regretted on that account.

THE MANCHESTER SHIP CANAL.

Manchester presents one of the most striking exceptions to be found to the general rule that all important cities, especially if they be commercial ones, are situated on the banks of navigable waters. But the men of Manchester have long been famous for their pluck and enterprise, and have made their town one of the principal business centres of Great Britain, in spite of the drawbacks offered by its inland position. That they are alive, however, to the disadvantages thereby imposed, is evidenced by the earnestness with which the proposal to construct a ship canal from the Mersey has been taken up. That the scheme would be an expensive one to carry out there can be no doubt, more particularly because it would be sure to be opposed tooth and nail by the large and powerful interests in Liverpool which would likely be prejudiced by its success, but there can be no doubt that it would be an immense boon to Manchester and the surrounding district. The plan most favoured and the one which the committee appointed to consider the question have decided to recommend, proposes to improve the present tidal portion of the river Mersey between Garston and Latchford, near Warrington, from which point up to Irlam it would be semi-tidal, and to construct a ship canal with locks between Irlam and Manchester. A counter scheme advocated the bringing of the sea right up to Manchester by means of tidal navigation over the entire distance. The project has so far taken shape that it will probably be brought before Parliament for sanction during the approaching session; and it may not be very long ere the inhabitants

of Manchester witness the strange sight of a forest of masts within their midst.

A NEW COALFIELD.

A further proof of the universal distribution of coal over the earth is afforded by the announcement of the discovery of the extensive nature of the deposit of coal which has long been known to exist in the Stormberg range of mountains situate in Cape Colony. The government of the colony have been prosecuting explorations, from which it would appear that there is an almost unlimited quantity of the mineral. The strata at a point where operations are about to be commenced are thus described:—Sandstone roof; coal, 6 inches; grey shale, 5 inches; coal, 10 inches; black slate, 9 inches; bottom coal, 14 inches; and lastly, shaly sandstone. The upper coal is stated to be of a soft nature, but bright, and burning easily, with a white ash; the 10-inch seam is highly bituminous, forming a good house coal; while the lower seam is hard and suitable as a steam coal. Should it prove that these beds of coal are able to be reached and worked under economical conditions, it will be a matter of vast importance to the colony, which would benefit largely by having within its own borders that which is so essential to a high industrial development. Cape Colony has already given proof of its richness in at least one of the most important of metals—viz., copper,—and if it turn out that the deposits of coal which it undoubtedly possesses are readily available, a new and yet brighter era would appear to be about to open up for it.

DOUBLE-ACTION WELL MACHINERY.

THE engraving on page 265 illustrates a very useful arrangement of water-raising machinery, by Messrs. W. Tasker and Sons, of Waterloo Ironworks, Andover. The apparatus is constructed wholly of iron, and stands on an iron curb-plate, 5 feet 9 inches by 4 feet 10 inches, with an opening for the passage of buckets 23 inches by 40 inches. A pulley is placed over the upper part of the machine, over which a chain passes with a bucket at both ends, so that when one bucket is delivered at the top full the other is being filled at bottom of well. On the curb-plate is placed a tank, provided with two catches, arranged that the buckets, on arriving at the top filled with water are so tilted over that the contents are emptied into the tank, as shown in our engraving, without the assistance of the person working the machine. The apparatus in this form is largely in use for raising water from wells up to 360 feet deep. Messrs. Tasker have, however, lately added a force pump, which is placed in the receiving tank on the curb-plate, and which is worked by the same handle as the well machinery, and the pipe from it conducts the water either to a tank on the top of the machine, as in our engraving, or to one fixed in any suitable position. When fixed on the top of the machine the tank is sufficiently high for delivering into water carts, for farm purposes, and it thus meets a long-felt need on hill farms.

The apparatus is so simple that one man with it can raise water from a well 150 feet, and force it to a tank placed 50 feet above the level of the machine, and as the whole arrangement is fixed above the surface of the ground, its superiority over deep well pumps with their attendant expenses must be obvious.

MINERS' STRIKES AND THEIR BENEVOLENT FUNDS.

IN an appeal to the miners of Yorkshire to join the Union and support a fund for the relief of widows and orphans just issued by the committee of that fund, some rather striking figures are given, showing the baneful effects of mixing up labour or strike funds with those intended for benevolent purposes. The circular, which is a lengthy one, shows the working of the Widow and Orphan Fund in connection with the Yorkshire Miners' Union since the year 1866, when the most disastrous explosion on record occurred at the Oaks Colliery. According to the circular, for the first seven years only accidental death claims were recognised, which threw 95 widows and 231 children on the fund, and in 1873, natural death claims were recognised, and 3d. per week was charged, and in three years £12,000 would have accumulated had the money been kept apart from the labour fund. From 1873 to 1876, the responsibilities of the fund greatly increased, the widows numbering 321, and the children dependent upon it 617. The evil day came, and in 1874 fully £20,000 of the general fund of the Union were expended in a strike, followed by a rapid withdrawal of several thousand members. In 1876 the membership had decreased nearly one half. £2300 were owing to the bank, whilst the liabilities of widows and orphans had reached £222 per fortnight. From 1873 to 1876 all claims were met, but in the latter year 1200 men were locked out, and had to be supported. This sealed the fate of the old fund, so far as the widows were concerned, to whom small grants were made, but the orphan and permanently disabled members have been and are still supported. In the latter half of 1878 a sum of £1600 was lent to the labour fund, seventeen branches of miners being then out on strike or locked out. The circulars says that during six years £20,266 were expended in strikes and lock outs, and £1119 were paid to victimised members.

A SPECIAL department for the purchase and sale of chemicals, minerals, and Algerian produce has been opened by Messrs. Dutrulle, Solomons, and Co., of Fowkes Buildings, Great Tower Street. The appointment of manager of this branch has been accepted by Mr. J. Desvignes, formerly the London manager for Messrs. J. Berger, Spence and Co.

HISTORY OF MODERN INVENTION IN THE MANUFACTURE OF IRON.

By W. Mattieu Williams, F.R.A.S., F.C.S.

(*Continued from page* 189.)

THE specification No. 578, March 1, 1860, by Henry Bessemer, is for various improvements in his process. First, for regulating and registering the supply of air blown through the metal in the converters, in order that the degree of oxidation that has been effected may be known at any stage of the process. A pair of horizontal high pressure engines are placed parallel to each other, so that one crank shaft and fly wheel only is required for the pair of engines. These engines work a blast (by arrangements fully figured in the drawings) in such wise that it shall be forced into a receiver, and from thence pass in a uniform current to the converter. As each stroke of the engines forces into the receiver a definite quantity of air, an apparatus for registering the revolutions of the crank shaft driving the piston rods of the blast cylinders indicates the quantity of air forced through the molten metal. The air may be artificially dried or mixed with other gases. This is rendered easy, as by the construction of the blast apparatus, the air is all taken in through a pipe leading out of the engine room. When the pig is melted in reverberatory or air furnaces they are erected at such elevation that the fluid metal may be run directly into the converters, and the furnaces are so grouped that each of them can run metal into any of the converters. For this purpose the converting vessels are made movable from place to place, and each has a rotatory motion on its own axes for filling and discharging, which is preferably effected by means of fluid pressure acting in a cylinder, the piston rod of which is formed into a rack at one end and actuates a spur wheel keyed on the axis of the vessel. The details are fully figured, the converters shown and described being of the shape and construction of those now commonly in use. The method of lining with ganister, &c., the preliminary heating as now practised, is also described, but a set of four converters are represented as attached to a "revolving framework supported on wheels, or on a central post or axis," in order that they may be brought under the melting furnaces for charging. This carrying of the mountain to Mahomet was at once practically superseded by the simple device (due, I believe, to George Brown, of Sheffield) of running the metal down a trough to each converter. The saving effected by this is rendered strikingly evident by the drawings and long description of the elaborate and ponderous machinery thus superseded by a few feet of open guttering, similar to that on the eaves of a house, but lined with ganister. The method of charging by tipping the converter so that the metal shall lie in the concavity of its side, and not rest on the bottom until the charge is completed, is also described; likewise the turning on of the blast before the converter is turned upright again, and the turning down to discharge into the previously heated casting ladle. The arrangement of this ladle on one end of an hydraulic lift, consisting of a frame strengthened by tension rods and fixed on an hydraulic ram, the other end carrying a similar ladle or counterbalance, and the whole turning so as to bring the ladle over a row of moulds arranged in circular curve, is also described; but instead of pouring its contents directly from its bottom plug into the moulds one after another, it is represented as running them into an intermediate basin or vessel, placed underneath it, and this basin having spouts at the upper edge or several bottom openings, so that while one large stream passes from the ladle into the basin, small streams flow from the basin into several moulds simultaneously. This is claimed as an improvement on the direct and successive pouring, as the metal will then "be conveyed with less force and in smaller quantities into the several moulds beneath, by which means sounder ingots will be produced, owing to the diminished velocity with which the metal enters the mould from these basins, while the slow filling of each mould by a small stream of metal also tends to improve the ingots, but at the same time does not prevent the rapid emptying of the casting ladle, and thus a large number of small ingots may be made from one large ladle of metal without retaining the metal therein until it has cooled too far for casting." This expectation has not been fulfilled; the running directly from the ladle to the moulds successively continued in use until the introduction of the device of running all into one mould and connecting this on each side with its neighbours by channels running from the bottom, so that the melted metal shall rise from below in all but the primary receiving ingot, and thereby be clear of dross and less liable to bubbles.

This specification is important, inasmuch as it formed the basis of a residual claim for a continued smaller royalty on the apparatus that was erected and used in Bessemer steel works when the patent for the fundamental invention for blowing had expired. It is always difficult to define the limits of merit as regards originality in the details of complex inventions where more than one have been concerned. In the course of many conversations that I have had with George Brown on this subject, he claimed a considerable proportion of the details of this specification.

No 772, March 24, 1860, by Isaac Blackburn, is curious, being as the inventor states, "founded upon the well-established fact that when a compound is subjected to an electrical current its negative and positive elements are detached from each other." He thus proposes to separate from the electro-positive iron the negative carbon, phosphorus, sulphur, arsenic, and silicon. He tells us that "when impure iron in an incandescent state is subjected to streams of electricity, the chemical affinities by which its various heterogeneous components are firmly associated, are immediately subverted, and the sulphur, phosphorus, and other impurities so degrading to the quality are readily removed." To create this current he employs "the agency of phosphorus, amorphous phosphorus, or other oxides with or without alumina or other pure clay." His method of employing such "electrisor" is simply to "throw in to melted pig-iron the phosphorus, amorphous phosphorus, or other oxides, protecting the same from the action of the oxygen of the atmosphere by a thin coating of alumina or other plastic clay, the electric current effects the subversion and completes the perfect electrisation of the metal." "The quantity of the electrisor to be used must be determined by analyses of the iron and the weight to be electrized." The process is the same in refining puddling, and founding. In all cases the phosphorus "or other oxides" is added, and this electrisor effects the desired separation, either in special receptacles attached, to the "stack furnace," or in the pig beds, or in the melted metal of the refinery, puddling hearth, or founders' melting pots or ladles. This notable invention evidently came out before its time. Had it been secured early in 1882, when the existing electromania was at its height, a company with a captital of half a million or more might easily have been "floated"; the inventor to have received £100,000 for his patent rights, of which £99,999 19s. 11¾ would have been absorbed by the agency expenses of the company-floaters.

No. 851, April 3, 1860, by Philip Woodruff, who states that "the best quality of iron has hitherto been made by using charcoal, instead of which I propose by this invention to use in the puddling furnace as a flux peroxide of manganese," the oxygen of which, he says, leaves it to combine with sulphur, phosphorus, and other impurities. He adds to a charge of 4 or 5 cwt. in the puddling furnace one to three pounds of peroxide of manganese, according to the nature of the pig-iron used, and the quality of iron required. This must be added just after the iron is melted; if added sooner, or after boiling has commenced, "the flux will not unite so thoroughly with the sulphur and phosphorus, nor will the manganese unite so thoroughly with the iron." Special fitness for tin plates is claimed for the iron thus treated. (Provisional only.)

William Parsons, in No. 872, April 5, 1860, claims the use of anthracite combined with air and steam under pressure, which are to be used in ordinary puddling, balling, and reheating furnaces, preferably constructed with longer and narrower fire grates than are usually employed. The ash pits to be closed, and steam and air under pressure to be supplied to such ash pits. A good proportion for a fire grate is 7 feet long by 3 feet 6 inches wide, the working bed of the furnace being 4 feet long and 3 feet 6 inches wide. The bars of the fire grate to be deeper and thinner than usual—about 10 inches deep, ½ inch thick, with ½ inch spaces between. The steam to be supplied to the closed ash pit by a pipe 2 inches in diameter, perforated so as to allow the steam to escape beneath the fire bars, and another perforated pipe about 1 inch in diameter for the air. The steam at a pressure of about 7 lb. to the square inch, and the air at about 2 lb. This inventor, resident at Pont-ar-Tawe, Swansea, is one of the many who have tried, with varying degrees of success and failure, to use the abundant anthracite of that district in the manufacture of iron. This effort is now likely to lose much of its importance by the growing demand for smokeless fires in London and other large towns; the present question being, not what shall we do with our anthracite, but where shall we find enough for domestic uses?

No. 874, April 5, 1860, is a communication from Charles Noel and Co. of Paris, to John Henry Johnson, and claims "the production or manufacture of a new metal alloy which is easily melted, and when cast, forms a superior species of cast steel;" the bases of this alloy are wrought iron and cast iron of any quality melted together in proportions giving the alloy the desired amount of carbon. The inventor says, "In relation to steel it is well known that wrought iron contains less carbon and pig-iron an excess of carbon. Now, by alloying with the wrought iron (which is in a sub-carbonised state) just as much pig metal (which is in a super-carbonised state) as will give the alloy the percentage of carbon required to make steel of any desired degree of hardness." Steel may be produced of any desired hardness. The inventor does not stop here, as others have done, but describes methods of purification by adding to the mixture of wrought and pig-iron, when melted down to a pasty condition, a mixture of oxide of manganese, sesquioxide of iron, sal-ammoniac and nitrate of potash, in proportions varying with the impurities of the iron. For ordinary "clean English, Scotch and Welsh iron," ½ lb. oxide of manganese ½ lb oxide of iron, and 3 oz. each of sal-ammoniac and nitrate of potash to each crucible, containing about 40 lbs. of iron. Other chemicals may be added.

No. 964, April 17, 1860, by Henry Adcock, is for improvements in puddling, balling, and mill furnaces. In place of having a considerable space between the front of the bridge and inside front of the fire-place and an opening or openings at the sides to feed the fuel, the front of the furnace is brought nearer to the bridge, and the fire is fed through a space under the front of the furnace. The fire-bars are set closer together than usual, and the fire is fed on to their front ends from a hopper above, or from a dead plate. The alternate fire-bars are capable of being slightly raised at their ends, to prevent formation of clinkers. Under the fire-bars is an inclined screen, down which the cinders fall towards the front of the ashpit, by which they are sifted and from time to time thrown up with fresh fuel into the hopper, or on the dead plate in front of the fire-place. (Provisional only, no drawings, and description of details obscure.)

The specification of Asahel Knowlton Eaton, No. 1036, April 25, 1860, describes a method of steel making by packing thin plates of cast-iron in boxes with sufficient carbonate or soda to cover them when melted. The whole to be kept at a bright red heat for several hours. The soda is said both to decarbonise and purify the iron, the carbon combining with the oxygen of the soda and sodium being set free and volatilised. This may be collected in the metallic state beneath the surface of melted paraffin or other liquids containing no oxygen; or more conveniently, allowed to re-oxidise. The other impurities (sulphur, phosphorus, silicon, &c.) combine with the soda. Carbonate of potash may be substituted for carbonate of soda. After the carbonates have become very impure by continual use, they may be purified by pulverising, mixing with sawdust, and exposure to a red heat, then to be dissolved and re-crystallised. Hydrates of potash and soda may be used, but neither so conveniently nor so economical as the carbonates.

UNDERGROUND TELEPHONING.—A trial has been made of a Siemens and Halske's telephone laid underground between Cologne and Elberfeld with very favourable results, every word being distinct. In the trial between Brussels and Paris a microphone was used, but was dispensed with on this occasion.

MINING AND ITS COST IN SWEDEN.

[Translated from a report by Prof. R. ÅKERMAN.]

MINERS in Sweden are generally paid by piece-work, at some places according to the quantity of rock broken out, but mostly according to the length of hole bored, and sometimes these two methods of payment are combined, and the workmen then paid for the length of hole bored by each. If day wages are paid, the miners receive from 1s. 6d. to 2s. 6d. per day; but, in addition to this, they have many advantages, such as free dwelling-house, fuel, potato land, fodder for a cow, &c., so that it is difficult to give the exact amount of their earnings. Single-handed or "one man's boring" is now general, by which method one man strikes with the hammer, whilst managing the boring tool; but at some places the so-called "two men's boring" is still in use. The bore-holes have a diameter of from eight to nine lines, and the cost for downward boring, "under hand," is from 2½d. to 6d. per foot, according as the workmen, besides wages, have more or less emoluments, but for boring upwards "overhand"—"dry boring"—often twice as much. Steel is now exclusively used for hammers and boring tools; and the most common explosives used are mining powder—both in round grains and in the form of cartridges—and dynamite, as well as others mixed with nitro-glycerine, as, for instance, sebastine. In consequence of the numerous accidents, the use of nitro-glycerine in its pure form was strictly prohibited some years ago; but as this prohibition has of late been relaxed, its use is again frequent. The work a miner is capable of performing naturally varies according to the hardness of the gangue, his own skill, and the explosives employed, but the following figures may be quoted as an approximate average. Per day and per man it is commonly 5 to 8 feet downwards, sometimes even 10 to 12 feet; but with boring upwards only half as much; and per month a workman may break as much as 50 tons of rock, whilst the quantity of explosives used of the more powerful kind is one pound to 1 to 2 cwt. of rock, or, if mining powder, 40 to 60 cwt. The cost of the dressed ore on the bank amounts to from 9 to 35 öre per cwt. or 2s. 6d. to 8s. 10d. per ton.

The winning of the ore is generally carried on by sinking shafts, driving levels, and underhand stoping, in such a manner that, when a shaft has been excavated through the loose layer of earth, and so deep into the bed of the ore itself that the part of the solid rock which has been bored through is considered to afford a secure roof, levels are laid out in the direction of the strike; and whilst thus the main sinking or shaft opened from the outset is continued steadily downwards, the ore is taken out by underhand stoping, the necessary supports being left for the walls of the mine. The space in the mine from which ore has been removed is thus, in general, left open or unfilled, and it is only in some of the iron mines whose sides, in consequence of cracks and loose places, cannot be kept up by supports that close timbering must be resorted to; still, of late years, the vacant spaces have in some mines been refilled with barren rock, and the ores then taken out by overhand stoping. At most Swedish mines the latter method of working is certainly unnecessary, but it is probable that in future it will be oftener used, as many mines have, with the other method of working, become insecure. On the other hand the want of sterile rock for filling the vacant space will prevent its adoption at several mining fields, as nearly half as much is required for this purpose as the entire mass of rock broken out. When the shaft is perpendicular, the ore is taken out of the mine in barrels (kibbles), either made of wood and hooped with iron, or of Bessemer metal, which hold 6 to 8 cubic feet or from 9 to 15 cwt. of rock, and these are hoisted to the bank by wire ropes. When the shaft is inclined, there are either employed so-called "slant ways," along which the ore is raised in barrels, or railways, both following the slope of the shaft, and if a railway is constructed, the ore is, in that case, loaded into waggons ("dogs" or "bears") which hold from 15 to 22 cwt. of rock. For the horizontal conveyance of the ore to the place from where it is raised, wheel-barrows, and, where the distance is short, hand-barrows, have hitherto been mostly used, but now railways begin to be more employed in their place. The ore is further, as a rule, reloaded at the shaft, and it is only when the hoisting is carried on with barrels, and a railway simultaneously employed for its conveyance from the working chamber to the shaft—as is, for instance, the case with overhand stoping—that the ore is raised to the bank without reloading. On the other hand, there is not found in any Swedish iron mine such an arrangement for raising several waggons simultaneously as is found in nearly every mine in England, and which is so necessary for raising any large quantity of ore at once. The cause of this is, in the first place, the way in which the mining is carried on in Sweden, by which it is but seldom possible to collect as much ore upon the same level as is required for this method of hoisting; and, secondly, by the difficulty of getting it raised to the height required, where water-power is employed as motor for this purpose. To replace the latter force by steam would in many places be very expensive in consequence of the want of fuel—a want felt in most iron-fields in Sweden. At mining fields, however, where the beds of ore lie so near each other that the same shaft may be used for several, and at the more extensive mining fields, where overhand stoping has been introduced, such hoisting arrangements would be very advantageous, and must even become compulsory, should the demand for iron ore cause an increased output.

The raising of water in Sweden is generally effected by suction pumps, placed under each other, or by so-called "pump-settings," each of which has a length of 30 to 36 feet, but in deeper mines force-pumps, which are much more effective, are employed. Some of these force-pumps are capable of raising the water to a height of more than 700 feet, and the greatest perpendicular depth of any Swedish iron mine is at present 800 feet. At smaller mines the same power is sometimes employed for raising both ore and water, but generally different motors are used for these purposes. As Sweden abounds in streams, available water-power is, as a rule, to be found in the neighbourhood of mines, and to bring the water-power to the mines, there are employed so-called "kopstgangar," consisting of wooden pipes joined together at the end, and in some cases also wire ropes Such "konstgangar," which sometimes have a length of 10,000 feet, are very common for bringing the water-power to the pumping stations, but they are seldom employed for raising the ore, steam being mostly employed for this purpose, especially where the distance between the mine and the nearest waterfall is too great to allow of the use of wire ropes. Steam-power must, however, sometimes be employed for raising the water in certain mines. In the year 1880 there were 193 steam-engines in use in the Swedish iron industry, of which 83 were employed in the iron mines, but most of these were only of 10 to 16 horse-power. That both the number and the power of the steam-engines employed at mines in Sweden must, in course of time, be considerably increased, is certain, in consequence of the increasing depth of the mines and growing demand for ore. Where water-power has hitherto sufficed for raising a small quantity of ore from a limited depth, a stronger motor will soon be required.

If the period of prosperity for the Swedish iron manufacture, which began in 1871 and ended in 1873, is excepted, the demand for Swedish ore has from year to year been in proportion to the supply, which has been met without difficulty, on account of which also the price of iron ore before the period just mentioned was at most mines so low—20 to 30 öre per cwt. (5s. 2d. to 7s. 8d. per ton)—that the only object of the mine-owner was to get up at the lowest possible cost, for the occasion, the exact quantity of ore necessary for the year's demand. Such a way of working a mine is, however, not compatible with a truly rational method; and it may further be a question whether such a method is at all possible in mines where, as is the case in many places in Sweden, the same deposit of ore, in a nearly vertical position, is worked not by a single company, but is divided among several different owners, who each work in their respective holes, and are apt to come into collision with each other underground. And although at many of the larger mining fields the available water-power may frequently be insufficient for raising a large quantity of ore, it can perhaps scarcely be denied that a greater effect might be obtained if all mines sunk on the same deposit were united and worked together, so that the raising of ore and water might be carried on in a few shafts, instead of, as is now the case, every separate sinking having its own winding gear, and being worked by itself. Although it is admitted that the arrangements and working at many of the Swedish mines are susceptible of improvement, it ought to be pointed out, on the other hand, that a greater part of the iron deposits in Sweden are too limited in extent, and the supply of ore too uncertain, to admit of any great outlay; and also that the existing state of things is, to a great extent, caused by defective arrangements in times gone by, which could not possibly be rectified without great difficulty and expense, and without the combined action of several very divergent interests. Besides this, it should also be borne in mind that, as regards transport, even the more extensive mining fields in that country were, up to the last few years, devoid of railway communication, and therefore the sending of ore any considerable distance was, if not an impossibility, at least attended with great risk and expense. During the last five to ten years many modern improvements have, however, been introduced into the mining industry of Sweden; and there is no doubt that, had the high prices which Swedish ore fetched ten years ago been maintained a little longer, mine-owners would have borne any expense in order to increase and generally improve their production. But the present unpromising state of the iron trade, when they have the greatest difficulty in getting rid of their limited yearly output—large enough only to cover the cost of raising—will certainly not encourage the mine owners in that country to any further outlay of capital. It ought, however, to be added that, while the present prices of Swedish ore cannot of course compare with those paid six to eight years ago, viz. kr. 0·75 to kr. 1·75 per cwt. on the bank (£1 to £1 10s. per ton), they have not receded to the figures common ten to twelve years ago, as the ores which then fetched on the bank 20 to 30 öre per cwt. (5s. 2d. to 7s. 8d. per ton) will now fetch 30 to 40 öre per cwt. (7s. 8d. to 10s. 4d. per ton).

With regard to the improved railway communication in Sweden referred to above, it ought to be pointed out that this is a factor of vital importance in the iron industry of the country, particularly as regards the transport of ore. In Sweden the latter has to be freighted long distances in order to be smelted, furnaces being erected only where there is a plentiful supply of fuel, which is, as a rule, totally absent in the vicinity of large iron deposits. For the hire of a man, horse, and cart, there is paid in Sweden from 2s. 8d. to 6s. 3d. a day, but for longer distances than seven miles the pay is from ¾d. to 1½d. per cwt. mile, or 1⅞d. to 4d. per ton of ore, for seven miles, while the rates for carrying iron ore on the state railways are as follows per ton:—For seven miles, ½d.; for seventy miles, 2d.; for 140 miles, 3½d.; and so on with a gradual increase for every 70 miles, but less in proportion as the distance increases. In the year 1880, the last for which we possess statistics, 352 iron mines were worked in Sweden, from which were raised 755,000 tons of ore and in which were employed 5008 persons, among whom 328 were women and children. There were thirty-six accidents, of which eighteen were fatal.

THE LEAD TRADE.

THE lead trade was the last of our important industries to feel the effects of the general commercial depression which set in some few years ago, and it was not unreasonably supposed that a metal of such general application would be the first to improve in value when credit was re-established. For at least half a century the trade has not been in a worse position than during the last three years, in which it is estimated that more than one-third of the lead found in Europe has been sold at an actual loss to the producer. The profits of the smelters have been reduced to a minimum; and even the manufacturers, who convert the metal into the sheets, pipes, red and white lead, and other articles of commerce, have been forced to sell their produce at prices which have left them little or no return. Great Britain is recognised as the centre of the lead trade, and the prices of the London Exchange regulate those of the European markets. The condition of so important an industry is obviously a matter of some interest. The relative quantities of lead produced in different countries may be thus stated:—Great Britain, 54,000 tons per annum; Spain, 120,000; Germany, 90,000; Italy, 10,000; Greece, 9000; France, 15,000; Belgium, 8000; Austria, 6000; Russia, 1500; United States of America, 10,000; Australia, and other sources of supply, 3500; total, 417,000. The figures are approximate only, and in the case of France and Belgium the sum is principally made up from the lead ores imported out of Spain and Italy. The United States imposed an import duty of £9 per ton on pig lead in 1864, since which time the American demand for it from Europe has been practically of no importance. As far as can be ascertained from our imperfect Board of Trade Returns, the lead trade of Great Britain during the last ten years has been as follows:—

Year.	British Production plus Imports.	Exports.	Amount Retained or Consumed.	Price per Ton.
	Tons.	Tons.	Tons.	£ s. d.
1872	143,129	59,904	83,225	20 0 0
1873	127,695	46,479	81,216	23 6 3
1874	133,798	55,531	78,267	22 2 6
1875	148,148	52,058	96,090	22 10 0
1876	150,624	56,282	94,342	21 13 9
1877	167,783	61,978	105,805	20 11 3
1878	171,708	51,033	120,675	16 15 0
1879	169,087	54,252	114,815	14 16 3
1880	164 963	52,292	112,671	16 7 6
1881	156,500	61,689	94,811	15 0 0

On the recommendation of a Parliamentary Commission in 1871 the items of red and white lead in these returns were included in "painters' colours," which is certainly not a correct classification; shot, used principally for sporting purposes, in "arms, military stores, and ammunition;" litharge in "chemical manufactures;" and acetate and other forms of lead in "manufactured articles unenumerated." Under the new headings, therefore, the items relating to lead cannot be ascertained and identified. But probably about 40,000 tons of lead are annually converted here into the manufactured forms above mentioned. In the table the imports and exports of manufactured lead, the returns of which no longer appear, have been put at 2200 and 13,000 tons per annum respectively, those being the amounts returned in 1870. It is generally believed that the production of lead in Europe is in excess of the consumption. There is no evidence in support of such a belief. On the contrary, it is now evident that any over production has been absorbed; for stocks—that is, stores of lead ready for sale in this country and abroad—are admitted to be unusually low. When the fall in the value of lead commenced in 1877 it was supposed that, as soon as the market price fell below the cost price of production, supplies would diminish. The market price did so descend, but supplies, nevertheless, continued to increase, and from the middle of 1878 to the middle of 1880, the heavy production, coupled with the general depression of trade, made lead unsaleable sometimes at £13 per ton. It must, therefore, be admitted that for a time the supplies exceeded the demand. Increased production with low prices, though apparently anomalous, is but a natural result. From an average lead mine, treated with due regard to the capital invested and to its future working, lead cannot be put in the market under £16 10s. per ton. A lower figure would entail direct loss on the producer, unless he exhausts his mine by intrenching upon its reserves, in which case, by neglecting current explorations, repairs, and outlay upon plant, and by increased production, his cost price may be reduced to from £14 to £15 per ton. When lead fell in value below £14 per ton, the producer, whose former experience disposed him to look upon such a price as abnormal and as probably of brief duration, had two alternatives. It must be premised that lead mines are, as a rule, worked on a system of royalties; but a minimum rent is in most cases payable, even although the mine be unworked. He might first stop the working of his mine, with the inevitable certainty of future expense in re-opening it, and the risk of its caving in, and dismiss his staff and workmen, many of whom would be practically unfit for other occupation. He would still be under the obligation of paying a dead rent to his lessor, amounting in some cases to thousands of pounds per annum, and must absolutely sacrifice all interest on the capital which he had invested. Or, secondly, he might economise in every direction and distribute his expenses over an increased production by attacking the hard-won reserves left unworked from former years. It is not surprising that the latter course was generally adopted, or that relief was sought at the risk of ruining or depreciating the mine. Hence increased production came to multiply the difficulties of the producer, lengthening the period and the depth of the depression. The inevitable result has been that a large number of mines have been absolutely worked out, which cannot be re-opened without the expenditure of much time and capital.

It is contended that, although the depression still continues, the production of lead in 1881 was not the sole or a sufficient source of the supply for consumption. An enormous decrease of makers' stocks in Spain is evident of late years, partly owing to increased railway and shipping facilities abroad, but principally to the necessity of realising to meet current obligations, which are always onerous on the maker in a falling market. It is plausibly argued that, as manufacturers' stocks in this and other countries have also decreased, the demand for lead has absorbed not only the current supplies, but the additional amount thrown on the market by the reduction of stocks as well. The lead trade of Europe may be fairly gauged by that of this country. In order to decide whether the low prices of late years, and particularly of last year, are justified, the figures of supply and demand, so far as they are obtainable, may be applied as a test. The supply can be estimated with some degree

of precision; the demand can only be judged of by way of inference, and particularly by the rise or fall in the value of lead. The changes of the lead market, when considered for the purpose of comparison, are, perhaps, best observed over quinquennial periods. It is of importance to determine whether the increased rate of production, which is evident, has been accompanied by an equally progressive rate of consumption. From 1845 to 1849, the earliest period for which fairly reliable returns are obtainable, the total imports into this country, *plus* native production, averaged 60 377 tons per annum, and the price £17 13s. 9d. per ton. From 1873 to 1877, the period immediately preceding the fall, these figures were increased respectively to 145,609 tons and £22 0s. 9d. Thus the increase in a period of twenty-eight years, of 140 per cent. on the total quantity produced and imported was accompanied by a rise in value equal to about 25 per cent. It may therefore be assumed that during this period the rate of consumption progressed equally with, or in an increased ratio to, that of production. The fact is hardly to be wondered at in view of the more extensive application of lead to manufacturing purposes, building operations, and gas, water, and sanitary apparatus. That a progressive improvement in any particular trade, such as has been clearly indicated above, should receive a check during a time of universal commercial depression, such as was felt in the years 1878 to 1880, is natural enough, especially since the producers, as a consequence of their struggle for existence, caused the amount of "imports and native production" to swell to 171,708 tons, which left no less than 120,675 tons for home consumption. This quantity, however, large as it was, has since disappeared from the market. In 1881 native production and imports were reduced to 156,500 tons, and the amount for British consumption to 94,811 tons, which cannot be very far from its requirements. It is admitted that the depression of the lead trade has been largely contributed to by the possession of insufficient capital on the part of a large number of producers, by the absence of banking facilities for obtaining advances on stocks held temporarily at home and abroad, and, finally, by the operations of speculators. Formerly the entire production of Spain was exported to other European countries as silver lead. The silver was extracted and the lead rendered marketable by long established manufacturing firms, having large financial resources and an extensive *clientèle* and well able to remain off the market when there was but a slight demand. The Spaniards became dissatisfied, not without reason, at the lowness of the prices they received and commenced to desilverise in Spain. This had a prejudicial effect, and a weak tone was imparted to the market. Whatever the general effect of the policy may have been, it was soon found that in any given district of Spain the smelter who did not desilverise could not compete in buying his raw material from the native miner with another who did: and the lower the prices fell the more clearly was his position of disadvantage apparent.

With supply and demand in equilibrium, there is a marked difference in the control exercised by strong, as compared with weak, sellers on the market. The yearly requirements being 150,000 tons it does not follow by any means that the demand can absorb month by month 12,500, still less weekly supplies of 3000 tons. If the trade is in strong hands, prices may be obtained over periods of slack demand; while the reverse must take place if the sellers are weak. Circumstances in 1878, 1879, and perhaps part of 1880, made a fine opening for speculators of which they were not slow to avail themselves. The market was at their mercy during that time and the hold they acquired upon it enabled them to continue their operations in 1881, when in reality the statistics of supply and demand showed evidence of a state of things which no longer favoured them. The *modus operandi* of the speculator, which has always a tendency to depress prices, is simple and requires but little working capital, if only it be practised on a sufficiently extensive scale. He makes sales or contracts for several months forward (a practice which is not adopted or approved by any *bona fide* lead producer) for perhaps some thousands of tons, without being in a position to deliver a tithe of such a quantity, and he secures the co-operation of the consumers by offering to deliver at a lower price than is ruling at the time. Thus, when the producer enters the market all the buyers are engaged, and the only purchaser he can deal with is the speculator, who has forestalled him, and who, of course, will only purchase at a lower figure than he has himself engaged to deliver at. When prices are dangerously low the speculator abstains for a time from operating, and prices improve. He desires, however, "*reculer pour mieux sauter*," and the improved prices, which are allowed to rule during his inactivity, serve afterwards as a new basis for speculative operation.

It is apprehended by pessimists that such an increase of production will follow on improved prices, that a rising market will be choked at the outset. This is by no means likely to follow. There are few lead mines which have not been more or less exhausted by attacking reserves in the quinquennial period which commenced with the year 1878, and low prices have been shown by experience to have caused an increased outlay. With remunerative prices again prevailing, the first and paramount interest of a mine owner will be to reconstitute the reserves he has been drawing upon, which in a well-conducted mine should represent three years' production. Whatever time he may have occupied in taking out reserves, it will require at least four times as long to reconstitute them. A long continuance of high prices will doubtless stimulate new enterprise; but it takes some years to open out a new mine. Some hopeful signs are to be detected. There is, first, the absence of large stocks. The amount in this country of lead actually held back from the market is liberally estimated at 20,000 tons, or £300,000 worth, against which there has been a large reduction of floating stocks in the hands of manufacturers. Copper, with stocks of 35,000 tons landed in England of a value of £2,400,000, has improved £10 per ton in price during the last twelve months. Lead stocks cannot, therefore, be considered high, especially when it is remembered that the trade in it is nearly double that of copper. A second encouraging fact is the absence of any excess of production in 1881. A third is the increasing rate of consumption. Electricity is likely to become the means of creating a new and important demand for lead. The accumulator, storage or secondary battery, is said to be as indispensable an adjunct to electric lighting appliances as a gasometer is to those for generating gas. It is calculated that for each house lighted by from twenty to thirty electric lamps about two tons of lead will be required where secondary batteries are used. A demand may, therefore, arise here for thousands and hundreds of thousands of tons. The secondary battery, like electric lighting generally, has not yet emerged from the experimental stage. But already contracts have been entered into for its supply to an extent which absorbs 400 tons of lead per month—an amount not to be despised by the producer, when supply and demand are already supposed to be in equilibrium. Another and cheaper medium for what is popularly called "storing" electricity may possibly be found; but, so far as is at present known, the only metals suitable for the purpose are silver, copper, and lead. Long before the demand is so great as to cause the price of the last to be equal to that of either silver or copper, the lead producer may look back with equanimity on the unhappy conditions of the quinquennial period which will terminate in 1882.—*Times*.

NOTICES OF BOOKS.

A Treatise on Trigonometry. By the Rev. J. B. LOCK, M.A. London: Macmillan and Co., 1882.

THIS work contains that part of the subject which can conveniently be explained without the use of infinite series. The examples are numerous, and for the most part easy. On that account the book is suitable either for class teaching or for private study.

Directory to the Iron and Steel Works of the United States. Corrected to July 25, 1882. Prepared and published by the American Iron and Steel Association, Philadelphia, 1882.

LIKE *Poor's Railway Manual*, this *Directory* is a trustworthy record of the progress of the United States. The book before us is the sixth edition of the work, the first having been issued in 1873. The greatest efforts have been made to render this edition correct as far as the constantly recurring changes in ownership and the large extent of the country permit of accuracy. A new and valuable feature of this edition of the *Directory* is the addition of a full alphabetical index to the names of all the iron and steel works of the country. To those having business relations with the United States this *Directory* is of very great service.

Minutes of Proceedings of the Institution of Civil Engineers. Vols. lxviii. and lxix. London: published by the Institution, 1882.

THE second and third volumes for the session 1881-82 of the Institution of Civil Engineers are now before us. Both volumes contain the usual records of the proceedings during that session, as well as a number of selected papers which, for want of time or other reasons, could not be read. They also include those valuable abstracts of papers from foreign periodicals and transactions for the publication of which the council deserve the thanks of young (and old) engineers. Taken as a whole, the two volumes show that the institution certainly issues a plentiful supply of matter, of which, in justice, it ought to be said that it is as good in quality as it is abundant in quantity.

Sewage Disposal. For the Guidance of Sanitary Authorities. By H. ROBINSON, M.Inst C.E. Second edition. London: E. and F. N. Spon, 1882.

IT speaks well for the spread of the recognised principles for the preservation of the public health that this little work should have passed so rapidly through its first edition. But this fact also indicates that there existed a want for a condensed description of the chief points which govern the question of sewage disposal, such as this book affords. The author has obtained much of the information contained in its pages when advising sanitary authorities as to the best means of sewering their towns and of disposing of their sewage. The data which he has thus been enabled to collect he has condensed into a compass for convenient reference, his book furnishing a ready means of obtaining guidance on points which are continually arising in sewage practice.

Proceedings of the United States Naval Institute. Vol. viii. No. 1, 1882. Annapolis, Maryland.

WE are in receipt of the first quarterly instalment of the eighth volume of the *Proceedings*, which contains, besides what we may term official matter, the prize essay for 1882, the subject of the latter being "Our Merchant Marine: the Causes of its Decline, and the Means to be taken for its Revival." Lieut. J. D. J. Kelley, U.S.N., who gained the first prize, suggests as a remedy for the decay of American shipping the more general adoption of iron for shipbuilding purposes, and the reform, in a liberal sense, of the American shipping laws. "Free ships," the author says, "with the co-ordinate measures of relief is the only solution of the problem submitted for discussion and proof." We are glad to learn that there is an able minority opposed to the present protective regimen, which is making efforts to introduce reforms also in the United States navigation laws.

An Elementary Treatise on Conic Sections. By CHARLES SMITH, M.A. London: Macmillan and Co., 1882.

The author has, in this work, investigated the more elementary properties of the parabola, ellipse, and hyperbola, defined with reference to a focus and directrix, before considering the general equation of the second degree. This arrangement is no doubt best for beginners. The examples in the body of each chapter are for the most part very easy applications of the bookwork, and have been carefully selected and arranged to illustrate the principles of the subject. The examples at the end of each chapter are more difficult, and include many of those which have been set in the recent university and college examinations, and in the examinations for open scholarships at Cambridge. The answers to the examples, together with occasional hints and solutions, are given in an appendix. There are also included in the body of the work, complete solutions of some illustrative examples, which will be found especially useful. Although the elementary parts of the subject are presented in a simple manner for the benefit of beginners, the work, to some extent, is made complete by including a chapter on trilinear co-ordinates, and short accounts of the methods of reciprocation and conical projection.

Manual of the Railroads of the United States. By HENRY V. POOR. New York: H. V. and H. W. Poor, 1882. London: Sampson Lowe and Co.

THE new edition of *Poor's Railroad Manual* reminds us that time speeds more quickly even than the railways, of the progress of which in the United States this bulky volume is the record. The returns supplied show that last year was one of extraordinary activity in American railway affairs, the greatest number of miles of new railway for any year—9358—having been constructed. The heaviest returns previously had been 7379 miles in 1871. Estimating last year's new lines at 25,000 dols. per mile, they cost 233,750,000 dols., and, in addition, the estimate is made that at least 75 millions were expended on lines in progress, and 100 millions more in improving existing railways, making a total of over 400 millions expended in railway construction in the United States in a single year. Mr. Poor estimates that the new mileage of 1882 will probably equal that of last year. Down to June 1, 3677 miles had been constructed, against 1734 miles for the same time last year. This rate of increase, however, will not be maintained throughout the year, but the aggregate new road, it is thought, will not be much short of 10,000 miles. At the close of 1881 the total railway mileage of the United States had reached the enormous figure of 104,813 miles. In the centennial year—1876—the total was only 76,808 miles. These strides are worthy of record, supplying us with unfailing evidence of the development of the United States. We ought to be thankful to Mr. Poor for enabling us, by his diligent labours, to judge correctly of that growth.

OBITUARY.

WOEHLER.—The death is announced from Göttingen, at the age of 82, of the celebrated chemist, Professor Woehler. Born near Frankfurt on the Main in 1800, the deceased acted as professor of chemistry in the Gewerbe schule at Berlin from 1827 to 1831, and since 1836 has experimented with great success at Göttingen. He was the discoverer of aluminium, did some illustrious work with Liebig in the field of organic chemistry, wrote several well-known text books and treatises on his special science, and for the last 44 years has edited a chemical and pharmaceutical journal. By the death of Professor Woehler the university of Gottingen and the science of chemistry have lost one of their most brilliant ornaments.

SCIENCE AND ART.

ST. MARK'S TECHNICAL COLLEGE FOR COACHMAKERS.—The inaugural meeting of the sixth winter session of this college will be held on Wednesday, October 4, at 7.30 p.m., at 33, George Street, Grosvenor Square.

A TECHNICAL SCHOOL AT NOTTINGHAM.—The Drapers' Company have offered £300 per annum for five years towards the establishment of a technical school in connection with University College, Nottingham, with a grant for the first year of £200 for purchasing apparatus, &c.

SCIENCE LECTURES FOR THE PEOPLE.—In the hope of making elementary science as popular among the working-classes of London as the Gilchrist lectures have made it in the manufacturing towns of the north, a course of short and simple lectures has been arranged, to be held on Friday evenings at the Victoria Hall, Waterloo Road. The first, by Mr. W. Lant Carpenter, on "Telegrams, and how they come," is fixed for this evening; the second, on "The dog as the friend of man," by Mr. Arthur Nicols, F.G.S., for October 6; and the third, on "A telescopic visit to the moon," by Mr. Matticu Williams, for October 13. If these lectures succeed it is intended to have more. Prices vary from sixpence down to a penny for different parts of the house.

SOCIETY OF ENGINEERS.—The next ordinary meeting of this society will be held on Monday, October 2 next, in the society's hall, at 6 Westminster Chambers, Victoria Street, S.W. A paper will be read on "The Fell Engines on the Rimutakai Incline, New Zealand," by Mr. R. F. Alford, the leading features of which are as follows:—General remarks on the construction of light railways by the government in a new colony; the necessity for steep incline on cheap lines; various methods of taking trains up inclines. Points in which these engines follow the general run of locomotive engines, such as boilers, tanks, &c., and most of work for outside engines. Points of special interest: Arrangement of blast and reversing handles inside valve motion; vertical axles with gripping wheels; rolling discs; sand injectors; slipper brakes; proposed alteration to vertical crank shaft; performance of engine on the incline. The chair will be taken at half past 7 o'clock precisely.

AMERICAN PATENTS.—Great activity appears to be maintained in the American Patent Office, the number of patents issued up to the last day of August being 263,669. The following is the proportion of one week's issue of patents to inventors belonging to the various States:—New York, 74; Massachusetts, 42; Pennsylvania, 32; Illinois, 31; Ohio, 21; Indiana, 19; California and Connecticut, each 14; New Jersey, 12; Wisconsin, 11; Missouri, 9; Iowa and Kansas, each 8; Rhode Island and Maryland, each 7; Georgia and Michigan, each 6; Minnesota, Texas, and Virginia, each 5; Arkansas, Nebraska, New Hampshire, and North Carolina, each 3; Maine, Tennessee, and Vermont, each 2; and one each for Colorado, Delaware, Columbia District, Idaho, Nevada, Oregon, and West Virginia. More interesting than the actual figures is the relation of the physical character of the State and its people to the general groove in which the inventions run. New York, for instance, deals principally with mechanical applications and scientific discoveries, and especially in matters

England States the tendency is almost entirely in favour of labour-saving machinery, and particularly as applied to small and apparently trifling things. Again, in the West and South, the bulk of inventions relate to agricultural machinery, while in the Pacific States and among the Rocky Mountains they are almost entirely confined to mining matters. In fact, the Patent Office of a great country like America becomes, as it were, a kind of geographical index to the wants and requirements of the people. In the week ending August 29 there were also 27 patents taken out by inventors belonging to foreign countries, of whom 12 were English, four from Canada, two from Germany, and one each from Denmark, France, and Switzerland. With all this profusion of inventive talent, it is sad to state that from well-founded calculations it has been proved that not more than one inventor in a hundred gets any returns for his trouble.

MEETINGS FOR THE WEEK.

MONDAY, OCT. 2

NORMAL SCHOOL OF SCIENCE AND ROYAL SCHOOL OF MINES.—Open.

NATIONAL ART TRAINING SCHOOL.—Open.

MEDICAL SCHOOLS.—Open: St. Bartholomew's; St. Thomas's, 3 p.m. (Dr. Sharkey); Guy's; St. Mary's, (Mr. Chambers); St. George's, 4 p.m. (Dr. Herbert Watney); Charing Cross and London.

KING'S COLLEGE.—4 p.m. (Rt. Hon. W. H. Smith, M.P.).

UNIVERSITY COLLEGE.—4 p.m. (Mr. Marcus Beeks).

MIDDLESEX.—3 p.m. (Mr. R. W. Lyell).

SOCIETY OF ENGINEERS.—7.30. Mr. R. J. Alford, on the Fell Engines on the Rimutakai Incline, New Zealand.

TUESDAY, OCT. 3.

DAIRY SHOW, AGRICULTURAL HALL.—(Four days).

MEETING OF ASSOCIATED CHAMBERS COMMERCE AT GLOUCESTER:—(Two days).

WEDNESDAY, OCT. 4.

PHARMACEUTICAL SOCIETY.—8 p.m.

DIALECTICAL SOCIETY.—(Col. R. D. Osborne, on the Incompatibility of Empire Abroad, with Popular Government at Home.

THURSDAY, OCT. 5.

TUNBRIDGE WELLS AGRICULTURAL ASSOCIATION SHOW.—(Two days).

FRIDAY, OCT. 6.

LIBRARY ASSOCIATION.—8 p.m.

METALLURGY AND MINING.

THE MOLECULAR CONDITION OF METALS.—M. S. Kalischer has published the results of some interesting experiments on the molecular condition of various metals. The foils of most metals can be rendered crystalline under the influence of heat, and, at the same time, their electric conductivity increased. Zinc foil becomes crystalline at the temperature of 150 deg. C., tin and cadmium at temperatures ranging from 200 deg. to 280 deg. C. Similar results are also produced on most metals by electrolysis.

SOUTH STAFFORDSHIRE MINES DRAINAGE.—From the annual reports of the South Staffordshire Mines Drainage Commissioners, which have just been issued, it appears that the total expenditure of the commission on surface drainage works from the commencement in 1874 to the end of last June was £262,134. The water to be dealt with in the mines is now 50 per cent less than it was eight years ago. On underground drainage account, the expenditure amounts to £262,509. The surface area dealt with is 80 square miles, and the minerals lie in a basin with an average of 400 feet above the level of the sea. There are in the district over 300 miles of surface streams, without coun ing numerous small contributories. During the past years large sums of money have been spent on surface works, and further works to cost £24,000 are to be carried out. In the Tipton and Bilston joint district there are 27 large pumping engines employed, and the quantity of water raised by them every 24 hours during the past year was 13,087,500 gallons. The actual cost of pumping water in the district last year was £18,108. Since the commencement of the commission in 1874 to the end of last June, the quantity of minerals raised in the district amounted to 33,946,444 tons. During the past year the total was 3,497,662 tons.

ELECTRICITY AND TELEGRAPHY.

NEW INCANDESCENT LAMP.—Mr. Werdermann, whose electrical discoveries have attracted much notice, has just patented a new incandescent lamp. The peculiarity of this lamp consists in the fact that the vacuum, indispensable in all other such lamps, is dispensed with. Mr. Werdermann employs silicium in place of carbon, and he has succeeded in procuring from it better results than if carbon were employed.

MECHANICAL HARDENING OF IRON AND STEEL.—M. Louis Cheesman published in *Wiedemann's Annalen*, vol. xv. 1882, a paper 'On the Effect of Mechanical Hardening on the Magnetic Properties of Steel and Iron,' which has been translated in the *American Journal of Science* for September. The conclusions arrived at are of great interest at the present time, showing that both mechanical and heat hardening brings about changes in steel and iron, which for the most part affect their magnetic properties similarly.

ELECTRO-GENERATIVE FUEL.—At the recent meeting of the French Association for the Advancement of Science, Dr. Brard, of La Rochelle, read a paper before the Physical Section in which he described a new method of generating electricity by the combustion of a peculiar kind of fire-slab. This slab consists of a brick of carbonaceous matter and a brick of nitrate of soda or nitrate of potash, placed together, but separated by a thin sheet of asbestos paper, and both enveloped in a wrapper of asbestos. The carbon brick is formed of about 100 grammes of coal dust kneaded into a paste with tar or molasses, and shaped in a mould by heat. The mould gives the brick a pitted surface above, and perforates it with holes through and through from the upper to the under side. Strips of brass or copper are also embedded in the under side of the brick to serve as an electrode for the carbon pole of the electro-generative element. The other brick consists of a mixture of three-parts ashes and one part nitrate of potash or soda, melted together and poured upon the pitted surface of the carbon, which, however, is first covered with a layer of asbestos paper. Strips of brass are also embedded in this compound to serve as an electrode. The slab thus formed constitutes a generator of electricity when wrapped in asbestos and placed in a furnace or fierce fire. In such an element the carbon forms the negative plate, and is oxidised just as zinc is oxidised in the ordinary voltaic cell; the nitrate of potash being the oxidising substance. The slab becomes a thermo-chemical battery, and Dr. Brard states that an electric current is obtained strong enough to actuate an ordinary electric bell. By connecting up several of these elementary slabs after the manner of a voltaic battery, a more powerful current is the result, three or four cells being sufficient to decompose water.

RAILWAYS & TRAMWAYS.

STEAM ON TRAMWAYS.—The light engines on the Dewsbury and Batley line have been doing excellent work of late, each engine drawing two cars and upwards of 160 passengers, and we hear there is some talk of working halfpenny stages—equal to carrying the passengers at ½d. a per mile. The Stockton and Darlington tramways, worked by seven of Merryweather's steep-gradient engines, have been running two cars to each engine, with 160 passengers. One of the gradients on which these engines runs with this heavy load is 1 in 18, with a number of inclines of 1 in 20.

PACIFIC RAILWAYS IN NORTH AMERICA.—The following five railway lines across the North American Continent are now either completed or in course of construction:—1. The oldest line, New York to San Francisco, 3280 miles; Omaha to San Francisco, 1899 miles, called the Union Central Pacific Railway. A branch, the Oregon Pacific Railway, ending at Yaquina, is 774 miles long. 2. To the north is the Northern Pacific Railway, which begins at Duluth, on Lake Superior, and ends at the mouth of the Columbia or Oregon River near Kaloma, with branch at the end to Tacoma on Puget Sound. The stretch Duluth to Kaloma is 1907 miles long, of which, in the east, the piece Duluth to Glendive, 248 miles, is completed; also a considerable piece in the west. This line, which traverses fertile and well-wooded regions, will be finished in a few years. 3. The Canadian Pacific Railway will traverse only English territory, and end in the west, about 44 deg. latitude. The portion Quebec to Nipissing has been first constructed, about 496 miles. The whole line will be over 3100 miles long, and will probably take a long time to complete. 4. The Atlantic Pacific Railway, of which the well-known Topeka and Santa Fé line forms a portion, is 3677 miles long, from New York to San Francisco. Lastly (5), the South Pacific Railway extends from Savanna in Georgia, approximately between the 32nd and 33rd degree of latitude, by Arizona to San Francisco, at last uniting with the Atlantic Pacific line. Its length will be 2573 miles. With it unites the Texas Pacific Railway, which begins at Galveston, and forms a considerable branch of 496 miles.

NAVAL ARCHITECTURE.

LAUNCHES.

SCOTCH.

Hammonia.—On September 13, this steamship, built for the Hamburg-American Steampacket Mail Company, was launched from the yard of Messrs. James and George Thomson, at Clydebank, near Glasgow. It may be mentioned that this is the fiftieth vessel which this company has built or purchased for them since their formation in 1848. They have over 60,000 tons of shipping employed in their mail service on three important lines—viz., Hamburg to New York, via Havre, Plymouth, and Cherbourg; Hamburg to the West Indies; Hamburg to Vera Cruz. The *Hammonia* is intended for the first of these routes. She is a steel vessel, and is the first mail steamer of that material for which her owners have contracted. She is intended to steam at a mean ocean speed of 15 knots. The machinery for driving her at this speed will be of 5500 indicated horse-power, and is of the three cylinder type. Steam will be provided by four double-ended boilers, 15 feet in diameter and 18 feet long, working at 85 lb. pressure. Her dimensions are:—Length, 375 feet; breadth, 45 feet 6 inches; depth, moulded, 34 feet 8 inches; tonnage about 4500.

Shap Fell.—On September 26, there was launched from the shipbuilding yard of the Campbeltown Shipbuilding Company an iron screw-steamer, built to the order of Messrs. Dunsmuir and Jackson, Glasgow, who are making the engines, for Messrs. Hume, Smith and Co., Liverpool. This steamer has been specially constructed to meet the requirements of a dead-weight carrying trade, and has great facilities for the rapid discharge of railway iron, pigs, blooms, &c.

FOREIGN

Dagmar.—On September 19, Mr. Emil Abrahamson launched from his yard on the Göta river this iron screw-steamer, of the following dimensions:—Length, between perpendiculars, 145 feet; breadth, 24 feet; depth of hold, 14 feet. She loads 500 tons dead-weight, and is fitted with two water-tight compartments. The engines, of 60 horse-power, will be supplied by the Lindholmen Engineering Works. She is built to the order of a Gothenburg steamship company, and is intended for the Baltic trade.

TRIAL TRIPS.

Albertina.—On September 18, this new screw-steamer, recently launched from the yard of Messrs. D. Baxter and Co., Monkwearmouth, and built to the order of Messrs. Fisher, Renwick and Co., of Newcastle, had a trial trip prior to proceeding on a voyage to Havre. She was built under the superintendence of Mr. A. Taylor, of Newcastle, and the engines supplied are that gentleman's patent. They have three cylinders working upon two cranks. The first high-pressure cylinder is placed above, and on a line with the ordinary high-pressure cylinder, and by this means is worked by the same piston rod. The ordinary high-pressure cylinder cover is in two pieces, so that it can be removed and the piston taken out without interfering with the top cylinder. The diameters of the cylinders are respectively:—1st, 14½ inches; 2nd, 20½ inches; 3rd, 40 inches; the stroke of the piston being in all three cases alike, namely, 33 inches. In these engines the steam goes into the upper cylinder first, then into the ordinary high-pressure cylinder; and next into the low-pressure cylinder, in the usual course. The steam is supplied from a boiler 11 feet 8 inches diameter and 10 feet long, the heating surface being 1300 feet. The furnaces are three in number, and measure each 2 feet 9 inches diameter. The working pressure upon the boilers is 150 lb. to the square inch. The pressure at the trial trip was only 140 lb., being 10 lb. below the full pressure. During the trial the engines indicated 470 horse-power, and the mean speed was nine knots, the vessel being laden.

ROYAL ALFRED AGED MERCHANT SEAMEN'S INSTITUTION.—We are desired to state that this excellent institution, at Belvedere, Kent, which provides for the sailor in his old age, by giving him a home or a pension, is in want of funds, and that donations and subscriptions will be gratefully received by the chairman, Capt. Hon. Francis Maude, R.N.; by the deputy-chairman, Capt. Henry Shuttleworth; and by the secretary, Mr. W. E. Denny, at the office of the institution, 58, Fenchurch Street.

DISASTERS AT SEA.—There were twenty-three British and foreign actual shipwrecks reported during the past week, making a total of 1005 for the present year, or a decrease of 177 as compared with the corresponding period of last year. British-owned vessels numbered 17, five were steamers, four being British owned. Total number of lives lost and missing, 144. Nine vessels were wrecked on the coasts of the United Kingdom, eight being British owned, and one French. Two British vessels sunk by collision.

A NEW CANAL.—M. Loran, the French engineer who has designed the canal works for connecting the San with the Dniester, expects that a commencement will be made with the undertaking at an early date, the required concessions having been granted by the Austro-Hungarian and Russian governments. The connection of the San, a tributary of the Vistula, and the Dniester will provide a waterway between Dantzig and Odessa, not less than 1125 miles long, and therefore the longest in Europe. The length of the canal to be constructed between the San and the Dniester will not exceed 25 miles. Considerable advantage, it is anticipated, will accrue to Germany, on account of the improved facilities that the new route will afford for the shipment of wood and corn.

GENERAL NOTES.

THE TIN TRADE.—The Cornish tin standards have been advanced £2 per ton, making £103 for common and £104 for refined tin. At Truro on September 21 269¾ tons of copper were sold, realising £11,923. The standard advanced £2 15s. Messrs. Vivian purchased 271 tons, for £1428; Messrs. Grenfell 855 tons, for £4226; Messrs. Nevill 643 tons, for £2013; Messrs. Williams 690 tons, for £3171; and Messrs. Mason 234 tons, for £1044.

THE BRITISH COAL COMPANY, LIMITED.—This is a company formed to take over the business of Messrs. Alpheus Smith and Sons, colliery agents, of London and Bristol. The capital asked for is £10 000, and the reason for the change of the concern from a private firm to a joint stock company is stated to be the necessity for additional capital to meet the requirements of a rapidly increasing trade. Every facility for examining the books is offered to intending investors, and we are informed that the remuneration of the managers (who will be members of the original firm) will be made, to a great extent, dependent on the profits realised by the company.

THE OIL EXPERIMENTS AT ABERDEEN.—The laying down of pipes, &c., at the entrance of the harbour of Aberdeen for the purpose of calming the sea in rough weather by means of oil having been duly accomplished on Wednesday morning. A trial was made with the apparatus. There was a strong south-east breeze blowing at the time, and a heavy sea was running, which dashed over the south breakwater and occasionally over the north pier. The oil was pumped through the pipes and rose speedily to the surface of the water. It at once brought the rough crests of the waves into subjection, and the billows came rolling smoothly inwards without breaking. Great satisfaction was expressed with the result of the experiment. Between 12 and 1 o'clock a second experiment was attempted, but it had to be stopped, owing, it is thought, to the valves with which the lead piping is supplied having become choked.

THE TRADES UNION CONGRESS.—At the meeting of the Trades Union Congress in Manchester on Friday last, resolutions were adopted in condemnation of working overtime, and of any attempt on the part of the Government to interfere with any system of indentured apprentices among the Thames watermen and lightermen, and in favour of land law reform, and it was agreed to hold the next congress in Nottingham. At the concluding meeting on Saturday resolutions were passed recommending the Parliamentary Committee to ask the Government to introduce a Bill dealing with the direct representation of pilots on Pilotage Boards; declaring that it is desirable to render it incumbent on local authorities to isolate persons in whose houses infectious diseases exist; in favour of introducing a Bill to give to persons employed on ships similar protection to that given under the Employers' Liability Act, to those engaged on shore; and urging the establishment of a Court of Criminal Appeal. A motion urging a closer connection of the trades forming the Congress was withdrawn.

FLOATING STEAM FIRE ENGINE FOR THE BRAZILS.—A new self-propelling floating steam fire engine, designed and constructed by Messrs. Shand, Mason, and Co., for the Brazilian Government, and for use by the fire brigade of the port of Rio de Janeiro was publicly tested in the presence of a number of gentlemen interested in such matters, on the

25th inst., in the River Thames. The first test, that of raising steam from cold water to 100 lb. on the square inch, was performed in 9 minutes 40 seconds. The boat was then moored off the Old shot tower wharf, Lambeth, and various fire jets were thrown up or over the tower, the best result obtained being that of the jet of 1¾ inches diameter which it is estimated was thrown 180 feet high, or 30 feet above the tower. The vessel was then taken to Southwark Bridge, where the engine was again tested with four different sized jets, and ultimately to the measured mile, where a speed was attained of upwards of ten knots per hour. The machinery consists of an equilibrium steam fire engine, and for propulsion a pair of inverted steam engines working direct on to the screw shaft, steam being supplied from the same patent inclined water tube boilers, both for the propelling and the fire engines. The whole is placed between two water tight compartments, with ample space for the tanks, which are capable of containing 4½ tons of fresh water for feeding the boilers, and for two tons of coals. There are two hose reels on deck, and additional space for hose in the engine room. The hose is made of double canvas, and has been proved to 400 lb. on the square inch. The tests were considered highly satisfactory.

THE HOME IRON AND COAL TRADE.

BARNSLEY AND SOUTH YORKSHIRE.—The house coal trade is just now very good, but the increase in the demand is undoubtedly due to the undue inflation in trade, caused by the rumour relating to the threatened stoppage of the pits. There has during the past week been a good deal of enquiries for house coal for London and the South, so that many of the pits are making as full time as the men will work. The demand for the Eastern Counties is also on the increase, and a large tonnage is finding its way there. Steam coal exhibits a falling off for shipment, so that the quantity sent to Hull and Grimsby is not near so large as it was a few weeks ago. Locomotive coal, however, is in good request, and some good orders are on hand. During the week the South Yorkshire steam coal owners held a meeting at the King's Head Hotel, Barnsley, to consider the Great Northern contracts and the prices at which contracts shall be made. The sale of small coal and slack holds well up, and there is a brisk demand for coke. The chief topic of interest is the demand for an advance of 15 per cent. The officials of the Yorkshire Miners' Union have sent letters to the secretaries of the South and West Coalowners' Associations asking for a joint interview either at Leeds or Sheffield. There will, however, be no general stoppage, as the unions have scarcely any funds on which to fall back upon. The iron trade continues very fair, and at most of the works the men are making full time. The output from the blast-furnaces is more than an average one.

BARROW-IN-FURNESS AND NORTH LANCASHIRE.—The demand for all qualities of hematite pig-iron is very fully maintained, and there is, if anything, an increased request, especially on foreign account. The Continent is taking a very large tonnage of iron of both hematite and forge descriptions, and it seems probable that during the winter months they will continue to place large orders in this district. Makers are very fully employed on this account, and with the colonial and home business on hand, it is evident there will be a continued state of activity during the autumn and winter months. The value of hematite iron is very steady, and the disposition is in the direction of a further improvement. Makers in all instances are very fully employed, and the proportion of furnaces out of blast is inconsiderable. Stocks of iron are kept down to a nominal point, and with a continuance of the present arrangements for regular delivery of metal, both on home and foreign account, there is no need to fear any increase in the tonnage of metal held in stock. Second-hand dealers hold heavy parcels, but these they are reducing as opportunity offers at prices current. The quotations given last week are maintained for both Bessemer and forge iron, 58s. 6d. for No. 1 Bessemer, and 56s. 6d. for No. 3 forge. Steel makers are in receipt of several good contracts, and the mills, both in the railway and merchant departments, are busily employed. Iron ore is quoted at 14s. to 14s. 6d. per ton at the mines, and there is a good demand. The coal and coke trades are steadily employed, and prices are fairly maintained. Shipping is busy, and is likely to continue so.

BIRMINGHAM.—The course of business in the local hardware industries has been tolerably good during the week, general, foreign, and home enquiries showing a slight increase. Prices are decidedly firmer in consequence of the rise in brass and copper and the upward tendency in the cost of metals and fuel. With the United States there is a better trade doing in tinplates, galvanising baths, naval brassfoundry and crude materials, while the South American markets are ordering more freely of cultivating implements, machinery, bridge work, tubes, and railway accessories. Egyptian orders are rapidly expanding, and a very good trade is expected by merchants in this town on the settlement of the internal affairs of the country. Australian customers are ordering larger parcels of shelf goods, fencing wire and machinery, and new steam pumps, dredgers, and agricultural implements are in improved demand for the same markets and for New Zealand. Builders' requirements at home have been stimulated by the favourable weather for building operations, which are being carried on with marked vigour in Birmingham and district. Country buyers are sending in more satisfactory orders for miscellaneous domestic requisites and for farming tools and appliances. There is a growing demand for lamps, chandeliers, and gasfittings, and also for gas stoves and cooking ranges, while bicycles, tricycles, coach ironmongery, springs, and axles keep on well sustained request. Metallic window bands are in better demand, and there is more doing in cables and anchors, though jewellers and button makers still report business in a quiet condition.

THURSDAY EVENING.—There is a more active enquiry in the iron trade, but manufacturers are unwilling to accept contracts for forward delivery owing to the disturbed state of the coal trade, and the probability of an advance in coal. Quotations this afternoon were firm for all classes of iron, but especially for sheets, plain and galvanised. Special qualities of marked bars were in request for India and the colonies, and also for local consumption. Girder plates and cable iron likewise met with a brisk enquiry, and crude metal was disposed of in fair parcels.

CARDIFF.—The Cyfartha Works are being rapidly proceeded with, and it is probable that steel making will commence earlier than anticipated. At the Plymouth Works the ground has been surveyed with the view of obtaining telegraphic communication with Merthyr. Negotiations are proceeding for the sale of these works by Messrs. Hankey. The Merthyr Wire Works commenced business on Saturday last, and it is anticipated that they will be able to turn out 350 tons of finished wire per week. The steel billets are made by the Rhymney Iron Company. Upon the whole, there is a brighter prospect for Merthyr than has existed since the great strike. The condition of the iron trade generally (or, more correctly, the steel trade) is brighter than it has been throughout the whole district, although prices do not rise. The operations of the Steel Railmakers' Association may, however, do something towards raising prices by lessening the output; but in that case it may be found that orders now sent from abroad may be executed elsewhere, while orders now given by British firms will go abroad. The strike at the Landore Steel Works is partially at an end, and in a few days more may totally cease. The old works are in full swing, while the melters commenced charging the furnaces at the new works on the 22nd inst. The hammermen at the latter works still hold out. It is stated that even now the masters offer better terms than can be had at any other place of a similar character. Iron was sent away from this port last week to the extent of 1,075 tons, while iron ore was received from Bilbao amounting to 11,818 tons, in addition to 1,268 tons from other places. Campanil Somorrostro is quoted 15s. 3d., c.i.f.; good Rubio, 15s., c.i.f., with a weaker tendency. Carthagena manganiferous ores are firm. Notwithstanding various reports from London and Liverpool, and the fluctuation of prices, several tin works in Glamorganshire and Carmarthenshire, as well as Monmouthshire, are about being re-opened, with a view to active operations. Coke-made vary in price from 16s. to 17s. per box, while charcoal-made are from 19s. to 20s. It is remarkable that brands are being sold at Liverpool for less money than they can be obtained for at the works. Both the steam and house coal trades are in good condition, the latter being stimulated by the approach of colder weather. A Liverpool contract has been accepted for 60,000 tons at higher prices than those obtained at the same period last year. There is no doubt that the tendency is towards heavier quotations. The amount sent away last week was 103,577 tons foreign, and 18,695 tons coastwise. Good colliery-screened may be obtained at from 10s. 9d. to 11s., but, some choice qualities, realise as much as 12s. 6d., while inferior sorts are as low as 8s. 6d. per ton. The freight market is better.

CARMARTHENSHIRE.—About 800 tons pig-iron have arrived by sea from Middlesbro' since last report. A cargo is expected from Glasgow at 5s. 6d. per ton freight to Llanelly. Messrs. Bright and Garrard, ironfounders, Carmarthen, have dissolved partnership. There is little if any alteration in tinplates, 16s. 9d. and 17s. being quoted for fair brands of cokes. It is said that the high price of raw material is depressing the make somewhat; 3471 boxes have been sent to Liverpool per steamer during the week. The agitation amongst the English colliers is causing mischief in this neighbourhood. The anthracite colliers in the Gwendraeth district are to meet early in October, when an effort will be made by the Unionist leaders to induce all not already working under the new agreement to take steps to do so. In the Saundersfoot (Pembrokeshire) anthracite collieries an advance of 5 per cent. in wages has been given, the previous rates being unusually low; but in this county the state of trade will hardly admit of any concession to the miners.

CLEVELAND.—The attendance at the iron market at Middlesbrough on Tuesday was thin, but the tone of business was a good deal more cheerful than it had been during the past fortnight, this having to some extent been caused by the improvement which had been reported in the Glasgow market, both in special brands and warrants. Then we have enormous shipments to record, and this, by foreshadowing a substantial decrease of stocks in the next returns of the Cleveland ironmasters, helps to impart a firmness to business. Up to Tuesday night 84,196 tons have been shipped from Middlesbrough this month, against 78,971 in the corresponding period of August, which month, it will be remembered, was itself remarkable for the largeness of its exports. Few ironmasters or manufacturers were present on 'Change on Tuesday, as the Vienna contingent has not yet arrived. Buyers were more ready to effect purchases, and prices may be declared up at least 3d. per ton compared with last week, it being difficult now to buy under 44s. 3d. per ton for f.o.b. prompt delivery of No. 3 G.M.B., whereas last week barely 44s. could be obtained, and there were even sales recorded at 43s. 9d. The leading firms among the makers are very stiff at 44s. 6d., as there are prospects of a heavy demand. A large transaction was reported on Tuesday at 44s. 7½d. for No. 3 October, March delivery. Warrants were rather better than last week, and as there is a demand, and a probability of a better, holders have ceased to press their iron upon the market, and are now keeping back for better prices. On Tuesday they were stiff at 44s. 3d., the same price as is being asked by merchants and some of the makers for makers' iron. Messrs. Connal and Co. held in their Middlesbro' stores on Tuesday 110,048 tons, which is a decrease of 1183 tons since the previous Tuesday. No. 4 foundry is quoted at 44s. 6d. and No. 4 forge at 43s. 3d. per ton. The shipments for the week ending September 23 amount to 17,555 tons, as against 25,491 during the previous week. Hematite and Bessemer pig-iron are in improved demand, and full rates are being paid in competition with West Cumberland. The quarterly meeting of the North of England coal and iron trades will be held at Middlesbrough on the 10th of October. Finished iron continues weak and languid, and for nearly all they sell producers have to accept lower rates than those they were disposed to take last month. The general value of common bars is £6; of angles, for shipbuilding, £5 17s. 6d. to £6; and of ship plates, £6 12s. 6d. to £6 15s. per ton, all less 2½ per cent. for delivery on trucks at makers' works. For small lots something more than this about 2s. 6d per ton has to be paid. The steel trade prices do not favour makers in the quantity of new business tendered for, although a 'better and more hopeful feeling prevails. Cleveland iron ore is about the same, viz., 4s. 6d. to 4s. 8d. per ton, according to quality, delivered at Middlesbrough furnaces; and Spanish, Rubio Bilbao, 17s., and Campanil Somorrostro, 17s. 3d. per ton, delivered "Tees." The coal trade remains active, and it is stated that an advance of 1s. per ton on household coals will be imposed on and after the 2nd of October next. Manufacturing coals are also likely to be dearer. Another furnace has just been put in blast by the Clay Lane Iron Co., South Bank, who now have five out of their six furnaces blowing.

DERBYSHIRE.—The house coal trade in this district is somewhat brisker, inflated, no doubt, by the threatened stoppage of the pits if an advance of wages is not conceded. The business doing with London by rail is just now very fair, but the improvement in prices at the pits are by no means in keeping with the advance in London. There is also an increased demand for house coal for local purposes and consumption, and some of the pits are working something like what miners term full time. Steam coal is in very moderate request, the district collieries sending very little to Hull. Orders for locomotive and ironworks are however, pretty numerous, and there is more doing in gas coal, some of the companies laying in slight stocks. But little coke is made in the district, but a good tonnage is received weekly from South Yorkshire. The agitation for a general advance of wages is causing a good deal of interest in the district. The delegates who assembled on Saturday at a meeting at Chesterfield, decided to demand 15 per cent. A circular is being issued to the coalowners, asking them to allow their men to attend a mass meeting at Chesterfield on October 4, deputations in the meantime being chosen to wait upon the coalowners There seems to be a strong feeling amongst a certain section of the men, in favour of enforcing the advance if it is refused, but the union is in a very weak state, and could afford very little support to the men if they left work. The manufactured iron trade is fairly active, the works being kept well going. The output of pig-iron is more than an average one, whilst sales are almost in keeping with the make.

DURHAM.—The pig-iron trade this week has shown rather more animation. There has been a higher rate asked by sellers, both makers and merchants, and an advance of about 3d per ton has taken place. This increase is traceable to the Scotch rise of iron which took place early in the week. The North of England trade was, however, placed in a position by reason of its heavy shipments and the large deliveries going forward, and the reduction of stocks which is taking place, to respond to the slightest cause for improvement from any quarter. The market was firm before the Scotch advance, and it only required that impetus for sellers at once to be stiffer. The present quotations are about: No. 3, 44s. 3d.; No. 4 forge, 43s. 3d. with middlemen. The makers ask 3d. per ton more. The shipments, considering that the present month is one day less, are likely to be as good as last month from the Tees, and it is fully expected that 95,000 tons will be sent away. What the course of the winter trade will be no one can determine. There is not quite such a favourable aspect in the finished iron department. The prices have rather been tending downwards, and it would rather appear as if there were not so much work in hand as was lately thought, for manufacturers have been rather keenly competing for orders and accepting lower prices. There were one or two large lots of plates offered lately, for which the figure did not exceed £6 12s. 6d., though the quotation of many of the plate producers is £6 15s. Bars, it is said, could be bought in good quantities for less than £6, though that figure is the regular quotation. Angles are £5 17s. 6d. to £6, less 2½ per cent. Puddled bars, £4, net. Boiler plates and sheets are about £7 15s., less commission The trade is in rather an uncertain condition just now with the wages question in the finished iron branches, and the coal trade unsettled. At least, wages are in one sense settled in the latter, but if the men succeed in establishing a rise in Yorkshire and other districts, the Durham pitmen will unquestionably follow suit. More may, therefore, have to be paid for fuel, whilst wages in the finished iron branches may also be increased. The orders now being worked in finished iron are unquestionably higher in the average price than was the case a few months since, but this would not have to be the sole criterion with an arbitrator in fixing the rate of wages, as the prospective condition of the trade would have to be taken into account. The award of Mr. Dale in the claims for extra wages for working up to three half pigs of hematite in the puddling furnace was on Tuesday given against the men. The Southfield Sheet Company have completed their works at Low Walker, and are in a position to roll sheets. The coal trade has shown no particular change, except that there has been rather a run upon households, which it was definitely decided on Tuesday are to be advanced in price 1s. per ton from the 1st of October, for the inland or depôt trade. The prices of coals for shipment must be regulated by the state of the market and the extent of the demand. Manufacturing coals firm at 5s. to 6s. per ton for ordinary qualities; inferior fetch less, and superior more. Coke unchanged, but demand good.

EAST WORCESTERSHIRE.—A very good business is doing in locally made pig-iron. Two furnaces which were blown out for repairs last month are now in blast again, viz., one belonging to Messrs. Roberts and Co., Tipton, and the Union Company, Stour Valley; and one blown out in July, belonging to the Pelsall Company, is also again at work. The number of blast-furnaces now blowing in South Staffordshire and East Worcestershire is therefore forty-nine. No heavy stocks of pig-iron are held by any firm. The railway stocks of crude iron are also less. Large quantities of pigs are being imported from Derbyshire, Northamptonshire, and other places; but stocks do not accumulate at the forges of manufacturers. The present aspect of affairs at home and abroad, with the Egyptian war virtually over, greatly tends to firmness of trade all round in finished iron. The good weather we have had lately has also been much in favour of trade. We may now reasonably look forward to a good demand for iron both on home and

foreign account, indeed, very good orders are at the present time being received at the local works. Iron for building purposes is enquired for, and orders in this department are also being placed. None of the makers of angles, tees, and channel iron are short of orders. Makers of bars, both round, square, and flat, are better employed. Nail rods are in brisker request. Plates for bridges and other constructive work are in greatly improved demand The call for cable bars is improving. The Halesowen and Rowley nail trade has experienced a "spurt," it being stated that sundry nail manufacturers in those districts have lately received large government orders for the supply of horse nails, originally intended for the Egyptian expeditionary force. Until lately the horse nail trade has languished a good deal; but, since the receipt of these orders, full operations have been the order of the day. The demand for native ironstone is good; oolites are dull. The demand for manufacturing coal keeps brisker, but that for household fuel is duller. The district colliers continue a somewhat intermittent agitation for an advance of wages on the 1st proximo. Furnace coal is at present 10s. per ton at the collieries east of Dudley; and according to the sliding scale, that figure governs a rate of wages to the thick coal collier of 3s. 4d. per day or "stint"; and to the thin coal miner of 2s. 8d. per day. An increase of 8d. and 4d. respectively on these wages has been demanded by a meeting of miners at Old Hill, and such demand would, if granted, necessitate a corresponding advance in the price of coal. It is the opinion of many of the leading coalmasters that an advance would, at this juncture, check a gradually-growing trade in fuel, as well as disorganise the iron trade, and we are therefore able to announce that no official "list" advance of coal prices in South Staffordshire and East Worcestershire will take place just yet. As soon as ever the state of trade shall warrant it, the coalmasters will need no urging to raise the price of coal. A good supply of oven and hard coke is offered in the market, and prices are not so firm. Makers and merchants are pressing for sales. Gas coke is much lower in price, and there is a fair supply.

FOREST OF DEAN.—The fact that stocks of crude iron are now very considerably reduced, and improvement shewing itself generally, in the crude metal branch, is a hopeful indication with regard to the future. At any rate the outlook is very much more favourable than was the case a month ago, and quotations are gathering strength. This remark will apply to the manufacturing branches as stated in a supplementary notice last week. At the tinplate manufactories the trade is steady. In one instance the puddlers have given notice for an advance. The mineral industry shows some improvement, although in the case of the Dowlais Iron Company, their Forest stock of iron ore is reported to be not less than 15,000 tons. The coal trade is presenting exceptional animation, and, according to the shipping returns, the present month's exports are in excess of any corresponding month since 1870. A few days ago there were seventy vessels awaiting cargo, since which day the number has been increased. In some cases the agents are declining to accept new orders otherwise than under the October advance of 1s. per ton. The employers held a meeting yesterday on the subject of prices, and the reported probable advance of 5 per cent. in the wages rate. No unanimous decision was arrived at, although a belief prevails that wages will be advanced to the extent named. The employers are urging that although an advance of 1s. may be declared on the 1st proximo, they have been obliged to make abatements during the summer to ensure trade, which, when recovered, would not, under a shilling rise, justify the proposed advance to the workmen. Messrs. Crawshay will, in all probability, give an advance, and this step will anticipate any complaint from the employes of their firm.

GLASGOW.—The warrant market has become quite excited this week, and a strong feeling has arisen that the price of iron is bound to go higher. There is an extensive demand, especially for the better shipping brands, stocks of which have got exhausted, allowing makers to exact very high prices for what they are now making. The upward movement is also assisted by the unsettled condition of the miners, in all districts they are agitating for higher wages, and it seems clear that, whether they strike or not, the cost of producing iron is likely to be increased. At the same time, the stock of iron in Connal and Co.'s store is still excessive, and the inroads already made in it are but of trifling amount. The reports received from America continue to be of a satisfactory nature, though the Canadian orders are about finished for the season. Continental houses are still buying freely, the autumn shipments are expected to turn out well. On Thursday business was done fron 49s. 11½d. to 50s. 3d. cash, and 50s. 2½d. to 50s. 6d. one month. On Friday renewed buying set in from 52s. 2½d. to 50s. 4½d. cash, and 50s. 5½d. to 50s. 8d. a month. On Monday there was quite a rush of buying from 50s. 3d. to 50s. 10d. cash, and 50s. 6d. to 51s. ½d. a month. Next day the price fluctuated between 50s. 10½d. and 51s. 1d. cash. On Wednesday, opening quietly at 50s. 10d. and 50s. 9d. cash, one firm bought heavily, the price rising to 51s. 2½d. cash, and 51s. 5½d. a month. Closing buyers at these prices, sellers asking ½d. per ton more. Makers' iron is in good demand, the prices of most of the brands were raised both on Monday and on Wednesday. Coltness No. 1 can hardly be got at any price, No. 1 Gartsherrie is selling at 3s, per ton more than was paid a few days ago, while some other good brands are quoted at 65s. to 67s. 6d. per ton. Makers' prices altogether are on a comparatively higher level than warrants. There are now 111 furnaces in blast, against 121 at this time last year, though it is expected that a few more may be blown in next month if the trade continues good. The shipments of pig-iron from Scotland last week were:—Foreign, 9445 tons; coastwise, 3488 tons; total 12,933 tons, against 12,841 tons in the similar period of last year. The imports of Middlesbro' pig-iron into Grangemouth last week were 5250 tons, against 7946 tons in the similar period of last year. The total imports till September 23, 1882, are 167,749 tons, against 217,713 tons till September 24, 1881, showing a decrease for this year of 49,964 tons. The stock of pig-iron in Connal and Co.'s store now amounts to 626,316 tons, showing a decrease for the week of 1586 tons. The malleable iron trade is in a satisfactory condition, and the works are well supplied with orders for sometime ahead; the steel works are especially busy. The shipbuilders, engineers, and founders are all busy, and trade as a whole is decidedly good in this district, with fair prospects of employment for the winter. The ship joiners' strike does not seem much nearer a termination. The coal trade is active, the shipments are fair for the season, and there is now more enquiry for splint coal; prices are firm, with an upward tendency. It is not expected that there will be any general strike of the colliers, but possibly a good deal of broken time, with some attempt at restriction.

LANCASHIRE.—A generally strong tone characterises the iron market here, with, if anything, rather more business stirring. What may be termed the actual local trade of the district does not, however, show any improvement, except so far as forge proprietors are concerned, and even in their case the orders they receive are not so much for consumption in the district as for shipment. The reports received from the Lancashire engineering branches of trade show, if anything, a falling off in the quantity of new work coming in, and the fact that moulders have of late in considerable numbers been seeking employment is an indication that the supply of new work passing through the foundries to the engineering shops is decreasing. The competition for orders amongst founders is also very keen, and in many cases tenders are made for contracts at figures that can little more than cover the cost of production. The iron-market is, however, in a healthy condition, owing to the activity in the shipping trade, and, although some of this is due no doubt to the pressure to complete shipments before the close of the Baltic and Canadian ports, there is a good export trade being done which is not affected by the winter season. Local makers of pig-iron have been doing a tolerably large business during the past week or so, mainly in forge iron, and in this quality they are now pretty fully sold; but for foundry iron the enquiry is only limited. Transactions have been on the basis of the full rates of 46s., less 2½, for both forge and foundry iron delivered equal to Manchester, and at this figure Lancashire makers are now very firm. District brands, such as Lincolnshire and Derbyshire irons, have also been moving off fairly well at full prices, but Scotch iron, which is going chiefly into consumption for engineering work has been only in moderate request. Finished iron makers are all well supplied with orders, and in some cases show a tendency to stiffen in their prices, although merchants who have low priced contracts still running are open to book at under current rates. For delivery equal to Manchester or Liverpool the average prices are about as under:—Bars, £6 7s. 6d. to £6 10s.; hoops, £6 15s. for common, up to £7 for the better qualities; plates, £8; and sheets, in which makers have great difficulty in keeping up with their deliveries, £8 12s. 6d. to £8 15s. per ton. Makers of railway plant of both locomotives and carriages are very busy, and the Ashbury Railway Carriage Company, Manchester, have just received an order for fifty-four carriages from the Metropolitan District Railway Company. The coal trade has been in a somewhat excited state, owing to the general anxiety which consumers have shown to get in stocks in anticipation of a stoppage of the pits and an advance in the market. This has been especially the case with house-fire coals, and colliery proprietors have been unable to keep up with their requirements of the customers; but other clases of fuel for iron making and steam purposes have also been in enlarged demand. The present pressure of demand will, however, of necessity only be temporary, and it is only in exceptional cases where prices have advanced more than about 6d. to 1s. per ton, whilst the Manchester firms, who are not putting up their rates until the end of month, are not going beyond an advance of 10d. on the wharf and delivery rates for house coal and 5d. per ton on engine fuel all round. Prices at the pit mouth at present average about as under:—Best coal, 9s. to 9s. 6d.; seconds, 7s. to 7s. 6d.; common house coal, 6s. to 6s. 6d.; steam and forge coal, 5s. 3d. to 5s. 9d.; burgy, 4s. 3d. to 4s. 9d.; and ordinary slack, 3s. 3d. to 4s. per ton. Shipping is fairly good at a slight advance on late rates.

LEEDS AND WEST YORKSHIRE.—The best Yorkshire iron forges are working this week some four and some five days, except that of the Leeds Forge Company, at Armley, which is very busy indeed and obliged to be kept going night and day, as much as is practicable. At that place some heavy orders have been received for best Yorkshire boiler plates which are to be used in the building of vessels on the Tyne and the Clyde. The corrugated flue system of this company has been adopted by the Mexican Government, and it is to be applied immediately to three of their largest steamships. At the same forge, ordinary and flanged boiler plates are being made for China and other foreign countries. In a week or two the newly invented and constructed corrugating mill, by which the corrugated boiler flues will be rolled instead of being hammered, will be started with some ceremony. It has been announced to the company that at the North of England Naval Engineering Exhibition they have been awarded the first prize for ironwork applicable to shipbuilding and marine engineering; except "uses" there is nothing elsewhere in particularly good demand. Some cast steel tires and axles are made, but not many, because of their dearness. For best brands of bar iron there has been a much more active enquiry this week, and some orders placed at the standard rates. In common merchant iron there is also rather more doing, and at some forges and foundries a very large quantity of special and various work is being turned out to the order of local engineers and machinists. The quantity of portable railway plant which is being sent away for exportation increases. Makers of special tools for marine engine work continue busy. Our local firm so famous for bullet making and small arms machinery, already busy enough, have been obliged to undertake fresh requisitions, both home and foreign. An improvement in the jute manufacture has given an impetus to the business of some smaller as well as larger firms of hackle, gill, pin, and comb makers. Dynamo machines are made at several workshops, and the number engaged in that branch is increasing. At one establishment it is claimed that they have possession of the only really efficient apparatus for the storage of electricity that has yet been discovered. The mechanical genius of the district is evidently at an extreme degree of tension, for a rather unobtrusive nail manufacturer asserts that in a short time he will work a machine which will turn out at least five tons of cut nails daily, and another ingenious individual has invented an apparatus for corking bottles as fast as by manual labour; the filled bottles can be placed in the machine and be removed. The West Yorkshire coal trade, both home and foreign, is better. At one large colliery a good number of the workmen have been put on full time. Higher prices are anticipated, and merchants are speculating on the certainty of a rise at the collieries. There is no doubt the colliers here will join in the proposed demand for 15 per cent. advance in wages.

LIVERPOOL.—The attitude of the market this week is strong, with a likelihood of further improvement. There is a fair business doing in tinplates with no change in values. The equilibrium of the pig-iron market is even, and shipments continue on a satisfactory scale. South Welsh iron commands a good sale at enhanced values, whilst steel rail orders are difficult to place, except at increased prices. Sheet iron makers are well employed on old specifications; there is, however, a dearth of new orders for this article. The absence of demand on a large scale from America still continues, whilst Canadian requirements are of a "hand to mouth" description. Mediterranean buying is, however, on a more satisfactory scale, and a continuous run of small orders on Baltic account come daily to hand. Home requirements are active, and the shipbuilding and engineering (both marine and locomotive) trades are well employed—enquiries for several large vessels likely to result in business are on the tapis, auguring well for the immediate future of these important branches of home industries.

LONDON.—The metal market remain steady, and a fair trade doing. On the whole prices are stiffer. Iron.—The pig-iron market has been advancing the passed week, and looks good for still higher prices. Scotch warrants close strong at 51s. 8d. Manufactured iron in fair demand. Copper continues to improve; Chili Bars, £70 5s., spot. Stocks are very much reduced. Tin.—The market is very firm. £107 15s. is offered for sharp cash, with very little offering. Fine foreign, £107 15s.; English ingots, £111. Tinplates firmer; there is more enquiry for cokes, 16s. 6d. and 17s., Liverpool. Lead, flat; soft Spanish pigs, £14.

NEWCASTLE AND THE TYNE DISTRICT.—A fairly good export business is being done in pig-iron from the Tyne, and the market is very steady. No. 3 Cleveland pig, delivered to the Tyne, is sold at 46s. 6d. per ton, an advance of 3d. per ton since this time last week. Manufactured iron is rather weaker, the supply being very great in consequence of the vastly increased making power brought into play during the past two or three years. Values are 2s. 6d. per ton short of last week's quotations, but at the reduced prices manufacturers are stiff. Ship plates are selling at £6 15s. to £6 17s. 6d. per ton, angle iron at £6 2s. 6d. bars at £6 2s. 6d., and boiler plates at £7 15s per ton, less 2½ per cent., delivered to Tyne shipyards or boiler works. There is no material change in the Spanish iron ore trade, large quantities are arriving for Bilbao in the Tyne and Sunderland Docks, principally for Consett and Tudhoe furnaces, and a good deal is also taken up the Tyne in large steamers to the Elswick Works. At Bilbao it is shipped at 7s per ton, in some cases a little less, and the freight to the Tyne remains 9s. per ton. The shipbuilding yards of the Tyne and the Wear are as busy as ever, and a little better enquiry for new steamers is reported. Although freights in most directions are rather low, still our dead-weight carrying steamers are constantly and profitably employed for the most part; and now that shipbuilders are rather anxious to secure contracts for building vessels by next summer at lower figures than they demanded at this time last year, some animation may fairly be expected to return to the trade as far as regards forward business. The engine works in our neighbourhood are all full of work, mostly marine; but at the two manufactories in Newcastle in which locomotives are seen in course of construction alongside marine engines, viz., Messrs. R. Stephenson and Co.'s, and Messrs. R. and W. Hawthorn's—there is a good deal of night work and overtime resorted to in order to complete large locomotive contracts. The last-named firm is getting well through with the American locomotives for which they secured orders some months ago. All the minor branches of the iron industry are active. The steam coal trade has improved in volume, but prices are lower in all large transactions; indeed, 9s. per ton, less 5 per cent., is about the top price for the best quality. Gas coals are in strong demand at 3d. to 6d. per ton more money; the best quality makes 7s. 3d. per ton, less 2½ per cent., and medium sorts 6s. 3d. to 6s. 9d. per ton, free on board in Tyne Dock. Manufacturing and smithy coals are firm at 7s. per ton for the best descriptions. Household coals are 6d. to 1s. per ton better than they were little more than a month ago. Coke is firm and unchanged in value. In chemicals a good trade is passing at a shade over last week's rates. Firebricks and cement go away freely at fully recent rates.

NEWPORT.—The tone of trade is steady, and prices in each department well maintained. Several sales of pig-iron have taken place at prices quoted in our last, and other contracts are about being arranged. There is no change to report in the iron ore market; Rubio is still quoted at 15s., c.i.f., and Campanil Somorrostro at 15s 3d., c.i.f. The imports of this article from Bilbao during the week have again been very heavy; the great portion, however, goes direct to the works, only a small quantity being banked at the docks. Welsh bars are in very strong demand, and for immediate delivery manufacturers are obtaining higher figures. There is very little business being done in iron rails, which may be quoted at £4 15s. to £5 per ton. The demand for iron rails has been falling off for some time, and enquiries are getting rare. Steel is in excellent demand, and there is a slight improvement in the prices of blooms. A number of orders for steel rails have recently been placed in the neighbourhood, and makers are actively employed. Prices keep firm at £5 5s. to £6, according to section. There is an increased demand for tinplates, and quotations are if anything a trifle firmer than last week. If manufacturers would only work well together prices would soon show a decided and permanent improvement, but there are makers who, as soon as the demand increases, offer boxes at less than current prices, and consequently spoil the market. Steam coals are in brisk demand and new orders are coming in daily. There is a good supply of tonnage, and prices remain very firm. Small coal is also in active request, and

quotations are well maintained. The pitwood market still shows signs of improvement, and the demand is stronger, with an upward tendency in prices. A fair amount of charterizg is being done, and the tone of the freight market is rather better. The coal clearances for the week show a total of 26,383 tons foreign, and 19 514 tons coastwise, against our last return of 27,792 tons foreign, and 19,605 tons coastwise. Of iron, &c., only 630 tons were sent away, this quantity going to Cape Town. The imports comprised 19,262 tons of iron ore from Bilbao, 1429 tons from other places, and 790 tons of pitwood.

NORTH STAFFORDSHIRE.—There is a continuation of the activity which has characterised the finished iron trade of this district for several weeks past. The merchant mills are fully employed, specifications in this department are coming in satisfactorily, and, judging by the accumulation of orders at most of the works, there is a probability of a brisk trade being done during the remainder of the year. This is partly attributable to the gradual improvement which has taken place in the home market, and there is also a satisfactory demand for the colonies, particularly from Australia. Canada and the United States are sending some good lots. There is still a steady demand for the larger sections of iron, such as are used in ship and bridge building, and some mills have sufficient orders booked to keep them running a couple of months at least. Hoops are in somewhat better request, and the plate trade is a little brisker, but the mills have as yet some difficulty in keeping on more than five turns per week. There are at present no indications of a general advance in prices, although they remain very firm, and in some instances a slight increase has been obtained.

SHEFFIELD.—The end of the quarter brings a lull of business in all branches, but there is still a feeling observable in all circles that business is improving, and that October will witness a stiffer trade. During the past fortnight there has been a heavy accession of orders in the cutlery department. East Indian houses are enquiring for large lots, and most important of all, the West Coast of Africa and Australian merchants are again busy. Levant houses are doing next to nothing. In the home market there is very little business; even the houses with a London connection being short of work, and travellers' sheets to hand are only light. The past season has not been a good one for the country houses, and prospects are not particularly good for the winter. In the heavy iron departments we notice that many more men are in employment, principally on bars and sheets for the northern shipyards; and best Yorkshire irons, hammered, are stiffer in price. Bessemer makers of rails are only doing a poor trade, but a very important alteration is taking place in this branch. Manufacturers appear to be mostly devoting their attention—in the making of Bessemer steel—to the obtaining of high-class qualities which will compete with best wrought irons, and in this they are becoming very successful. Two years ago best wrought irons were fetching more than Bessemer steel, to-day that is not the case, and the introduction of steel plates for boiler and ship plates at low rates has made it a neck and neck race between the two qualities of material as to preference. Several of the Sheffield houses are now very largely employed in making best Bessemer for special cutlery purposes, but though the prices are heavy the material is found to answer well, being mostly converted from foreign irons. In the last number of IRON it was stated that difficulties would arise in this district with the colliers as a result of the National Conference of miners, recently concluded at Manchester. That has proved to be the case. The colliers of South Yorkshire have resolved on an advance in wages of 15 per cent. This will bring on difficulties, and within a month we may have to record a series of strikes or lock-outs.

SOUTH STAFFORDSHIRE.—The iron trade continues to improve, and it is now in a better position than for some time past. Sheets are still in best request, and so full of orders are the makers, the galvanisers and merchants alike complain of difficulty in getting sufficiently prompt deliveries. Prices are 5s. higher than a month ago. Singles are £8 to £8 5s.; doubles, £9 to £9 5s., and lattens, £10 5s. to £10 10s. The demand for boiler and tank plates is improving, and makers quote £8 to £9 per ton. The marked iron houses are only partially employed, but they are strong in maintaining the standard of £7 10s. for bars. Medium bars are £7, and common bars £6 10s. to £6 5s. The native pig-iron trade is quiet but firm. Some all-mine pig vendors are demanding a rise of 2s. 6d. per ton upon the price which regulated former sales, and their quotation now is 66s. 3d. per ton. Part mine pigs may be set down as an average of 50s. per ton, and cinder pigs are 37s. 6d. to 40s. Hardware manufacturers do not report much change on the week. Current business is largely of a hand-to-mouth sort, but the factories generally keep well employed. Export orders are of most size and worth. Notwithstanding the end of the war, the army authorities are still buying some sorts of goods. Manufacturers have this week tendered for the supply of 60,000 infantry mess tins and 5000 cavalry mess tins, and hopes are expressed that South Staffordshire may be able to secure some of the contracts for carriage and wagon ironwork, and bridge ironwork, which the India Office require for the state railways. From Alexandria orders are already beginning to arrive for builders' hardware.

SWANSEA.—Iron remains very steady. Hematite pig is firm. The steel industries are in fair activity, and at Landore the critical points at issue have been adjusted. The steam coal clearances for the preceding week reaches 30,532 tons against 28,332 in the week before. Prices are firm, and demand good. Over 6000 tons of patent fuel have been cleared. Tinplates are better.

WEST CUMBERLAND.—There is a very good trade being done in hematite pig-iron in this district, and makers find no difficulty in keeping their works fully employed, as they have not only a splendid opportunity of taking new orders, the demand being fully maintained from all quarters, but they have on hand a very large number of contracts which require their early attention, both on American and Continental account, and it is evident from the heavy traffics on the local railways, the tonnage of metal finding its way into the hands of British users is more considerable than it has been for some time past. The indications of the future point to a still more active state of things, and it is only reasonable to suppose, from what can be seen at present, that makers will find it essentially necessary to increase the output, although probably this will not be done during the autumn and winter months. That plenty of work will be furnished for the mills during the remainder of the year is evident from the fact that makers at the present are sold forward to an extent which will render such a state of things necessary. Prices are 58s. 6d. for No. 1 Bessemer at works, net; No. 2, 57s. 6d.; and No. 3, 56s. 6d.

SCOTCH PIG-IRON SHIPMENTS.

The table below (copied from the *Public Ledger*) is a comparative statement of the weekly shipments of Scotch pig-iron from the beginning of this year and the corresponding weeks of the previous four years, up to last week. The shipments were:—

Week ending		1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons	1878. Tons.
Jan.	7	3,389	6,182	6,689	6,069	6,085
	14	5,767	6,677	12,288	6,291	4,532
	21	7,742	4,608	7,566	6,331	6,170
	28	8,041	8,906	13,383	4,969	6,550
Feb.	4	12,236	7,226	14,190	6,130	5,637
	11	10,786	10,072	10,612	7,272	5,722
	18	10,528	7,405	15,152	8,996	5,124
	25	10,739	11,266	12,603	8,318	7,836
March	4	12,600	9,900	17,968	13,910	6,816
	11	13,287	8,261	23,985	10,743	8,662
	18	17,544	7,893	20,987	11,167	7,728
	25	12,375	12,262	23,598	9,463	11,499
April	1	10,107	10,421	15,822	15,653	7,448
	8	12,662	10,647	18,309	12,913	9,441
	15	11,694	13,736	15,784	13,228	9,513
	22	14,170	11,492	16,279	11,795	8,382
	29	18,056	13,147	17,749	12,923	8,853
May	6	11,387	9,461	14 799	13,135	9,348
	13	14,982	10,718	13,123	9,919	7,820
	20	12,122	9,532	11,036	11,415	10,742
	27	9,760	11,943	12,819	15,434	7,362
June	3	9,867	14,509	13,198	8,402	7,008
	10	14,270	12,331	11,860	6,156	10 310
	17	15,308	13,537	9 502	7,278	6,326
	24	10,147	10,977	11,514	7,074	7,175
July	1	15,324	13,095	12,527	8,252	7,446
	8	10,474	13,850	10,158	5,619	7,151
	15	13,136	11,118	10,478	9 383	8,101
	22	13,763	12 805	10,815	3,923	5,610
	29	13,116	9,285	10 015	10,670	5,973
Aug.	5	13,579	12,669	12,260	7 504	5,993
	12	13,258	11,700	14,252	8,652	6,102
	19	13,983	10,965	15 870	7,260	8 700
	26	13,151	11,239	13,530	18,312	8,493
Sept.	2	16,076	13,795	15,522	11,795	9,918
	9	10,629	14 812	12,546	11,443	9,792
	16	10,903	14,079	10,789	15,650	7,956
	23	12 933	12,841	8,070	17,935	6,455
Totals		460,010	414,992	517,647	380,382	292 810

CLEVELAND PIG-IRON SHIPMENTS.

The following table contains comparative statements of the weekly shipments of Cleveland pig-iron from the beginning of this year and the years 1881 and 1880, up to last week, as well as the monthly shipments from January to August of 1882 and the previous four years:—

WEEKLY SHIPMENTS.

Week ending		1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan.	7	14,992	12,331	14,347	—	—
	14	18,128	13,454	21,712	—	—
	21	16,125	10,246	19,384	—	—
	28	18,648	6,893	15,315	—	—
Feb.	4	14,990	9,761	11,988	—	—
	11	15,591	15,035	18,082	—	—
	18	14,929	14,681	15,725	—	—
	25	16,941	16,116	21,055	—	—
Mar.	4	25,669	19,135	28,546	—	—
	11	21,245	13,474	14,322	—	—
	18	19,400	17,464	18,295	—	—
	25	15,433	19,370	24,241	—	—
April	1	19,850	20,498	12,138	—	—
	8	17,530	13,154	22,145	—	—
	15	14,934	19,390	18 835	—	—
	22	16,406	19,221	17,111	—	—
	29	16,286	22,946	20,878	—	—
May	6	14,000	15,537	20,509	—	—
	13	16,841	15,395	19,239	—	—
	20	17,609	16,480	16,471	—	—
	27	16,801	21,436	21,648	—	—
June	3	8,943	17,568	22,400	—	—
	10	17,678	19,796	18,368	—	—
	17	15,596	21,834	17,078	—	—
	24	15,715	21,827	12,312	—	—
July	1	20,893	22,802	24,117	—	—
	8	18,473	15,265	18,613	—	—
	15	12,349	21,159	19,190	—	—
	22	14,218	22,046	17,302	—	—
	29	18,477	21,529	17,135	—	—
Aug.	5	22,361	20,983	15,734	—	—
	12	21,199	15,982	17,651	—	—
	19	20 002	17,980	18,387	—	—
	26	18,864	21,923	14,067	—	—
Sept.	2	20,536	15,027	20,609	—	—
	9	26,000	22,364	15,375	—	—
	16	25,491	16,866	14 472	—	—
	23	17,555	17,218	19,165	—	—
Totals		676,671	664,173	694 621	—	—

MONTHLY SHIPMENTS.

Jan.	31	71,458	47,890	78,941	39,751	47,932
Feb.	28	66,893	58,376	71,573	57,458	51,097
Mar.	31	89,837	81,609	84,375	73,105	61,386
April	30	68,909	78,894	88,018	65,250	69,256
May	31	71,405	75,729	81,829	71,456	74,043
June	30	68,373	91,577	82,186	60,808	68,804
July	31	74,311	87,580	82,306	61,825	78,628
Aug.	31	95,861	84,901	72,665	61,499	73,275
Totals		607,047	606,550	641,893	491,152	525,039

THE CONTINENTAL IRON AND COAL TRADE.

BELGIUM.—BRUSSELS, WEDNESDAY EVENING.—Our Bourse des Métaux of to day, though crowded enough, was not much more animated than on the two or three preceding days; but, if orders are not yet very plentiful, there is no doubt many will be booked in a short time, at prices at least as good as those now ruling. All kinds of pig-iron and manufactured iron are very firm. The following are our last official quotations:—

	Sept. 20. Francs.	Sept. 27. Francs.
Belgian foundry pig	75	75
Belgian forge pig	65	65
Luxemburg foundry pig	57·50	57·50
English foundry pig	65	65
Bars No. 1	140	140
Joists	145	145
Angle iron	150	150
Nailrod	145—150	145—150
T iron	145—150	145—150
Ordinary plates	190	190
Boiler plates	210	210
Sheets	290	290
Steel rails	160	160
Tires	235	235
Axles	245	245

There is also great firmness in the coal market. The prices of coke will probably rise in a week or two, and for house coal and fuel for industry there are also bright prospects, present quotations being very well maintained. Current quotations are:—

	Sept. 20. Francs.	Sept. 27. Francs.
House coal	16—18	16—18
Large coal	16—19	16—19
Unscreened coal	11·50—14·50	11·50—14·50
Small steam coal	10—11	10—11
Small coking coal	11	11
Coke	19	19
Half washed coke	21	21

SWEDEN AND NORWAY.—The returns for the seven months of the year just issued show the imports and exports of the following articles in Sweden as compared with those of the previous year to have been:—

	1882	1881
Imports.		
Machinery and implements	£73,000	£58,000
	Tons.	Tons.
Coals	43,500	27,600
Exports.		
Iron ore	1,305,900	942,800
Pig and cast iron	311,410	276,460
Bar and rolled iron	836,890	587,610
Plates and hoops	299,130	227,710
Blooms	40,790	33,300
Rails	1,630	1,600
Galvanised products	10,080	9,670
Nails	4 810	4,820
Steel	43,470	29,340
Zincblende	126,320	54,800
Machinery and implements	£23,000	£17,300

There is no change in the Swedish iron market. A dispute which promises to benefit the Swedish iron trade has arisen between the Stora Kopparbergs Berslag, one of the largest exporting companies of iron ore, pig-iron, and wood goods in Sweden and the Gefle Dalsland railway, in consequence of the high rates of freight charged by the latter. As there seems little chance of a compromise, this company will in future effect their shipments from Stockholm, instead of from Gefle: and as their export of wood goods amounts to 60,000 tons a year, 20,000 tons of iron, necessary as ballast for this quantity may be shipped yearly from Stockholm at one third or one-half of the freight now paid. It is just this circumstance that iron is always required for ballast in a vessel with a cargo of wood goods, which enables the iron merchants at Gothenburg, where there is always plenty of wood, to forward their goods to England at half the cost of what those at Stockholm have to pay, where no wood is to be obtained. On the other hand, English coals and coke may be shipped to Stockholm at a much lower rate when there is return cargo to be obtained than is now the case, which is demonstrated by the fact that, whilst the rate of freight on coals to Stockholm is now 5s. 6d., the rate to Gefle, which is much further up in the gulf, is only 3s. 6d.

The working during last year of one of the largest manufacturing works in Sweden, the Uddeholms Works, in Värmlands län, whose brands of pig and Lancashire iron, as well as cast steel, are well known in our iron trade, shows that there were raised from their mines about 25,000 tons of iron ore, and purchased from others 5100 tons. There was smelted 12,200 tons of pig-iron, of which 4100 tons were intended for the manufacture of Bessemer and Martin steel. Of other articles the works produced: 8100 tons blooms, 1800 tons cast iron in the Bessemer blasting, 3500 tons bar and rolled iron, 1600 tons rolled Lancashire iron, 4000 tons Martin and 600 tons Bessemer steel, as well as 110 tons blister steel. The sales during the year amounted to nearly 10,000 tons, and realised £90,000. The value of the stock on hand at the beginning of the year was nearly £23,000, while the company's assets were valued at £370,000. There seems to be a revival in the nickel industry of Norway, formerly one of the most profitable metal trades of the country, which declined some years ago owing to the sudden fall from 1½s. to 3s. in the value of this article. At many mines where no work has been done for years working has of late been resumed. An attempt is, for instance, now being made of re-working the Foldalen nickel mine, one of the richest in Norway, by an association of Norwegian capitalists—the capital being about £50,000—who intend to build a railway to the works. The production is estimated at 40,000 tons of ore per annum. The nickel mines now worked in Norway are chiefly owned by Englishmen, who bring the raw ore to England for dressing and refining.

NEW PATENTS.

ALL the patents are placed alphabetically, with the official numbers attached. The new applications range from No. 4437 to No. 4566, being the entries from Sept. 19 to Sept. 25, 1882.

NEW APPLICATIONS.

A Hay Bogie.—*R. Swan, and J. Batie, Bedlington, Northumberland.* [4517

A Powder for Cleaning Grease from Tin.—*T. N. Pickford, Newport, Monmouth.* [4471

Air Gas.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4442

Arrangement of Gas and Heating Stoves.—*J. S. Willway, 17, St. Augustine's Parade, Bristol.* [4524

Bark sor Paper.—*W. M. Riddell, Finsbury Pavement, Middlesex.* [4447

Batteries for Generating Electricity.—*C. C. Skrivanow, Paris, France.* [4460

Bicycles, &c.—*C. Clarke, Westmoreland, Jamaica.* [4473

Biscuits, &c.—*T. C. S. Cook, Southern Hill, Reading, Berks.* [4486

Biscuits.—*G. Baruch, Podgorze, Galicia, Austria.* [4465

Blind Roller Furniture.—*J. W. Andrews, Whittlesea, Cambridge.* [4438

Bottles, &c.—*A. Pullan, New Cross Road, Surrey.* [4565

Break Mechanism for Carriages.—*A. Oliver, Hawkhurst, Kent.* [4563

Breech Loading Firearms.—*H. and E. Hammond, both of Winchester, Hants.* [4541

Buttoned Boots.—*C. Chambers, Highbury Vale, Middlesex.* [4463

Buttonhole Attachment for Sewing Machines.—*J. Nasch, Whitechapel Road, Middlesex.* [4520

Carbon Conductors.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4462

Chimney Tops, &c.—*J. McPhail, Minories, London.* [4458

Closing, &c., Windows.—A communication.—*E. Edwards, 40, Southampton Buildings, Middlesex.* [4466

Combination Nut Crackers.—*W. Brown, and D. Robertson, both of Glasgow, Lanark.* [4566

Coupling Railway Vehicles.—*W. C. Braithwaite, 35, King William Street, London.* [4441

Combined Range and Grates.—*W. Y. Stevens, Thomas Street, Bristol, Gloucester.* [4419

Combined Spade and Pick.—*H. M. Alexander, Coleraine, Ireland.* [4443

Composing and Distributing Machines.—A communication.—*E. G. Brewer, 33, Chancery Lane, Middlesex.* [4560

Compound Atmospheric Funnels.—A communication.—*E. Wery, 38, Thurloe Place, South Kensington, Middlesex.* [4544

Connecting Lamps to Bicycles.—*J. Lucas, Birmingham, Warwick.* [4457

Construction of Firearms.—*W. W. Greener, Birmingham, Warwick.* [4516

Construction of Ships.—*J. Scott, Helensburgh, Dumbarton, N. B.* [4533

Coupling Apparatus.—A communication.—*A. W. L. Reddie, 66, Chancery Lane, Middlesex.* [4530

Decoration of Ceramic Ware.—*A. Wenger, Hanley, Staffs.* [4481

Drain Pipes.—*F. H. Nevett, 5, Chancery Lane, Middlesex.* [4500

Driving Screw Piles.—*T. Wrightson, and W. Clark, both of Stockton-on-Tees, Durham.* [4464

Drip Course Bricks.—*W. H. Cooper, 37, Gloucester Street, Regent's Park, Middlesex.* [4491

Dynamo Electric Engines.—*A. Lalance, and M. Bauer, Paris, 30, Boulevard Magenta.* [4555

Dynamo Electric Machines.—A communication.—*F. C. Glaser, Berlin, Germany.* [4535

Dynamo-Electric Machines, &c.—*J. W. Swan, Newcastle-upon-Tyne.* [4161

Dynamo Electric Machines.—*R. Barker, Port View, Seacombe, Chester.* [4547

Electrical Meters.—A communication.—*T. J. Handford, 48, Southampton Buildings, Middlesex.* [4446

Electro Magnetic Engraving Machines.—A communication.—*B. J. Carter, Edith Road, West Kensington, Middlesex.* [4527

Embroidering Machines.—A communication.—*A. M. Clark, 53, Chancery Lane, Middlesex.* [4501

Extracting Moisture from Air.—A communication.—*W. R. Lake, Southampton Buildings, London.* [4546

Fastenings for Blind Cords.—*S. C. C. Currie, 121, Warwick Street, London, S. W.* [4437

Feed Cups for Lubricants.—*R. Baird, 134, St. Vincent Street, Glasgow.* [4455

Folding Cases.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4537

Forming Temporary Partitions, Class Rooms, &c.—*J. W. Cook, Bury Street, Middlesex.* [4514

Freeing Ferruginous Solutions of Certain Salts.—*C. Senper, Philadelphia, U. S. A.* [4140

Frosted Glass.—A communication.—*W. H. Beck, 139, Cannon Street, London.* [4528

Gas Lamps.—*I. Spielmann, 2, Westbourne Terrace, Middlesex* [4497

Gas Motor Engines.—*F. W. Crossley, Manchester.* [4480

Governing Apparatus for Steam Engines.—*B. Fowler, and W. Daniel, both of Leeds, Yorks.* [4566

Governing Electric Currents.—*J. S. Beeman, W. Taylor, and F. King, all of 110, Cannon Street, Middlesex.* [4503

Grape Sugar, &c.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4474

Guard Rails for Fishing Boats.—*J. Gunn, 'Golspie, Sutherland.* [44520

Handles for Table Cutlery.—*H. Hall, Wetherby, Yorks, and T. W. Hall, Sheffield, Yorks.* [4482

Hair Pins.—*F. Kingston, Albyn Road, St. John's, Kent.* [4488

Harvesting Machines.—*J. Paul, Harvard, Dorset.* [4540

Hoisting, &c., Heavy Weights.—*J. T. Roe, Wandsworth, Surrey.* [4478

Indicating the Presence of Water in Cisterns.—*J. Shaw, and F. Millan, Lockwood, Huddersfield, Yorks.* [4550

Injectors.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4553

Iron.—*W. Clarke, Birmingham, Warwick.* [4539

Joining, &c., Rails.—*E. E. Talbot, Paddington, London.* [4467

Lamps Burning Mineral Oils.—A communication.—*J. Imray, 28, Southampton Buildings, Middlesex.* [4512

Leather Paring Machines.—A communication.—*E. G. Brewer, 33, Chancery Lane, Middlesex.* [4507

Loading and Unloading Carts.—*F. Wheeler, East Cowes, Isle of Wight.* [4554

Looms for Weaving.—*W. Smith, Heywood, Lancs.* [4515

Looms for Weaving.—*H. Lomax, Darwen, Lancs.* [4557

Machines for Bricks.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4495

Machines for Harvesting.—A communication.—*T. D. Stetson, 23, Murray Street, New York, U. S. A.* [4456

Machinery for Doubling, &c., Yarns.—*J. and J. Horrocks, Manchester, Lancs.* [4500

Machinery for Wire Netting.—A communication.—*M. A. F. Mennons, 52, Rue Basse du Rempart, Paris* [4406

Malted Farinaceous Food.—*J. Schweitzer, Loughborough Park, Brixton, Surrey.* [4523

Measuring Electric Machines.—*J. S. Beeman, W. Taylor, and F. King, all of 110, Cannon Street, Middlesex.* [4504

Mechanism for Transporting Goods.—*F. Jenkin, Great Stuart Street, Edinburgh.* [4548

Metal Hurdles, &c.—*S. Bayliss, and W. Bailey, Wolverhampton, Staffs.* [4549

Nails and Screws.—*S. Beaven, Campinas, Say Paulo, Brazil.* [4444

Nut Locks.—A communication.—*C. A. Snow, Washington, Columbia, U. S. A.* [4468

Paints.—A communication.—*A. B. Rodyk, 7, Mincing Lane, London.* [4552

Paper Pulp.—A communication.—*W. R. Lake, Southampton Buildings, London.* [4529

Perambulators, &c.—*W. J. Ingram, Strand, Westminster.* [4531

Phosphorites for Manures.—A communication.—*J. Imray, 28, Southampton Buildings, Middlesex.* [4487

Porcelain, &c.—*W. E. Langdon, Derby, J. C. and G. Fuller, both of Bow, Middlesex.* [4450,

Portable Voltaic Batteries.—*J. Mackenzie, Osnaburgh Street Regent's Park, Middlesex.* [4512

Potato Planting Machines.—A communication.—*H. Gardner, 166, Fleet Street, London.* [4513

Preventing Noise of Sewing Machines.—A communication.—*I. Hain, New York, U. S. A.* [4475

Preventing Shocks to Ships when at Anchor.—*B. C. Le Mousu, MacLean's Buildings, New Street Square, Middlesex.* [4526

Printing Fabrics.—A communication.—*J. Ingleby, 7, St. Peter's Square, Manchester, Lancs.* [4439

Producing Electric Currents.—*A. R. Bennett, Worthing, Sussex.* [4492

Producing Electric Currents.—*F. Swift, The Green, West Drayton, Middlesex, and A. J. M. Reade, St. Leonard's Villa, Slough, Bucks.* [4543

Producing Reliefs with Equally Deepened Excavations—*L. H. Philippi, Hamburg, Germany* [4562

Pumps.—*J. S. Sawrey, A. Attwood, and H. Woodburne, all of Ulverston, Lancs* [4542

Purification of Gas, &c.—*H. Symons, Totnes, Devon.* [4538

Purifying Gas.—*T. Coley-Bromfield, Hove, Sussex, and G. Symes, Locksley Street, Limehouse, Middlesex.* [4545

Railway Couplings.—*T. Archer, jun., Dunston, Durham.* [4551

Railway Couplings.—*R. Lansdale, Halewood, Liverpool, Lancashire.* [4534

Registering Padlocks.—A communication.—*W. R. Lake Southampton Buildings, Middlesex.* [4493

Regulating Currents from Voltaic Cells, &c.—*W. B. Ayrton, and J. Perry, Finsbury, Middlesex.* [4532

Resistance Coils for Electrical Purposes.—A communication.—*J. H. Johnson, 47, Lincoln's Inn Fields, Middlesex.* [4484

Revolving Chairs.—*R. Cruikshank, jun., Denny, Stirling.* [4453

Rigging of Boats.—*G. Hughes, Wolverhampton, Staffs.* [4502

Sealed Vessels for Liquids.—A communication.—*W. A. Barlow, 6, St. Paul's Churchyard, Middlesex.* [4448

Secondary Batteries.—*F. C. Hills, Deptford, Kent.* [4561

Secondary Batteries.—*F. M. Lyte, Trafalgar Square, Middlesex.* [4525

Secondary Voltaic Batteries.—*A. Khotinsky, Cannon Street Hotel, Middlesex.* [4490

Securing Windows.—*W. McNicol, Leith, Midlothian, N. B.* [4479

Shields for Buttons, &c.—A communication.—*W. P. Thompson, 6, Lord Street, Liverpool.* [4485

Shipping and Unshipping the Rudders of Ships.—*M. Horsley, Hartlepool, Durham.* [4518

Sizing Machines.—*W. Whalley, Amsterdam, Holland.* [4521

Sliding Gas Chandeliers.—*E. Horton, 239, Bradford Street, Birmingham, Warwick.* [4445

Spring Mattresses.—*J. Lokie, Glasgow, Lanark, N. B.* [4522

Spring Packings.—*T. Duffield, Dore, Derby* [4483

Soap used in Scouring, &c., Woollen Fabrics.—*J. Glover, Silcoates, Wakefield, Yorks.* [4477

Steam Boilers.—*T. Gilmour, Kilcattan, Bute, and J. Gilmour, Glasgow, Lanark.* [4559

Stitching Machines.—*B. Hague, Nottingham.* [4499

Stop Watches.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4536

Storing, &c., Electricity.—*J. D. F. Andrews, Glasgow, Lanark, N. B.* [4511

Sugar Mills.—*E. Death, and J. Ellwood, both of Leicester.* [4498

Supports for Revolving Chair.—*J. Unger, Cannstatt, Stuttgart,* [4564

Tablet Diaries.—*J. W. Cochrane, Glasgow, Lanark, N. B.* [4480

Tobacco Pipes.—*E. Lorge, St. Claude, France.* [4556

Transmitters for Telephones.—A communication.—*W. P. Thompson, 6, Lord Street, Liverpool.* [4454

Treatment of Middlings.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4459

Treatment of Steel Ingots.—A communication.—*P. M. Justice, Southampton Buildings, Middlesex.* [4528

Treating Dough to Form Loaves.—*R. Abercromby, Glasgow, Lanark, N. B.* [4558

Tricycles, &c.—*D. Pidgeon, Holmwood, Putney Hill, Surrey.* [4470

Vases to Contain Flowers.—*F. Barford, Hemel Hempstead, Herts.* [4469

Ventilating Saloons.—*J. and J. K. Leathe, both of Liverpool, Lancs.* [4519

Ventilating Tramway Carriages.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [4451

Washing, &c., China Clay.—*J. F. Lackersteen, New Cross, Kent.* [4474

Wheels and Axles for Tram Cars.—A communication.—*W. Morgan-Brown, 38, Southampton Buildings, Middlesex.* [4505

Wheels for Railway Carriages.—A communication.—*G. W. von Nawrocki, Berlin, Germany.* [4476

Working Tram Cars by means of Ropes.—*C. Hinksman, 117, Great Russell Street.* [4472

ABSTRACTS OF SPECIFICATIONS RELATING TO METALS

PUBLISHED DURING THE WEEK ENDING SEPT. 25, 1882.

(Prepared by PHILIP M. JUSTICE, 53, Chancery Lane, W.C.)

Corrugating Cartridge Cases.—609 (1882).—*W. W. Greener.*—The corrugating is requisite for holding the wadding and charge in its proper position in the cartridge case. A cylindrical head is constructed in the interior of which are seven bevelled studs on to this is fixed a mandrils to which a piston and rod are attached. The projecting studs form the grooves on the cases from the mouth of the case to the wad.

Puddling Iron.—645 (1882).—*R. Thompson.*—This relates to an improvement on Patent No. 1852 of 1879. A stirrer is driven from above by means of a vertical shaft carried by a radial arm, and driven by gearing. This radial arm can be raised or lowered by hydraulic or other power for the purpose of changing the stirrer blade.

Blast Furnaces.—828 (1882.).—*W. Ferrie.*—The retorts are arranged with sliding doors one at the bottom of each retort and the other at a part where a passage from the retort meets the arch of the blast furnace. The purpose of this is to produce a more effectual sealing of the retorts. Another part of the invention provides against the materials when charged into the opening of the furnace, falling with too great a weight upon the contained charge. This is effected by suspending from the charging cone a second inverted cone. Another feature of the invention consists in the utilisation of blast furnace gases for the purpose of destructive distillation of shales, coal ironstones in stills, retorts, or other apparatus.

Moulding Boxes.—836 (1882).—*C. Bailey.* Provisional Protection only.—The framework of the moulding box is formed of one bar or piece. The bar forming the framework is divided in a vertical direction, and near to this point is provided a bracket or carrier. The box is also fitted with guides and constructed to open at the divided part. The object of the construction is, that after the patterns are moulded, the box can be relieved from the sand.

Weldless Tubes.—846 (1882).—*R. Elliott.* Final Specification not filed.—The object of the invention is to produce tubes, with the grain of the metal in a helical direction to prevent splitting of the tubes. The metal is forced through a die in which the helical grooves are formed.

Locking Nuts.—854 (1882).—*Clark*, communicated by S. Pattee and A. B. Smith.—The bolt is formed with a right and left hand thread, the two threads crossing each other. Two nuts are employed, one matching each thread. Between the two nuts are interposed a plate with projecting ears which lap over the edge of both nuts, and prevent turning.

Wrought Nails.—894 (1882).—*J. Maynes.*—One or more pairs of feed rolls intermittently driven, are placed in front of the machine and serve to feed the metal rod through a conical tube, into which a gas flame is admitted. The heated metal is then acted upon by swages or compressors, actuated by cams, and afterwards cut into lengths by shears.

Tin Plates.—894 (1882).—*A. J. Mashray.* Provisional Protection only.—The removal of oxide of iron from the surface of iron plates is effected while they are within the annealing pots, by subjecting them to the action of carbonic oxide formed from charcoal or other carbonaceous substance.

Casting Steel Tubes.—910 (1882).—*B. Johnson, jun.*—The core is constructed of an inner tube or piece which is of metal, and an outer piece of thin metal. The molten steel is poured into the mould and flows round and in contact with the outer sheath or case.

COMMERCIAL.

NEW COMPANIES.

AFRICAN DRY PLACER GOLD AMALGAMATOR COMPANY, LIMITED.—This company proposes to acquire patent rights and similar privileges for the African Continent or any part thereof, for inventions for gold washing, and in particular of "The African Dry Placer Amalgamator," invented by Mr. Erastus Stephen Bennett, of Denver City, Colorado, U. S. A. It was registered on the 19th inst., with a capital of £50,000 in £20 shares.

ANGLO-AMERICAN PATENT DEVELOPMENT COMPANY, LIMITED.—Upon terms of an agreement of the 29th ult., this company proposes to purchase the business carried on by Wm. Downie, in conjunction with Patrick O'Halloran, at 28, Southampton Buildings, under style of the Anglo-American Patent Development Agency. It was registered on the 15th inst., with a capital of £50,000, in £1 shares.

ATLAS WAGON COMPANY, LIMITED.—This is the conversion to a company of the business carried on by Mr. Jabez Mullins Haime of the Atlas Wagon Works, East Moor, of Cardiff. It was registered on the 13th inst., with a capital of £10,000, in £5 shares.

BELCHER MINING COMPANY, LIMITED.—Upon terms of an unregistered agreement of the 3rd inst., this company proposes to purchase and work mining property situate on the Sultan Mountain, in the Las Annimas Mining District, San Juan County, U. S. A. It was incorporated on the 13th inst., with a capital of £25,000, in £5 shares.

BRADA MINES, LIMITED.—This company proposes to purchase a lease of mineral properties in the Isle of Man, granted by the Woods and Forest Commissioners on 17th April to R. Rome, A. Grant, and W. Baxter. It was registered on the 15th inst., with a capital of £10,000, in £1 shares.

DENVER GOLD COMPANY, LIMITED.—This is a reconstruction of the Quartz Hill Gold Mining Company, Limited, in conformity with resolutions passed by the shareholders of that company at extraordinary meetings held on the 4th and 19th ult. The new company was registered on the 16th inst., with a capital of £62,000, in 240,000 shares, of 5s. each.

DUCHY DUPLEX LIGHT AND STORAGE COMPANY, LIMITED.—Registered on the 13th inst., with a capital of £50,000, in £1 shares, to carry on the business of an electric light and power company in all branches.

FERRANTI, THOMPSON AND INCE, LIMITED.—This company proposes to purchase any electrical business and the benefit of any patents relating to electricity. It was registered on the 15th inst., with a capital of £240,000, in 12,000 A shares, and 36,000 B shares, of £5 each. The profits of the company are to be divided as follows: 1st., in payment of 5 per cent. on the A shares; 2nd., in payment of 5 per cent. upon the B shares; 3rd., sixth-twentieth of the balance to the A shares, and fourteen-twentieths to the B shares.

FORDER AND COMPANY, LIMITED.—This is the conversion to a company of the business of a carriage maker, carried on by Frederick Forder and Livingston Thompson, at Bilston Street and Garrick Street, Wolverhampton, and at 7, Upper St. Martin's Lane, London. It was registered the 12th inst., with a capital of £50,000 in £50 shares.

JOHN NUNNERLEY AND COMPANY, LIMITED.—This is the conversion to a company of the business of builders' merchants carried on by the above firm at Warrington, Lancaster. It was registered on the 19th inst., with a capital of £20,000 in £10 shares.

KAYE, HIRST AND COMPANY, LIMITED.—This company proposes to purchase the mine and other property of the Albert Brick and Coal Company, Limited, at Rhos, near Ruabon, Denbigh. It was registered on the 14th inst., with a capital of £2000, in £5 shares.

LANCASHIRE MAXIM-WESTON ELECTRIC COMPANY, LIMITED.—This company proposes to adopt an unregistered agreement of the 16th inst., with the Maxim-Weston Electric Company, Limited, and to supply the electric light in Lancashire, Cheshire, and North Wales under the Maxim and Weston systems. It was incorporated on the 19th inst. with a capital of £100,000, in £1 shares.

LAPPAL TUNNEL BRICK COMPANY, LIMITED.—This company was registered on the 14th inst., with a capital of £30,000, in £5 shares, to take over the business and effects of Mr. John Garlick, brick manufacturer, of Carlifornia, Harborne, in the county of Stafford.

LIVERPOOL, BARROW, AND WEST CUMBERLAND STEAMSHIP COMPANY, LIMITED.—Incorporated on the 16th inst., with a capital of £50,000, in £1 shares, to carry on the business of shipowners in all branches.

SOUTH WALES STEAMSHIP COMPANY, LIMITED.—Registered on the 18th inst., with a capital of £26,000, in £100 shares, to purchase the steamship *South Wales* from Schlesinger, Davis and Co., of Wallsend, Newcastle-on-Tyne, shipbuilders.

STEAM CULTIVATING COMPANY, LIMITED.—This company proposes to acquire and to let out and work on the hire system, steam cultivating machines and engines of all kinds, and in particular to acquire from the Agricultural and General Engineering Company, Limited, and to work on the hire system, or otherwise, Darby's Patent Broadside Steam Digger. It was registed on the 15th inst., with a capital of £10,000, in £5 shares.

TOLLINGTON COMPANY, LIMITED.—This company was registered on the 19th inst., with a capital of £12,000, in £100 shares, to acquire and work mining properties, and to carry out an unregistered agreement, dated 18th inst., between A. J. Paine and A. Fisher Clarke.

METROPOLITAN BOARD OF WORKS.

RETURN *of the Testings made at the Gas Testing Station during the Week ending September 26, 1882.*

Company and District.	Illuminating Power.* (In standard sperm candles.)			Sulphur. (Grains in 100 cubic feet of gas.)			Ammonia. (Grains in 100 cubic feet of gas.)			Sulphuretted Hydrogen.	Pressure.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.		
Gas Light and Coke Company.											
Netting Hill ...	17·6	17·1	17·3	9·6	7·8	8·8	0·3	0·0	0·1	None in excess.	
Camden ...	17·8	16·8	17··	12·4	8·6	10·8	0·2	0·0	0·0		
Dalston... ...	17·6	16·9	17·2	12·2	9·5	10·9	0·0	0·0	0·0		
Bow‡	18·1	17·4	17·8	10,6	9·5	12·1	0 7	0·3	0·5		
Chelsea... ...	17 4	17·1	17·3	14·0	11·4	12·4	0·3	0·0	0·1		
Kingsland Rd.	17·7	16·9	17·3	9·9	6·1	8·4	0·1	0·0	0·0		
Westminster (cannel gas)...	21·9	20·8	21·3	8·9	7·7	8·3	0·5	0·0	0·3		
South Metropolitan Gas Company.											
Peckham ...	17·1	16·6	16·8	11·0	8·9	9·7	0·6	0·2	0·4		
Clapham ...	16·3	16·1	16·2	11·2	7·5	9·2	0·6	0·4	0·5		
Tooley Street...	16·9	16·3	16·5	13·0	9·8	11·7	0·2	0·4	0·5		
Commercial Gas Company.											
Old Ford ...	17·6	16·7	17·2	9·8	6·1	7·6	0·2	0·1	0·1		
St. George-in-the-East ...	17·4	16·6	16·9	6·0	4·9	5·5	0·2	0·1	0·1		

W. J. DIBDIN, F. I.C., F.C.S.,
Consulting Engineer and Superintending Gas Examiner.

* The standard illuminating power for common gas in the metropolis is 16 sperm candles, and for cannel gas 20 sperm candles. Sulphur not to exceed 17 grains in the 100 cubic feet of gas. Ammonia not to exceed 4 grains in the 100 cubic feet of gas.

† Pressure between sunrise and midnight to be equal to a column of one inch of water. Pressure between midnight and sunset to be equal to a column of six-tenths of an inch of water.

‡ Meter under repair.

PRICES CURRENT OF MANUFACTURED GOODS OF BIRMINGHAM AND DISTRICT,

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The quotations given are manufacturers' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

September 27.

The iron market continues very firm, and in most cases makers get the small advance quoted last week. Galvanised sheets are in large request and prices are likely to advance, the manufacturers being very cautious in accepting orders for forward delivery. The Brass and Copper Wire Drawers' Association have advanced the price of brass and copper wire ½d. and ¼d. per lb. respectively, the rates for rivets, nails, washers, &c., being increased accordingly. Good orders are coming to hand from the Colonies and South America for various kinds of manufactured hardware, and in view of the improved tone in the iron market higher prices generally may shortly be looked for.

ABRIDGED LIST.

AMERICAN WIRE HOBS, 1 lb., 42/6; 1½ lb., 36/6; 2 lb 3/6; 2½ lb., 31/6; 3 lb., 30/6 per cwt.

ANCHORS, common, 1 to 10 cwt. 14/ per cwt.

ANVILS (Common), 16/9 per cwt.; Best anvils, not warranted 20/ per cwt.; Best warranted anvils (bicks tied in 1 to 5 cwt.), 21/6 per cwt.

AUGERS (shell), ½ inch to 2 inch, 11/ to 44/ per doz., less 57½%; (screw), ½ inch to 2 inch, 16/ to 64/ per doz., less 57.

AXES, ship carpenters', /4½ to /5½ per lb.; Kent and house carpenters' ditto, /4 to /5; ditto. steel polished, 5 to 6, felling axes, /4½ to /4½; bright and blued, solid steel, /7 to /8. American felling or wedge axes, steel, polished, /11 per lb.

AXLE PULLEYS, iron, 8/ to 26/6, 1½ inch; Brass face ditto 26/6 to 46/6, 1½ inch.

AXLES, 35 to 45%

BASINS.—Bright tinned, shallow, 8 inch, 2/6; 9 inch, 2/9; 10 inch, 3/4; 11 inch, 4/; 12 inch, 4/6; 13 inch, 5/; 14 inch, 6/; 16 inch, 8/6 per doz.; galvanised ditto, 8 inch, 2/3; 9 inch, 2/6; 10 inch, 3/; 11 inch, 3/9; 12 inch, 4/3; 13 inch, 4/9; 14 inch, 5/9; 16 inch, 7/9 per doz.

BASTARD BELLOWS, 52½ %; best extra nailed bastard bellows, 47½%; best improved long thistol, 42½%; common smiths' bellows, 62½%; best warranted extra double nailed, 45 to 50%; ditto, with movable pipe for shipment, 52½%.

BELLS.—House brass, rough, /8 to /10 per lb.; turned edge, 8½ to /10½ per lb.; turned and lacquered on edge, 1/5 to 1/10 per lb.; cattle and sheep bells, with brass loops, 1/1 to 1/3 per lb.; clock bells, 1/5 to 1/6 per lb.

BELL STAPLES (the tinned) ½ inch, /11; ¾, /14; 1, /24; 1¼ /36; 2, /54; 2½, /68 per gross.

BED SCREWS, London, black heads, 6, and 7-16, and ½ inch 8/6 to 10/6 per gross; London heads, with bright turned collar, and 7-16, and ½ inch nuts, 11/9 to 12/9; black welded heads, 8/3 to 9/3; common slit heads, 6, and ½, and ¾ inch, 8/9 to 9/9; bright turned notched heads, 6, and 7-16, and ½ inch, 12/3 to 13/3; black notched heads, 10/ to 11/ per gross. Bedsteads, cheap stump, 6 feet by 3 feet 6 inches, 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches.

BOLTS.—Solid end tower, 72½ to 75%; ditto, solid end barrel, 67½ to 70%; best solid tower bolts, 75%; japanned Scotch tower bolts, 55%. Bolts and nuts, black, ¼, and 5-16 to 2 inch and under, 3/6 and 4/; ¾ 5/6, 7-16 6/7 per gross, ½ and 9-16 21/, ⅝ and 11-16 21/, ¾ to 1¼ inch, 20/ per cwt.; 1½ to 3 inch, ¼, 4/, 5-16 4/7, ⅜ 6 6, 7-16 7/10 per gross; ½ and 9-16 21/, ⅝ and 11-16 10/, ¾ to 1¼ 18/ per cwt. Square heads, round necks, square nuts, bright engineers hexagon heads, 2½ to 3 inch, ¼ 22/, 5-16 24/, ⅜ 27/ 7-16 31/ ½ 45/ 9-16 51/ ⅝ 67/ ¾ 69/ ⅞ 126/ inch 184/ per gross. Bright engineers hexagon nuts, ¼ 10/, ⅜ 12/, ½ 14/, ⅝ 20/, ¾ 28/, 1 inch 36/ per gross. Black nuts, square, blank, ¼ inch 16/, ⅜ 14/6, 1 inch 14/6, 1¼ inch 16/6 per cwt. delivered.

BRASS HEAD NAILS, 57½ to 65%; star head, 50%; brass plated countersunk head, 30 to 35%; blacksmith's tongs, 23/ per cwt.; real fine wrought box irons, 20 to 25%; fine cast, 60%; middle cast, 50 to 55%; Victoria charcoal box irons, 45 to 50%; ordinary charcoal ditto 0 62½; brushes, painters', 50 to 75%; best ditto, 15 to 50%; brass rolled, 2 to 12 inches wide to 30 W.G., /7½ per lb. Brass sheets, 24 and 26 inch, 8 lb. and upwards, or 27 W.G., /8½ per lb.; ship and turret bells, 1/4 per lb. Battery kettles, 125/ per cwt.; brass jelly pans, with bails, /6½ to /9½; without bails, /10½ to /10½; Muslin kettles, cast, 4 to 10 inch, /9 to /9½ per lb. Brass shoe bills, /9 per lb.; brass scale pans, 1/6; brass toddy kettles, 15 to 20%.

BRASS CORNICE POLE RINGS, light, middle and strong, 45%.

BRASS WIRE, /7½ per lb. up to No. 20 W. G.; back bands, 3 lb. and larger, 10/9 per cwt.; ditto, smaller, 2/ per cwt. extra; double swivel ditto 1/ per cwt. extra.

CART TRACES, 9 to 12 links to foot, 16/3 to 18/9 per cwt.

CHAIN, machine made, Wire, single link, "Iron," 55%; double link ditto, 55%; machine-made Wire Chain, single link, "Brass," 55%; registered ditto, 55%; close link brass chain, 55%; oval link brass chain, 55%; brass clock chain, 35%; short link tested (rigging) chain, 3-16 inch, 19/9; ¼, 17/; 5-16, 15/3; ⅜, 15/; 7-16, 13/6; ½ 12/9; ⅝, 12/; ¾, 11/6; 1 inch, 11/ per cwt.; well chain, twisted or straight link, ¼ inch, 25/1; 3-16, 18/; ⅛, 16/; 5-16, 14/9 per cwt. delivered.

CHAIR NAILS (brass), lacquered or gold colour, No. 1 to 12, 2/ to 7/6 per 1000; machine polished, 1/9 to 2/3 per 1000; lacquered or gold coloured, 2/ to 1/2½ per lb.; discount per 1000, 57½%; per lb., 55, delivered.

CHIPPING CHISELS, solid cast steel, /6 per lb.

COACH BOLTS AND NUTS, round or cheese heads, square necks and nuts, black, ¼ inch by ¾, 4/3; ⅜, 4/3; 4, 5/1; 4½, 5/7; 5 inch 6/1 per gross. Bright, ¼ inch by ¾, 4/9; ⅜, 5/3; 4, 5/9; 4½, 6/3; 5 inch 6/9 per gross. Black, ¼ inch by 5-16, 4/9; ⅜, 5/3; 4, 5/9; 4½, 6/3; 5 inch, 6/9 per gross. Bright ¼ inch by 5-16, 5/6; ⅜, 6/; 4, 6/6; 4½, 7/; 5 inch, 7/6 per gross delivered.

COACH SCREWS.—Patent bright pointed, 2 inch and under, ¼ inch, 3/1; 5-16, 3/8; ⅜, 4/6; 7-16, 5/4 per gross; ½ inch, 20/; ⅝ inch, 23/; ¾, 30/ per cwt.; 4½ to 6 inches long, ¼ inch, 26/6; 7-16, 25/; ½, 21/; ⅝, 19/; ¾, 18/ per cwt.; above 6 inch, ¼ inch, 25/6; 7-16, 24/; ½, 20/; ⅝, 18/; ¾, 17/ per cwt.; 1/ per cwt. extra for hexagon heads, delivered.

COACH SPRINGS, 40%.

COCKS.—Brass range cocks, ½ inch, 30/; ¾, 42/; 1, 53/6; 1¼, 64/; inch 75/ per doz., less 30% discount; brass racking cocks, fast key, 1¼ inch, 11/; 5-16, 13/; ⅜, 15/; 7-16, 18/; ½, 23/; 9-16, 34/; ⅝, 38/; ¾ 45/; ⅞, 59/; 1 inch, 60/ per doz.; loose key, 1/ to 18/ per doz. extra discount, 60%.

COFFIN FURNITURE, registered, 50%; ditto, common, 75%.

COPPER BOAT NAILS, ½ inch to 2 inches and above, 1/8 to /11½ per lb.; copper boat roves, ¼ to ½ inch and above, 1/6 to 1/ per lb.; cut copper nails and tacks, ½ inch to 1 inch and above, ¼ to /10 per lb.

COPPER WIRE, /10 per lb. up to No. 20, W. G.

COMPOSITION Sheathing and Slating Nails, 1 inch, /8½ per lb. Copper brads and bills, /10 per lb.; round copper kettles, bare rivets, 2 wire 1/2 per lb.; light round covered rivets, 2/6 to 2/7 per lb.; loaded 1/5 to 1/6; oval copper kettles, bare rivets, 1/10 to 1/11 per lb.; oval bare rivets, raise down, 1/11 to 2/ per lb. Copper slating nails (cut), 1 to 1½ inch and upwards, /10½ to /11½ per lb.; copper scale pans, 1/6 to 1/10 per lb. Copper nails and tacks (wrought), 1 inch, 1/2 per lb. Chair webbing, No. 9, 4/3; 10, 4/8; 09, 5/1; C12, 4/6 per gross of 66 yards. Carpet rings, 1/ to 1/4 per gross. Cornice poles, 2½ inch, brass, best burnished, 4/6 per foot, less 45%; ¾ covered brass poles, 1/2 per foot, less 45%; 2½ inch real birch cornice poles, polished, self or mahogany colour, with ends and rings complete, /8 per foot; 2½ inch real mahogany cornice poles, with ends and rings complete, 1/7 per foot; 2½ inch birch rings, polished, self or mahogany colour, 10/ per gross; 2½ inch real mahogany rings, 28/ per gross net; japanned pillar chains, 1 yard, 16 by 6, 5/8 to 6/6 per doz. Japanned manger chains, 1½ yard, 16 by 6, 7/3 to 8/6; japanned rack, 1 yard, 18 by 6, 8/ to 6/; japanned dog, 1½ yard, 12 by 7, 5/6 to 6/6; 2 yards, 14 by 6, 10/ to 11/. Cowties, 6/6 to 8/6; open ring, 6/6 to 8/6; close ring, 5/6 to 6/6 per doz.; japanned watering chains, 14 by 6, 4/ to 5/; tinned ditto, 4/6 to 5/6; bullock chains, ½ inch hook at each end, 14/6 to 15/6; chest handles, improved japanned, 82½%; broad plate, strong and extra strong, 15 to 65%. Curtain rings (brass), 45 to 50%; square box coffee mills, 30 to 60%; common post coffee mills, 30 to 40%; best brass bushed mills 40 to 45%; London mills, 40 to 45%.

CUT NAILS.—Clasp, rose, and clout, 3 to 9 inch, 8/9; 2½ and 2¾ inch, 9/3; 2 and 2½ inch, 9/9; 1¾ inch, 10/3; 1½ inch, 10/9; 1¼ inch, 11/9; 1 inch, 13/9; ¾ inch, 16/ per cwt.

DISH COVERS, blue japanned wire, 3/3 to 5/6 per set of 6.

DOOR SPRINGS, X, 85%; XX, 77½%; XXX, 72½%; XXXX, 65%; brass circular and iron circular, 55 to 65%; brass reliance, 10 to 20%; climax, 20%; universal, 55 to 60%; paragon, 20%; O'Connor's patent lever hinge springs, 10 to 20%. O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass 25 to 30%.

FILES, 55% the list.

FLOOR BRADS.—2 inch, 9/3; 2½ inch, 9/; 2¾ inch, 9/; 3½ inch 9/6 per lb.

FRY PANS, 7½ inch to 17 inch, oval, bright, 12/ to 55/ per doz.; tinned, 14 to 59/ per doz.; fry pans, 5½ inch to 10 inch round bright, 10/ to 26/ per doz.; tinned, 11/6 to 29/ per doz.; fry pans, 10½ inch to 15 inch round, bright, 30/ to 60/ per doz.; tinned, 33/ to 64/ per doz., all fry pans 72½% and 5% delivered. Fire-irons, kitchen, in sets, /5 to /6 per lb.; tongs, /5½ to /6; pokers, /4½ and /5; fishhooks, best, 40 to 45%; common, 60 to 65%; light kitchen fenders, 5 inch, assorted, 2 feet 6 inches to 3 feet 6 inches, black fronts, 28/ to 30/ per doz.; bright fronts, 31/6 to 34/. Manchester pattern kitchen fenders, 5 feet, 1 inch top, black front, 2 feet 9 inch to 3 feet 3 inch, 37/6 to 40/ per doz.; 3 foot 3 inch to 3 feet 9 inch, 42/6 to 47/6 per doz.

KNITTING PINS, iron, /2½ to /3 per lb.; steel ditto, 15 to 18 W.G., 1/8 to /9 per gross, brass ditto, 1/ per lb.; keys and blanks, 50 to 65%; extra strong plate, 30 to 37½%; extra strong Banbury pinned keys, 35 to 40%; brass shutter knobs, 55%; brass cupboard turns, 55%; brass draw knobs, 55%; brass ashpan knobs, 55%; brass range knobs, 40 to 45%; lock furniture, brass, 52½%; chain lock furniture, 37½ to 45%; ebony lock furniture, 2½ inch, Wilkes' spindles, 18/ per doz. sets; sham ditto, 8/ to 9/ per doz. sets; Norfolk latches, common, 82½%; Suffolk latches, 75%; best ditto, 55%, and larger, 9/1 per cwt.; brass head nails, 62½%.

GALVANISED BUCKETS, 12 inch, 38 lb. to the doz., 6/3; 11 inch, 5/1; 10 inch, 4/6; 13 inch, 7/3; 14 inch, 8 9; 12 inch, 42 lb., 7/; 10 inch, 5/1; 11 inch, 6/; 13 inch, 8/; 14 inch, 9/6.

GALVANISED WASHING TUBS, oval, 22 inch, 27/; 24 inch, 30/; 26 inch, 34/.

GALVANISED WIRE NETTING, 1½ inch mesh and larger, 67½%; 1¼ inch mesh and smaller, 72½%, delivered.

GIMP PINS.—Best black iron wire, ⅜ by 18, ½ by 18, ⅝ by 18, all /5½ per lb.; 19 gauge, /1 per lb. extra; coloured, /1 extra; best bright iron panel pins in 1 lb. packets, ½, ⅝, and ¾ by 17 inch, /1½; 1 and 1¼ by 16 inch, /1; 1½ by 15 inch, /; per lb.; tinned, /1½ per lb. extra; brass panel pins, /9½ per lb., all sizes; copper ditto, 1/1 per lb. all sizes; brass escutcheon pins, ⅜ by 16, ½ by 15, ⅝ by 14, ¾ by 14, 1 by 13 inch, /9½ per lb.; brass gimp pins, 19 gauge, 1/ per lb.; ditto, 18 gauge, /11½ per lb.

GRID IRONS. London pattern, fluted, 70%; light ditto, 77½%; hanging round bar, 60%; doublet, 45%; round bar, /1½ per bar, 67½%; best fluted bar, 67½%; flat bar, 67½%; common flat bar, 67½%; common gridirons, /1 /1½ and /2 per bar less, 65 to 75%; gimblets, 50%.

HAMMERS.—Cast steel stone breaking and quarry, per cwt.; solid cast steel engineers' hand, 1½ lb. each and above, /8 per lb.; solid cast steel boiler makers' hand hammers, 1½ lb. each and above, /8½ per lb.; iron and steel boiler makers' sledge hammers, 6 lb. and above, 17/ per cwt.; iron and steel sledge hammers, 6 lb. and above, 18/6 per cwt.; solid cast steel sledge, 28/ per cwt.; platelayers' keying, 28/ per cwt.; holdfasts, japanned, 18/ to 20/ per cwt.; common Kent hand hammers, 55%; patent hasps and staples, 20 to 25%.

HINGES.—Patent, edge butts, 60 to 70%; patent Scotch butts, 55 to 60%; broad and narrow same discounts; patent table, bed, and back-flap hinges, 57½%; patent chest hinges, 55%; patent strap hinges, 55%; H hinges, 55%; HL hinges, 55%; japanned and Garnett hinges, double washered, light and strong, 40%; best best, London or Lancashire patent tees, 67½%; patent light japanned Scoth tees, 67½%; light patent hook hinges on plate and to drive, 30 to 35%; weighty Gothic, 20/ to 24/; scolloped edges, not japanned, 22/ to 24/; Scotch japanned tees, double washered, 20/ to 23/; Gothic Scotch japanned tees, 19/ to 22/; Gothic Scotch ees, self colour, 17/ to 21/; light "patent" broad Butts, polished joint, No. 200, 50%; ditto, No. 564, 35%; box hinges, 50%; light Parliament hinges, best strong 45%; best best ditto, 15% off list. Wrought hinges, common, 55%; best, 52½%; best best, 50% off list. Heavy wrought hinges, common black, 13/6 per cwt.; ditto, common bright, 18/ per cwt.; filed edges, 17/6; japanned Gothic fancy, 15/6 to 18/; common bright, broad eye, 17/ to 18/; japanned, broad eye, fancy, 18/6; best bright, 21/ to 23/; best broad eye, 21/ to 23/ per cwt.; cast hinges, polished joint, light patent tariff butts, 200, 50%; 333, 42½%; 564, 35%; pressed hinges, common, 65 to 70%; best, 57½ to 62½%; common brass butt hinges, 1½ inch, 14/ per gross pairs net; very light, 8/6.

HOLLOWARE.—Best, 45%; common, 55 and 50%; enamelled ditto, best, 30%; common, 35%.

HORSESHOES.—Fullered fore, 16/ to 18/; fullered hind, 17/ to 19/; stamped fore, 16/6 to 18/6; hind, 17/6 to 19/6.

IRONFOUNDRY, GENERAL.—Ash grates 7/9 to 9/ per cwt.; air bricks, 2/9 to 3/6; half-single, 3/3 to 3/6; double, 5/6 to 6/; bars and bearers, 7/3 to 8/3; barrow wheels, 8/; bake pans, 8/6 to 9/3; camp ovens, 9/; cooking stoves, 9/ to 10/6; cellar grating, 8/6; clock weights, 7/6; Dutch stoves, 8/6 to 10/; dumb bells, common, /7 to 9/; best best japanned, 15 to 17/9; furnaces up to 50 gallons, /33 to /4; galvanised ditto, /7 to /9 per gallon; furnace doors, 9 6 to 12/; furnace grates, 8/6; heaters for box irons, 6/6 to 7/6; heaters for urns, 8/6 to 9/6; oven doors and frames, 8/6 to 10/6; three legged pots, Danish and plumbers' 9/; plumb bobs, 10 6; pudding pans, 10/6 to 11/6; pump spous, 10/6 to 11/; sash weights, 4/6; ditto, with pulleys, 7/ to 8/6; shoe anvils, 8/6; Italian irons, 50%.

MELTING LADLES, 2 inch to 8 inch, 2/ to 16/ per doz., less 15%; Pitch Ladles, 3 inch to 6 inch, 3/6 to 12/ per doz., less 10%.

NAILS.—Patent forged nails, "Iron or Steel." Strong rose flat points), 1 inch, 4 lb. 45/6; 1¼ inch, 6 lb., 38/; 1½ inch, 7 lb., 36/, 1¾ inch, 8 lb., 34/6; 2 inch, 10 lb., 32/6; 2¼ inch, 12 lb., 31/; 2½ inch, 17 lb., 28/6; 2¾ inch, 20 lb., 28/; 3 inch, 23 lb., 27/9 per cwt. Fine Rose (flat points), 1 inch, 2½ lb., 72 6; 1¼ inch, 3½ lb., 58/6; 1½ inch 4 lb., 54 6; 1¾ inch, 5 lb., 48/6; 2 inch, 7 lb., 43/6; 2¼ inch, 8 lb 41/6; 2½ inch, 10 lb., 37/9; 2¾ inch, 14 lb., 34/; 3 inch, 17 lb., 32/ per cwt. Coopers' rose (sharp points), 1½ inch, 7 lb. per m., 2/4; 1¾ inch, 8 lb., 2/7; 2 inch, 10 lb., 3/; 2¼ inch, 12 lb., 3/5; 2½ inch, 17 lb., 4/5; 2¾ inch, 20 lb., 5/1; 3 inch, 23 lb., 5/11 per m. Fine Clasp (sharp points), 1½ inch, 4 lb. per m., 2/1; 1¾ inch, 5 lb., 2/4; 2 inch 7 lb., 2/10; 2¼ inch, 8 lb., 3/09; 2½ inch, 10 lb., 3/58; 3 inch, 14 lb., 4/4½ per m. Best Canada (sharp pointed), 1½ inch, 4 lb. per m., 2/ 2 inch, 7 lb., 2/9; 2½ inch, 8 lb., 3/09; 2¾ inch, 9 lb., 3/58; 3 inch, 12 lb., 4/4½ per m. Pound Nails, 6dy, 2 inch, 28/6; 8dy, 2½ inch, 27/; 10dy, 3 inch, 23/6; 20dy, 4 inch, 23/ per cwt., discounts 52½% off iron, 47½% off steel. Nails, cast lath, 9/ per cwt.; wall nails, cast, 8/6 per cwt.; cast headed bills, ½ by 8 oz., 12/ to 14/; fine round, cast bills, ½ inch, 11/ to 13/; strong round ditto, ½ inch, 12 6 to 14/; cast slate pegs, 10/ to 12/; black coffin nails, 55 to 60%; white ditto 45 to 55%; black coffin bullens, 50 to 55%; white ditto, 40 to 45%.

PICKS, iron and steel excavators, /3 to /5 per lb.

PLANES, 45% off the list.

PLOUGH TRACES, 9 to 12 links to foot, 17/3 19/9 per cwt.

RAILWAY BEATER PICKS, /3 to /5 per lb. delivered in London or Liverpool. Rakes, light garden, 50 to 60%; light solid end rakes, 47½ to 52½%; boxtered teeth garden rakes, 50%; solid end, bolstered teeth garden rakes, 40 to 45%.

RATCHET BRACES, improved, 8 inch, 20/; 10 inch, 22/; 12 inch, 24/; 14 inch, 28/; 16 inch, 32/; 18 inch, 36/; 20 inch, 40/; 22 inch, 44/; 24 inch, 48/ each, less 65% off list; ditto, with eccentric levers, 8 inch, 22/; 10 inch, 24/; 12 inch, 26/; 14 inch, 28/; 16 inch, 30/; 18 inch, 33/; 20 inch, 36/; 22 inch, 39/; 24 inch, 42/ each; drills for above, 15 per doz., less 40% eccentric lever braces.

RIDDLES, common, ½ inch by 18, 21/ per doz.; do foundry or gravel, ½ by 18, 27/ per doz., less 35%.

RIVETS.—Copper hose, ⅜ by 8 and above, at/11 per lb.

RIVETS, Machine-made Wire, No. 6, 18/ per wt.; iron boiler rivets, 23/6 to 24/6 per cwt.; brass ditto, /9 per lb. Ship, tank and girder Rivets, 1 inch, 17/; ⅞, 13/6; 7-16, 13; ½ inch, 12/6 per cwt.; Best Boiler Rivets, 1/ per cwt. extra. Ship Iscrapers, black stee blades, 50 to 55%; bright, 47½ to 52½%; cast steel black, 47½ to 52½%; bright, 42½ to 47½%; best cast steel black, 40 to 45%; bright, 30 to 40 p.c.; sash chain, copper, 55 p.c.; zinc, 55 p.c.; iron prepared ditto, 50 p.c.

SAD IRONS, common, 7/6 to 8/ per cwt., delivered; best japanned, 12/6 to 13/6 per cwt.; best best opanned, 15/6 to 18/6 per cwt

SCALES, copper, 72½ to 77½%.

SCREWS, iron wood screws, 70% brass ditto, 60%; copper wood screws, 35%; stove ditto, 65%; do wel ditto, 70%; brass headlock screws, 40%.

SCREW STOCKS and DIES, 57½% off list.

SHOE BILLS, in 1 and 5 lb. parcels, extra strong, and strong, 9 to 13 W.G., 11/3; middle, 14 W.G., 11/3; fine, 15 W.G., 11/3; extra fine, 16 W.G., 12/3 per cwt Shoe heel, York, No. 1, 2/6 to 2/9 No. 1/1 to 3/1; No. 3, 6/9 to 7/6 per gross net; Dundee hot turned, 4/9 to /53 bright edge imperial or solid Scotch, 8/ to 8/9; bright York, 61 B, 6/9 to 7/3; bright solid, 6/3 to 6/9 toe plates, 83/ to 8/9 per gross.

SHOVELS, common iron, round back, dust, 4 inch to 8 inch, 1/9 to 6/ per doz., less 25%; socket handles, 1/ per doz. extra; Bell mouth Shovels, 7 inch to 10inch, 2/ to 4/ per doz., net: ditto, japanned with wood handles, 3/4 to 5/6 per doz. net. Shovels, all steel, crutch handles, No. 2, 17/ No. 3, 18/3; No. 4, 19/9 per doz.; No. 5, 20/9 per doz.; eye-handles, 1/ per doz. extra; riveted ditto, 2/ per doz extra; Spades and bovels, common, 62½%; second, 52½%; Best, 42½% discount off the list

SIEVES, brass and iron, 55% off list; Wove wire, brass and iron, 55% off list.

SOFA SPRINGS, "Bright," 8 by 5 inch, 10/8; 8 by 6 inch, 10/9 8 by 7 inch, 12/6; 8 by 8 inch, 13/6; 8 by 9 inch, 15/3; 8 by 10 inch 19/ per gross, less 15 per cent. "Coppered," 1/ per gross extra in to 8 by 8; all above 1/6 per gross; coiled, /6 per gross extra.

SPLIT COTTERS, 67½% off list. American Wire Tacks, 75% off list.—**W. Gorse and Son**, Icknield Square, Birmingham.

SPOKES.—Steel bicycle and perambulator, tinned, cut to lengths, and beaded, No. 6, 29/9; 7, 30/3; 8, 30/6; 9, 31/; 10, 31/6; 11, 32/; 12, 32/9 per cwt. Bright, 9/ per cwt. less.,

STAIR RODS, turned ends, 85%; ditto, solid fancy ends, 85%.

STAPLES, Wire fencing, 1½ to 2 inch, No. 6, W.G., 12/; No.

STEEL TOYS, 25 to 30% off the list.

STEELYARDS, 65%.

TACKS, fine cut, in 1 and 7 lb. parcels, ¼ inch, 20/6; ⅜ inch 28/ 6; ½ inch, 19/9; ⅝ inch, 18/3; ¾ inch, 17/6; ⅞ inch, 15/9; 1 inch 16/9 per cwt., tinned, 8/ per cwt. extra; in ½ cwt. bags, 1/ per cwt, less.

TUBES, iron gas, 70%; fittings, 75%; galvanised iron gas tubes, 55% fittings 60%; lap welded boiler tubes, 50%, delivered; bell tube, zinc 33/ to 35/ per cwt.; patent cased tube, 57½ to 62½%, cut to lengths if required; polished and lacquered twisted brass tube, 40%; patent cased taper iron tube, 40 to 45%; patent taper iron tube, 40 to 45%; parallel iron brased tube, 40 to 45%; twisted iron parallel tube, 40%; patent cased parallel tube, 40%; Brass Tubes, plain, rough, ⅛ inch and above, /9; other shapes /10½ to /11 per lb. Bell copper tube, ⅛ inch and upwards, /11 to 1/ per lb.; brass ditto, 1/10 to 1/3; locomotive and marine boiler tubes, seamless, 1½ to 3½ outside diameter, to 14 W.G., /11 per lb.

VICES, best warranted, "Black" staple, solid box, 26/ per cwt.; Best warranted, "Bright" staple, solid box vices, 28/ to 30/ per cwt.; vice boxes and pins, 66/ per cwt.

WASHERS.—Light iron, 77½%; heavy washers, 13 to 16 W.G. 12/ per cwt.

WIRE.—Iron, bright, 0 to 6, 10/; 7, 10/6; 8, 10/ 9, 11/1; 10/, 11/9; 11, 12/3; 12, 13/; 13, 13/6; 14, 14/; 15, 14/9; 16, 15/6 17, 16/; 18, 17/; 19, 18/ per cwt.; galvanised, 0 to 6, 1/3 per cwt. extra; best annealed drawn fence wire, oiled, 0 to 6, £9 5/; 7, £9 15/; 8, £10 9, £10 10/ per ton; galvanised, 0 to 6, £12 10/; 7, £13; 8, £13 10/ 9, £14 per ton. Steel fence wire, round or oval, £2 per ton extra Black rolled fence wire, 4 or 5, £7 per ton. Tinned bottling wire, No. 22, 31/; 23, 33/; 24, 35/ per cwt., cut in lengths and made up in 7 lb. parcels. Fine galvanised iron wire, No. 23, 4/3 per stone of 14 lb.; cast steel wire, /5 per lb.; charcoal iron wire, 4/ per cwt. extra; tinned ditto, 9/ per cwt. extra, delivered in London; 5/ per tonsea l in Liverpool.

WROUGHT, best, countersunk clout and cone head Nails 1 inch, 29/3; 1½ inch, 24/9; 2 inch, 22/; 2½ inch, 19/9 per cwt.; Best fine Swedish iron counter sunk horse nails, stamped, 6 lb. per m., 53/ per cwt.; 8 lb. per m. 49/; 10 lb. per m. 45/9 per cwt.; 12 lb. per m. 43/6 per cwt., or subject to 45% Derby list. Wrought rose and deck head spikes, 4 inch, 12/3; 5 inch, 11/; 6 inch, 10/3; 7 inch, 10 per cwt.; galvanised, 4/9 per cwt. extra; Wrought rose nails, at or sharp points, 2 inch, 21/0; 2½, 20/9; 2¾, 19/; 3, 17/6 per cwt. Wrought nails, May 1826 list, 40 to 45%; wrought Bromsgrove nails March 1878 list, 30 to 35 p.c.

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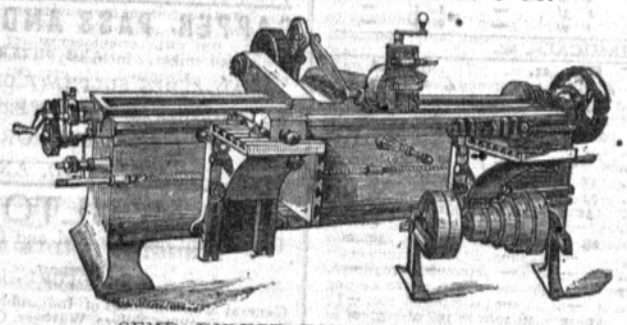

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PRICE LIST OF IRON AND STEEL.

PREPARED BY

MESSRS. BOLLING & LOWE,

2, LAURENCE POUNTNEY HILL, LONDON, E.C.

STAFFORDSHIRE.

List Brands at Works. Per Ton.

BARS—
½ in. to 3 in. rounds and squares £7 10 0
1 in. to 6 in. flats 7 10 0

Rounds and Squares.
3½ in., 10s. per ton extra.
4 in., 20s. ,,
4½ in., 40s. ,,
5 in., 50s. ,,

Rounds only.
5½ in., 70s. ,,
6 in., 90s. ,,
6½ in., 110s. ,,
7 in., 130s. ,,

Round and Squares,
7-16 in., 10s. ,,
½ in., 20s. ,,
5-16 in., 30s. ,,
¼ in., 40s. ,,
3-16 in. 70s.

HOOPS—
1 in. to 6 in. wide by usual guage £8 0 0
¼ in. wide up to 20 w. g., 20s. per ton extra.
1 in. wide up to 20 w. g., 40s per ton extra.
½ in. wide up to 20 w. g., 80s. per ton extra.
½ in. wide up to 20 w. g., 120s., per ton extra.

PLATES—
To 15 feet long by 4 feet wide, not exceeding 4 cwt. £9 0 0
4 to 5 cwt., 20s. per ton extra.
5 to 6 cwt., 25s. ,,
6 to 7 cwt., 50s. ,,
7 to 8 cwt., 75s. ,,
8 to 9 cwt., 110s. ,,
9 to 10 cwt., 120s. ,,
10 to 11 cwt., 140s. ,,
15 to 20 ft. long, 20s. ,,
20 to 25 ft. long, 40s. per ton.
4 to 4½ ft. wide, 20s. ,,
4½ to 5 ft. wide, 40s. ,,

SHEETS—
Singles 13 to 20 gauge. £9 0 0
Doubles, 30s. per ton extra.
Lattens, 60s. ,,

ANGLES—
1 in. by 1 in. to 8 united inches £8 5

TEES—
1 in. by 1 in. to 8 united inches £8 10
For each inch above 8 united inches 10s. per ton extra.
Best, 20s. per ton extra.
Best, best, 40s.
Treble best, 60s.

STAFFORDSHIRE, MIDLAND, &c.

Ordinary Brands (at Works).

	£ s. d.	£ s. d.
Bars	6 10 0 to 7 10 0	
Hoops	7 0 0 to 7 10 0	
Plates	8 0 0 to 8 10 0	
Sheets	8 0 0 to 8 10 0	
Angles	7 0 0 to 7 10 0	
Tees	7 0 0 to 7 10 0	

Best, 10s. to 20s. per ton extra.
Best, best, 20s. to 30s. ,,
Treble best, 40s. to 60s. ,,

CLEVELAND AND NORTH OF ENGLAND BRANDS (at Works).

	£ s. d.	£ s. d.
Bars	5 2 6 to 6 5 0	
Ship Plates to ½ cwt.	6 15 0 to 7 0 0	
Angles	6 2 6 to 6 5 0	

Best, 10s. per ton extra.
Best, best, 30s. ,,
Treble best, 50s. ,,

SCOTCH (at Glasgow).

	£ s. d.
Bars N B crown	7 0 0
Hoops	7 10 0
Ship Plates	8 0 0
Boiler ,,	8 0 0
Angles	7 10 0

Best, 10s. per ton extra.
Best, best, 30s. ,,
Treble best 50s. ,,

WELSH (Newport and Cardiff).

	£ s. d.	£ s. d.
Bars	5 10 0 to 5 15 0	
Plates	7 0 0 to 7 10 0	

Best, 10s. per ton extra.

BELGIAN, (f.o.b. Antwerp).

	£ s. d.	£ s. d.
Bars	5 12 0 to 6 10 0	
Hoops	6 10 0 to 7 0 0	
Plates	7 10 0 to 8 10 0	
Sheets	8 0 0 to 10 0	
Angles	6 0 0 to 7 10 0	
Nail rods	6 10 0 to 7 0 0	

IRON ROLLED GIRDERS—
Narrow flanges 6 0 0 to 7 10 0
Wide flanges 6 10 0 to 8 0 0
STEEL ROLLED GIRDERS, ANGLES and CHANNELS at proportionate differences.

BEST YORKSHIRE (at Works).

BARS—

	£ s. d.
To 3½ cwt.	19 0 0
3½ to 5 cwt.	20 0 0
5 cwt. and upwards	22 0 0

BOILER PLATES—

To 2½ cwt.	22 0 0
2½ to 3 cwt.	23 0 0
3 to 3½ cwt.	25 0 0
3½ to 4 cwt.	27 0 0
4 to 5 cwt.	30 0 0
5 to 6 cwt.	33 0 0
6 to 7 cwt.	36 0 0
7 cwt. and over	39 0 0

Plates over 6 feet to 8 feet wide, 40s. per ton extra.

Sheets	24 0 0
Angles and Tees	22 10 0

	£ s. d.
Tyres to 4 cwt.	19 10 0
4 cwt. to 5½ cwt.	23 0 0
5½ cwt. and over	26 10 0
Axles to 5 cwt	19 10 0
5 cwt. to 6 cwt.	22 10 0
6 cwt. and over	25 10 0

RAILS (at Port nearest Works).

	£ s. d.	£ s. d.
Heavy iron	5 5 0 to 5 10 0	
,, Steel	5 5 0 to 5 10 0	
Light iron	5 12 6 to 5 17 6	
,, Steel	5 15 0 to 6 0 0	

Steel Mining Rails, 10 to 15 lb. per yard, £6 5/0 to £6 15/.
Fish Plates, heavy, 20s. per ton above rails.
Fish Plates, light, 60s. to 80s. per cwt. do.

BOLTS AND NUTS, for fishes—

Heavy	16 0 0 to 20 0 0	
Light	26 0 0 to 28 0 0	

SPIKES—

Heavy	14 0 0 to 16 0 0	
Light	16 0 0 to 18 0 0	

PIG-IRON.

Scotch Wrnts (Glasgow) 51s. 3d.
Cleveland Warrants No. 3 (Middlesborough) ... 44s. 6d.
Cleveland No. 1 (Tyne or Tees), G.M.B. ... 48s 6d.

CASTINGS (f.o.b. Shipping Port).

SOCKET PIPES (for gas or water)—

	£ s. d.	£ d.
1½ to 2 in.	5 10 0 to 6 0 0	
2 to 3 in.	5 5 0 to 5 15 0	
3 to 8 in.	5 2 6 to 5 12 6	
8 to 20 in.	5 0 0 to 5 10 0	
20 to 48 in.	4 17 6 to 5 7 6	
Chairs	4 15 0 to 5 0 0	
Girders	5 15 0 to 8 0 0	

SCRAP—

Old rails, D.H.	3 10 0 to 3 15 0	
Do. flange	3 0 0 to 3 5 0	
Engineers' heavy scrap	2 18 0 to 3 0 0	
Light do.	2 0 0 to 2 5 0	

WIRE.

Rolled Fencing Wire (at Works)

	£ s. d.	£ s. d.
Nos. 0 to 4	7 0 0 to 8 0 0	
5	7 10 0 to 8 10 0	
6	8 0 0 to 9 0 0	

Galvanized.

Nos. 0 to 4	11 0 0 to 11 5 0	
5	11 10 0 to 11 15 0	
6	12 0 0 to 12 5 0	

Drawn Fencing Wire.

Nos. 0 to 6	9 0 0 to 9 10	
7	9 10 0 to 10 0 0	
8	10 0 0 to 10 5 0	
9	10 10 0 to 11 0 0	
10	11 10 0 to 12 0 0	

Galvanised.	£ s. d.	£ s. d.
Nos. 0 to 6	13 0 0 to 13 10 0	
7	14 0 0 to 14 10 0	
8	14 15 0 to 15 0 0	
9	15 0 0 to 15 10	
10	16 0 0 to 16 10 0	

Drawn Bright Wire.

Nos. 1 to 6	11 0 0 to 11 10 0	
7	11 10 0 to 12 0 0	
8	11 15 0 to 12 5 0	
9	12 5 0 to 12 15 0	
10	13 0 0 to 13 10 0	

Drawn Bright Steel Wire.

Nos. 1 to 6	12 5 0 to 12 15 0	
7	12 15 0 to 13 5 0	
8	13 0 0 to 13 10 0	
9	13 10 0 to 14 0 0	
10	14 10 0 to 15 0 0	

Galvanised Fencing Strand (B.B) 7 wires.

	£ s. d.	£ d.
No. 0	17 10 0 to 18 0	
1	18 0 0 to 18 10 0	
2	18 10 0 to 19 0 0	
3	19 0 0 to 19 10 0	
4	19 10 0 to 20 0 0	
5	21 0 0 to 21 10 0	
6	21 10 0 to 22 0 0	
7	22 15 0 to 23 5 0	
8	24 10 0 to 25 0 0	
9	24 15 0 to 25 5 0	

3 wires.

	£ s. d.	£ s. d.
No. 0	16 10 0 to 17 0 0	
1	17 15 0 to 17 5 0	
2	17 10 0 to 18 0 0	
3	18 0 0 to 18 15 0	
4	18 5 0 to 19 0 0	
5	18 10 0 to 19 0 0	
6	19 5 0 to 19 15 0	
7	20 0 0 to 20 10 0	
8	20 0 0 to 21 0 0	
9	22 0 0 to 23 0 0	

STEEL (at Works).

Siemens-Martin or Bessemer.

	£ s. d.	£ s. d.
Plates	10 10 0 to 11 10 0	
Sheets	11 0 0 to 14 0 0	
Bars	9 0 0 to 10 0 0	
Angles	9 10 0 to 11 0 0	
Tees	10 0 0 to 11 10 0	
Spring Stl.	12 10 0 to 14 0 0	
Cast Steel for Tools	40 0 0 to 60 0 0	

GALVANISED IRON ROOFING SHEETS (at Liverpool).

CORRUGATED SHEETS 5, 6, 7, 8 feet long.
Gauges 16, 18, and 20, £14 0s. to £15 0s.
22 and 24 gauge, £15 0 to £16
26 gauge, £17 10 to £18 10s.
28 gauge, £19 10s. to £20 10s.
Sheets 8 to 9 feet long, 20. per ton extra.
Sheets 9 to 10 feet long, 40s. per ton extra.
Sheets 10 to 11 feet ong, 60s. per ton extra.
Sheets 11 to 12 feet, long 80s per ton extra.

LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

Metal Market, City, Thursday Afternoon, 4¼ P.M.

(*September* 28, 1882.)

METALS AND ORES.

	Sept. 21. £ s.	£ s.	Sept. 28. £ s.	£ s.
COPPER (per ton)—				
Chili, *for* 96 per cent.	69 10/	—	70 5	—
Wallaroo	73 0/	—	73 0	—
Burra Burra	72 0/	—	72 0/	—
English Tough	71 0/	72 0	71 0/	72 0/
English Ingot, best	73 0/	74 0/	73 0/	74 0/
Sheets sheathing and rod	76 0/	—	76 0/	—
Bottoms	8 0/	—	8 0/	—
Ore per unit	—	—	—	—
PHOSPHOR BRONZE				
Special Bearing Metal (p tn)	117 0/	—	117 0/	—
Other alloys (per ton	125 0/	140 0/	125 0/	140 0/
TIN (per ton)—				
Straits (Cash)	106 2 6	—	107 15/	—
Do. for arr.	—	—	—	—
Billiton	—	—	—	—
Banca	—	—	—	—
English Ingots	116 0/	—	111 0/	—
Do. Bars	112 10	—	112 0/	—
Do. Refined	111 0/	112 0/	113 0/	—
Australian	111 0/	—	107 15/	—
TIN PLATES, per box, I.C. coke f.o.b. London	0 16 9	0 17 6	0 16 6	0 17/6
IX. do.	0 21 0	0 23/6	0 21 6	0 23 6
I.C. charcoal	0 20/	0 22/	0 20/	0 22/
I.X ,,	0 25/	0 27/	0 25/	0 27/
Red lead	16 10/	—	16 10/	—
White	21 10/	—	21 10/	—
Patent shot	17 10/	18 0	17 10/	18
ZINC (per ton)—from No. 9 Gauge.				
Sheets, rolled	19 15/	—	19 10/	—
Do., foreign	19 15/	—	19 5/	—
LEAD (per ton)—				
Soft English pig	14 5/	14 10	14 5/	14 10
Do. W.B.	—	—	—	—
Spanish soft	14 0/	—	14 0	—
Do. with silver	—	—	—	—
SPELTER (per ton)—				
Silesian, com	17 10/	—	17 10/	—
Rhenish	—	—	—	—
English	—	—	—	—
QUICKSILVER, bot.	6 0/	—	6 0/	—
ANTIMONY ore (per ton)—				
Australian	—	—	—	—
Spanish	—	—	—	—
French Star	—	—	—	—
Regulus—				
Crude (per cwt.)	5 0	55 0/	0/	55 0/
NICKEL (per lb.)	1 14/	—	1 14/	—
BRASS (per lb.)—	0 3/3	—	0 3/3	—
Sheets, 48×24	0 0/8	—	0 0/8	—
Tubes	0 0/11	0 1/	0 0/11	0 1/
Wire	0 0/8½	—	0 0/8½	—
Yellow metal	0 0/6	0 0/6	0 0/6	0 0/6
ASBESTOS (per lb.)	0 0/3	0 0/6	0 0/3	0 0/6
PLUMBAGO (per cwt.)—				
Ceylon lump	1 2/	1 5/	1 2/	1 5/
Do. chip	0 10/	0 14/	0 10/	0 14/
Do. dust	0 10/	0 12/	0 10/	0 12/
COALS (per ton)—				
East Hartlepool	1 2/	—	1 2/	—
Lambton	1 4/	—	1 4/	—
Tees	1 4/	—	1 4/	—
Hartley	1 2/	—	1 2/	—
Hetton	1 4/	—	1 4/	—
Hawthorn	1 3/	—	1 3/	—
Tunstall	1 2/	—	1 2/	—

OILS, CHEMICALS, &c.

	Sept. 21. £ s.	£ s.	Sept 28 £ s.	£ s.
OILS (per ton)—				
Olive, Galloli	—	—	—	—
Do. Gioja	—	—	—	—
De. Levant	36 0/	37 0/	36 0/	37 0/
Do. Seville	—	—	—	—
Do. Corfu	—	—	—	—
Seal, pale	35 0/	35 10/	33 0/	34 0/
Sperm head	74 0/	75 0/	74 0/	74 0/
Cod	31 10/	32 10/	31 10/	32 10/
E.I. Fish	—	—	—	—
Rape, English brown	29 0/	30 10/	31 10/	32 0/
Do. refined	—	—	—	—
Foreign Refined	—	—	—	—
Ground nut and Gingelly Madr.	—	—	—	—
Palm oil, fine	35 0/	36 10/	35 0/	37 0/
Palm nut oil	—	—	—	—
Linseed oil	22 15/	23 5/	22 10/	23 0/
Cot cessed (per ton), Crude	22 15/	26 0	22 15/	26 0/
Refined	28 10/	29 10/	28 10/	29 10/
Hull	25 15/	—	25 15/	—
Lard, English	60 0/	62 0/	64 0/	65 0/
Cocoanut, Cochin	35 10/	36 5/	35 10/	36 10/
Do. Ceylon pipes	29 5/	30 10/	29 5/	31 0/
Sydney	—	—	—	—
OIL CAKE (per ton)—				
Linseed, Lndn.	8 5/	8 10/	8 5/	8 10/
American barrels	8 12 6	8 0/	8 12/6	8 0/
Do. bags	—	—	—	—
Marseilles	8 5/	—	8 5/	—
Rapeseed	5 12/6	6 0/	5 12/6	6 0/
Cottonseed	5 5/	5 17/6	5 15/	5 17/6
TALLOW—P.C. old (per cwt.)	51 0/	53 6/	51 0/	53 6/
S. American, Beef	—	—	—	—
N. American ,,	—	—	—	—
Australian Beef (fine) (per cwt)	0 42	0 43/6	0 41/	0 45/0
Do. Sheep ,, (per ton)	0 45 6	0 46 6	0 45 6	0 46 6
PETROLEUM OIL—(per gal)				
Refined coal oil	0 0 6½	0 0 6½	0 6½	0 6½
Naphtha	0 0 6½	0 7½	0 0 7	0 0/8
TURPENTINE—(per cwt.)				
French Spirits	—	—	—	—
American do.	—	—	—	—
WHALEFINS (per. ton)—				
Davis' Straits	800/	900/	900/	1000/
Arctic	800/	900/	900,	1000/
BRIMSTONE (per ton)—				
Rough 3rds	6 15/	—	6 15/	—
Roll	10 15/	12 10/	10 15/	12 10/
Flour	10 15	12 10/	10 15/	12 10/
ACID, (per lb.)				
Acetic	0 19/	0 26/	0 19/	0 26/
Second quality (per gal.)	—	—	—	—
Citric (per lb.)	—	1/1½	—	1/1½
Muriatic (sp. salts per cwt.)	0 4/6	0 7/6	0 4/6	7 6
Nordhausen 50 per cent.	0 45/	0 50/	0 45/	0 50/
Nitros	0 0/2½	0 0/4½	0 0/2½	0 0/4½
Oxalic (per lb.)	0 6½	0 6/	0 /6	—
Sulphuric, white	—	—	—	—
Do. Brown	0 0/0½	0 0/1	0 0/0½	0 0 1
Tartaric Crystal	0 1/8½	0 1/7	0 1/8½	0 1 7
Do. Powdered	—	—	—	—
AMMONIA—				
Carbonate, per lb.	0 0/6½	0 0/6½	0 0/6½	0 0/6½
Sulphate, Best White (per ton)	20 5/	21 0/	20 5/	21 0/
ARSENIC—White Lump (per cwt.)	0 24/6	0 25/	0 24/6	0 25/
Powdered do	0 10 6	0 10/9	0 10/6	0 10/9
Bleaching Powder 35 %	0 2/6	0 5/	0 2/6	0 5/
BORAX, Ritc., Eng.	0 60/	0 63/	0 60/	0 63/
COPPERAS, green, tierces (ton)	0 45/	—	0 45/	—

	£ s.	£ s.	£ s.	£ s.
LEAD, Sugar, Eng., white	0 33/0	0 36/0	0 33/0	0 36/0
Brown	—	—	—	—
Red (per cwt.)	0 16 6	0 17/0	0 16 6	0 17/0
White, ground	0 21/	0 21/6	0 21/	0 21/6
LITHARGE (pr cwt.)	0 17 6	0 21/6	0 17 6	0 21/6
LIME (per ton)—				
Acetate, Brown	12 5/	12/ 0	12 5/	12/ 0
Distilled	18 5/	18 10/	18 5/	18 10/
POTASH—				
Bichromate (lb.)	0 0/5½	6 0/	0 0 5½	0 6/
Chlorate (pr. lb.)	0 0/5½	—	0 0 5½	—
PRUSS. RED (lb.)	1 10/	—	1 10/	—
Do. Yel. lb.	0 10/	0 10/	0 10/	0 10/
Sulphate 80% (per ton)	8 1/	9 10/	8 1/	9 10/
SALTPETRE (per cwt.)—				
Engl. refnd. kgs.	0 26/	0 27/6	0 26/	0 27/ 6
Do. barrels	0 27/	0 29/	0 27/	0 29/
Do. Bengal	0 10/6	1 1/6	0 10/6	1 1/6
SODA, Acetate (per cwt.)	0 26/	—	0 26/	—
Bicarbonate	0 0/6	—	0 0 6	—
Caustic 60 to 62 %	0/0	11/0	0/0	11 0/
Crystals grw. hts. exship (p ton)	3 2 0	3 5 6	3 2 6	3 5/
Nitrate	13 /4½	13 6/	13 /4½	13 0/

BUSINESS CARDS.

CHILD BROTHERS,
Falcon Works.
SMETHWICK, NEAR BIRMINGHAM.
Manufacturers of all kinds of Engineers', Machinists', Carriage and Coach
BOLTS AND NUTS;
Set Screws: Patent Pointed Coach Screws, Patent Boiler Ship, Tank and Girder Rivets, Anvils, Vices, Washers, &c.
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REGISTERED.

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GENERAL BRASS FOUNDERS, &c.,
MANUFACTURERS OF
RAILWAY WAGON & COLLIERY BRASSES OF EVERY DESCRIPTION.
HEAVY MACHINE BRASSES FOR ENGINEERS, &c.,
OF UNSURPASSED QUALITY,
ALSO
ALL KINDS OF CASTINGS IN BRASS AND OTHER ALLOYS, at low rates.
PORTLAND STREET BRASS WORKS, NORTHGATE, HALIFAX.

CAPPER, PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD, ASHES SULPHATE OF LEAD, LEAD SLAGS, ANTIMONIAL LEAD, COPPER MATTE, TIN ASHES, &c and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

S. MOULTON & CO.,
KINGSTON INDIA-RUBBER MILLS,
BRADFORD-ON-AVON.
General Manufacturers of Indiarubber Goods, Buffers and Bearing Springs, Packing Valves, Washers, Cord Belting, Hose Tubing, &c., &c. Patent "Moss" Inking Rollers for Printers, Truss Pads, Pessary Rings, Umbilical Cones, &c.,

THE GARNKIRK FIRE CLAY CO.
GARNKIRK WORKS, NEAR GLASGOW.
OFFICE: 243, BUCHANAN STREET, GLASGOW.
Manufacturers of
FIRE BRICKS and BLOCKS for the highest heats for Iron blast-furnaces, forge, rolling, puddling and steel furnaces, pottery bottle and flint glass furnaces, copper, calcining, roasting, and refining furnaces, chemical works, coke ovens, boiler seat blocks, locomotive bricks, &c.
Special Bricks made for Siemens' Patent Regenerative Gas Furnace. Registered Trade Mark, "GARNKIRK."

STEPHENS AND EBSWORTH,
BILBAO, SPAIN,
IRON ORE MERCHANTS.
Agents for the purchase and sale of Steel Rails, Bessemer and other Pig Iron, Coal, Coke, &c.
Steamship and General Commission Agents.
From Mr. Stephens' long residence in Bilbao, now twenty years, as managing partner of Blast-Furnaces, Iron Works and Iron Mines, he is the better able to select such iron ores and fuel as are best suited for use in iron and steel-making establishments. He is further open to act as consulting engineer in connection with the laying out of Iron and Steel-making establishments in this country.

JOSEPH WOOLLEY,
Allestree Carriage Works,
DERBY,
Manufacturer of Carts, Wagons, Trollies, Drays, Dobbin Car and Wheelbarrows, and every description of Railway Contractors' Plant. Drawings and Estimates on Application.

IRON.

No. 508.

LONDON, FRIDAY, OCTOBER 6, 1882.

MINERAL STATISTICS OF THE UNITED KINGDOM FOR 1881.

THE IRON TRADE.—I.

WE are reminded of the rapid flight of time by the appearance of a fresh volume of Mr. Hunt's admirable statistics. It seems only a few months since that we had before us the figures for 1880, and now already there is the record of the results of the operations of another year calling for notice. The steady expansion in trade which was experienced last year, to which the total exports of metals for the twelvemonths bore unmistakeable witness, is fully reflected by the statistics compiled by Mr. Hunt, relating to the mineral industries of our country. For 1881, the value altogether of the coal, iron, tin, copper, lead, and zinc ores, and other metals and mineral substances raised within the United Kingdom amounted to £76,201,695, against £74,094,638 for the preceding year, or an increase of £2,107,057. The total values of the metals obtained from ores during the same periods were £22,514,508 and £21,582,501 respectively, and as the grand result of the two years' workings we have the following comparison:—

Total Value of Minerals and Metals obtained from the Mines and other Mineral Workings of the United Kingdom.

	1880.		1881.
	£		£
Coal	62,395,414	..	65,528,327
Metals	21,582,501	..	22,514,508
Minerals not reduced, salt, clays, &c.	3,539,635		2,817,652
	87,517,550		90,860,487

As we shall see when we come to treat of the coal trade of the country, the increase thus exhibited is principally due to the larger quantity of coal raised. The metals obtained from ores reduced have, it is true, yielded about £1,000,000 more, but this improvement is almost entirely neutralised by the diminished value of the mineral substances, such as clays and salt, which have been produced. In fact, although the value of the extracted metals has increased considerably, yet, if we take the value of the iron, tin, copper, &c., in the ore, there is a falling-off of several hundred thousand pounds shown. So far as iron is concerned, the total quantity of ore raised last year was 17,446,065 tons, valued at £6,201,068, against a production during the preceding twelvemonths of 18,026,049 tons, of the value of £6,585,806; while the pig-iron manufactured amounted to 8,144,449 tons in 1881, as compared with 7,749,233 tons in 1880, the respective values being £20,301,122 and £19,373,082. It will be our duty later on to trace the cause of the increased yield of pig-iron which has taken place in spite of the reduction in the quantity of ore raised, for it is not due to an enhanced importation of foreign ores. These, in reality, have been less freely brought into the country during the past year, and the total tonnage of ore smelted throughout the United Kingdom shows a very considerable diminution, as will be seen from the annexed statement:—

Total Quantity of Iron Ore smelted in the United Kingdom.

	1880. Tons.		1881. Tons.
From mines and workings not in the coal measures ..	12,628,932	..	12,312,711
Argillaceous and black band from the coal measures ..	5,397,477	..	5,133,354
"Burnt ore" from cupreous pyrites	427,730	..	352,500
Iron ore imported	2,632,601	..	2,450,698
	21,086,740	..	20,249,263

According to this comparison, there has been a falling-off in the supply from each source, so that the decrease can hardly be regarded as due to fortuitous circumstances. Taking the country by districts, there is a diminution shown, as regards the first division, in nine cases, and an increase in ten; the principal instances in which a smaller output is observable being Northamptonshire and Lincolnshire, in the former 279,469 tons less having been raised, and in the latter 133,078 tons. Ireland has produced 199,862 tons, against 239,323 tons in 1880. On the other hand, a satisfactory growth is observable in the production of Cumberland and of the Cleveland districts, that of the first mentioned locality having increased by 124,252 tons, and that of the latter by 51,817 tons. As regards the ore obtained from the coal measures, the falling off is even more general in its extent, the only exceptions of note having been North Staffordshire and Yorkshire; but the most striking fluctuation is in the case of South Wales, the production of which has diminished from 278,361 tons in 1880 to 170,000 tons last year. We are, unfortunately, not able to say from which of the sources of our foreign supply we have drawn less last year, as no table is given in the present volume showing the countries from whence our foreign supplies of ore were received.

The following summary of the output in 1881 of the ore obtained from mines and workings not in the coal measures requires no apology for its reproduction, as it is of the highest interest to all connected with the iron trade:—

Counties or Districts.	Quantities. Tons	cwt.	Values. £	s.	d.
Cornwall	7,460	0	4,411	11	0
Devonshire	11,198	5	8,244	7	0
Somersetshire	29,883	0	22,236	14	0
Gloucestershire	90,497	9	45,248	14	6
Wiltshire	39,222	0	7,844	4	0
Oxfordshire	8,614	0	1,507	9	0
Northamptonshire ..	1,270,544	10	176,426	17	0
Leicestershire	99,599	0	14,939	17	0
Lincolnshire	1,021,506	14	154 608	11	0
Staffordshire, North ..	30,728	0	16,366	1	0
Lancashire	1,189,836	7	755,827	12	6
Cumberland	1,615 635	10	1,186,709	6	3
Yorkshire, N.R.	6,538,471	1	1,062,501	11	0
Northumberland and Durham	70,771	0	42,462	12	0
North Wales	2,154	16	1,077	8	0
South Wales and Monmouthshire	81,372	0	44,062	0	0
Isle of Man	120	0	60	0	0
Ireland	199,862	19	85.925	10	0
Scotland	5 234	15	3,901	1	3
Total	12,312,711	6	3,634,391	6	6

To render this more complete, we subjoin a statement of the quantities of iron ore obtained from the coal measures in the various districts:—

Counties or Districts.	Quantities. Tons.	Values. £	s.	d.
Cheshire..	300	150	0	0
Derbyshire	59,207	29,603	10	0
Gloucestershire	120	60	0	0
Lancashire	1,900	950	0	0
Nottinghamshire	750	375	0	0
Shropshire	190,000	95,000	0	0
Staffordshire, North	1,431,642	715,821	0	0
,, South	306,952	153,476	0	0
Somersetshire	488	244	0	0
Warwickshire	31,513	15,756	10	0
Yorkshire	320,981	160,490	10	0
North Wales	24,126	12,063	0	0
South Wales	170,000	85,000	0	0
Scotland..	2,595,375	1,297,687	10	0
Total	5,133,354	2,566,677	0	0

From the former of these it will be seen that the value of the ore from mines and workings not in the coal measures averaged about 5s. 10d. per ton, which is almost fourpence per ton less than the average price obtained in 1880, when 12,628,932 tons realised £3,887,067. The lowness of the average value indicates the small percentage of iron which the greater proportion of the ore contains. The rich hematite deposits which are worked in Cumberland and Lancashire give a much higher average, say 14s. 8d. per ton in the case of the former and 12s. 8d. per ton in the case of the latter; but even these figures are from ninepence to elevenpence per ton under the price which the like ore fetched in the previous year. The vast yield of the Cleveland district, on the other hand, shows an average price of only 3s. 3d. per ton, which again is some threepence per ton below what the ores of that field returned in 1880. These few instances will suffice to prove that the falling-off in the total value of the ore raised in Great Britain during 1881 is not entirely due to a diminution in the quantity raised, but is owing also to the lower prices which prevailed.

Amongst the other matters connected with iron ore which Mr. Hunt's valuable statistics treat of, there is none of more interest than the information which he has been able to collect in reference to the distribution of the ore raised in the different localities. To one who knows anything about it, it is apparent that the difficulties lying in the way of procuring complete information on such a point must be very great; and in some instances the details given are not of a very full description; but sufficient have been obtained in the principal cases to enable us to form a tolerably correct notion of the destination of the greater portion of the ores. Of the quantity raised in Lincolnshire, we find, for instance, that 327,261 tons were carried out of the district, while 694,245 tons were used in the local ironworks. As regards the produce of the Lancashire mines, it would seem that 979,399 tons were smelted at the neighbouring furnaces, and the remainder was disposed of as follows:—Shipped from Barrow to South Wales, 7690 tons; to Lancashire, North Wales, &c., 16,623 tons; to Scotland, 20,643 tons; to Ireland, 356 tons; and to foreign ports, 23,080 tons; while 142,045 tons were sent by rail to Lancashire, Yorkshire, Staffordshire, &c. The returns in respect of the ore raised in Cumberland are not so complete, but we learn that there were shipped from Whitehaven to South Wales and Scotland, 8387 tons; that 6958 tons were conveyed to Barrow for shipment; and that 50,900 tons were sent to Scotland, and 17,570 tons to the east coast by railway. The weight of ore carried over the North Eastern system during 1881 amounted to the large total of 5,938,983 tons. Turning for one moment to the importations of foreign ores, it would appear that South Wales took almost one-half of the total quantity received, or 1,074,959 tons out of 2,450,698 tons; the north-east coast ports took 913,717 tons; 264,710 tons went to Scotland; while the balance was chiefly consumed in Lancashire and Cumberland. The large extent to which the works in South Wales are dependent on foreign supplies of ore will be recognised when it is stated that, although its production of ore amounted to only 251,372 tons, yet there were 910,965 tons of pig-iron manufactured in the district. Adding to the quantity of foreign ore which—we have just seen—was imported into South Wales, the shipments of ore thither from other parts of England, so far as they are recorded, we arrive at a total of 1,088,338 tons, so that it is evident there must be a considerable quantity of ore used in the Principality, the origin of which we have no record of in the pages before us.

IRON TRADE SUMMARY.

THERE is no very marked change to report in the position of the English iron trade since our last notice. Quotations are, generally speaking, firmly maintained, and better prices are looked forward to with confidence. At both Glasgow and Middlesbrough there has been a rise for the week of about 6d. per ton in the value of pig-iron. Scotch iron continues in good demand both for home and foreign account, and the shipments abroad show a very respectable increase so far as this year has gone. Makers of pigs in the Cleveland district have determined to restrict their output for three months more, independently of the action of the Scotch manufacturers, and iron is reported scarcer. The shipments from Cleveland reached the very large total of 100,838 tons for the month of September. The condition of the hematite iron markets is very satisfactory, prices continue to rise, and it is expected will go higher. For No. 1 Bessemer the quotation is now 59s. per ton in West Cumberland and North Lancashire. Steel makers on the north-west coast are consuming large quantities, and the foreign demand continues heavy; while in the Forest of Dean the prospects are regarded as very bright, stocks of crude iron being low, and the demand equal to the production. As a rule, the state of the manufactured iron trade is encouraging, the reports from almost every centre pointing to a steady, if not increasing, consumption. An exception is, however, to be noted in the Newcastle and Tyne district, where a slackening tendency is observable, evidently due to over production, as the quantity of iron going into consumption continues large. Things may improve there shortly, notwithstanding, since enquiries for new vessels to be laid down next spring are reported to be more frequent. On the other hand, the trade in South Staffordshire is better, and higher prices are being asked for bar iron and sheets. The improvement in Lancashire is not so marked, but quotations are firmer. In Yorkshire matters remain without noteworthy change. At Birmingham a decided expansion in the demand for hardware has been experienced, especially from the colonies and North America for edge tools. From South Staffordshire a better feeling is reported, and the cessation of the war in Egypt is already stated to have operated beneficially. The approach of winter is also telling in some directions. At Sheffield there is reported to be a much better feeling in all branches, with prices advancing. The steel trade continues firm, but there is no conspicuous alteration to record. Makers at Barrow are fully employed, especially in the rail trade, and are well booked with orders. The same remark applies to South Wales, where the works are very actively engaged, the production being maintained on a large scale. In the tinplate trade values remain without much change, and there is a sufficiency of orders to keep the works going steadily. The shipbuilding industry in the Barrow district is fully employed, but the engineering trades of Lancashire are not in such a good position, with the exception, perhaps, of locomotive builders. The engineering establishments on the Tyne are kept at full work. The coal trade has naturally been much unsettled in consequence of the miners' demands, and prices are generally higher. Makers of coke have no difficulty of disposing of their whole production, the demand being very great.

There is positively nothing new to report with regard to the foreign iron trades. The markets maintain the tendency of former weeks. The Belgian iron market continues animated, the demand being especially brisk for pig-iron. Manufactured iron appears to have settled down to 140 fr. as a minimum quotation. There is no great change reported from France, with the exception of a rising tendency in pig-iron, for which 70 fr. (forge pig) and 84—85 fr. (foundry pig) is being obtained in the Meurthe-et-Moselle. Quotations for manufactured iron are steady in the Nord, Haute-Marne, and at Paris. In the Haute-Marne iron has been sold on

THE HIGHGATE HILL CABLE WAY.

THE HALLIDIE SYSTEM.

(*For description, see page 288.*)

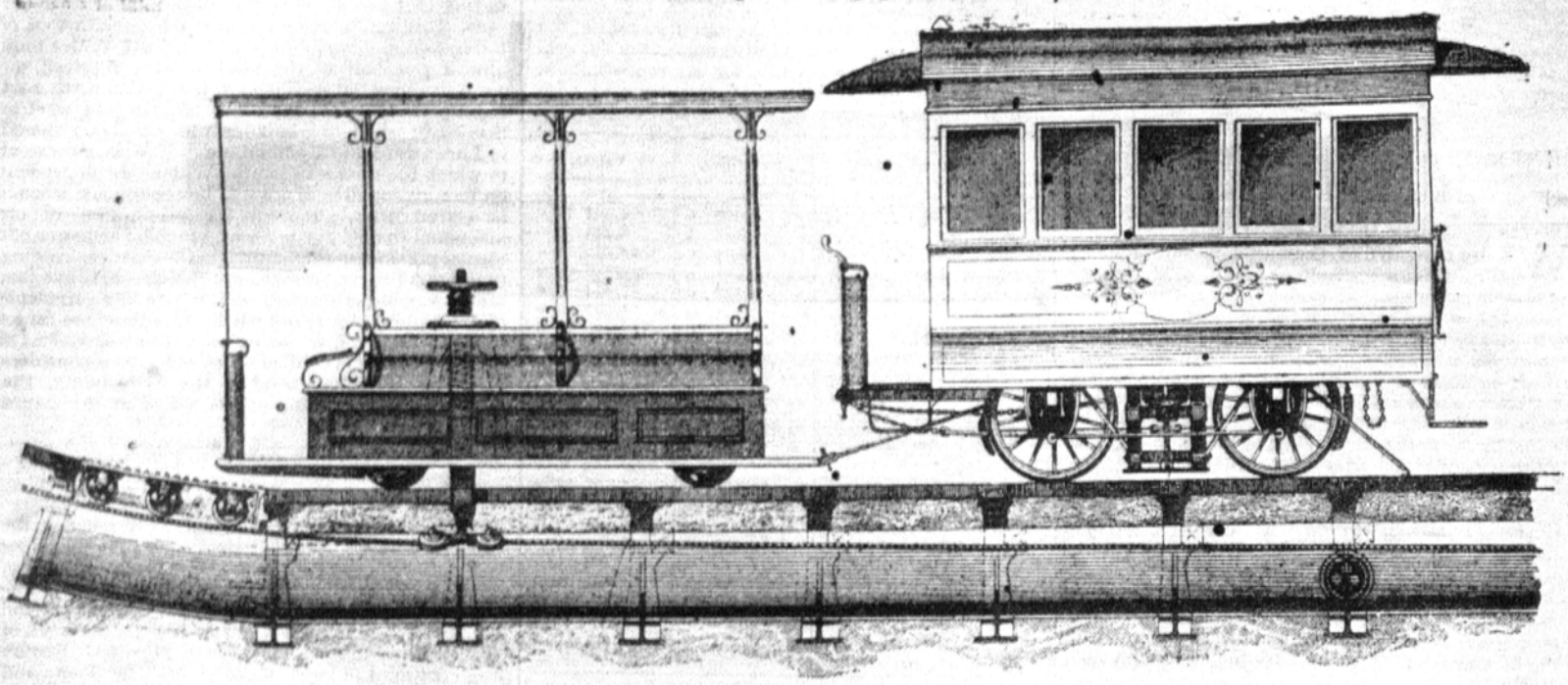


Fig. 1.

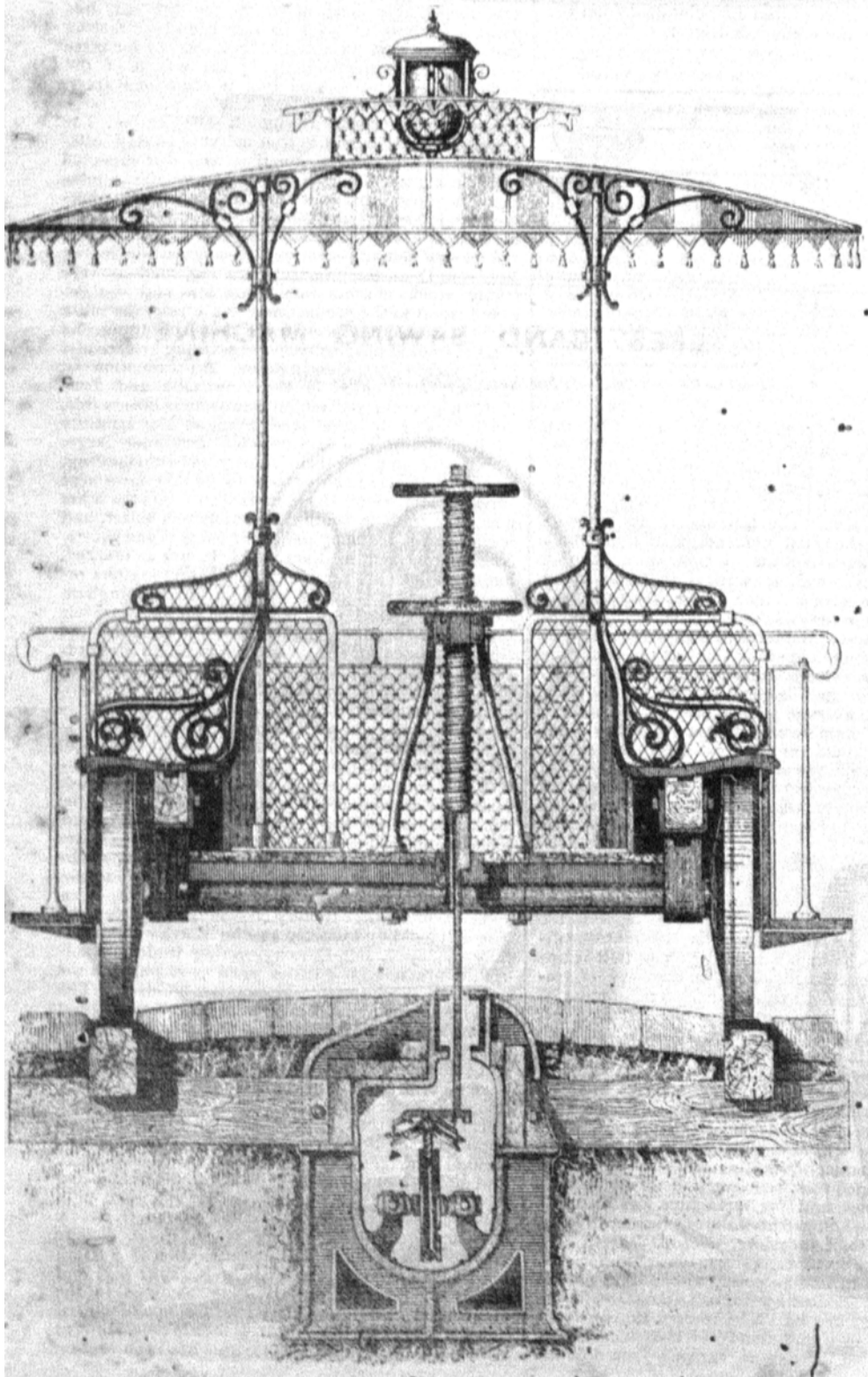


Fig. 2.

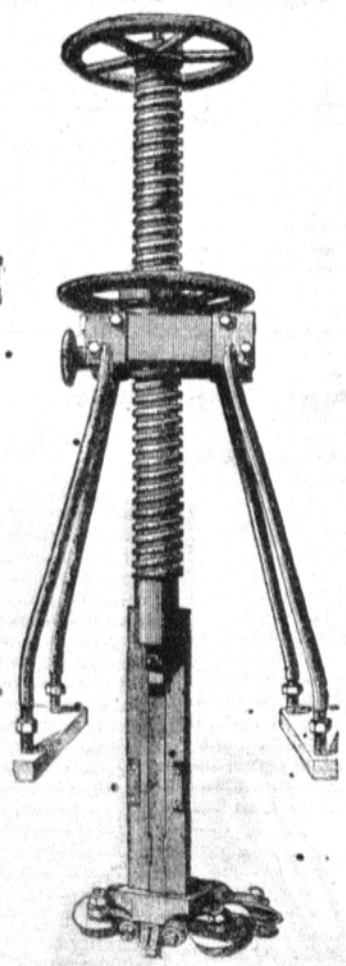


Fig. 3.

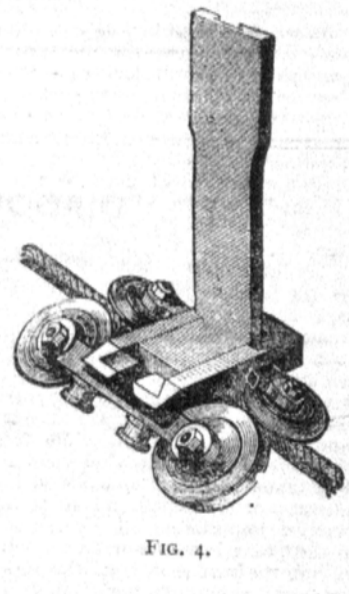


Fig. 4.

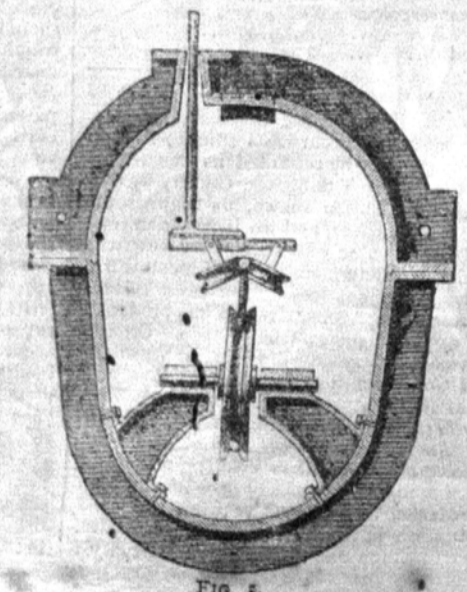


Fig. 5.

TIMMIS AND HODGSON'S REVERSIBLE BOAT.

(*For description, see page* 288.)

FIG. 1.

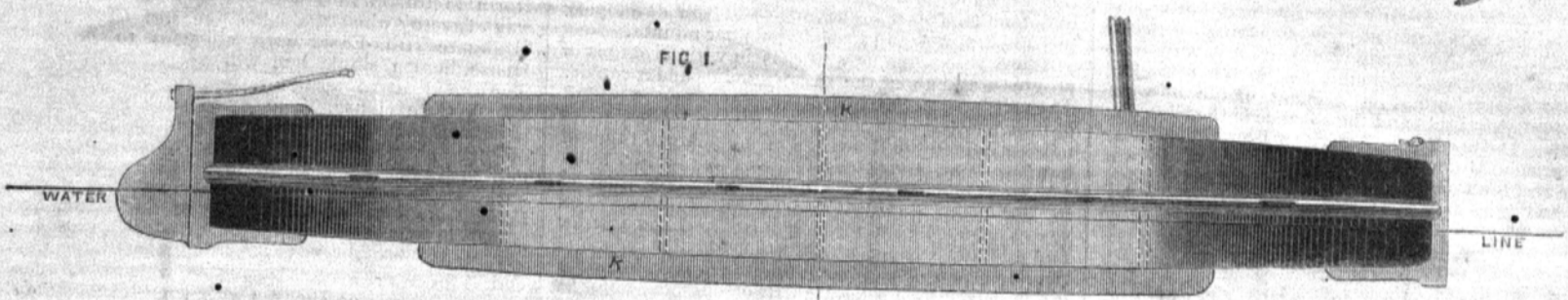


FIG. 2.

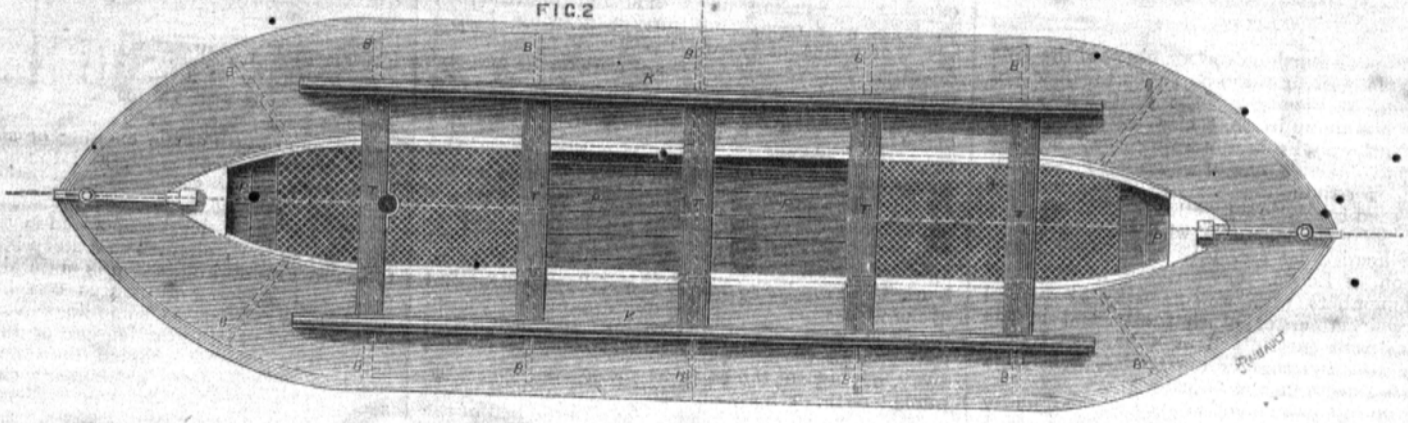
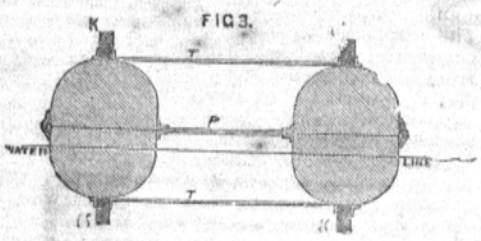


FIG. 3.



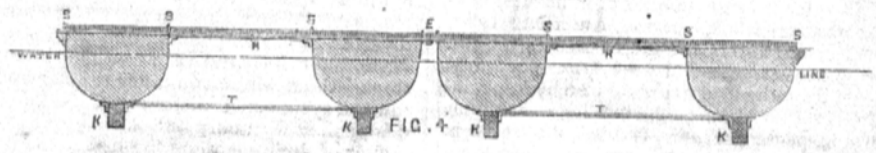
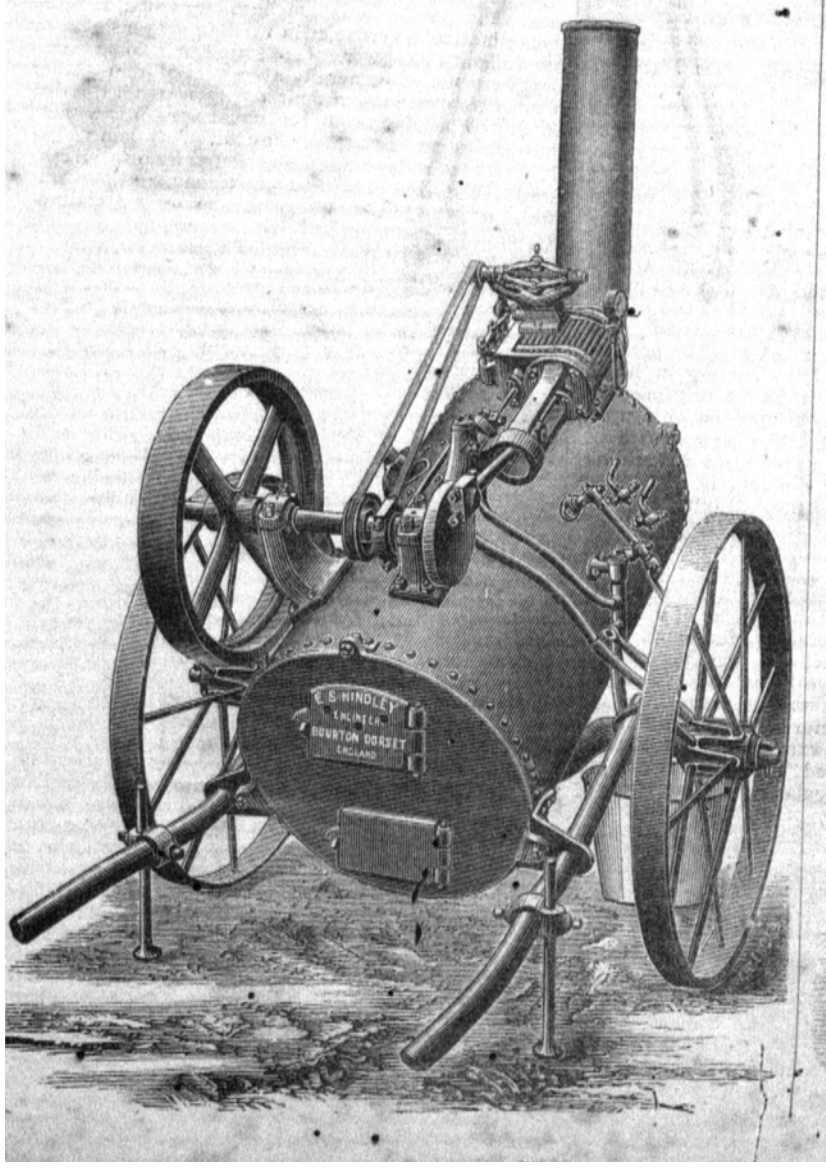


FIG. 4.

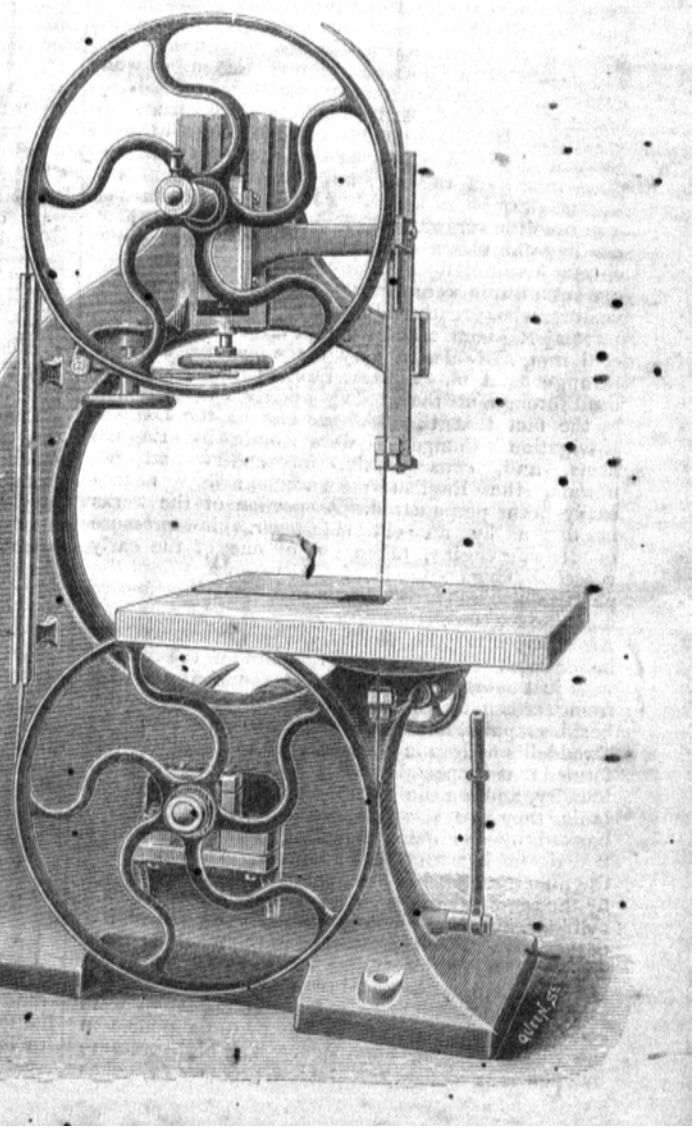
THE "DIAGONAL" ENGINE.

(*For description, see page* 290.)



LEES' BAND SAWING MACHINE.

(*For description, see page* 290.)



the basis of the old rates (210 fr. for coke iron), with deliveries extending up to June 30, 1883. The firm tone of preceding weeks continues also in the German iron market. Both blast-furnaces and manufactured iron works are fully and remuneratively employed. Great activity is maintained in the coal markets of the Continent, prices having a rising tendency. The American iron market is very firm. There is no special demand for Scotch iron, but quotations are higher, on account of the upward movement in freights and the advance in the Glasgow market. The market for American iron is also firm, and prices are unchanged. Choice brands are scarce and tank descriptions weak. Steel rails have been sold at 42 dollars.

THE IRON AND STEEL INSTITUTE VISITS.

Of the three or four hundred members of the Iron and Steel Institute who had been the observed of all observers in Vienna for the past four days, hardly one remained in that city after Thursday night, for early on Friday morning they became divided into two parties, one of which left for Styria, and the other for Buda-Pesth. The larger party of the two, headed by Mr. I. Lowthian Bell, went to Styria. Those of the members who went to Buda-Pesth were headed by Mr. Fisher Smith and Mr. James Kitson, of Leeds. On arriving at Pesth at 3 p.m., the members were welcomed by Herr Karl Rath, Oberbürgermeister of that city, and in the evening they were entertained at a banquet by the Hungarian iron and engineering trades, and by the Society of Engineers in Buda-Pesth.

The next morning the members visited the foundry and engineering works of Ganz and Co., over which they were conducted by the manager, Herr Andreas Mechwart. This firm makes chilled points and crossings, and also a large number of "hardt-guss-eisen" disc waggon wheels of the American type, with curved corrugations for increase of strength. They are made at the rate of 125 per day. They are cast from the best charcoal iron by a special process, the moulding being effected by a machine. The visitors inspected a new turbine that was in course of manufacture, and also several Hungarian corn mills, with chilled steel rollers, both plain and fluted. Messrs. Ganz and Co. are noted for their manufacture of these mills, having been among the first firms to make them; they have now sent out upwards of 7000 of their twenty-four different types of these mills. The gear works very smoothly, being of the description known as "chevron," the first specimen of which came from M. A. Piat's foundry in Paris, and is described and illustrated at p. 110, vol. xvi. of IRON.

Proceeding up the river by steamer to Alt-Ofen, the party next visited the shipbuilding works of the Danube Steam Navigation Company, where they were received by Herr Luwig Ullman, general director, and Mr. Murray Jackson, the works manager, who led the way over the various departments. These works employ about 2500 hands, and construct the vessel complete throughout, including all the fittings. They do not, like builders in the Clyde and Tyne, produce iron from the pig, but they roll rounds and squares, large bars as well as light sections of angle iron from the scrap, most of which is their own. Nor do they roll plates or special sections that require careful manipulation. Many specimens of these two classes of iron were arranged for inspection by the visitors, who greatly admired a large channel iron 12 × 2½ × ¼ inch, rolled from X. Salgó Tarjan charcoal iron, and also a very clean bar of Z section. Strange as it may appear, English dimensions are used throughout the works; and this is explained by the fact that the first vessels for the Danube Navigation Company were built by English firms, and, consequently, in repairs and renewals, the English measurement has necessarily been perpetuated. A portion of the works is driven by an old side-lever, low-pressure condensing engine, taken out of one of the early vessels. This engine is of interest as a relic of the past, as also was a rather primitive but very effective machine for converting refuse timber into firewood. After inspecting the smithy, the party entered the boiler shop, where some steel boilers for the *Kaloca* were just being finished. This department turns out from sixteen to eighteen new boilers every year, besides repairs, nearly all the work being done by Tweddell's hydraulic riveters. The visitors were informed that a special casting was to be run in the foundry, and, on the metal being poured from the ladle, they saw slowly appear in growing letters, backed by the dark moulding sand, the words, "Welcome Iron and Steel Institute," surmounted by the miners' symbol of two hammers, and surrounded by the segments of cogwheels, the section of a steam cylinder, and other typical designs. The fine quality of the iron was well exemplified in the machine shop, where a turning was taken off a shaft the whole length of one cut without breaking, and this showed remarkable tenacity. In the erecting shop were some compound engines just ready to be placed in the *Baranya* lying alongside. The high-pressure cylinder is 32 inches, and the low-pressure 50 inches in diameter, the stroke being 4 feet. At 39½ revolutions per minute the engine will develop a power of 762 horses. The engines of another vessel, the *Hildegarde*, a new type of vessel 215 feet long, and 26 feet beam, are also of the compound type, the small cylinder being 32 inches and the large 54 inches in diameter, with a stroke of 4 feet, and developing 740 horse-power at 33 revolutions per minute.

There were seven new vessels in various stages of progress, and about the same number under repair. They all have perfectly flat bottoms, so as to permit of their passing over shoals in summer. The visitors next examined the drawings of a combined tug and hauling boat, the *Ordovy*, designed by Mr. Murray Jackson on the same principle as that adopted in Handyside's steep-gradient locomotives. The vessel is built like a torpedo boat, and has a screw fore and aft, both of which are worked at the same time by a pair of engines. On the upper deck is a drum, driven by a separate pair of engines, which is capable of winding up a thousand metres (1083 yards) of wire rope, and thus of drawing along a vessel or series of vessels too heavy to be towed directly. This vessel has been at work on the Danube since June, giving excellent results. She is 75 feet long and 12 feet 9 inches the beam. The diameter of the two propellers is 30 inches, their engines being 10½ inches in diameter and 1 foot stroke, while the winding engines are 8 inches in diameter and 9 inches stroke. The screw shaft runs at 350 revolutions per minute, and the vessel makes 10 knots an hour in still water, or hauls a barge laden with 250 tons against the stream at a speed of over 3 miles an hour. The *modus operandi* is as follows:—One end of the wire rope coiled on the drum being passed over the stern of the steamer and made fast to the barge to be taken in tow, the boat steams away, paying out the cable as she goes. When the whole length, or less, according to circumstances, is paid out, the steamer is fixed fast to the bed of the river by means of two poles which are let go from her sides. Steam is then turned into the winding engines, which proceed to haul the barge up to the steamer. When she comes up the steam is again diverted to the propellers, and off goes the steamer for another thousand yards without loss of time. By this method, which combines the tug and the chain-towage systems, a distance of 60 kilometres is accomplished with only a thousand metres of rope; the laying of the rope along the bed of the river is saved, and yet the mechanical advantage of chain-towage is obtained. The visitors were next conveyed by the steamer to Margarethen-Insel, a long island in the Danube, the property of the Arch-Duke Josef, and containing his summer residence, but which serves as a public promenade. Here the party was entertained by the city authorities at luncheon, Herr Rath presiding, supported by Count Emanuel Andrassy and Mr. Jas. Kitson.

Re-embarking once more on board the steamer, the party were conveyed down stream, and landed near a new grain elevator on the American principle. They were then conveyed in tramcars to the locomotive works of the Hungarian State Railway. The principal points of interest at these works, which employ 1000 men, were the foundry and castings, which latter are of exceptionally fine character. This is of course due, in a great measure, to the splendid iron which is used. As a rule, 10 per cent. of No. 3 Clarence pig is added to one part of Hungarian iron obtained from Count Andrassy's works in Ober, Hungary, one part of old castings, and 30 per cent of soft giess-eisen from Reschitza. But a good deal must be attributed to the careful selection and manipulation of the moulding sand used. Four kinds, all obtained from the country, are mixed with sand that has been already used in a proportion varying with the size of the casting in hand, and also whether it is thick or thin. A certain proportion of coal-dust, carefully ground, is, of course, also added. Then again something must be said for the careful moulding. In many cases a moulding machine is used, in which the mould is withdrawn from the patterns, instead of the pattern from the mould, as is the best practice. But the gun-metal moulds are remarkably smooth, and the best results are obtained. Some axle boxes were being moulded, the mould leaving the pattern without the necessity of any working up again by hand. Some of the same castings were afterwards examined, and found to be so perfect that the two parts fitted together without any machining, the bolt eye-holes not even being drilled out. A self-acting machine for making the straw and hay bands for foundry use causes the reel to travel backwards and forwards automatically, for winding the bands as twisted, the attendant being only to feed the material regularly. In the evening the visitors, at the invitation of the city authorities, attended a national performance in the Volkstheater.

THE HIGHGATE HILL CABLE WAY.

It is generally admitted that tramways have so great a future before them that any invention calculated to lessen their working expenses, or to render extinct the barbarous horse system, cannot be too carefully considered. We therefore propose to lay before our readers some particulars of the system of cable tramways which the Steep Grade Tramways and Works Company propose to introduce on Highgate Hill, and for which an Act of Parliament was obtained in August last, in confirmation of the provisional order of the Board of Trade.

The Highgate Hill Tramway will commence near the Holloway Road termini of the London Street and North Metropolitan Tramways, opposite the Archway Tavern, when a double line will be laid up Highgate Hill East, until adjacent to Fairseat House, here a single line will be extended to the Southwood Road terminus, not far off the well-known Gate House. The system to be adopted is illustrated in the engravings on page 286 of our present issue. It is by no means a new one, inasmuch as it has since 1873 been successfully worked in San Francisco. It is the invention of Mr. A. S. Hallidie, of San Francisco, and consists of a strong endless steel wire rope, actuated by a steam engine stationed at either end of the tram road. This cable, which runs upon grooved wheels or sheaves within a tube or small subway situated beneath and along the centre of the track, is kept travelling at an uniform speed, and from it the propelling power is transmitted to the cars by means of a special gripping attachment fixed to the car by a vertical steel bar which passes through a narrow slot on the upper side of the tube, the extreme width of the opening or slot being only three quarters of an inch, and therefore not wide enough to admit the wheel tire of the smallest carriage. It appears that at whatever rate the cable travels an equal degree of speed is transmitted to the cars, so that, whether on a steep incline or level, the same rate of progression is maintained throughout. The gripping apparatus can be applied to any kind of car, but on some lines in San Francisco it is confined to the driving car or dummy. Fig. 1 shows this dummy coupled to a passenger car, together with gripping attachment, cable, and side section of tube, while fig. 2 is a sectional view of a dummy, with a transverse section of the tube below. The gripping apparatus is shown at fig. 3, a larger perspective view being supplied at fig. 4; fig. 5 is a cross section of the tube and pulleys. From this last view our readers will gather the essence of the whole system, showing as it does the underground tube in which runs the endless wire rope, supported by pulleys or guide wheels, through the slit the flat rod of fine steel enters, which carries the gripping arrangement, enabling the travelling wire to be taken hold of or released at will.

With reference to stopping the car, in the event of any accident, while travelling along a very steep incline, it should be mentioned that both the dummy and car are supplied with powerful brakes which can at once bring the car to a standstill. Strong iron drags are likewise provided, so that if an accident should occur in going up hill they will immediately catch, and prevent the car from going backward. We understand that curves are as easily passed over as grades, by the application of special rollers, and that single or double lines, turnouts, and the complication experienced in existing systems present no difficulty whatever. It is stated that horse tramways are worked generally at a cost of from 75 per cent. to 85 per cent. of their receipts, steam traction about 60 per cent., but the cable system is worked at from 30 per cent. to 35 per cent. This being so, a high rate of return may be expected from the Highgate Hill Cable Way, and which may, and probably will, lead to the further extension of the Hallidie system. We should add that the engineer-in-chief of this tramway is Mr. James Cleminson, C.E., of Westminster.

TIMMIS AND HODGSON'S REVERSIBLE BOAT.

In the engravings on page 287 we illustrate a new and useful boat, which can be employed either as an ordinary ship's boat for rowing, paddling, or sailing, or as a life boat, or as a raft or pontoon for landing troops and artillery. It is the result of long and careful study and experiment, and has been patented by Mr. Illius A. Timmis, C.E., of 17, Great George Street, Westminster, and Mr. J. R. Hodgson, who was formerly known on the north-east coast as the "Stormy Petrel," from the number of lives he has saved and his daring acts of bravery in cases of shipwreck. Fig. 1 in our engraving shows an elevation of the boat, from which it will be seen that the top and bottom halves are alike, and that the water line is below the middle or deck line, so that whichever way the boat is put into the water it is always right way up. This will be equally apparent by referring to fig. 3, which is a transverse section of fig. 1. The thwarts are movable, and in case they are below (under the water) they can be readily removed as the deck is movable in parts. This deck is shown in plan at fig. 2. Part is of wood and part of rope network. In figs. 2 and 3, B B are watertight bulkheads; K K, keels; T, thwarts; P, deck planking; and N, deck netting. The wood deck (which may also be made of steel plates) is shown to illustrate the kind of deck put in when the boat is made in two halves as in fig. 4, which is a cross section, showing the top half thrown back. Each half has a deck, and the whole is stiffened by beams run across, and the centre wood decks serve as a gangway to land troops,

artillery, &c., across. A number of them can be readily fitted together, and serve to cross rivers, and then by putting axles and wheels under them, they make very convenient baggage waggons. In this figure, T T are the thwarts which can be removed, E strong iron links, R R strong beams held by iron eyes, S S to keep the raft stiff.

The rope network deck serves two purposes; firstly, it enables all the water which may be shipped in a rough sea to run through. It may not generally be known, but is a proved fact, that however rough the sea may be, no water ever rises up in the middle under the deck, and if no water is shipped over the sides, the deck never gets wet. Secondly, in case children have to be thrown in, in the event of shipwreck, the rope netting is good for the purpose, and moreover it does not hurt seamen's feet. The boat can be made of any material, such as wood, cork, &c., but thin steel plates with bulkhead partitions, are preferred. The compartments formed by these bulkheads serve to put provisions, water, and stores in. The two ends of the boat are alike, and the rudder and mast can be fitted so that she can move through the water either end first. The boat can be stowed away on chocks on her side, or otherwise at the davits, and lowered in the ordinary way. But one strong point with the inventors is, that she can be stowed in any position, and can be run out on rollers, end on, into the sea, and so be always available to be launched on the lee side of a ship. The boat is also specially designed to serve as an anchor boat for the conveyance of stones, blocks, &c., to be dropped through the deck in making breakwaters and harbour works. In short, from whichever point we look at this boat, the inventors appear to have practically dealt with every difficulty and met almost every want without sacrificing one advantage to gain another. The captain of the Tynemouth Life-Boat Station states: "It is the most efficient boat or raft I have seen, and it is impossible to capsize it." As was shown by Mr. Hodgson at the Tynemouth Exhibition, the boat can also be readily attached fore and aft, to travel on a jackstay in conjunction with rocket lines thrown to a ship and pulled out to the ship in the same way that a cradle is now worked with lines, and the shipwrecked crew saved in less time than it now takes to row a lifeboat out to a stranded ship. The following obvious advantages are claimed for this boat. 1. No lifeboat crew is required if a rocket line can be thrown to a stranded ship. 2. The boat is wholly available to hold the persons who have to be saved. 3. Even if it strikes against rocks it is impossible to smash it or to swamp it, and the people in it are also fully protected. In short, the boat appears to satisfy the most important conditions of life-saving craft, and we are glad to learn that it is being taken up warmly on the east coast. We are pleased to be able to add that this boat has just been awarded the first prize (a silver medal) at the Tynemouth Exhibition. In testing the boat a very strong point was made of its applicability to the rescue of a ship's crew.

OCCASIONAL NOTES.

SECOND CRYSTAL PALACE ELECTRICAL EXHIBITION.

IT is an evidence of the great progress electric lighting is making that we should have this winter two electrical exhibitions going at the same time. To the practical exhibition to be held at the Aquarium we have already referred. Following so closely on the late electrical exhibition at the Crystal Palace, some speculation is rife as to the probable success of the second to be opened there on October 24. But as a novel feature has been added, by making the display at the same time a gas exhibition, we have little doubt but that the Crystal Palace Electrical and Gas Exhibition will again prove an attractive one. As far as can be judged at present, the electricians will make a goodly show, although the representatives of the progress of electricity will be mostly those who did not appear on the former occasion. A few, however, of those who did well in the last display will repeat their shows in new form. Amongst those who were not in the last exhibition, the most important is Mr. Werdermann, to whom has been assigned the Alhambra Court, which, after the beautiful display of the Lane-Fox incandescent lights made in it last winter by the Brush Company, must be looked upon as the first place in the palace, and great things are expected of this veteran in electric lighting. A gigantic dynamo, in which novelties of importance are introduced, is in process of manufacture, and rumour is already dealing with a new incombustible electrode, on which he is engaged in working out the details, as a competitor with the pretty incandescent lights. But we will not further descant upon wonders that may be in store for us in the form of the electric light and its adjuncts. The advocates of gas will not be less powerfully in force. The Siemens Patent Gas Light Company will light the dome of the concert room, Mr. Heron the entertainment court, the Albo-Carbon Gas Lighting Company the Pompeian court, whilst the Birmingham court will be lighted by M. Popp's gas incandescent lights. The gas incandescent lights of M. Clamond will also be displayed; and amongst the most important of the other gas exhibitors are Messrs. Sugg and Co., Messrs. Strode, Mr. Bray, Mr. Hulett, Mr. Davies, Messrs. Defries and Sons, Messrs. Greene and Sons, and Pintsch's Patent Lighting Company. The gas lighting of the south nave will be under a plan which will secure the due representation of the various systems of gas burners. We hear that Sir James Douglas, the engineer of the Trinity House, will show his argand burners. There will be also a display of stoves and other useful applications of gas, and very probably this will be supplemented by a collection of the products of gas manufacture. Altogether, there will be a good show, enabling us to contrast gas with its brilliant rival.

AN ELECTRIC LAUNCH.

It is now forty-three years since the Russian Jacobi first propelled a boat upon the waters of the Neva by the aid of a large but primitive electro-magnetic engine, worked by galvanic batteries of the old type, wherein zinc plates were dissolved in acid. Two years ago, a little model boat was shown in Paris by M. Trouvé, actuated by accumulators of the Faure-Planté type. It was therefore, no doubt, with a feeling of mingled curiosity and novelty of the situation that Professor Silvanus P. Thompson took part in the trip, last week, in the little vessel *Electricity* upon the Thames. The little craft is the property of the Electrical Power Storage Company, Millwall, and, save for the absence of steam and steam machinery, may be called a steam launch. She is 26 feet in length and about 5 feet in beam, drawing about 2 feet of water, and is fitted with a 22-inch propeller screw. On board are stowed away under the flooring and seats, fore and aft, forty-five accumulators, each a cube 10 inches in dimensions, of the latest type as devised by Messrs. Sellon and Volckmar, being a modification of the Planté accumulator. Fully charged with electricity, they are calculated to supply power for six hours at the rate of 4 horse-power. These storage cells are placed in electrical connection with two Siemens dynamos of the size known as D 3, furnished with reversing gear and regulators, to serve as engines to drive the screw propeller. Either or both of these motors can be "switched" into circuit at will. At the day of the trial trip the vessel started from the wharf of the works of the above company. After a run of a few minutes down the river, and a trial of the powers of the boat to go forward, slacken, or go astern at will, her head was turned Citywards, and she sped silently along the southern shore, running about eight knots an hour against the tide. At 37 minutes past 4 London Bridge was reached, where the head of the launch was put about. Slipping down the ebb, the wharf at Millwall was gained at 1 minute past 5, thus in 24 minutes terminating the trial trip of the *Electricity*. The total electro-motive force of the accumulators at the trial was 96 volts, and during the whole of the long run the current through each machine was steadily maintained at 24 ampères. This corresponds to an expenditure of electric energy at the rate of 3 1-11 horse-power. As this boat is the first electric launch that has been constructed in this country, and the very first in which the electric propulsion of a vessel has been undertaken on a commercial scale, no small amount of interest attaches to this first practical success.

ARBITRATION IN THE IRON TRADE.

The recent arbitration in the matter of the puddlers' wages at certain of the works in the North of England cannot be regarded as one of first-rate importance, and it is not to be compared with that which took place in the early part of the year, and in which Sir J. W. Pease acted as arbitrator. In the present instance, although, if Mr. Dale's award had been given in favour of the workmen's claim, the issue would have been greatly widened and the bearings of the case much magnified, the question as it was submitted for his decision only affected the workmen employed at three establishments. The matter in dispute was, in brief, as follows. The puddlers at the Moor Ironworks, the Stockton Malleable Ironworks, and the West Stockton Ironworks claimed extra payment for any admixture of hematite with Cleveland pig-iron in the puddling furnace, at the rate of 6d. extra per ton where half a pig of hematite was used per cwt., and 1s. for two half-pigs, and 1s. 6d. for three. The contention on the part of the men was that, where hematite was used additional labour was necessary, more skilled men were required, and that the iron was more valuable in the market. At present 9d. per ton extra is paid when four half-pigs are used, but there is no additional payment when anything under that number is employed. It will be seen that the workmen's claim was not only that there should be a proportionate allowance in respect of smaller quantities, but that it should be on a scale much above the rate of the existing rule in the case of the four half-pigs. On the part of the employers it was urged that it was erroneous to say greater skill was requisite in puddling hematite, the fact being that hematite made the iron easier to work; only a little steadiness was necessary, and, as a compensation for this, the men were able to make a greater tonnage on account of the superior materials supplied. In addition, it had been the custom of the district since the formation of the board of arbitration to pay no extra for mixtures of hematite beyond the 9d. for the four half-pigs. In giving his award—rightly, we think—against the workmen, Mr. Dale based his decision chiefly on the inexpediency of altering the custom which had prevailed for such a length of time, and of raising the general rate of wages for puddling as the result of local and special claims.

SUBMARINE TELEPHONES.

We referred a few weeks ago to the successful submarine telephoning operations carried on at Havre. These have now been followed by similar and equally successful ones in this country. In the experiments made in France, however, telephonic communication was merely established with a vessel anchored a mile off shore. In the recent trials made by Mr. Wake, engineer of the River Wear Commissioners, and Mr. Irish, manager of the Northern District Telephone Company, on the contrary, the practicability of using the telephone for diving purposes was thoroughly tested, and the instrument found as effective under water as on land. A diver descended in his dress to the bottom of the dock, where he successfully carried on an animated conversation with persons on *terra firma*. In order to test thoroughly the practicability of the apparatus, he asked at various times for implements used in diving operations to be sent down to him, and put several questions to the persons on land, finally stating that he was about to ascend. On the other hand, the persons on land interrogated him as to the condition of the bottom of the dock, the depth of water whether the supply of air through the pumps was satisfactory, as to his whereabouts in the dock, and when he was coming to the surface. Although under the circumstances it could hardly have been expected that the apparatus would work as successfully when submerged as when it is above ground, in consequence of the action of the air pumps, the result showed that it was as well adopted for submarine purposes as for others. These experiments having proved so successful, it was thought advisable to illustrate the same at the North-East Coast Exhibition at Tynemouth, and last week the telephone in a diving dress was severely tested by Mr. Lambert, of the firm of Messrs. Siebe and Gorman, submarine engineers, who descended on three occasions into the diving tank, and placed himself in all the positions that a diver has to assume in order to carry out his work. The length of cable used in these experiments, through which the conversations were carried on, was 600 yards. The want of a system of verbal communication with a diver in his dress, &c., has long been felt, and it would appear from the above account that it has now been met.

MECHANICAL TRACTION ON CANALS.

The problem of dragging canal boats in a more expeditious and less primitive manner than that now pursued appears to have been at length solved, and in a very practical way too, by M. Rigoni, a Belgian engineer, experiments having recently been made on the canal from Antwerp to Liége with his system of mechanical traction by means of a moving cable. The system is very simple. An endless cable made of Bessemer steel is set in continuous motion by fixed engines on the banks of the canal. It is supported along the bank by special pulleys and directed by return pulleys of large diameter lodged in chambers of masonry under the level of the tow-path. The length of the cable is five miles. Thus a canal is divided into as many sections, each worked by a fixed engine, as this length of five miles is contained in it. The steam engine acts on the cable through a pinching pulley, similar to the Fowler pulley. The attachment of the boats to the cable is by means of checked nippers embracing the cable. On coming to a supporting pulley, or a pulley at a curve, the nippers pass without releasing the cable. One of the principal advantages of M. Rigoni's system is a considerable increase of speed. At present the daily stretch covered in hauling with horses is from 10 to 11 miles, and with men only from 7 to 8 miles. By the new method it is easy to make 3 miles an hour. Further, there is a considerable economy both in the capital required at first and in the cost of working over other systems. We believe the new system will soon be in general favour, and be rapidly established wherever there is a large canal traffic. It will enable canal companies to compete more successfully with railways with regard to rapidity of transit.

COAL MINING IN NEW ZEALAND.

New Zealand is blessed by bountiful nature in more than one respect, and amongst the treasures thus bestowed not the least considerable are her coal supplies. Among the coal mines rapidly being developed in the colony is one situated near the town of Westport, on the west coast of the Middle Island, which is distinguished by two remarkable, if not unique, features—viz. the thickness of its coal seams, which range from 6 feet to 53 feet 6 inches in depth, and the fact that these enormous deposits are placed, and can be easily worked, at a latitude of from 800 feet to 3000 fee above sea level. Some of these seams are exposed on the faces of the cliffs, and can be got at with the greatest ease by tunnelling. Besides the comparative immunity from ordinary accidents which this remarkable disposition of the coal deposits affords, there is the further advantage that the mines are absolutely safe from floods, and almost, if not quite, secure from the risk of explosion from fire-damp. There is the further advantage that the coal can be loaded on board ship by gravitation, the danger and expense of hauling the coal up a deep perpendicular shaft being entirely avoided, while the full coal trucks can be made to convey themselves down the mountain slope to the harbour, and at the same time haul up the empty trucks along a parallel line of railway on the system adopted at the stone quarries at Portland, in this country.

THE MINERS' AGITATION.

THE coal trade has been somewhat perturbed for the last week or two by reason of the threatened difficulties in respect of wages. At the conference of miners held in Manchester in the beginning of September a resolution was adopted to the effect that the time had arrived when an effort should be made to secure an advance in wages, and that, if necessary, a general strike should be resorted to to attain this object. A general cessation of work amongst coalminers would be nothing short of a national calamity, dependent as England is, as a great manufacturing country, upon an abundant and cheap supply of fuel. But, although the men could work intolerable mischief to trade generally, if even only a large proportion of them strick, such a proceeding on their part would entirely defeat their own object, since the demand, upon which they found their claims, would be paralysed, rather than stimulated, in the long run, by the withdrawal of the supplies of coal. There is not much fear, however, of a general strike taking place; wiser counsels have prevailed on the part of most of the men, and, except in one or two isolated instances, a disposition to meet the colliery owners in a friendly spirit is manifested. A want of unity on the part of the men is also apparent, for when the period for action arrived the extreme step was taken in only a few cases, the miners elsewhere temporising in one manner or another with the masters; while in some districts of Scotland they have not acted on the recommendations of their own delegates, but continued at work without making any claim. Whether the time has come when a moderate advance in wages might be conceded it is not for us to say, but there certainly seems to be no grounds for a 15 per cent. rise as demanded by the men. Perhaps they went on the Scotch principle, and thinking that if they plucked at a gown they might get a sleeve of it, determined to claim the 15 per cent. advance in the hope that the owners would offer to compromise the matter by conceding 7½ per cent. It is true that the coal trade has undergone some little improvement lately, but that has hardly affected prices yet; in fact, in some districts, prices were lower before the agitation commenced than they were last year. On behalf of the men, however, it must be allowed that for a long period now their wages have been very low, and it was natural that they should endeavour to improve them when they thought the opportunity offered itself. It is to be hoped, nevertheless, that they will not be misled by a transient effect that the agitation has had upon the trade. Anticipating a partial strike, or a restriction in the output, consumers have been taking the opportunity of laying in some stock, which of course has given rise to a considerably increased demand, enabling colliery proprietors to obtain some advance in prices. Such an improvement is only temporary, and is totally different from the demand created by an increase in the actual consumption; but, we fear, some of the men may be misled by it, and persuaded to persist in their demands. For the sake of all parties concerned, we trust that some arrangement will be come to, such as has been concluded in North Wales, where the men have agreed to work on at an advance of 5 per cent., while the owners have undertaken to meet the delegates of the colliers at the end of the month to consider the question and grant a further rise if possible. When the tide of trade just appears to be turning for the flow, and business men as a rule are looking forward to the future with some hope, it would be most deplorable were the prospects to be blighted by ill-considered action on the part of the men. We are confident, however, that the good sense of the majority of them will avert such a calamity.

LEES' BAND-SAWING MACHINE.

THE illustration on page 287 represents an endless band-saw machine, possessing several novelties in design which merit notice. The main frame is a substantial trunk-casting in one piece, it has an extended bedplate, which ensures rigidity in working. The opening at the bottom part of the main frame carries the bearings for the lower saw-wheel, and which are made adjustable. The striking gear lever also passes through the base of the machine, thus being readily under the hand of the operator. It will be seen by the illustration that an extra amount of curve has been given to the column, thus rendering it possible to manipulate long pieces of wood around the saw. The top saw-wheel is fitted with an extra long boss bearing, and has tension and spring adjustment for preventing breakage of the saws. The saw-table can be set to an angle for bevel sawing, and the saw is fitted with guides and packing pieces immediately below and above the cut, thus keeping it steady in working. A revolving steel disc receives the back thrust of the saw. Guards are also fitted to prevent accidents should the blade be fractured in sawing. Altogether, it is a well-designed machine of its class. Messrs. T. and R. Lees, Hollinwood, near Manchester, are the designers and makers of the machine.

THE "DIAGONAL" ENGINE.

IN our report of the Royal Show at Reading we briefly referred to a novelty in portable engines which we found at the stand of Mr. E. S. Hindley, of Bourton. This was the "Diagonal" engine, of which we give a perspective view in the engraving on page 287. It is a 2-wheeled portable, and has a cylinder 4 inches in diameter with a 6-inch stroke, and mounted on the top of a boiler which occupies a diagonal position when the engine is at work. The boiler is of the multitubular type, the tubes being so arranged that they are entirely covered with water; it has 20 square feet of heating surface, and from its arrangement the mud settles down below the ash-hole, where the blow-off cock is placed. The engine is intended to run at a speed of about 240 revolutions per minute, and when at work the shafts are lowered and carried in adjustable standards resting on the ground, as shown in our engraving. These, together with another standard under the smoke-box end of the engine render the whole perfectly steady under work. For travelling, the stays are removed and the boiler is carried well clear of the ground between the road-wheels, which are of wrought-iron 3 feet 6 inches in diameter. These useful little engines are being made of from 1½ to 4 horse-power. They are specially designed for travelling on rough roads, and are mounted in such a way that all is above the axle, and yet the weight is low down so that the whole is evenly balanced, scarcely any weight being thrown on the horse's back.

AMERICAN IMPORTS OF IRON AND STEEL FOR YEAR ENDING JUNE 30, 1882.

THE chief of the United States Bureau of Statistics, Hon. J. Nimmo, jun., has issued his detailed statement of the United States imports and exports for the fiscal year 1882, from which the following table, exhibiting the imports of principal articles of iron and steel from all countries in that period, compared with similar imports in the fiscal year 1881, has been compiled:—

Articles.	Gross Tons.		Values.	
	1881.	1882.	1881.	1882.
			Dols.	Dols.
Pig-iron ..	417,848	496,044	8,766,461	9,213,556
Castings ..	163	1,453	11,733	91,538
Bar iron ..	46,482	67,140	2,507,058	3,159,499
Boiler iron..	103	305	4,097	17,753
Band, hoop, &c. ..	7,925	1,560	348,744	59,640
Iron rails ..	172,312	81,343	610,404	736,794
Steel rails ..	179 982	214,324	6,507,048	7,147,949
Sheet iron..	5,116	9,511	610,404	736 794
Tinplates ..	165,182	196,843	14.149.387	16 599,264
Scrap iron..	267,500	177,020	6,381,608	3,364,925
Anchors chains, &c.	905	1,572	99,800	159,514
Total ..	1,213,518	1,247,115	39,997,344	41,287,226

It will be observed that the imports enumerated in the above table for the two years are very nearly equal in both quantity and value. Steel blooms are not included in this table but in the table below; their value causes the total value for 1882 to considerably exceed the total value for 1881, and if their weight were known it would have the same effect on the table of weights above. The weight of the other articles of iron and steel imported is not given in Mr. Nimmo's report, but their values are given, and are as follows, for the fiscal years 1881 and 1882:—

Articles.	1881.	1882.
	Dols.	Dols.
Hardware	77,869	73,938
Machinery	1,668,305	2,027,840
Fire-arms..	1,166,360	1,498,910
Steel ingots, &c... ..	6,218,453	13,341,052
Cutlery	1,861,676	1,959,973
Files	147,433	175,482
Saws and tools	14,475	29,892
Other manufactures ..	6,222,903	6,026,384
Total	17,377,474	25,133,471

Adding the values given in both tables, we find that the total value of all iron and steel imported into the United States in the fiscal year 1882 was 66,420,697 dols, against 57,374,818 dols. in the fiscal year 1881.

THE MOSCOW EXHIBITION.

THE great exhibition of industries and manufactures of the Russian Empire, which has been open during the summer in Moscow, closed on Saturday last, September 30. As those who have visited previous exhibitions in Russia seem to agree that the progress made by the Russian iron and engineering industries during the last ten years is something remarkable, the following brief account of those branches of the exhibition will no doubt be read with interest. It may be unnecessary to inform those acquainted with the subject that the old ironworks in the Ural Mountains still maintain their well-known reputation, and can, as regards a pure and refined iron, fully compete with similar works in other countries, but this fact must have struck even the uninitiated who have taken the trouble of examining the exhibits at Moscow, as, for instance, those of Demidof and Sienbock Fermor. The pure fractures, the perfect bars twisted into the most shapely knots, and the fine elastic steel plates, as well as the tough, flexible ropes and wires there exhibited can fully claim comparison with any manufactured abroad. It is remarkable that this progress in the Russian iron manufacture of late years is chiefly due to the Ural Railway between Jekaterinburg and Perm, which now enables the refining works in these mountains to sell their produce in the most distant marts of the empire, whilst the increased duties and the low value of Russian money makes it possible even for these manufacturers to undersell the English and Swedish manufactured goods imported at St. Petersburg. These manufactories cannot, however, be developed to their greatest extent until the Ural Railway is in direct communication with the entire Russian railway system. The great shipments of unrefined goods will then, as now, be effected in the cheapest manner over the great Kama and Volga watercourses, but it is only the possibility of a continuous and quick despatch of goods to the markets of Russia that will ensure the erection of such works as those above-mentioned for the manufacture of fine iron, for which the excellent ores of the Ural are most suited. The iron works which take their supplies from the deposits in Central and South Russia will, in consequence, always be of most importance to this industry. The works in Central Russia have now obtained their full development, but this is far from being the case with those situated in the south, where the people are still as behindhand and indifferent to the utilisation of the enormous mineral deposits as to the tilling of their fertile soil. In fact, if we except the iron industry which Tula has for centuries enjoyed, and one or two engineering works in Moscow, there are only two works in Central Russia of any importance, and these are the great establishments of Struve at Kolomna and of Maltzow at Briansk. Both these are founded on the gigantic basis which the Russians are so fond of, and which may perhaps answer the peculiar circumstances under which they labour, but which nevertheless invariably inspires a visitor accustomed to the centralising system, and the distinct division of manufacturing followed in the works in the west of Europe with a certain amount of distrust. In Russia the principle followed seems to be that the manufacturer ought to be independent, on one side, of the changes in the demand of the market, and, on the other, of the fluctuations in price of the raw material; and it is for this reason that in Russian works the making of raw material and the manufacture of finished articles is effected side by side, the finished goods thus buying their raw material cheaper, whilst the latter are always ensured a steady consumption. There seems also to be a disposition in that country rather to follow general theories and logical deductions of such than the teachings of practical experience. Still the methods and system followed at the Creusot and at a few other works have to some extent influenced the method of working now adopted in Russian works.

The above-named two works made, nevertheless, at the Moscow exhibition a splendid show of what they are capable of producing, and whether they will continue in the complicated manner hitherto pursued, or separate into smaller concerns, these ironworks will always, and particularly if the protective policy now carried out is continued, be of great importance in the utilisation of the enormous deposits of Great Russia. Both exhibited steel in semi-raw state in the shape of tires and rails, and finished goods in the shape of machinery, railway engines and carriages, as well as agricultural implements. What attracted special attention among the exhibits from the works at Briansk was a steel rail 196 feet long, which has been bent and twisted in several places without the slightest deterioration. The ironworks in the south of Russia, of which one hears so much of late years, were, however, poorly represented at Moscow. On the other hand, the collective exhibits made by the owners of the coal mines in the Donetz district demonstrated the remarkable development which the latter industry has undergone during the last ten years in Russia. Still, this section showed rather what may be expected from this industry than actual results, as the existing incomplete means of communication and the great difficulty in Russia of obtaining labourers skilled in coal mining have prevented its development to its fullest extent.

Having thus dealt with Ural, the Great Russian and the Little or New Russian ironworks, we come to the Polish. These may, as regards raw material, perhaps not offer anything very remarkable, but they have, as regards finished articles, attained a very high state of perfection. The Polish iron industry is naturally so intimately connected with the German that its progress is chiefly regulated by the latter, particularly as regards improvements and new methods. Some of the ironworks on the Polish frontier are thus merely branch establishments of certain works in Germany, whose manufacture consists solely of such articles as pay the lowest duties when sent into Russia, where they are subsequently finished—at their own establishments—for purposes for which they were originally manufactured. Among the Polish exhibitors, the palm was, undoubtedly carried off by Messrs. Lillop, Rau and Löwenstein, of Warsaw, who showed their articles in their own pavilion, and where was found almost everything which can be turned out from an iron and engineering works: axles, hoops, bolts, railway carriages, tramcars, steam engines, saw-mills, harvest and threshing machines, steel ploughs, &c. This show was no doubt one of the most attractive the exhibition can boast of.

Riga, the most important of the Baltic towns, was poorly represented within this branch of the exhibition, whilst, on the other hand, St. Petersburg deserved particular attention for what it exhibited. The capital of Russia occupies, in connection with the iron industry, a peculiar position, as one may almost say that this industry is here of a somewhat moral character, and not developed through a natural combination of circumstances, caused by the proximity to the state machinery and the official contractors, and which is almost the only cause for the creation of an iron industry of such respectable dimensions on a spot where natural advantages towards its development are so few. The ironmasters in St Petersburg must during the short summer months obtain their supplies of raw material and fuel from distant parts, and have not even the advantage of water-power at their works. The only circumstance in their favour seems thus to be an easy communication with the sea, and even this is not of much benefit as long as the new harbour—on which work has been going on for some years—is unfinished, and there are no quays directly in connection with the Russian trunk railways. These disadvantages are to some extent counterbalanced by the stimulating influence of the capital, which seems to give a stronger impulse to the undertakings it fosters. It is to this circumstance in particular that one must ascribe the cause of St. Petersburg occupying such a prominent position in the iron industry of Russia, and it is remarkable that in spite of financial difficulties under which the manufacturers of raw material have to labour—due to the constant oscillations in the financial policy of the government—the ironworks in St. Petersburg, both as regards excellence of manufacture and cheapness of making, can fully compete with and may even outstrip the works of the interior. The difficulty for certain works to exist now, when the government have levied a duty on all foreign raw material and accorded to the manufactories which use Russian iron only special privileges, has forced these to make every effort to reduce the cost of manufacture, particularly as regards labour. The foundry works at Alexan-

drovsky have for this reason adopted the modern method of dephosphorisation, and have succeeded so far as to have been able, at the exhibition, to show a Martin steel produced from old iron chips and shavings quite equal to any produced at any English works. The exhibition furnished several striking proofs of what can be done in Russia with poor materials. The various works belonging the crown made an excellent show of their manufacture: guns, cannons, projectiles, &c.; and a colossal steel axle for a rolling mill, manufactured at one of them—the Obuchoff Steel Works, of St. Petersburg—was decidedly worthy of special notice, its surface being remarkable for purity and absence of blemish. That these works should be able to produce such excellent articles is perhaps not unnatural, when it is considered that at the government works the cost of the articles manufactured is of no consequence whatever. The works situated at St. Petersburg use chiefly Swedish pig-iron of the best brands for their manufacture, but equally excellent articles are exhibited from the government works at Perm, where iron from the Ural is solely employed.

The works manufacturing railway stock and kindred goods made a splendid show of engines, saloon and other carriages, sick, transport, and ice waggons of all kinds, this section occupying a very large space. A first-class sleeping car, made at Nishni-Novgorod, with seats which may for the night be converted into bedsteads, on a plan for many years in use in Russia, as well as a complete engine from the Semjannikoff Works at St. Petersburg, were so tastefully decorated and so well finished it seemed almost a pity to expose them to wear and tear. Carriage building has, as is generally known, attained a high degree of perfection in Russia, of which the Moscow exhibition has furnished fresh proof. The vehicles exhibited from the works at St. Petersburg and Moscow do great credit to these establishments, and one must admire the elegance displayed the more when it is considered that the roads in Russia do not permit of the adoption of the light and fragile form which in other countries give equipages such a pleasing appearance, as tough springs and strong wheels are required to keep a vehicle together, driven at the great pace which is the custom in Russia.

The Russian engineering works made rather a fair and extensive show of their industry, many of the objects exhibited being highly creditable. Among these the well-known firm Messrs. Nobel Bros., of St. Petersburg, took the lead. This branch of their business is, however, now of minor importance in comparison with their extensive naphtha and astaka production, of which combustibles they also exhibited some very fine samples. Of the more artistic objects in this branch of the exhibition should be mentioned the steel articles exhibited by Messrs. Winkler, of St. Petersburg, among which a pair of gigantic steel candelabra, purchased by the Grand Duke Vladimir, were really works of art. Another firm, in order to attract attention to their manufacture of needles, had covered two enormous bears in wax with these articles by way of fur. It is stated that the artistic arrangements of the exhibition were designed by M. Mellgren, a Swedish architect. In conclusion, it must be said that it seems strange that this exhibition, giving such a clear and comprehensive idea of the present state of the industries of Russia has been visited by so few foreigners, particularly those interested in the subjects dealt with above, when it is considered what an excellent market Russia offers to some countries.

THE CALEDONIAN STEEL AND IRON COMPANY.

THE Thomas-Gilchrist process continues to make headway, and is now being introduced into Scotland by a limited company under the above title. It would appear that Scotch pig is specially suitable for treatment by this process, which is the only known method of removing phosphorus and sulphur, the objectionable impurities in pig-iron; and the process is specially adapted for being employed upon the least valuable kinds of pig-iron. In order that the manufacture of steel by this process on a large scale may be commenced immediately, an agreement has been entered into with the Glasgow Iron Company for the acquisition of their Wishaw blast furnaces, coal and ironstone pits, &c., with ample ground for the addition of the necessary steel-making plant. The mineral fields contain clayband and blackband ironstone, both of which are suitable for making iron for this process. Blackband being the purer mineral, will enable a larger proportion of cinder to be used in the furnaces, thus reducing the cost of production. The acquisition of these works will enable the company to manufacture steel in the most economical way by using iron direct from the blast-furnace without re-melting, thus effecting a large saving in the cost of production. The services of Mr. George R. Wood, for many years manager of the Wishaw Works and Collieries, have been secured for the company, and he will be the managing director. A highly respectable and responsible board of directors appears on the prospectus (which will be found in our advertising columns), and, as far as can be seen, all promises well for the success of the concern.

ON THE CHEMICAL COMPOSITION AND TESTING OF STEEL RAILS.*

By Mr. J. G. Snelus, Workington.

THE author has been induced to bring this subject under the notice of the institute with a view of starting a profitable discussion upon these important points, and not because he can lay claim to any originality in the treatment of the subject, or because he has any discoveries to record. Most of the members of the institute will have seen the valuable papers upon the subject by Dr. Dudley of Altoona, chemist to the Pennsylvania Railway Company, but probably very few have carefully studied these, and the elaborate and thoughtful remarks which were made upon them by American metallurgists at the meetings of their institute of mining engineers. For the benefit of those who are not acquainted with them, the writer may state that he refers to the paper on the "Chemical Composition and Physical Properties of Steel Rails," by Dr. Charles B. Dudley, read at the Lake George meeting, October, 1878, and the paper on "The Wearing Capacity of Steel Rails in Relation to their Chemical Composition and Physical Properties," by the same author, read at Philadelphia in 1881. These papers and the discussions are so valuable that it would be well if they could be incorporated bodily into our own transactions, for the benefit of many of our younger members, who may not otherwise be able to consult them.

Whatever may be thought about Dr Dudley's *deductions*, there cannot be two opinions as to the thoroughness and general reliability of his investigations. No similar research has been attempted on this side of the Atlantic. Our worthy president, Mr. Smith, did, however, precede Dr. Dudley in investigating the relation between the chemical composition, physical properties, and wear of steel rails, and embodied his results in a paper read before the Institution of Civil Engineers, session 1874-75. This was followed in 1876 by a paper by R. Price Williams on the "Permanent Way of Railways," in which also many important facts were brought to light. Mr. C. P. Sandberg has also presented to the American Institute of Mining Engineers a thoroughly practical paper on rail specifications and rail inspection in Europe.

But notwithstanding these valuable papers and the discussions to which they have given rise, it may fairly be said that the proper composition for a steel rail is far from settled yet. Mr. J. T. Smith and Dr. Dudley both came to the conclusion, as the result of their experiments, that the softer steel rails, that is, those with low tensile strain and great elongation, gave the best wear. Unfortunately, those tested by Mr. Smith were only examined for carbon. The percentage of this element was shown to increase with the hardness of the rail. Dr. Dudley carried his analysis farther, and examined altogether 89 rails most carefully for carbon, silicon, phosphorus, and manganese. He has also attempted to fix the relative hardening properties of each of these elements, and assumes that 1 part phosphorus, 2 silicon, 3 carbon, and 5 manganese produce the same hardening effect upon steel, and he sums up the combined effect of all these elements in what he terms phosphorus units. These phosphorus units he arrives at by taking the analysis of the steel and adding together the phosphorus, one-half the silicon, one-third the carbon, and one fifth the manganese, expressed in hundreds per cent.

Now, it is well known that the effect of any one element is intimately dependent upon the proportion of others that may be present in the steel. Thus steel with the large percentage of silicon shown in the following analysis:—Iron, 98·784; carbon under, ·100; silicon, ·833; sulphur, ·043; phosphorus, ·075; manganese, ·216; was found to bend well and be very tough. Indeed it is well known that the steel used for castings may contain very large quantities of silicon and comparatively high carbon, and yet be very tough so long as it is well annealed. But annealing is not practicable for rails, and all steelmakers are aware that if the silicon rises to over ·2 per cent. the carbon must be kept down to about ·35 per cent., or the rail will ordinarily be brittle. One of the rails tested by Dr. Dudley showed the following remarkable analysis:—Carbon, ·483; silicon, ·480; phosphorus, ·035; manganese, ·782. Notwithstanding this, it was tough, and one of the best wearing rails. It will be noted, however, that the phosphorus is very low, and it had in all probability been practically annealed by cooling very slowly on the hot bank.

Dr. Dudley, as the result of his investigations, arrived at the following ideal composition for the best wearing rails:—Carbon, ·334; silicon, ·060; phosphorus, ·077; manganese, ·491. This result he arrived at by taking the average composition of 32 slow-wearing rails, and he suggested that this should be modified to:—Carbon, ·300; silicon, ·040; phosphorus, ·100; manganese, ·35; because American manufacturers cannot work to so low a phosphorus as that given in the previous analysis. In his first investigation he found that the average of 12 rails which did not break showed carbon ·287. In those which broke the average of carbon was ·366. Similarly in 12 unbroken rails the phosphorus averaged ·077, and in the broken rails phosphorus averaged 1·32, and in every case in which the phosphorus was above ·12 the rail either broke or crushed. Again, in the unbroken rails he found manganese average ·369; in the broken, ·521; but he found scarcely any difference in the silicon, that in the unbroken rails being ·044, and in the broken ·047.

From his investigations of the 64 rails in regard to wear, Dr. Dudley concluded that the 32 slower-wearing rails, as compared with the 32 faster-wearing rails, yielded the following results:—

Mr. Smith concluded as the result of his investigations that the best material for rails should contain ·3 per cent. carbon, and have a tensile strain of from 51 to 53 tons per square inch. Notwithstanding the apparently convincing proofs adduced by Mr. Smith and Dr. Dudley in favour of a soft steel for rails, there are plenty of advocates for harder material, and the North-Eastern Railway Company, after stating that Bessemer steel made in recent years has not been found to wear so well as that made earlier, specify that their rails shall contain ·45 to ·5 carbon. And well-known English engineers give the following composition for manufacturers to work to:—"Carbon not less than ·3 or more than ·45; silicon, ·06; phosphorus, ·06; sulphur, ·06. There must be no other material present except manganese and iron." The writer, having made more than half a million tons of rails approximately to the composition just mentioned, can testify to the toughness of those so made, but he has had no opportunity of ascertaining the result of their wear; indeed he doubts much if any of them have yet worn out. While many contracts made under his supervision have guaranteed the rails for five years or more, no single rail has ever been returned as worn out during the guarantee, and very few indeed have either broken or crushed.

Dr. Dudley considers that wear is "a function of the amount of distortion by bending that a piece will bear," and endeavours to explain it by an ingenious hypothesis, which may be worth repeating. He says:—"As to the second question, Is there any conception which helps us to understand why it is that the softer rails give the better wear? I will say that in view of our absence of knowledge as to exactly what quality or combination of qualities of steel wear is a function of, the answer to this question becomes difficult. Nevertheless we may possibly get a little help upon this point by devoting a few moments to the consideration of what takes place when steel suffers loss of metal by wear. What then is the condition of the surfaces involved in wear? What are the forces which act, and what are the strains produced?

"If I understand the matter correctly, no two surfaces ever have been made, or can be made, that are absolutely smooth. At the very best, the smoothest surfaces are made up of elevations and depressions, very minute, it is true, perhaps almost infinitesimal and entirely incapable of measurement, but nevertheless real elevations and depressions. When these elevations and depressions are tangible, we call the surface rough; when they are infinitesimal, we call it smooth. If, now, this reasoning is correct, the surface of the head of a rail, as well as that of the circumferences of the wheels above it, are made up of elevations and depressions, which, when the two surfaces are in contact, must more or less fit into one another. And it is this fitting-in of the minute elevations and depressions of the two surfaces that gives rise to friction. If the two surfaces were absolutely smooth, there would be no friction, and, consequently, no tractive power in the locomotives, nor would the wheels under the cars turn round. Friction of this kind we are accustomed to call rolling friction. In reality, then, a rail and the wheel which rolls above it may be regarded as a rack and pinion with infinitesimal teeth, lacking, of course, the element of regularity as to the position of the teeth which characterises a rack and pinion. So much for the surfaces involved in wear. Now what are the forces involved in wear and what strains do they give rise to? If I understand the matter rightly, there are two kinds of friction which may occasion loss of metal by wear in the case of rails; first, rolling friction, which occurs when the wheels turn round and the trains move forward; and, second, sliding friction, which occurs when the wheels turn round in the same place, as in the case of slipping drivers, or when the wheels do not turn round and move along the track, as in the case of sliding wheels. It is probable, however, that by far the largest portion of the loss of the metal which rails suffer is due to rolling friction; it will, therefore, perhaps, be sufficient for our purpose to consider this case only.

"The forces which act between the top of the head of the rail and the wheels in rolling friction may, it seems to me, be regarded as two in number. There is first, a force acting directly downwards, due to the weight of the locomotives and cars. This force may be regarded as a vertical force acting perpendicularly to the head of the rail, and is in action both when the train is standing still and when it is in motion. Secondly, there is a force acting parallel to the head of the rail, due to the traction or impelling power of the locomotives. In the case of the driving wheels, this force may be supposed to act in the direction opposite to that of the motion of the trains. In the case of all the other wheels, this force may be supposed to act in the direction of the movement of the trains, and it is antagonism to this force by the rail that causes all these wheels to turn

Number of Line.	Number of Rails in Average.	Description of Averages.	Loss per Million Tons.	Grade.	Degree of Curve.	Torsion Tests. Height of Diagram.	Length of Diagram.	Elastic Limit.	Area of Diagram.
17	32	All conditions, slower wearing.	·0506	—	—	3·00	13·59	1·16	34·13
18	32	All conditions, faster wearing.	·1028	—	—	3·26	11·08	1·27	30·35

Number of Line.	Tensile Tests. Unannealed. Tensile Strength.	Unannealed. Elastic Limit.	Unannealed. Elongation.	Annealed. Tensile Strength.	Annealed. Elastic Limit.	Annealed. Elongation.	Shearing Tests. Shearing Stress.	Shearing Tests. Depression.	Bending Tests. Maximum Load.	Bending Tests. Deflection.	Chemical Analysis. Carbon.	Phosphorus.	Silicon.	Manganese.	Phosphorus Units.	Density.
17	75·125	36·031	17·1	73·219	33·281	18·5	57·537	·0033	2878	160°	·334	·077	·060	·491	31·3	·78211
18	80·188	38·125	14·2	77·188	36·594	13·8	61·922	·0856	3222	133°	·390	·106	·047	·647	38·9	·78165

* Read at the Vienna Meeting of the Iron and Steel Institute, September 1882.

* The tensile tests, &c., are given in pounds per square inch.

round. In the case of the drivers, the amount of this force acting parallel to the head of the rail is sufficient to overcome the total train resistance; in other words, to cause the train to move. In the case of the other wheels of the train, acting individually, this force parallel to the head of the rail is small, being only that necessary to cause the wheels to turn round; in other words, to overcome journal friction. The force parallel to the head of the rail acts only when the train is in motion.

"In the case of rolling friction, there is, of course, no wear except when both these forces are acting at once. But when two forces are acting at the same time, their line of action must be regarded as in the direction of the resultant of the two forces. In the case we are considering, we have a vertical force and a horizontal force acting at the same time, and the resultant line of action must, of course, be a diagonal. In other words, in rolling friction, if the conceptions given above are correct, the line of action of the force which produces wear must be regarded as a diagonal to the line formed by the head of the rail. In the case of the driving wheels, the diagonal is inclined towards the front end of the train, and in the case of the other wheels it is inclined towards the rear of the train.

"Returning for a moment to the conception previously mentioned, that the top of the head of the rail and the surface of the circumference of the wheel are a rack and a pinion, with infinitesimal teeth, but without regularity in the teeth, let us see what kind of strain would be produced in these minute teeth by a force acting diagonally to the line of the head of the rail. I hardly see how we can avoid the conclusion that this strain would be a bending strain. In the case when the infinitesimal teeth of the wheel and rail did not fit into interstices, but struck against each other, in which case the ends of the teeth only would be involved in the strain, then surely the strain would be a bending one. And again, in the case in which the teeth mutually engaged each other as a rack and pinion so long as there was motion of the train, which is a necessary condition of rolling friction, it seems to me that the strain would still be that of bending.

"If we are right in regard to the nature of the surfaces involved in wear and the strains produced, wear is simply the breaking or pulling off of the infinitesimal teeth by the strains to which they are subjected. And here we see why it is that the softer rails give the better wear, for the harder the steel the more brittle it is, and the more brittle the steel the more readily will these infinitesimal teeth be broken off by the strains applied. On the other hand, the softer the steel the more readily will these infinitesimal teeth bend and flatten down under the strain without breaking off. Or, to make the statement general, if the nature of the steel is such that under the strains applied, whatever they may be, the teeth readily break off, which is characteristic of hard steel, the more rapid will be the wear. If, on the other hand, the nature of the steel is such that the teeth readily suffer distortion without rupture, bend and flattening down without breaking off, which is characteristic of soft steel, the slower will be the wear."

It is clear, from the experiments of Mr. Chanute, that with 14,000 lbs. weight and upwards on a locomotive driving wheel the pressure exerted exceeds the elastic limit of the steel at the points where the wheel touches, and that therefore these minute projections, which we must admit exist upon the surface of every rail, will be permanently distorted by every revolution of the wheel, and ultimately break off. On the other hand, the diagrams of worn rails exhibited by Dr. Dudley show clearly that in many cases there is a remarkable flow of metal from one point to another. Now, whether more metal will be removed by the flow of a soft material, or by the breaking off of minute surfaces by a grinding action, will depend upon many circumstances, and can only be determined by actual experiment for each set of circumstances. It is quite a common thing at railway stations, where brakes are much used, to see flakes of steel fairly squeezed off the heads of the rails to the outer side, and gradually broken away. The same kind of wear must take place in a minor degree upon all portions of the line.

While, however, it is by no means a well-settled point whether hard or soft steel rails wear the best, there can be no doubt that hard steel rails are more liable to fracture, and therefore, on the whole, it is perhaps better for the manufacturer to err on the soft side. But Dr. Dudley's ideal composition for a rail is one which it would be difficult and expensive for the manufacturer to work to absolutely; besides which there is no doubt whatever that it is not the composition which would produce the soundest ingots. The writer agrees, with Mr. Jones of the Edgar-Thompson Works that "the first thing towards making a good serviceable steel rail is to make a sound ingot, free from porosity, sponginess, or honeycomb;" and this opinion is endorsed by Mr. E. Williams and many other authorities.

Now, is the composition laid down by Dr. Dudly likely to give a sound ingot? We think not, and that to get sound Bessemer steel, as ordinarily made, either more carbon, more silicon, or more manganese must be introduced. The question is, which of these elements can be increased with the greatest advantage? Probably the silicon, because it is well known that a very small extra amount of silicon will tend to produce solid steel; so that if the silicon be raised to ·1 or even ·15 per cent., the steel would be improved without being seriously hardened; and besides, Dr. Raymond has shown, by a remarkable mathematical formula deduced from Dr. Dudley's analysis, that within certain limits silicon does not increase the loss of metal by wear. Manganese may also be used with a like result, and probably in larger quantity, as any excess behaves like so much iron. This will explain why English manufacturers now use so large an excess of manganese with impunity. As, however, it is an expensive element, there is every reason to economise its consumption compatible with making sound ingots. There appears, then, to be no reason why the manufacturer should be tied down to the narrow limits of ·04 silicon and ·35 per cent. manganese, even though it may be true that the soft steel wears best and produces least fractured or crushed rails. There is, however, every reason for keeping the phosphorus low. There can be very little doubt that this element, even in minute quantities is highly dangerous, and the attempt to hide its dangerous qualities, as in the manufacture of the Terre-Noire phosphoric rails, has had a very poor success. The writer has on more than one occasion, expressed his opinion that the small excess of phosphorus in English Bessemer over Swedish steel is the main reason for the inferiority of the former, and he cannot too strongly insist upon the advantages of the basic process in enabling us to remove the last traces of this noxious element. Really, we require in a steel rail many of the qualities which exist in good cutlery steel. Thus a good knife will retain a keen edge without being brittle on the one hand or doubling up on the other; and so we require steel for rails of such a quality that the teethlike projections, described by Dr. Dudley, shall neither break off or be squeezed off.

We would say then that a railmaker should aim at the following composition for steel rails:—Carbon, ·35 per cent.; silicon, ·10 per cent.; phosphorus, as low as possible, but not above ·075 per cent.; manganese, ·75 per cent. About ·1 should be allowed as a limit of variation in carbon and silicon, and ·25 for manganese. We would also say that a slight modification should be made in the values affixed to each element by Dr. Dudley in estimating their phosphorus units; and after careful consideration, we think this factor should be determined by adding phosphorus + ⅓ carbon + ⅓ silicon + ⅛ manganese. Taking the formula just given, we should then have:—Carbon, ·35 = ·116; silicon, ·10 = ·033; phosphorus, ·06 = ·060; manganese, ·75 = ·093; total, ·302. Or removing the decimal point two places, 30·2 as the phosphorus units in a good rail. Now, taking a rail with all the elements the same, but raising the carbon to an undoubtedly dangerous limit—say ·6 per cent.—we should raise the phosphorus units to 38·6. Similarly, taking carbon, phosphorus, and manganese constant, and raising the silicon to ·35, we should have 38·5 phosphorus units. Again raising the phosphorus to ·15, we should get 39·2 phosphorus units; and lastly, raising the manganese to 1·5, we should have 39·6 units; while, if we take all the elements at the extreme limits allowed, we should get 41·2. The steel should therefore be fairly safe with about 35 phosphorus units on this scale. The American manufacturer will make a steel with more phosphorus, and the German maker with more silicon, and each must reduce the carbon in proportion, but at the expense of producing a worse steel. No doubt a steel with considerably more silicon and less carbon, as made in Germany, would stand tensile strains equally well, but it would give way in bending and concussive strains, while the more phosphoric steel would not stand either one or the other test as well as our English standard.

Great credit is due to Dr. Dudley and his assistants for the patient investigations which they have made, but it is perfectly clear that he has not succeeded in convincing all, or even a great portion of those interested, that soft steel is better on the whole than moderately hard metal. We agree with Mr. Sandberg that this question can only be satisfactorily settled by a number of railway companies each laying down, say, 1,000 tons of soft rails on one side of the line and 1,000 tons of hard rails on the other. To ensure regularity in all other respects (as far as possible), except that of chemical composition, these two sets should be made by the same manufacturer. This plan would be a comparatively simple one, and it would involve the testing of such a large number of samples, that an average might then be struck with safety, as individual exceptions would have very little effect upon the average; whereas even in Dr. Dudley's more extended series only *one* abnormal rail upsets the calculations in a most serious manner. There would be no difficulty in any railmaker preparing two such sets of rails; their average chemical composition, absolute weight, and many other properties, could be determined beforehand, and the only drawback would be that we should have to wait some years for the results. Meantime we must go on manufacturing by the present formula or any that may be ultimately proved to be better.

In laying down a chemical formula for the manufacturer to work to, the writer does not wish to assert that rails made according to this composition will be perfect, as he is aware that many other circumstances besides the mere chemical composition affect the quality of the steel rail. The hardening effect of wear pointed out by Mr. Smith is a phenomenon to which comparatively little attention has been given, but that it is a point of importance will be seen from the sample of a steel rail now before you. This is a portion of a steel rail made by the Mersey Company and laid down on the main line of the Caledonian Railway Company, where it has been in use on the main line in a cutting three-quarters of a mile from Buchanan Street Station, on a down gradient of 1 in 80, for over nine years, viz., from August, 1872, to September, 1881. It had lost about 21 lb. per yard, and when taken up was tested by a falling weight of 1800 lb., the fall gradually increasing from 3 inches to 3 feet, the 3-feet fall, at which the rail broke, being the eighth blow. The rail was placed on 3-feet bearings. The rail shown has the following composition:—Iron, 98·911; carbon, ·450; silicon, ·037; sulphur, ·130; phosphorus, ·076; manganese, ·396; total, 100·000, which certainly does not indicate any special reason why it should be so very brittle; and the fact that it has been in hard service so many years would seem to prove that it was hardly so brittle originally, so that its present condition must be to some extent the result of the molecular change from constant vibration, to which Mr. Smith refers. It is curious that it is almost identical in phosphorus units to Dr. Dudley's theoretical good rail; as it gives 32·3 instead of 31·3.

The reduction of area in rolling, temperature at time of rolling, rate of cooling, and many other accidental circumstances, will affect the quality of steel rails; and therefore railway companies and railway engineers should not specify a hard and fast line for the manufacturer to work to, but be satisfied with testing the quality of the rail when made by a simple plan which will correspond in some degree to the work the rail is expected to perform. This brings us to the second part of the subject.

Testing Steel Rails.—The following methods of testing rails are at present in use or suggested:—(1) By examination of the fracture; (2) by chemical analysis; (3) by a blow from a falling weight; (4) by bending under, or the lever test; (5) by taking the tensile strain, elongation, and contraction of area; (6) by the torsion test; (7) by the punching test, suggested by our President. Some engineers' specifications provide for only one of these tests, others for several; and at times engineers specify for a chemical composition and a physical test which are quite incompatible.

We will take these tests in order.

(1) *Examination of the Fracture.*—There is no doubt that the fresh fracture of steel is a very accurate guide, in highly skilled hands, to its quality; but the test is entirely empirical, and so much depends upon the judgment of the individual, that it is not one which could be implicitly relied upon.

(2) *Chemical Analysis.*—It has already been stated that chemical analysis should be used by the manufacturer as a guide to the production of the proper quality of steel, and that he should aim at a definite chemical composition as the most important means of producing the desired result. But it has also been conclusively shown that two rails differing widely in chemical composition may be equally good in use, and at the same time that rails having an apparently perfect chemical composition may yet be inferior from other causes. Under these circumstances it is evident that a moderately wide range should be allowed in chemical composition, and that rails should not be condemned on this head alone. At the same time, in cases of failure, it is always desirable to make an analysis, as this will very often point out the cause.

(3) *The Falling-Weight Test.*—This is probably the simplest and best mode of testing rails, as it enables the inspector to make his tests rapidly upon the full section of the rail, and the test, when reasonable, approximates in some measure to the effect produced upon the rail in actual use. It infallibly detects rails that are either too hard or too soft. But engineers almost invariably specify a test far in excess of anything the rail will ever be called upon to suffer in actual use, and this often leads to the rejection of rails that are really good. Further, it is the custom of some engineers to insist upon all rails being tested, and some even go so far as to insist upon a full 30-feet rail being tested, refusing to test one that is, for instance, 27 feet long. This is surely a gross waste, for the quality of the steel can equally well be determined by testing the crop ends; and if this is done regularly, the test of an occasional short rail just to satisfy the engineer, who cannot be present during the whole process of manufacture, ought to be sufficient. Some engineers specify that as much as 2 per cent. of good rails must be subjected to this wasteful process. With rails at £5 per ton only, this means a loss to the manufacturer of nearly 1s. per ton, exclusive of the cost of testing. This would mean to a works of moderate capacity, say making 100 000 tons rails per year, a loss of £5000 per annum. Manufacturers have to work very hard to effect this much saving in any other part of the process of rail-making. The falling-weight test, properly applied, is, however, in the opinion of the writer, the best that can be made. In the West Cumberland Works, it is systematically applied to a large portion of the crop ends, say one from each blow on every shift, and it is also used to test the quality of the steel before it is sent into the mill.

A small ingot, 2 inches square, is cast during the running of the first ingot, and is taken, while still hot, to a tilt hammer, drawn down to ⅜ inch square, allowed to cool in the open air, and when just cold placed under a falling weight, and bent by one blow to an angle of 45 degrees, thus V. Unless the steel will stand this test the ingots are not sent into the mill, but placed on one side for further examination.

There is one difficulty in connection with the specification of the falling-weight test, and that is, that the test to be applied, must vary with every section of rail; and the particular test which a rail will stand can only be determined by actual experiment. The deflection given by rails of a number of sections in common use, and by steel having approximately the composition mentioned in the former part of this paper, may be of service to some, and is recorded in the Appendix.

(4) *Lever Test.*—This is a test which may reasonably be applied to finished rails within the limits of elasticity, but if extreme limits are applied up to the point of rupture, it should be on crop ends, so as not to waste good rails. The falling weight-test, however, properly applied, gives nearly the same information that can be obtained by extreme lever tests; and therefore this test might, as before stated, be confined to weights within the elastic limit of the rail.

(5) *Tests by Rupture.*—A good testing machine will no doubt afford very valuable information regarding the quality of steel; but certain varieties of steel, as was abundantly proved in the case of the *Livadia's* plates, will give very good tensile strain, elongation, and contraction of area, and yet be very brittle. This fact is now becoming well known to those engaged in testing German steel, and therefore the testing machine ought not to be relied upon as a means of testing steel rails, even if it were practicable to take a full section of a rail and pull it asunder. But when, to carry out this test, portions have to be cut from the rail, it becomes unreliable from another cause, viz., that metal from different parts of the rail will give different tensile tests. But the chief reason why this mode of testing is inapplicable to rails is that it is utterly impossible to make a fair number of tests within a reasonable time, and therefore the results could only be ascertained long after the rails ought to have been finished and delivered.

(6) *The Torsion Test.*—Most of the remarks about tension tests apply to this also, and it is very rarely specified.

(7) *The Punching Test, suggested by the President.*—This has never yet been applied in practice, and now that so many rails are drilled and not punched, it becomes inapplicable. A modification of this test, however, might very well be made, and appears to the writer to be both a simple and practical test, while it has the advantage of being scientific in its application, and, above all, capable of being applied to every rail. Most of our mills are now rolling three-length rails, and therefore a single crop end would fairly represent three rails. If a small hydraulic punch were placed near the saw, a crop from each rail could be thrown into a bosh of running water, and, as cooled, these could be tested by placing them in the machine and noting the depth of the indentation caused by a known pressure of a cone-shaped punch. The rail crop should be placed head uppermost, so that the indent is always made upon this part. It might be preferable to cut off a section of 3 or 4 inches from the rail and use this instead of the crop. These samples could then be kept for a while for examination. No fixing would be needed, and the testing would easily keep pace with the rolling without any expensive superintendence, especially if the instrument be made self-registering. By making it self-recording also, a perfectly permanent record could be obtained of the relative hardness of every rail. By con-

structing the instrument so as to exhibit the depth of the indent on a dial, the attendant could instantly call the attention of the manager to any extreme cases of hard or soft rails, and thereby check the manufacture in time, and the test could easily be repeated without delay. Of course the crop ends would be hardened by cooling them in water, but this would be rather a gain than otherwise, as it would emphasise the characteristic of hardness or softness; and as they would all be hardened from nearly the same temperature, the effect would be a constant one. By using this test and then subjecting a single crop end from every blow to a set falling weight, very perfect records would be obtained, that would, in the author's opinion, obviate the necessity of any more elaborate tests. It would be comparatively easy after making the pressure test to follow any doubtful rails, and mark them for subsequent examination by other methods. As stated in the commencement, the author's object in presenting this paper to the institute is rather to initiate a discussion than to offer suggestions or to record facts.

ON THE SUCCESSFUL ROLLING OF STEEL INGOTS WITH THEIR OWN INITIAL HEAT BY MEANS OF THE SOAKING PIT PROCESS.*

By MR. JOHN GJERS, Middlesbrough.

WHEN Sir Henry Bessemer, in 1856, made public his great invention, and announced to the world that he was able to produce malleable steel from cast iron without the expenditure of any fuel except that which already existed in the fluid metal imparted to it in the blast furnace, his statement was received with doubt and surprise. If he at that time had been able to add that it was also possible to roll such steel into a finished bar with no further expenditure of fuel, then undoubtedly the surprise would have been still greater. Even this, however, has come to pass; and the author of this paper is now pleased to be able to inform this meeting that it is not only possible, but that it is extremely easy and practicable, by the means to be described, to roll a steel ingot into, say, a bloom, a rail, or other finished article with its own initial heat, without the aid of the hitherto universally adopted heating furnace.

It is well understood that in the fluid steel poured into the mould there is a larger store of heat than is required for the purpose of rolling or hammering. Not only is there the mere apparent high temperature of fluid steel, but there is the store of latent heat in this fluid metal which is given out when solidification takes place. It has, no doubt, suggested itself to many that this heat of the ingot ought to be utilised, and, as a matter of fact, there have been, at various times and in different places, attempts made to do so; but hitherto all such attempts have proved failures, and a kind of settled conviction has been established in the steel trade that the theory could not possibly be carried out in practice. The difficulty arose from the fact that a steel ingot when newly stripped is far too hot in the interior for the purpose of rolling, and if it be kept long enough for the interior to become in a fit state, then the exterior gets far too cold to enable it to be rolled successfully. It has been attempted to overcome this difficulty by putting the hot ingots under shields or hoods, lined with non-heat-conducting material, and to bury them in non-heat-conducting material in a pulverised state, for the purpose of retaining and equalising the heat; but all these attempts have proved futile in practice, and the fact remains, that the universal practice in steelworks at the present day all over the world is to employ a heating furnace of some description requiring fuel.

The author introduced his new mode of treating ingots at the Darlington Steel and Iron Co's Works in Darlington early in June this year, and they are now blooming the whole of their make, about 125 tons a shift, or about 300 ingots every twelve hours, by such means. The machinery at Darlington is not adapted for rolling off in one heat; nevertheless they have rolled off direct from the ingot treated in the "soaking pits" a considerable number of double-head rails; and the experience so gained proves conclusively that with proper machinery there will be no difficulty in doing so regularly. The quality of the rails so rolled off has been everything that could be desired; and as many of the defects in rails originate in the heating furnace, the author ventures to predict that even in this respect the new process will stand the test. Many eminently practical men have witnessed the operation at Darlington, and they one and all have expressed their great surprise at the result, and at the simple and original means by which it is accomplished. The process is in course of adoption in several works, both in England and abroad, and the author hopes that by the time this paper is being read, there may be some who will from personal experience be able to testify to the practicability and economy of the process, which is carried out in the manner now to be described.

A number of upright pits (the number, say, of the ingots in a cast) are built in a mass of brickwork sunk in the ground below the level of the floor, such pits in cross-section being made slightly larger than that of the ingot, just enough to allow for any fins at the bottom, and somewhat deeper than the longest ingot likely to be used. In practice the cross-section of the pit is made about 3 inches larger than the large end of the ingot, and the top of the ingot may be anything from 6 inches to 18 inches below the top of the pit. These pits are commanded by an ingot crane, so placed in relation to the blooming mill that the crane also commands the live rollers of the mill. Each pit is covered with a separate lid at the floor level, and after having been well dried and brought to a red heat by the insertion of hot ingots, they are ready for operation. As soon as the ingots are stripped (and they should be stripped as early as practicable) they are transferred one by one, and placed separately by means of the crane into these previously heated pits (which the author calls "soaking pits"), and forthwith covered over with the lid, which practically excludes the air. In these pits, thus covered, the ingots are allowed to stand and soak; that is, the excessive molten heat of the interior, and any additional heat rendered sensible during complete solidification, but which was latent at the time of placing the ingots into the pit, becomes uniformly distributed, or nearly so, throughout the metallic mass. No, or comparatively little, heat being able to escape, as the ingot is surrounded by brick walls as hot as itself, it follows that the surface heat of the ingot is greatly increased; and after the space of from twenty to thirty minutes, according to circumstances, the ingot is lifted out of the pit apparently much hotter than it went in, and is now swung round to the rolls by means of a crane, in a perfect state of heat for rolling, with this additional advantage to the mill over an ingot heated in an ordinary furnace from a comparatively cold, that it is always certain to be at least as hot in the centre as it is on the surface.

Every ingot, when cast, contains within itself a considerably larger store of heat than is necessary for the rolling operation. Some of this heat is, of course, lost by passing into the mould, some is lost by radiation before the ingot enters into the soaking pit, and some is lost after it enters, by being conducted away by the brickwork; but in the ordinary course of working, when there is no undue loss of time in transferring the ingots, after allowing for this loss, there remains a surplus, which goes into the brickwork of the soaking pits, so that this surplus of heat from successive ingots tends continually to keep the pits at the intense heat of the ingot itself. Thus, if occasionally it happens that inadvertently an ingot is delayed so long on its way to the pit as to arrive there somewhat short of heat, its temperature will be raised by heat from the walls of the pit itself; the refractory mass wherein the pit is formed, in fact, acting as an accumulator of heat, giving and taking heat as is required to carry on the operation in a continuous and practical manner. During the soaking operation a quantity of gas exudes from the ingot and fills the pit, thus entirely excluding atmospheric air from entering; this is seen escaping round the lid, and when the lid is removed combustion takes place. It will be seen by analyses given hereafter that this gas is entirely composed of hydrogen, nitrogen, and carbonic oxide, so that the ingots soak in a perfectly non-oxidising medium. Hence loss of steel by oxidation does not take place, and consequently the great loss of yield which always occurs in the ordinary heating furnace is entirely obviated.

The author does not think it necessary to dilate upon the economical advantages of his process, as they are apparent to every practical man connected with the manufacture of steel. The operation of steelmaking on a large scale will by this process be very much simplified. It will help to dispense with a large number of men, some of them highly paid, directly and indirectly connected with the heating department; it will do away with costly heating furnaces and gas generators, and their costly maintenance; it will save all the coal used in heating; and what is perhaps of still more importance, it will save the loss in yield of steel; and there will be no more steel spoiled by overheating in the furnaces. The process has been in operation too short a time to give precise and reliable figures, but it is hoped that by the next meeting of the institute these will be forthcoming from various quarters.

At Darlington there is a set of eight soaking pits. These pits are built in a mass of brickwork on a concrete foundation; the ingots standing upright in the pits. The pits are lined with firebrick lumps, six inches thick, forming an independent lining which at any time can be readily renewed. A cast iron plate takes in four pits, and is dropped loosely within a large plate which surrounds the pits. The cover has a firebrick lining, and there is a false cover of firebrick, one inch smaller than the cross section of the pit, put in to rest on the top of the ingot. This false cover need not necessarily be used, but is useful to keep the extreme top of the ingot extra hot. The bottom of the pit is composed of broken brick and silver sand, forming a good hard bottom at any desired level. The author then described an arrangement consisting of two sets of soaking pits, eight each, placed under a 25-feet sweep crane. This crane, if a good one, could handle any ordinary make-up to 2000 tons per week, and ought to have hydraulic racking-out and swinging-round gear. This crane places the ingots into the pits, and, when they are ready, picks them out, and swings them round to the blooming mill. With such a crane, four men and a boy at the handles are able to pass the whole of that make through the pits. The author recommends two sets of pits as shown, although one set of eight pits is quite able to deal with any ordinary output from one Bessemer pit.

In case of an extraordinarily large output, the author recommends a second crane, for the purpose of placing the ingots in the pits only, the first crane being entirely used for picking the ingots out and swinging them round to the live rollers of the mill. The relative position of the cranes, soaking pits, and blooming mill may of course be variously arranged according to circumstances, and the soaking pits may be arranged in single or more rows, or concentrically with the crane at pleasure.

Mr. Stead, the well-known metallurgical chemist, of Middlesbrough, has investigated the heat phenomena and the composition of the gases in the soaking pits, and I have pleasure in giving his report as follows:—

I.—ON THE RELATIVE PROPORTION OF HEAT IN FLUID STEEL AND STEEL HEATED AT SUITABLE TEMPERATURE FOR ROLLING.

JOHN GJERS, Esq.

DEAR SIR,—At your request we have, with the assistance of your son, Mr. L. Gjers, made two comparative experiments at the Darlington Steelworks to ascertain what proportion of heat is contained in fluid steel over and above what is required for heating the ingots to the temperature suitable for rolling. In the first experiment the heat in the fluid steel was estimated. In the second, the ingot from the first experiment was heated in a mill furnace to the full bright heat necessary for ingots when rolling directly into rails, and this was treated in the same way as the fluid steel, excepting that the mould was not put into the calorimeter. The results, although perhaps not giving the actual heat units in the steel, yet may fairly be considered to give a relative idea of the proportion.

The calorimeter consisted of a cylindrical vessel of lined iron, capable of containing fifteen gallons of water, enclosed in a second vessel, in diameter about eight inches greater than the first, and about four inches deeper. The space between was packed with dry cotton waste. The interior vessel, closed at one end and open at the other, was provided with a tightly-fitting non-conducting pluck, consisting of a bag filled with dry cotton waste. At the bottom of this vessel were placed two firebricks to support the hot steel ingot. Water was then added, the quantity and temperature being most carefully recorded. This somewhat crude apparatus, containing water considerably below the atmospheric temperature, when allowed to stand for above two hours in the Bessemer shop, was not sensibly affected, the temperature of the water remaining stationary, and when at the end of an experiment (when the water had a temperature of 47 deg. C.) the vessel was allowed to stand for twenty minutes it only cooled down to 46 deg. C., a loss of 1 deg. C. The mould for securing the metal or steel was cubical in form, and was made in two halves, and these were secured in position by an iron ring. The cavity in the interior was a four-inch cube, and the thickness of the walls or sides two inches. A passage one inch in diameter communicated with the inside of the mould.

In order to prevent the fluid steel coming into contact with the exterior of the mould, a large, wide-mouthed funnel, lined with loam, was fixed into the opening at the top. When everything was ready, fluid steel from the Bessemer ladle was conducted from the funnel to the mould; and as soon as it was filled, the funnel was removed, a little sand thrown into the git, and the mould containing the steel plunged into the calorimeter, and there allowed to remain till the water ceased to increase in temperature. This required a period of twenty minutes. In order to expedite the cooling of the steel, the ring was slipped off the mould and the water allowed to come in contact with the steel ingot. After the maximum temperature was obtained, the water was allowed to stand for twenty minutes, to ascertain approximately the loss which must have occurred during the twenty minutes when the water was absorbing heat from the ingot mould and steel. The loss sustained by the heated water on standing, theoretically would be slighter than the original loss; but as it only amounted to 1 deg. C, I have not made any allowance for the difference in conditions.

The second experiment was made as before described, by heating the ingot from the first experiment, and cooling in the calorimeter. After making corrections for the heat remaining in the steel ingot, in the ingot mould, and in the bricks, it was found that for every 100 units in the heated steel there are 154 in fluid steel.

Heated Steel	100
Fluid Steel	154

It is necessary to state that the steel ingot was heated to as high a temperature as it was capable of bearing without being burnt.

II.—ON THE GASES EVOLVED FROM STEEL INGOTS WHEN INTRODUCED INTO THE GJERS HEAT ADJUSTING PITS.

JOHN GJERS, Esq.

DEAR SIR,—On July 11, 1882, samples of gas were drawn from your heat-adjusting pits at Darlington, and these were carefully analysed in our laboratory by Dr. Salvin Pattinson, with the following results, viz.:—

	No. 1. Per Cent. by Volume.	No. 2. Per Cent. by Volume.
Nitrogen	62·92	69·65
Hydrogen	25·16	18·62
Carbonic oxide	7·95	6·90
Carbonic acid	3·97	4·83
Oxygen	nil	nil
	100·00	100·00

It is impossible to tell exactly what proportion of the nitrogen present is due to the air originally present in the pits. It is clear, however, that a very large proportion must have been derived from that source. The carbonic acid in all probability has been produced by the combustion of carbonic oxide originally evolved from the steel, the oxygen having been supplied by the air in the chamber. By calculation we find that after deduction of this oxygen and accompanying nitrogen, the gases would have the following composition:—

	No. 1. Per Cent. by Volume.	No. 2. Per Cent. by Volume.
Nitrogen	59·91	66·63
Hydrogen	27·21	20·47
Carbonic oxide	12·89	12·90
	100·00	100·00

The proportion of hydrogen burnt by air leaving nitrogen it is impossible to calculate. There must, however, still be a very large amount. The following analysis represents the composition of the gas evolved from fluid steel, the sample having been taken from the top of a closed ingot mould when it was being filled with fluid steel from the bottom:

Hydrogen	8·25 per cent.
Carbonic oxide	12·5 "
Carbonic acid	nil "
Nitrogen	80 "
	100·0

It is possible that a small proportion of the hydrogen might have been derived from the moisture in the slightly

* Read at the Vienna Meeting of the Iron and Steel Institute, September 1882.

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NOTICES.

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THE UNITED STATES.

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damp runner bricks; but there can be no doubt that the bulk of it passed out of the steel. This analysis is introduced here as useful for comparison with the analysis of the gases evolved from the solid steel. The composition of the gases remaining in the pits after the removal of the ingots was as follows:—

Nitrogen	83·15 per cent.
Hydrogen	5·82 "
Carbonic oxide	0·85 "
Carbonic acid	3·39 "
Oxygen	6·79 "
	100·00

The presence of these highly reducing gases, carbonic oxide and hydrogen, surrounding the hot steel ingots, must have a very important influence in protecting them from oxidation, and is a very important feature in the improved process.—We are, dear sir, yours truly,

Pattinson and Stead.

Depreciation of Colliery Property.—The collieries belonging to the Dodworth and Silkstone Coal and Iron Company (Limited) were last week offered for sale, by auction, at the King's Head Hotel, Barnsley, in presence of a large and influential company of colliery proprietors and mineral owners. The sale was ordered by the Court of Chancery. When the biddings had reached £1600, the auctioneer announced there was no reserve, and when the biddings reached £2000 the collieries were knocked down for this sum to Mr. Robert Whitworth, of Manchester. The collieries were floated in 1873, with a nominal capital of £300,000, in six thousand shares of £50 each. Formerly they employed 2000 hands. There is still 1824 acres of coal to get. The depreciation has been described in some quarters as "extraordinary," but it will not appear so when it is remembered that £7000 has to be paid annually for minimum rents.

CORRESPONDENCE.

[*The Editor does not hold himself responsible for opinions expressed by correspondents.*]

WELDING STEEL.

To the Editor of Iron.

Sir,—Can any of your readers inform me through your columns what "stucco" for welding steel is composed of?—I am, &c.,

G. Bohanna.

16, Wood Street, Hulme, Manchester,
Sept. 26.

NOTICES OF BOOKS.

Science in Short Chapters. By W. Mattieu Williams, F.R.A.S., F.C.S. London: Chatto and Windus, 1882.

This is a book full of very pleasant and, on the whole, easy reading. The author has here collected some of his numerous contributions to various periodicals, with a view of supplying a growing want of these busy times, when so many of us are prevented by the struggles of business from sitting down to the consecutive systematic study of a formal treatise. He has, probably without thinking of it at the time he resolved to publish his essays in book form, also succeeded in producing a book which may be taken up at leisure by those familiar with the subjects upon which he writes, but who may now and then like to refresh their memory on certain points. The book will also serve to shorten long weary hours on beds of sickness, by furnishing light scientific reading to invalids strong enough to undergo intellectual exercise. Mr. Williams has selected subjects which are likely to be interesting to all readers who are sufficiently intelligent to prefer sober fact to sensational fiction, but who, at the same time, do not pretend to be scientific specialists. But the book is by no means "dry" reading. On the contrary, the author contrives to introduce humour into scientific subjects. The paragraph referring to the fishmonger and the electric eel must be read to be enjoyed. In his paper on "Science and Spiritualism," the author shows his power of wielding the pen by fearlessly and in indignant terms repelling an attack upon scientific men which was as undeserved as it was spiteful. Summing up, Mr. Williams proves once again that he is an able and versatile writer.

Illustrirtes Hand- und Hülfsbuch für den praktischen Metallarbeiter. By H. Schuberth. Parts 2 to 10. Vienna: A. Hartleben's Verlag, 1882.

It is not so very long ago since the first part of this work made its appearance; but since then nine more parts have followed in quick succession, so that we may soon hope to have the whole work complete before us. Without waiting, however, for the conclusion of this *Handbook for the Practical Metalworker*, we are able to say that it will form a perfect vade mecum for those engaged in the metal industries. It is, as we stated in our former notice, divided into six sections, dealing, successively, with (1) the chemistry of metals, their occurrence and winning of the same, metallic preparations, and instructions for qualitative analysis; (2) casting and the galvanoplastic art; (3) the various manipulations by which metals are worked; (4) the decoration of metal manufactures; (5) motors used in metal working; and (6) the auxiliary sciences: drawing, geometry, and mechanics. The above is an elaborate programme; but we are able to say that it is most conscientiously being carried out. The fourth division is nearly completed, and so far the publishers have fully performed what they promised. The coloured plates are handsome productions of the printer's art, and the woodcuts are also good. We have every reason to be satisfied with the way in which the work is brought before the public.

Our Factories, Workshops, and Warehouses, their Sanitary and Fire-resisting Arrangements. By B. H. Thwaite, Ass.M.I.C.E. London: E. and F. N. Spon, 1882.

The author deserves the hearty thanks of operatives for having courageously grappled with a state of things which is a slur upon our boasted progress and civilisation. Compared with similar establishments in the United States, for instance, although the Factory Acts have proved to some extent beneficial, yet the sanitary arrangements of the majority of our factories and workshops are—to speak with the author—"disgracefully defective." In justice to high-minded employers of labour, we should add that there are many who look after the wellbeing of those who work for them; but, unfortunately, they form at present a very small minority. The labour of most of our various branches of manufacture, if relieved from the insanitary accompaniments, would not be nearly so exhaustive. Accidents, moreover, are as numerous as ever, partly attributable to the absence of, or insufficient and defective, fencing, but partly also owing to the ignorance or carelessness of operatives. We may, however, expect that the Employers' Liability Act of 1881 will lead to improvement in this respect. The chapters of the work dealing with the prevention of accidents and the construction of workshops with a view to their resistance to fire are, we think, most valuable. Altogether, Mr. Thwaite's book is a good book, whose excellence will, we trust, ensure to it a large circle of readers.

Illustrirtes Baulexikon. By Baurath Dr. O. Mothes, Architect. Fourth edition. Parts 9 to 13. Leipzig and Berlin: Otto Spamer.

We drew attention on a former occasion (see Iron of August 12, 1881) to the merits of this work, and pointed out its chief features. There is consequently no need to repeat what we stated then. If a book passes through four editions within a comparatively short space of time, it is a sure sign that it has been accepted as a standard work of reference by those for whom it is intended, in this case, the architect and engineer. We may, however, be permitted to make one suggestion, and that is, that it would be advisable to hasten the publication of the work. The first part of the present edition was issued in 1880, and it is only after two years that the thirteenth part makes its appearance. At this rate of progress, as the whole work is to be published in sixty parts, it would take ten years to complete it.

Ingenieur-Kalender für Maschinen- und Hüttentechniker, 1883. Edited by P. Stuehlen. Essen: G. D. Baedeker.

This *Almanac for Mechanical and Mining Engineers*, of which the eighteenth annual issue is now before us, proves once more, if proof were needed, how the indefatigable editor is endeavouring to keep abreast of the progress of science. As in former years, the *Calendar* is both an almanac and a diary, and contains besides a condensed collection of the more important tables, formulas, and results relating to engineering. Amongst the novel features of this the latest issue of the *Almanac*, we may mention the newly revised standards for cast iron pipes fixed by the Union of German Engineers and the German Association of Gas and Hydraulic Engineers; a table of weights for boiler pieces; tables of caloric calculations, &c. We commend the *Almanac* to the attention of English engineers having relations with Germany. It is one of the best published there.

New Books.—Messrs. Macmillan's scientific publication for the coming season will include *A Text-book of Geology* by Professor Archibald Geikie; *The Chemistry of the Sun*, by Mr. J. Norman Lockyer; *A Treatise on Applied Mechanics* by Professor J. H. Cotterill; and new editions of Sir William Thomson's *Papers on Electrostatics and Magnetism*, and of Mr. Routh's *Dynamics of the System of Rigid Bodies*.

NEW BOOKS.

Arithmetical Chemistry: Arithmetical Exercises for Chemical Students. By C. J. Woodward. Simpkin and Co.

California for Health, Pleasure, and Profit. By C. Nordhoff. New Edition. Low and Co.

Complete Practical Machinist (The.) By Joshua Rose. Low and Co.

Geology. By A. H. Green. Part I., Physical Geology. Third Edition, enlarged. Rivington.

Guide to China Painting (A.) From the German of A. Klimke. J. Walker and Co.

Human Morphology. By H. A. Reeves. Vol. I. Smith, Elder and Co.

Metropolitan Building Acts (The): a Text-book for Architects, Builders, and Surveyors. By Banister Fletcher. Batsford.

Principles of Gothic Ecclesiastical Architecture (The). By M. H. Bloxam. Eleventh Edition. 3 vols. Bell and Sons.

BOOKS RECEIVED.

Geological Record for 1878 (The). By W. Whitaker, B.A., F.G.S., and W. H. Dalton, F.G.S. London: Taylor and Francis.

Malay Peninsula (The). By C. B. Dowden. London: Effingham Wilson.

Sanitary Engineer (The). Vol. 5. London: E. and F. N. Spon.

Science in Short Chapters. By W. Mattieu Williams, F.R.A.S., F.C.S. London: Chatto and Windus.

OBITUARY.

Agnew.—David Agnew, one of the pioneer ironmasters in Western Pennsylvania, died at his residence in Sharpsville, Mercer county, Pennsylvania, on Thursday, August 24, aged almost 77 years. He was born at Frankstown, Blair county, Pennsylvania, on September 25, 1805. When he was about 20 years old he accepted a clerkship under Dr. Peter Shoenberger at Maria Forges, in Blair county, and soon afterwards he followed the doctor's fortunes to Pittsburgh and afterwards to Wheeling. At the latter city he became a partner with the doctor in the erection of the first rolling mill in West Virginia. This was in 1832. In 1846 he removed to Sharon, and in connection with Dr. Shoenberger and others built the Sharon Furnace. Afterwards, in company with General Curtis, Mr. Boyce, and other citizens of Sharon, he assisted in organising the Sharon Iron Company, which built the rolling mill at Sharon, until recently known as the Westerman Iron Works (now Sharon Iron Works), and of this company Mr. Agnew was a director and manager. A year or two afterwards Mr. Agnew and his brother, John P. Agnew, became the owners of Sharpsville Furnace, near Sharon. Mr. Agnew's name, says the *Bulletin* of the American Iron and Steel Association (to which journal we are indebted for these particulars) is honourably identified with a most important chapter in the history of the manufacture of iron in this country. He and his brother were the first persons in the United States to use Lake Superior iron ore in the blast furnace. This they did at their Sharpsville Furnace in 1853. The particulars of this event will be found on page 1340 of the Census Report on Iron and Steel for 1880. Since 1869 Mr. Agnew has resided at Sharpsville, having the general supervision of the books and accounts connected with the various iron, coal, and other concerns in which the late General Pierce was interested, and acting also as secretary and treasurer of the Sharpsville Railroad Company. During the last years of his life Mr. Agnew was one of the valued correspondents of the American Iron and Steel Association, his long experience as an ironmaster, his unimpaired memory, his elegant penmanship, and his fine literary sense enabling him to render important service in the collection of local iron history. His letters on file in our (*Bulletin*) office, written when he was about 75 years old, are among the best specimens of penmanship in our possession.

Leclanché.—The death is announced, at the early age of 43 years, of a Frenchman, whose name is known wherever electricity is used—Georges Leclanché. He was the inventor of the well known Leclanché pile, whose use is probably

more widespread than that of any other form of electrical generator. He quitted the service of the Eastern (of France) Railway Company about 1867 to devote himself to his researches on the peroxide of manganese piles. His first patent for the porous vase elements is dated 1867; in 1875 new patents were taken for his cylindrical agglomerated plates; in 1876-8 he perfected his new elements of movable agglomerated plates, at present those most generally in use. If the number of Leclanché's inventions has been small, their success has been as complete as could be wished. The inventor realized a large fortune, and the manufacture of the Leclanché cell is in itself an important Paris industry; on an average 2000 agglomerated plates are manufactured daily.

THE RATIONALE OF PRACTICAL METALLURGY.

No. VIII.

THE subject of the present paper, viz., the Rationale of Fluxing, brings us face to face with a wide-spread popular fallacy that has remained undisturbed and unrefuted (so far as we know) by any our teachers of modern science. Workmen generally believe that by adding what is called a flux to a melted or melting metal, the metal is made to melt at a lower temperature, or that being melted the flux renders the metal more fluid.

If this were really the case it would be a very remarkable fact, well worthy of scientific investigation. It would disturb all our tables of fusing points and the prevailing scientific doctrines of the relations between the solid and liquid states of matter.

Let us first consider the familiar cases of soldering fluxes. For soft soldering we may use rosin or ammonium chloride (sal ammoniac) or hydrochloric acid (spirits of salt). What happens in such cases? The tinman, for example, places a stick of solder an alloy of tin and lead, on his work and applies the soldering-iron. If no flux is used, the solder melted off from the stick forms a little ball, which stands sluggishly on the tinplate and is ineffectual. If, on the other hand, a little powdered rosin is there when the soldering-iron is applied, the melted solder "runs," spreads itself with decided fluidity over the surface to which the rosin has been applied. The solder flows and hence the rosin is fairly regarded as a flux.

Take another case. Two pieces of brass, fitted or pressed together with considerable surfaces of contact, are to be united by soldering. If these are placed in the fire bound together and heated to no matter what temperature, and a piece of soft solder be applied at the boundaries of the surfaces in contact no solder will run between these surfaces. If, however, a solution of sal ammoniac, or hydrochloric acid, or chloride of zinc be dropped or brushed against the edges of the joints just when the metal is at about the heat of boiling water, and this liquid be thus made to run into the joints, a great difference is made. The workman now has only to carefully heat the metal to a certain temperature (presently to be defined) when he finds that on application of the stick of solder it not only melts, but spreads or runs rapidly over the surface that was moistened by the flux; and if the operation is skilfully performed it insinuates itself with the fluidity of water between the joints, however close-fitting they may be. The fluidity thus imparted is even more decided than in the first case.

Hard soldering, whether silver soldering or brazing, is performed in a similar manner, excepting that the silver or the "spelter" (a fusible brass) is applied in granules mixed with the flux in a state of powder, the flux in these cases being borax.

The writer has had considerable experience in both hard and soft soldering of brass work, and after some reflection has framed the following theory:—

He is quite satisfied that these fluxes have no effect on the melting point of the solder, nor even any direct effect on its fluidity when melted, and believes that their whole efficiency depends on their power of presenting to the melted solder a pure metallic surface, to which it can adhere or in fact alloy itself more or less completely. We know that melted tin or lead or zinc will this adhere and alloy themselves to clean surfaces of other metals, just as mercury will amalgamate with certain metals. If a piece of dirty brass or copper be dipped into a bath of tin or lead, or the solder alloy of these, it will come out unaltered; but if it be very carefully cleaned it will be "tinned" all over by them. The tinning and galvanising of iron plates further illustrates this.

How, then, do the above named fluxes act?

Let us consider the rosin first. This is a hydrocarbon, a powerful reducing agent, and which, when heated, combines with the oxygen of such metallic oxides as those of tin, and thus effects a reduction of the pure metal on the surface to which it is applied. Thus the tinman deoxidises his tinplate surface and then his solder amalgamates or alloys itself freely with and runs over or "wets" it. We take the liberty of using this term "wets" on account of its analogy with the familiar action of water which adheres to some surfaces or wets them, but runs off of others, such as greasy or dusty surfaces. This difference corresponds to the action of the solder with and without the flux.

But what is the action of the ammonium chloride? Careful observation enables us to answer this question. After applying the solution, the water dissolving the salt boils off, and there is left behind a white coating of the salt itself. Then we go on applying more heat, and if we are skilful, we watch this white frost, and when we see it begin to dissipate by volatilising in white fumes, we apply the solder before the last of it has gone. Then the solder runs, but if we had applied it sooner or later, we should have failed.

In this case we believe that the ammoniacal salt dissolves the thin film of oxide, forms a compound which, like all the other compounds of ammonia is volatile at a certain temperature. Now in this case the temperature of volatilisation of the flux corresponds to the melting point of the solder, and hence their adaptation to each other.

As our practical readers know—especially the old hands—the use of sal ammoniac is now rather old-fashioned, having been nearly superseded by solutions of zinc in hydrochloric acid, or of the acid itself.

The action of these is the same as above described, but more decided and more easily demonstrable, just as they are more efficacious. The hydrochloric acid dissolves the oxide, and the chloride thus formed is a volatile salt, especially the chloride of zinc.

In our apprentice days, when we received our first lesson in soldering together the segments of a "staff head" before turning it in the lathe, we were told to watch the brass until it became "beefy," and then apply the solder. What was this beefyness? We have tested this question experimentally, and find that it is due to a removal of a superficial film of zinc from the brass, thus exposing a red or coppery surface, to which the term "beefy" may be fairly applied when it is hot and free from oxide. The zinc in the brass oxidises more readily than the copper, the zinc oxide is more readily soluble in hydrochloric acid or chlorides, and zinc oxide and its salts are more volatile than those of copper. Hence the preferential removal of the zinc and exposure of the beefy copper.

The same beefyness is displayed in hard soldering, and may be seen even after the soldering is completed and the work has cooled if some portion of the brass surface that was denuded by the flux was not covered by the brass solder. Brass tubes frequently show this.

But why is borax used rather than the chlorides, and how does it act? To answer this question we must consider the chemical properties of borax. It is a compound of boracic acid and soda, nearly resembling water glass, which is a compound of silicic acid and soda. Both of these, when heated with metallic oxides, form glassy compounds. Blowpipe analysis largely consists of fusing metallic oxides with borax or boracic acid, thus obtaining a glass bead in which the oxide is dissolved, the colour and other appearances of such bead indicating the presence of the particular oxide. When powdered borax is laid over the metal to be soldered, and the metal is heated, the borax fuses, forms a glassy film upon the surface of the metal, which film takes up all the oxide and combines with it, forming a glassy borate of the metal. But this is not sufficient; for if that glassy film remained, it would be as bad as the oxide in preventing the adhesion or amalgamation of the solder. Here then comes to our aid another property of the borates, viz., their volatility at high temperatures. The borax, with the oxide it has taken up, flies off at a bright red heat, just at the temperature at which the granules of silver or the spelter brass melt. Thus they fuse upon a virgin surface of clean metal and unite with it.

We have thus gone a little aside from our direct subject, on account of the confusion that the use of this term "flux" may induce. Borax is also used as a flux in metallurgical operations where a metal, such as gold, mixed with impurities is melted. These impurities are taken up by the borax, made into a fusible glass, and thus fluxed or melted away. It is not the gold which is made more fluid, but the oxides of the baser metals that have to be removed.

The fluxing in the blast-furnace is similar to this. Its action is not the liquefaction of the iron itself, but the gathering together of the impurities of the ore, converting them into a glass that shall fuse and run down with the melted metal, for we must always remember that the fundamental problem of the modern blast-furnace is that everything pitched into its throat must come out either as a gas or as a liquid. The retention or formation of any infusible solid would choke or "gob" the furnace and put an end to its profitable operation.

Silicic and boracic acid are the two chief glass making agents, the boracic glasses fusing at lower temperatures than the corresponding silicic glasses, and also being more volatile. But we may now dismiss these, and confine our attention to the silicates, and they do the fluxing in the blast-furnace.

This statement may appear paradoxical for the moment, seeing that not silica, but lime is the so-called flux of the blast-furnace charge. This is easily explained by reference to the analyses of the clay ironstone ores already given. They all contain silica, in some cases partly free as sandy matter, or combined with alumina, or combined with the iron itself.

Silicate of alumina alone is objectionable, on account of its high fusing point. Silicate of iron fuses readily enough, but is a thief, as it carries away as useless glass the material we are seeking to obtain as reguline metal. We therefore require to add something that is more powerfully basic than the iron or its oxides, which will therefore combine more readily with the silica, and this should form a glass that is readily fusible and which will somehow separate itself from the melted iron. Cheapness is another primary desideratum.

All of these desiderata are united in lime. It is a powerful base, it is very abundant and cheap; its glass is much more fusible than iron, and is also so much lighter that it floats freely on the the top of the melted iron, and thus may be run off through an overflow-conduit or tap-hole. Lime, therefore, is used, but it must not be used at random for the following reasons.

If the supply of lime is not sufficient to combine with the silica, this will unite with the oxide of iron and form a wasteful iron glass, or its silicon will remain excessively in combination with the iron itself. If, on the the other hand, the lime is in excess, we may get into trouble, due to the fact that uncombined lime is a most refractory substance, practically infusible, as proved by its use in the lime light where a mixture of oxygen and hydrogen gases in vivid combustion strikes against a cylinder of lime, making it so intensely white-hot that the light it emits is the most brilliant obtainable. This oxyhydrogen is hotter than any furnace yet constructed.

This explanation of the rationale of fluxing in the blast-furnace also explains the composition of the cinder (so often misnamed "slag," as we shall explain hereafter), which carries away everything excepting the pig-iron and the gases. It is mainly a lime glass, and being a glass, a multitude of schemes have been devised and patented for using it as a material for bottles and for other purposes to which glass is applied. The inventors have not sufficiently considered the fact that lime glass is much more friable than lead glass, or soda glass, or potash glass, or the mixtures of these that form the material for our windows, bottles, &c.

The problem of utilising this mixture of silicates in which silicate of lime variably preponderates is not yet solved, on a scale commensurate with the supply of the material. It still remains a worse than worthless waste product, as its disposal is costly, partly on account of its bulk and weight in carriage, and partly on account of the ground it covers and renders useless. Of all the waste products of British manufactures this one is about the most unmanageable.

THE WORK OF DAVID KIRKALDY.

THE writer had the opportunity recently of spending a couple of hours in the testing and experimenting works of David Kirkaldy, No. 99, Southwark Street, London, the whole of the time in the company of the eminent experimenter himself, who took great pains in showing his machinery for testing, the museum of pieces tested since the works were established, and a fire-proof safe full of written books of record. Visitors to the Philadelphia exhibition in 1876 will recollect the fine display of steel made at the Fagersta Works, Sweden, including some hundreds of broken test pieces, the work of Mr. Kirkaldy, and his book entitled "An Experimental Inquiry into the Properties of Fagersta Steel," copies of which were given to many visiting engineers. The specimens and the book are fair samples of the character of the work, upon which Mr. Kirkaldy has spent the whole of his time since 1858, although the world is not aware, as it should be, either of the character or of the extent of that work, chiefly for the reason that Mr. Kirkaldy has not been a book maker. He seems to have avoided printer's ink as far as it was possible for him to do so, has even resigned his membership in one if not more of the English engineering societies, which act would of course tend to keep his name out of the sight and thought of the busy world. The real record of his work, therefore, is only to be seen in the extensive museum of tested specimens, including iron, steel, wood, stone, brick, rubber, leather, telegraph cables, bronzes, copper, and other metals and substances, and in his numerous books of record which have never yet been exposed to the public eye. One published book, however, which remains, after having been in existence nearly twenty years, a standard work of the engineer's library, Mr. Kirkaldy has given to the world. It is entitled "The Results of an Experimental Inquiry into the Tensile Strength and other Properties of various kinds of Iron and Steel, by David Kirkaldy, 1862." For this work the Institution of Engineers in Scotland awarded him a gold medal, and he is still so proud of that book as to write, a few months since, concerning it, "No one has yet pointed out a wrong conclusion, a false statement, a wrong figure, nay more, a misplaced decimal."

Mr. Kirkaldy's first work in testing metals was done for the eminent firm of shipbuilders, Messrs. Robert Napier and Sons, of Glasgow, in 1858. For several years previous to that time he had been in the employ of that firm. As early as 1851 he had completed a series of coloured drawings of the Cunard steamships *Europa*, *America*, *Niagara*, and *Canada*, for which the Paris exhibition of 1855, awarded to Mr. Robert Napier, as exhibitor, the gold medal, with the decoration of the Legion of Honour, to Mr. Kirkaldy a medal as draughtsman. After eight years spent in testing, during which the *Experimental Inquiry on Wrought Iron* was published, Mr. Kirkaldy completed his large testing machine of a million pounds capacity, which is still the chief feature in his testing works in London. In building this machine, as he told the writer, he deliberately disregarded the advice of all his friends, and spent his last shilling upon it. The machine is strangely like Mr. Kirkaldy himself in some of its features. It is a wonderfully fine and accurate, as well as strong piece of mechanism; like him it is very sensitive, and like him at the time it was built it was at least fifteen years in advance of the times. It has taken Mr. Kirkaldy and his machine fifteen years of hard labour to educate the world up to believe in their own great usefulness; and the machine's usefulness, as well as Mr. Kirkaldy's, will likely be better appreciated after Mr. Kirkaldy is resting in his honoured grave than they have been hitherto. Mr. Kirkaldy's strong constitution, however, like that of his machine, gives promise of yet many years' active service. The machine is in some respects similar to the eight hundred thousand pound machine belonging to the United States Government at Watertown Arsenal, which was finished about three years ago. Its pressure or pulling stress is applied by a large hydraulic cylinder, fed by three hydraulic pumps, driven by a steam-engine. It, of course, does not have Mr. A. H. Emery's new system of weighing stress, which is in use only on the Watertown machine, but does its weighing by a system of knife edge levers. It is strange that after Mr. Kirkaldy's knife edge machine had done such accurate work as early as 1866, the system of weighing stress by hydraulic gauge should still be persisted in by some testing machine makers.

In the numerous recent discussions in the American engineering societies concerning the re-establishment of the United States Testing Board, considerable stress has been laid upon the worthlessness of tests of small test pieces as a measure of the strength of large sections such as are practically used in construction, and it has been insisted that tests should be made on full-sized specimens, such as bridge beams, columns, and tension members, before we can have satisfactory data for the proper proportioning of bridges and like structures. For sixteen years Mr. Kirkaldy's testing machine has been engaged upon just such full-sized specimens. Columns twenty feet and more in length, riveted plates twenty-four inches wide, full-sized beams for traverse stress of various depths, whole sections of suspension and telegraph cables, leather and other belts, cubes of stone and brick in compression, the heaviest kind of chain cables, and numerous other heavy and full-sized specimens are to be seen in his museum. But, as has been truthfully said of the tests of large-sized specimens at the Watertown Arsenal during the last three years, they are almost worthless to the public, since they were made for private parties and the results are not published. So of the tests of Mr. Kirkaldy, both large and small, many are not published, because they were made for private individuals, and their publication would not be authorised; others, the publication of the records of which could harm no "vested interest," are hidden away in Mr. Kirkaldy's fireproof safe. The reason they are not published is probably merely Mr.

Kirkaldy's aversion to that kind of publicity which a person can secure by "blowing his own horn" in printer's ink. It is a great pity, however, that these records are not published. They would be of immense value to the engineering profession the world over, and if published they might render unnecessary a great deal of the projected work of the proposed new Testing Board and other "Research Committees." It is to be hoped that Mr. Kirkaldy will yet overcome his peculiar aversion, and, as the crowning act of his life, give to the world the record of his labours. If he would do this, his posthumous fame as an experimenter would eclipse that of Smeaton, Hodgkinson, or Fairbairn.

Anyone who visits Mr. Kirkaldy in his works cannot fail to be impressed with the intense individuality of the man. He is the personification of many of the best traits of the old-style Scotchman. Chief of these traits are the rugged and uncompromising honesty, the "bristling" qualities of the Scotch Thistle, and a religious adherence to Scotia's famous motto, "*Nemo me impune lacessit.*" These qualities have all strongly cropped out on a recent occasion, about two years ago, when Mr. Kirkaldy, in violation of his usual custom, "rushed into print." The Institution of Mechanical Engineers, from which society Mr. Kirkaldy resigned in 1870, appointed a committee to report on the subject of riveted joints. Mr. Kirkaldy has made more experiments on rivetted joints than any other man living, but the committee never went near him nor his museum, made their report without consulting him, but in it they used some of his experiments, which they seem to have garbled badly. The Scotch Thistle, if rashly, but slightly touched, while it is rapidly passed by, is apt to give a severe sting; and so the committee passing by Mr. Kirkaldy, but withal touching him in his most sensitive point, his testing work, have received two severe stings from him in the shape of two open letters. The first of these was to the Members of the Research Committees of the Institution of Mechanical Engineers, dated January 28, 1880, and the second to the President, Members, and Council of the Institution of Mechanical Engineers, dated April 8, 1880. In both of these letters Mr. Kirkaldy shows his ability as a writer of the most vigorous English. Occasionally they bristle with such epithets as "wilful and deliberate falsehood," and sometimes he leaves the reader's imagination to supply adjectives, as in the sentence, "I demand fair play at the hands of Dr. Siemens and every member of the committees and now call for their verdict on their * reporters * proceedings;" and a footnote says he leaves the spaces marked by the asterisks blank, "so that all may have an opportunity of filling in whatever words they consider most suitable." His first letter was answered privately by Dr. Siemens to the effect that he was certain "that in writing the report there has not been any intention of doing an injustice either to you or to any one else." Mr. Kirkaldy, however, was not satisfied with this answer, considering that the committee had done him a great and wilful injustice, and he throws his second letter at them, covering twelve large printed pages, and full of figures, to substantiate his claim that the committee not only garbled his figures, but that their whole report is worthless. His chief argument against their report may be given in the following extract from his first letter:—

"Is there an engineer, shipbuilder, or boilermaker in the world, 1880, who would not greatly prefer to rely on results which have been obtained on grand scale as incontestably demonstrated by the contents in the Museum of Fractures, namely, on specimens from 9 to 24 inches wide (standard width being 12 inches) from plates 1-16 to 1⅛-inch thick (and still thicker when required), having from six to thirty rivets in each, all tested under exactly the same conditions in one gigantic and very costly patent testing machine, designed and made expressly for the purpose of carrying out scientific experiments, by a person out of his own private means, and entirely at his own risk, who never sought for any grant from the government, exhibition fund, city trusts, or from any of the institutions or societies, or from any individual, either public or private; who can only hope for support in his most anxious undertakings, by giving continued proof of his care and exactness in all committed to his trust, and who holds himself responsible for the truthfulness of his reports; or to little bits of specimens riveted together, sometimes with only a single rivet, pulled asunder in all sorts of ways, by all sorts of appliances, by all persons, and for all sorts of purposes?"

The above in perhaps all that need be said on the question of riveted joints, but the letters contain much information which is not generally known concerning Mr. Kirkaldy's work in testing that a few more extracts may be given. It may be surprising to know that dishonesty characterised a great deal of the testing of metals before Mr. Kirkaldy's works were established, but here are his own words for it, and for his own honest work:—

"Is it not a notorious fact that sham experiments have been 'got up' with the very object of deception and fraud, in some cases for trade purposes, and in others to deceive judges and juries? I gave convincing proof at the very first public experiments made by me in London, namely, on the 23rd of February, 1866, that I should not allow my testing machine to be desecrated, and when some of my would-be friends said that I 'was foolish to quarrel with my bread and butter.' It just so happened that amongst the fifty-five professional gentlemen, whose autographs in my visitors' book attest their presence on that, to me, memorable day, were two from the War Office, who came to watch my actions and to report. As work commenced to flow in immediately from that department, and continued to do so for years, their report must have been satisfactory. One day, long afterwards, when both of them were at my works to witness some experiments, one of them asked me, Do you know how the War Office came to send you work so very soon after starting? I replied, No; and that it had been a mystery to me, when they both smiled. He then said, Do you remember that day when you were testing some patent girders? when after an announcement of their marvellous property to stand such a high strain and 'the set a mere nothing,' that you indignantly sang out the actual amount of strain and the actual set, we looked at each other, and agreed 'Come, come, no humbug here.' A civil engineer was also present who has ever since been a true friend, and who has never deserted me, although many underhand attempts have been made by honourable men to induce him to do so, who has come and who has brought others, at all hours, to see what was going on. This gentleman's, together with some others, uninterrupted support for fourteen years, has enabled me to pursue investigations regarding the mechanical properties of all the materials employed in the constructive arts."

One remarkable peculiarity of Mr. Kirkaldy's experimental work, in which it differs from that of most other experimenters, is that it is all done by himself, and is not done by deputy, whether employé, clerk, or student. All his original note-books, used at the testing machine, now over 130 in number, are carefully indexed and preserved in his fireproof safe, together with over 8000 double quarto pages of copies of reports. As a sample of the thoroughness with which all his work is done, the following, concerning the work on riveted joints, is conclusive:—

"The total number up to the present time is 368 joints, of these, 269 the plates fractured at the rivet holes, and 99 the rivets sheared. In addition to and in connection with these I ascertained the respective effects of differences due to the mode of making the rivet holes, namely by drilling, punching, punching and annealing, punching and rimering, a series of 284. In ascertaining the effects due to differences in the distances from edge of plate to centre of rivet holes, both for single and double rows, 34 specimens. In ascertaining the strength of the plates, the contraction of area at fracture, the extension and appearance of the fracture, 1445 specimens. In ascertaining the tensile strength and quality of the rivets, 193; and that of rivet bars, 168. Total number of experiments connected with these riveted joints being thus 2492."

Yet, after all this amount of experimenting, what does the engineering profession at large know about riveted joints to-day? The published report on the subject by the Committee of Research of the Institution of Mechanical Engineers, Mr. Kirkaldy tells us, is worthless, and Mr. Kirkaldy, who has the best facilities in the world for writing a complete report upon it, has not yet done so. We anxiously await his opinion on the whole subject of riveted joints. It will be of much more importance to engineers than his opinion on the committee or on their report. We must admit that Mr. Kirkaldy has had full provocation for writing these pathetic words:—

"All must remember that it cannot be otherwise than of vital importance to myself, my beloved son and daughter, that the reputation for scrupulous care, exactness, and truthfulness, in all that I have undertaken during a period of upwards of thirty-five years—slowly and steadily acquired—should not by ignorance, deceit, and falsehood, be ruthlessly destroyed, and that towards the close of an anxious and busy life."

But the very best protection an experimenter has against ignorance, deceit, and falsehood, is the prompt, full, and clear publication of the facts which he has discovered. Let us hope that Mr. Kirkaldy, for the sake of his reputation, for the gratification of his posterity, and for the benefit of the world at large, will yet publish a book giving to the world the results of his labours.—W. K., in the *American Engineer*.

SCIENCE AND ART.

South Kensington Museum.—Visitors during the week ending September 30, 1882:—On Monday, Tuesday and Saturday (free), from 10 a.m to 10 p.m., Museum, 11,140; Mercantile Marine, Building Materials, and other Collections, 5247. On Wednesday, Thursday, and Friday (admission 6d.), from 10 a.m. to 5 p.m., Museum, 1608; Mercantile Marine, Building Materials, and other Collections, 428; total, 18,423. Average of corresponding week in former years, 18,552. Total from the opening of the Museum, 21,374,318.

Birkbeck Literary and Scientific Institution.—The prospectus for the sixtieth session of the parent institution in Southampton Buildings, Chancery Lane, has been issued. Evening classes will be held for both sexes in all the different departments of education, and lectures will be delivered on various branches of art, science, and literature. The annual distribution of prizes will be held under the presidency of the Right Hon. W. H. Smith. On that occasion five Whitworth Scholarships will be handed to students of the institution, who have succeeded in obtaining so large a number of these distinctions. As it has become imperative to provide fitting accommodation for the 3500 students attending the institution, it is intended shortly to lay the foundation-stone of the new building to be erected in Bream's Buildings, Chancery Lane. The sum of £10,000 is still required in order that the new premises may be opened free of debt. Those willing to aid the work inaugurated by the late Dr. Birkbeck are asked to contribute. The bankers are Messrs. Smith, Payne, and Smiths, Lombard Street.

Manchester Geological Society.—The annual meeting of the members of the above society was held on Tuesday, in the rooms of the Literary and Philosophical Society, Manchester, and there was a fairly good attendance. Mr. G. C. Greenwell occupied the chair, and Mr. J. S. Martin (hon. sec.) read the annual report of the Council, which congratulated the society on the satisfactory position it now held, and on the excellent work done during the past session. The two meetings, which according to arrangements had been held during the past session at Wigan, proved so successful that the council in their report proposed that during the forthcoming session the number of meetings to be held in Wigan should be increased to three, and this arrangement will no doubt be hailed with satisfaction by the large number of mining engineers in the West Lancashire district who are members of the society. Passing on to the progress made by the society, the report showed very satisfactory results. During the past year the number of members had continued to increase. Thirty-seven new members had been elected, and seven had been lost by removal or death, amongst whom special reference was made to the late Mr. E. Binney, who had for so many years been prominently identified with the society. There were now 224 members, which showed a net gain of 30, and the financial position of the society was in an equally healthy condition. The report, which also briefly reviewed the work done during the session, which has from time to time been dealt with in these columns, was with the balance sheet, on the motion of Mr. Wm. Bryham, seconded by Mr. J. S. Burrows, unanimously adopted, and the officers for the ensuing year were elected as follows:—President, Mr. J. Aitken; vice-presidents, Messrs. Wm. Bryham, W. B. Hulton, Ed. Pilkington and Mark Stirrup; treasurer, Mr. H. M. Ormerod; and secretaries, Messrs. J. E. Forbes and J. S. Martin. A vote of thanks to the retiring officers then brought the proceedings to a close.

MEETINGS FOR THE WEEK.

MONDAY, Oct. 9

Photographic Society.—Exhibition opens.
Aristotelian Society.—7.30 p.m.
Royal Academy.—8 p.m. Professor Marshall, on Anatomy.

TUESDAY, Oct. 10.

Oxford Michaelmas Term Begins.
Horticultural Society.—3 p.m.
Gresham Lectures.—6 p.m. Mr. J. E. Nixon Rhetoric. (Four days).

WEDNESDAY, Oct. 11.

Amateur Mechanical Society.—6 p.m.
International Dairy Show.—Dublin.

THURSDAY, Oct. 12.

Metropolitan Drawing Classes, Guildhall.—Distribution of Prizes by the Baroness Burdett-Coutts, evening.

FRIDAY, Oct. 13.

New Shakespeare Society.—8 p.m. Mr. Peter Bayne, on the Supremacy of Shakespeare.
Royal Academy.—8 p.m. Professor Marshall, on Anatomy.

SATURDAY, Oct. 14.

Zoological Society.—4 p.m.

NAVAL ARCHITECTURE.

LAUNCHES.

English.

Brankelow.—On September 28, Messrs. M. Pearse and Co. launched from their yard at Stockton this iron screw-steamer, of the following dimensions:—Length between perpendiculars, 300 feet; extreme breadth, 38 feet; depth, 25 feet 9 inches. She is about 2500 tons gross register, and of a deadweight carrying capacity of 3550 tons. Her engines are of 200 horse-power nominal, by Messrs. Blair and Co., Limited.

Draco.—On September 26, Earle's Shipbuilding and Engineering Company, Limited, launched from their yard at Hull this steel steamship, built for Messrs. Thomas Wilson, Sons, and Co., of Hull. The steamer is intended for Messrs. Wilsons' Baltic and Mediterranean service. Her dimensions are:—270 feet between perpendiculars, 34 feet beam, and 18 feet 3 inches depth of hold. Her gross tonnage will be about 1800 tons, and her deadweight carrying capacity 2350 tons. The engines, which have been made by Earle's Company, are 140 nominal horse-power.

Ilala.—On September 27, this iron ship was launched from the yard of the Whitehaven Shipbuilding Company. The measurements of the vessel are:—Length over all, 247 feet; length between perpendiculars, 225 feet; length at head-lines, 224 feet 3 inches; extreme breadth, 37 feet 5½ inches; breadth, moulded, 37 feet 3 inches; depth, moulded, 23 feet 4½ inches; depth of hold to floor plate, 21 feet 8½ inches. Her gross tonnage is 1330 tons. She has been built for Messrs. Lowden, Edgar and Co., Liverpool.

Ingram.—On September 29, Messrs. E. Withy and Co. launched from Middleton Shipyard, West Hartlepool, this iron screw steamer, built to the order of Mr. George Steel, o West Hartlepool, for Messrs. Steel, Young, and Co., of London. Her principal dimensions are:—Length between perpendiculars 257 feet 6 inches; beam (extreme), 34 feet 6 inches; depth, moulded, 20 feet 4½ inches; and her deadweight carrying capacity will be about 2350 tons. Engines of 150 nominal horse-power will be fitted by Messrs. J. Richardson and Sons, of Hartlepool.

Louise.—On September 28, there was launched from the yard of Messrs. Raylton, Dixon and Co., Middlesbrough, this vessel, built to the order of Messrs. Burdick and Cook, of London, of the following dimensions:—Length over all, 270 feet; breadth, 35 feet; depth of hold, 17 feet 6 inches; and is intended to carry about 2000 tons on a draught of 16 feet 6 inches. Her engines, which are 150 horse-power, will be fitted by Messrs. Blair and Co., of Stockton.

Malta.—On September 27, this screw steamer, built to the order of Mr. William D. C. Balls, Tynemouth, was launched from Messrs. John Readhead and Co.'s yard, South Shields. Her dimensions are:—Length, 250 feet; breadth, 36 feet; depth, 17½ feet. The steamer will be fitted by the builders with engines of 145 horse-power nominal.

Rennie.—On September 28, there was launched from the yard of the Tyne Iron Shipbuilding Company, Willington Quay, this screw-steamer, built to order of J. Wait and partners, of Newcastle and North Shields. The dimensions of the vessel are as follows:—Length, 250 feet; breadth, 35 feet; and depth of hold from top of floors to deck, 16 feet. The deadweight carrying capacity of the vessel is about 1850 tons. The engines are of 150-horse power, and have been built by the Wallsend Slipway Company, under the inspection of Mr. Baird. The cylinders are 40 inches and 58 inches, and the stroke 36 inches. The boilers are of steel, with a pressure of 90 lb. to the square inch.

Thomas Allen.—On September 29, Messrs. Bartram, Haswell and Co. launched from their yard at Sunderland this iron screw steamer, for Mr. John Allen, of London. Her dimensions are:—Length, 358 feet; breadth, 36 feet; depth of hold, 18 feet 6 inches, with a carrying capacity of 2200 tons. The engines, of 160 nominal horse-power, will be supplied by Mr. John Dickinson.

Scotch.

An Ding.—On September 29, this twin-screw patent hopper dredger, built and engined by Messrs. W. Simons and Co., was launched complete from their works at Renfrew. The vessel is the property of the Chinese Government. She will dredge from 2 to 30 feet depth of water,

and also carry 600 tons of its own spoil at a speed of seven miles an hour.

Craigton.—On September 29, Messrs. Ramage and Ferguson launched, from their shipbuilding yard at Leith, this iron screw-steamer for the Glasgow Steamship Company. Her principal dimensions are:—Length, keel and fore rake, 275 feet; breadth, moulded, 37 feet; and depth, moulded, 23 feet 6 inches; gross tonnage, about 2100 tons; dead-weight capacity, 2800 tons. The machinery, of 200 horse-power nominal, which will be supplied by Messrs. Blaikie Brothers, Aberdeen, will have cylinders 32 inches and 64 inches by 42 inches stroke, and steam will be supplied by two boilers.

Dilsberg.—On September 30, Messrs. Murdoch and Murray launched from their yard at Port Glasgow this screw-steamer of about 1560 tons. She has been built of the Steel Company of Scotland's steel, for Messrs. Raeburn and Verel, Glasgow, for the Eastern trade, and will be fitted with compound engines of about 170 horse-power nominal by Messrs. Kincaid, Donald, and Co., Greenock.

Hye Leong.—On September 29, this iron screw-steamer, of about 550 tons, was launched by Messrs. Blackwood and and Gordon, Port Glasgow. Her builders will fit her with compound surface-condensing engines of 110 horse-power nominal.

Kiang-Yu.—On September 28, there was launched from Pointhouse Shipyard, Partick, by Messrs. A. and J. Inglis, this paddle-steamer for the China river trade.

Loire Inferieure.—On September 27, this steamer was launched from the shipbuilding yard of Messrs. Pearce Brothers, of Dundee. Her dimensions are as follows:—Length, 200 feet; breadth, 29 feet; depth of hold, 13 feet 9 inches; engines, 90 horse-power, 990 tons gross. She has been built to the order of the Compagnie de Nantes.

Shap Fell.—On September 27, the Campbeltown Shipbuilding Company launched from their yard at Trench Point this steamer, of about 500 tons burthen, her dimensions being 155 feet by 24 feet by 11 feet. The vessel is built to the order of Messrs. Hume, Smith, and Co., of Liverpool, and is the sixth steamer of their Fell Line. She is to be fitted with a pair of compound surface-condensing engines of 70 horse-power by Messrs. Dunsmuir and Jackson, Govan Engine Works, Glasgow.

Tarawera.—On September 30, there was launched from the yard of Messrs. Denny and Brothers, this steel screw-steamer, of 1950 tons burthen, built to the order of the Union Steamship Company of New Zealand. The vessel is of the following dimensions:—Length, 285 feet; breadth, 36 feet; depth, 25 feet. She will be fitted with a pair of compound direct acting engines, inverted cylinders; nominal horse-power, about 2000.

TRIAL TRIPS.

Audacious—The final trial trip of this ironclad took place on September 28, prior to the vessel proceeding to her destination—the China station. Full speed was obtained at eight o'clock precisely, and a course was shaped which took the vessel down Channel abreast of Falmouth, returning towards the Eddystone and Prawle Point. At starting the ship did not do so well as on her former trials. Two reasons, however, are assigned for this. On one of the two previous occasions she has been out Nixon's hand-picked navigation coal has been used, and very experienced stokers from the steam reserve have been in the stoke hole. On September 28, the ordinary coals from the ship's bunker, consisting of one-third north country and two-thirds Welsh coal, was the only fuel consumed, while the stokers were all new to the ship. The result of the trial, therefore, as officially sent to the Admiralty, is deemed satisfactory. The revolutions were 71 per minute, and the total indicated horse-power obtained was 3051, producing a speed of 11·7 per hour. The consumption of coal to produce this speed was 3·7 lb. per hour per indicated horse-power developed. Experiments were made as to the time occupied in stopping and reversing the engines. When at full speed ahead, both engines were stopped, and had been started full speed astern in eight seconds. They were again reversed to full speed ahead in five seconds.

Benwell Tower.—On September 26, this new screw-steamer, built for Messrs. Stumore, Weston and Co., of Liverpool and London, by Messrs. J. Wigham Richardson and Co., Neptune Shipyard, Low Walker, had a satisfactory trial trip at sea. The vessel is 310 feet long, 37 feet broad, and 28 feet deep, and she is propelled by a pair of engines, also built by Messrs. Richardson and Co., of 300 horse-power nominal, and 1400 horse-power indicated. During the trial the engines worked without the slightest hitch, and a speed of 11¾ knots per hour was obtained.

La Plata.—This steam ship, the latest addition to the Royal Mail Company's fleet, was last week taken to Stokes Bay for an official trial on the measured mile, before being placed on the company's mail route between Southampton, Brazil, and the River Plate. Her leading dimensions are as follow—Length, 332 feet; breadth of beam, 40 feet; depth of hold, 33 feet; gross tonnage, 3,240; registered tonnage, 2,969; and she is propelled by engines of 600 horse-power nominal. An average of four runs on the measured mile gave a mean speed of 13·539 knots per hour; pressure of steam, 79 lb.; vacuum, 27 inches; revolutions, 53 per minute. The vessel's draught of water was 16 feet 3 inches forward, and 19 feet 10 inches aft; and she had 768 tons of coal and 42 tons of water on board. The machinery worked smoothly and easily throughout the trial, and the performances of both ship and engines gave great satisfaction.

Disasters at Sea.—There were 24 British and Foreign actual shipwrecks reported during the past week, making a total of 1029 for the present year, or a decrease of 182 as compared with the corresponding period of last year. British owned vessels numbered 14; five were steamers, four being British owned; total number of lives lost and missing, 13. Three vessels were wrecked off the coast of the United Kingdom, all being British owned. Two British vessels and one Dutch sunk by collision, two (British) being lost off Great Britain.

The "Polyphemus."—This torpedo ram arrived at Spithead last week from Sheerness, and afterwards steamed into harbour. She came under easy steam all the way, five of her boilers only being used. Though intended for 120 lb. pressure, they were arranged to blow off at 70 lb., while the air pressure in the stoke hole was equal to 1 inch instead of 3 inches, which is intended to be the normal draught. The engines worked very well and very little heating was observed in the boilers. The *Polyphemus*, as our readers are aware, is an entirely exceptional and experimental ship, and has been fitted with experimental locomotive boilers and experimental torpedo gear. In the circumstances, it is not surprising that she should exhibit various defects. During her passage from Sheerness she is reported to have rolled about like a gunboat, notwithstanding her displacement of 2,600 tons. It is intended to replace her present boilers by cylindrical boilers of the ordinary return tube pattern working up to 120 lb., and in consequence of the peculiar construction of the ship it is thought that the easiest method of relieving her of her present set will be to cut holes in her bottom and drop them through. While the set of new boilers are being constructed by the contractors, she will be put through a series of trials by the officers of the *Vernon*, with the object of getting over the difficulties which at present prevent either her broadside or direct ahead torpedoes being used with effect. She will also be fitted at Portsmouth with electrical firing and signalling gear.

GENERAL NOTES.

Governors.—We are informed that Messrs. Durham and Churchill were awarded the silver medal—the first and highest prize for governors—for their governor at the Tynemouth Exhibition. The judges were Mr. Parker, of Lloyds; Mr. Kirk, of Messrs. Napiers; Mr. Wallace, of the Allan line, and Mr. Goodwin.

Exhibition of Railway Appliances.—A four days' international exhibition of railway couplings, signals and other appliances was opened on Tuesday at Darlington in the presence of a large number of railway men. The exhibits are sent from all parts of the United Kingdom, and from Australia, America, Canada, France and Italy.

Sheffield Trade with the United States.—Dr. Webster, American Consul, gives the returns of Sheffield exports to the United States for the quarter ending September 30. The total value is £311,573, being £29,000 less than for the corresponding quarter of last year. Steel has increased by £20,711 and cutlery has decreased by £2103.

Ventilation.—Messrs. Robert Boyle and Son's system of ventilation has been selected by the committee and architect for the ventilation of Lloyds, Royal Exchange, to where it is being at present applied. Messrs. Boyle's system is also being applied to Claremont, the residence of H.R.H. the Duke of Albany, and has been adopted for the ventilation of Portland Prison.

A Forty-nine Ton Fly-wheel.—An enormous fly-wheel, the largest ever constructed in the United States, has been successfully finished at Newark, in the State of New Jersey. It is constructed in seven sections, each weighing 7 tons. The diameter is 25 feet, and the face 7 feet 6 inches. In turning up the wheel, the lathe was two weeks running, and 5 tons of chips were planed off the surface. Each revolution of the wheel on the lathe occupied nearly six minutes.

The Wigan Tramways.—We are informed by the manager and secretary of the Wigan Tramways, that one of the 6½ ton engines (Wilkinson's Patent) now working their line, draws two workmen's cars coupled together, every morning, with a load of two hundred passengers, and on one occasion last week the number reached two hundred and fifteen. An incline of one in sixteen has to be mounted en route, and which the engines have never yet failed to overcome during the eight months they have been working.

The Anchor Fire-Engine.—On Wednesday afternoon some experiments took place on the vacant land on the Victoria Embankment, near Blackfriars Bridge, with a new form of portable fire-engine. The engine, as it is called, is of the Extincteur class as regards size and shape, but the propulsive power is compressed air, which is stored in a copper globular receiver, screwed on the top of the water cylinder, the whole being carried on a man's back by shoulder straps. The engine was tried against the Extincteur, and for all practical purposes, the results, as far as extinguishing fire were concerned, were identical. It is, however, claimed for the air-engine that no chemicals are required, pure water only being employed, and that being so the surrounding furniture is not damaged in the event of an outbreak of fire as is the case where chemicals are used. The invention is being introduced by Messrs. Vinning and Anderson, of No. 15, Walbrook, London.

Chesterfield and Derbyshire Institute of Mining, Civil, and Mechanical Engineers.—The next general meeting of the members of the institute will be held in the Stephenson Memorial Hall, Chesterfield, on Satuday, October 14, at 2.30, p.m.—Lord Edward Cavendish, M.P., president, in the chair. The following papers will be open for discussion:—1. On compressed air, viz., Mr. D. P. Morison's paper "On the Application of Compressed Air to Coal Mines." (See Part I., Vol. VII.) Mr. Joseph Timms' paper entitled, "The Connection between Heat Expended and Work thereby. Done; also the Use of Compressed Air as a Transmitter of Power Theoretically Considered." (See Part II., Vol. IX.) The late Mr. C. T. Owen's paper, on "A Compensating Air Compressor." (See Part II., Vol. IX.) 2. Mr. J. A. Longden's paper, on "Pit Ponies." (See Part IV., Vol. IX.) 3. The Report of the Coal-dust Experiments Committee. (See Part I., Vol. X.) The following will be taken as read:—"On Mining Coal by Compressed Lime, under Sebastian Smith and Moore's Patent." By Mr. Sebastian Smith, Shipley, Derby. "The Manufacture of Coal Gas, and its Application to Artificial Illumination. Fifth Paper of the Series. Distributing Apparatus, Meters, Burners, &c." By Mr. Charles Edwin Jones. "The Electric Exhibition at the Crystal Palace, London; closed June 3rd, 1882." By Mr. G. E. Smith, Nottingham.

Harvest-saving Trials at Reading.—Mr. W. A. Gibbs, of Gillwell Park, Chingford, writes to protest against the action of the Royal Agricultural Society in the trials of harvest-saving machines at Reading. After saying that he declined to compete, and that he has devoted twenty-two years and £10,000 to prove that our harvests can be saved, and proved it, Mr. Gibbs says "that half a day's muddled trial ought not to outweigh the accumulated evidence of years, and the voluntary testimony of great landowners and farmers who have told the country that 'not only can their harvests be saved, but that the costliest means of doing so repays its own cost also in two or three seasons.'" He adds that the weather consisted of five days' rain, during which the coarse marsh grass had lain spread out on the ground so as to get as wet and rotten as it could; it was shaken out by hay-tedders whilst the rain was falling, trampled and kicked about by enraged visitors, and rolled in by nearly all the dirty little boys and girls of Reading. Lord Ashburton's Harvest-Saver dried that "stuff" into hay fit for stacking in six hours, and it required no other treatment whatever; it is also on record that that stack was sold by open auction at £3 6s. per acre; whilst the only other stack put up on the same day and in the same condition sold for £1 1s. per acre, and is a mass of mould. The assertion that this system cannot make such good hay as by field-work is in complete contradiction to the results and opinions of the society's own chemist, Professor Voelcker; it also ignores the fact that on the Duke of Northumberland's, Mr. Fuller's, and many other estates, the feeding value of such hay is proved to be higher than that made in the old way.

Fire Extinction Notes.—An elegant and a powerful steam fire-engine, manufactured by Messrs. Merryweather and Sons, on the same principle as that which obtained for them the double gold medal award at the Paris Exhibition (the trials of which were witnessed by her Imperial Majesty and the late Emperor) has just been delivered at the residence of the Empress Eugenie. Steam was raised to a pressure of 100 lb. in eight minutes from time of lighting the fire, and a stream of water projected from a large nozzle considerably above the highest point of the house. Afterwards two fine jets were discharged through long lines of hose, striking the roof with great force. In addition to the steam fire-engine, there is also an excellent system of hydrants, London Brigade hand pumps, hose, and buckets. The whole of these appliances have been supplied by Messrs. Merryweather and Sons, of London and Greenwich. The trial of a similar engine took place recently in Jersey in the presence of the mayor. Here also the experiments were most satisfactory, and it has been decided to abandon the old manual engines and to adopt the steamer. A powerful steam fire-engine has also just been constructed by Messrs. Merryweather for a fire float for the Roumanian Government for river service. The same firm are also building steam fire engines for tug boats for the Mersey Harbour Board, and the North Eastern Railway to protect their dock premises. Acting upon the fact that the Sydney Exhibition has but just followed the fate of the Alexandra Palace, viz.: destruction by fire, Messrs. Bertram and Roberts have inaugurated a volunteer fire brigade amongst their staff, Mr. William Bertram holding the position of captain. This brigade is formed to protect the property of the firm in and about the palace from fire, its services will be purely volunteer, and the public may command the same by night or day. The engine is a fine manual, costing upwards of £1000, and is known as the "Hodges' Testimonial," constructed by Messrs. Merryweather and Sons. For the present Mr. James Henry Cleaver, who originated fire brigade competitions at the Crystal Palace, together with Mr. J. Compton Merryweather and Captain Hodges, will attend to drill the new brigade with the intention of making it the smartest institution of its class in the kingdom.

THE HOME IRON AND COAL TRADE.

BARNSLEY AND SOUTH YORKSHIRE.—The coal trade is in a somewhat peculiar position, the entire district being greatly exercised by the miners' agitation for an advance of wages. The house coal trade is still unduly inflated by the threatened stoppage of the collieries. Reports received from the representatives of the various collieries in London, however, report that prices are weaker, and there is now more difficulty to make sales. Many of the leading Barnsley and Silkstone collieries are, however, sending largely to London and the eastern counties. Some of the coalowners on Wednesday cancelled the rates quoted up to the last day of September, and now quote best house coal at the pits at 8s. and seconds at 6s. 6d. per ton. There is not near so much doing in steam coal for shipment as was the case a few weeks ago, so that the tonnage to the Humber ports is now less than it was. Owing to the falling off and the extra demand for house coal, some of the pits are stacking hard coal, whilst others are quoting at 6s. per ton for large quantities at the pits. Engine fuel and slack meets a free sale at rather more money, but the increase is doubtless due to the unsettled nature of affairs rather than to any improvement in trade. Locomotive coal is in very fair request, but as nearly all this class of fuel is sold contract prices do not vary. The coke trade is very active, and the large output which is made daily is easily disposed of and sent away. The satisfactory position of the iron smelting made in North Lincolnshire causes the demand to be very great. The output will be shortly further increased by the starting of the ovens at the Church Lane and North Gawber Hall Collieries, which have recently changed hands. The threatened strike of miners is the all-absorbing topic, and, judging from the temper of the men, it is to be feared they will rush headlong into a hopeless struggle. The district iron trade is, on the whole, fairly active. The ironworks at Milton and Elsecar are busy producing plates, sheets, &c., for which some fair orders are on hand. The Thorncliffe Ironworks are fairly off for orders for gas apparatus and general castings. Pig-iron is in fair request, and a good tonnage is made at Parkgate, Milton, Thorncliffe, and other places. The foundries are better off for work, but a good deal of what is done consists of repairs. Builders' and colliery castings are not over good to sell.

BARROW-IN-FURNESS AND NORTH LANCASHIRE.—The evidences of improvement in the iron trade which have been noticed for some weeks past, are developing in a most interesting way, and in the direction of a fuller demand, an increased business, and higher prices. Such a state of things occurring at the close of a season, and

just when the autumn and winter trade is on the point of setting in, is a strong indication of the immediate permanent stability of the iron market. It is believed on all hands that the winter's trade will be one of activity, and that the metal produced will obtain a considerable sale, not only in the home markets, but on general foreign account. The value of iron is quoted at 6d. per ton higher than previously noted, 59s. being the market price for No. 1 Bessemer, net at works; 58s. for No. 2; and 57s. for No. 3 forge. Both qualities of iron are in considerable output, and the orders on hand are such as will maintain this activity for a considerable time to come. It will probably be necessary to increase the output of the furnaces, but of course makers are diffident about taking such a course in the opening of the autumn season. Stocks are kept very low, and are not likely to be increased, as deliveries are heavy on all hands. The steel trade is very briskly employed, and makers are in receipt of a very full budget of orders, and the mills in all departments are very well furnished with work. Steel makers are busy, especially in the rail trade, and iron shipbuilders have a full order book of steamships, there being very few sailing vessels in course of construction in the district. Iron ore is quoted at 14s. to 15s. per ton, and it is more difficult to buy at these figures than it was a month ago. The mines are very fully employed, and orders are largely held. The coal and coke trades are brisk, and higher prices are quoted. Shipping fairly busy.

BIRMINGHAM.—There has not been much alteration in the trade of the town and district during the past week, and altogether manufacturers report an improving trade. The prospects of at least a fair harvest have had a tendency to give renewed confidence to business men. The indents from abroad during the past fortnight have been of a most encouraging nature, and from the colonies and North America the demand for most descriptions of Birmingham manufactures—and more particularly for edge tools—has been decidedly better than it has been for the past few months. Local ironmasters also report an improving trade, and in the South Staffordshire district there are orders. The makers of heavy ironfoundry—bridges, girders, &c.—are working full time, and there are enough orders in hand to last for several weeks hence. The Birmingham gun trade, both in the military and birding branches, is somewhat quieter, and in several instances makers are only working half time. The brassfoundry industry is moderately active, the supply being chiefly for the Continent and Australia, whilst in the jewellery department there has been a slight revival for silver ware. The button trade is tolerably steady, and the japanners report a fair supply of orders.

Thursday Evening.—The market was very firm to-day, but business was limited, owing to the near approach of the quarterly meetings. Manufacturers of common bars asked 5s. a ton more than a week ago, the minimum prices being £6 10s., while for best medium qualities £7 was obtained. Manufacturers were reluctant to accept current rates for lengthened contracts, in consequence of the probability of an advance in fuel list. Iron will probably remain unaltered at the quarterly meetings unless coal is raised in the meantime.

CARDIFF.—The various iron and steelworks are fully employed, and there is no probability of any slackness for some months to come. Prices are low, and it remains to be seen whether the operations of the Steel Railmakers' Association can raise them. There are only thirteen firms in this branch of trade in the whole country, so that a combination can be easily effected if thought desirable. The determination of the committee is to keep prices as near as possible to a remunerative point, and not either unduly raise or depress them. This is a very different matter to a "ring." The Landore Steelworks are now nearly in full swing again, only the hammermen at the new works remaining out. The winter is approaching, and the men will soon see the wisdom of earning more money in five days than an agricultural labourer does in a month! The amount of iron sent away last week was 1386 tons, while iron ore has been received to the extent of 12,414 tons from Bilbao, and 420 from other places. The large quantity arriving and the steadiness of the price indicate that the absorption for this commodity is large in the district. Campanil Somorrostro maintains its position at 15s. 3d., c.i.f.; good Rubio, 15s., c.i.f.; Carthagena manganiferous ores are steady. Tinplates, in consequence of the lowness of stocks, are firm at from 16s. 6d. to 17s. per box; for coke-mades and charcoal-mades from 18s. 6d to 20s. 6d. At one works the men are giving one day a week to the masters in order to make matters easier, and it is anticipated that many of the closed works will not remain so much longer. It is probable that all will be open if not in full swing, this winter. The steam and house-coal collieries are all doing their best to turn out large quantities, which are shipped away as fast as they arrive. The want of increased dock accommodation is much felt at the present moment. The clearances for the week amounted to 139,958 tons foreign, and 19,409 coastwise. In addition to the four seams of coal found at Coegnant, another has just been struck at Ynysybwl, near Pontypridd, 2 feet 10 inches thick. The Treforg Valley is about being opened up, and attention is also being directed to the Cwmgorse district. Both these places abound with coal. The latter place will find its outlet at Swansea, and not at Cardiff. Mr. Thomas Joseph, whose failure was recently announced, hopes to form his various undertakings into a company, by which he will be enabled to pay his creditors 20s. in the pound. The valuation made of his properties gives their total at £230,000.

CARMARTHENSHIRE.—A large iron ship now on the stocks at Messrs Samuel Brothers' yard, and ready to be launched, has been inspected by the Board of Trade Surveyor, and is sold, but not for the tinplate carrying trade, as has been stated. The different tin works in Llanelly, Carmarthen and neighbourhood, are going steadily, with no lack of orders. Raw materials all continue high, and very likely coal will become dearer still. Common cokes are at 16s. or 17s. For charcoals 18s. to 20s. 6d. has been obtained. The *Neath Abbey* s.s. with tinplates, grounded near the entrance of Llanelly harbour, but got off without damage on Tuesday. The anthracite trade of the county is fairly brisk, and the Mynydd Mawr Railway traffic having fairly commenced, stone coal can be brought to the coast from the Cross Hands district by a more direct route than heretofore.

CLEVELAND.—The attendance on 'Change at Middlesbrough was very good, and in spite of the flatness reported respecting the Glasgow market, business was very brisk, and buyers were eager, paying very readily as much at 44s. 6d. for early f.o.b., deliveries of No. 3, G.M.B., but they could seldom get iron at this figure towards the close of the market, for some of the merchants quoted 1½d. more, while others would not sell under 44s. 9d. Thus compared with last Tuesday there has been a rise of from 4½d. to 6d. per ton, and the tendency was still upwards. Iron was reported very scarce, both in makers' and merchants' hands, and especially is this the case with No. 3. In fact, in consequence of this scarcity, steamers have had to lie alongside makers' wharves for days, where a little while ago they could have got immediate despatch. Thus there is some delay in getting particular brands. Most of the stock held is in the hands of a very few firms, and producers thus have no necessity to press sales, seeing that iron in second hands has gone up so much during the last week; and as the makers are much pressed to sell, they at their usual meeting before the market advanced their quotations 6d. per ton, and 45s. for early deliveries of No. 3, G. M. B., cash Mondays, is now their regular price. They further decided to continue the restriction in this district for three months more, irrespective of what Scotland does. Prices now are, No. 1, 49s.; No. 3, 45s., and 44s. for No. 4 forge, f.o.b., or on trucks at makers' works. There is an improved demand for warrants, which can be easily disposed of at 44s. 6d. per ton, but holders prefer adopting the waiting policy. Messrs. Connal and Co. had in their Middlesbrough stores on Tuesday night 108,858 tons as compared with 110 048 tons on the previous Tuesday, being a decrease of 1190 tons on the week. In Glasgow the firm hold 626,031 tons. The shipments for the past month have been enormous, and amount to 100,838 tons, as against 95,861 for August, and the largest amount since September 1879, when 104,154 tons were shipped. The shipments for the week ending September 30 amount to 27,395 tons, while they are still well kept up, and for the first three days of this month up to Wednesday night 14,707 tons have been shipped. Hematites and Bessemer qualities of iron are obtaining full rates, with increased activity. The manufacturing iron trade is quiet, and the demand continues weak, but prices are not lower than last week; and, seeing that coal is dearer, it is not likely that a lower point will be touched, though consumers are waiting. We quote, ship plates, £6 12s. 6d.; angles, £5 17s. 6d.; and common bars, £6, all less the usual 2½ per cent. discount. There are no signs of improvement in the foundry trade which remains dull. Cleveland and Spanish iron ore remains unchanged, prices being the same as quoted last week. The demand in the coal trade still continues in spite of the advance in prices which has been made. Sellers are asking 1s. per ton more for household coal, and coal for manufacturing prices has been raised 6d. per ton, and 9d. per ton more has now to be paid for coke. The shipbuilding trade continues active. On Tuesday afternoon, after the market, the Cleveland ironmasters' returns, for the month of September, were issued, and they are of a highly gratifying character. There are 120 furnaces in blast; the same number as at the end of August. Eighty-three of these furnaces are making Cleveland iron, and thirty-seven hematite, basic, and spiegel pig-iron. During the month two furnaces have been taken off hematite, and two have been put on Cleveland iron. The Claylune Iron Company have blown in a furnace, and Messrs. Bolckow, Vaughan and Co. have put one out of blast, and Messrs. W. Whitwell and Co. have changed a furnace from hematite to Cleveland. The make of Cleveland iron has been 149,155 tons, being an increase on August of 1,337 tons, and the output of other kinds of iron has been 70,655 tons, a decrease of 6,294 tons on August. The total make has been 219,810 tons, a reduction of 4,957 tons, which is owing to the month being a day shorter than August. Stocks and stores show a large decrease. At the end of September the total quantity of iron in stocks and stores was 269,237, being a reduction of 40,221 during the month. There were 105,102 tons in makers' stocks, a decrease of 15,217 tons; and the quantity of iron in makers' stores amounted to 47 041 tons, a decrease of 14,796 tons. In public stores there were 117,230 tons, a decrease of 10,208 tons. When the restriction agreement with Scotland was entered into a year ago, stocks and stores amounted to 434,441 tons, consequently during the past twelve months they have decreased 165,168 tons, and nearly one half of this large reduction has been in public stores. Of the 100,838 tons shipped last month, Scotland took 26,105 tons, and Wales 10,075 tons. On the continent, France received 10,160 tons, Germany, 22,336 tons, Holland, 8,747, and Russia, 5,075 tons, the remainder being distributed over some of our ports, the continent and the colonies.

DERBYSHIRE.—It is many years since the labour market in this district was so exercised as it is at the present time. The miners are keenly asking for an advance of 15 per cent., and are much encouraged by the fact that Messrs. Seely and Co. have, through their manager, offered an advance of 12½ on the black shale, and 11 per cent. on the low main seam. The Boythorpe and Remshaw Colliery owners have offered 10 per cent. Clay Cross, Reddings, and Messrs. Oakes and Co. 7½, and Remshaw Park, Holbrook, Eckington, and Killamarsh Collieries 5 per cent. advance. The Clay Cross Company, owing to the men declining the offer, and no doubt guided by the Yorkshire coalowners' decisions have since unreservedly withdrawn the offer. On Wednesday a large mass meeting was held at Chesterfield to consider the position of affairs. The Clay Cross and other district collieries being laid idle in order to permit the men to attend. Great surprise is expressed at the conduct of some of the firms in offering these advances, particularly when both South and West Yorkshire have declined to grant any advance. It may be stated that whereas in South Yorkshire the yield of the Barnsley seam is in some instances only equivalent to about 15 per cent. on the output of the seam, the Derbyshire collieries yield nearly all house coal. The London trade holds well up, and a good tonnage is being sent to the metropolis, where prices of late have increased. It is, however, stated on good authority that the supplies of Seabourne coal is so great that present prices are with difficulty sustained. The house coal trade for local markets is also better, but this arises in a great measure from the threatened stoppage of the collieries. Hard coal for smelting and similar uses is in fair request, and there is about an average enquiry for small coal and engine fuel. A good tonnage of coke is being imported into the district from South Yorkshire. The iron trade is fairly active, and at most of the works the men are making full time. There is a very fair output of pig-iron, most of which meets a ready sale, whilst the foundries are in receipt of a tolerable number of orders for repairs and colliery castings.

DURHAM.—The pig-iron trade has been very firm during the past week. Business has been much more active and prices higher. The very heavy shipments and decrease in stocks have had a most favourable effect. They have stimulated sellers, whether makers or merchants, to ask for more money, which they have been able to obtain, not only for present but forward delivery. Up till within the last ten days the market has been entirely devoid of animation, and the business done had not been smaller for months. Then a better feeling appeared, which has gradually strengthened, and resulted in a rise all round of about 9d. per ton in prices, and what is equally satisfactory a favourable tone and good indications for the future. That over 100,000 tons of iron should have been shipped from the Tees alone during last month and nearly 96,000 tons in the previous month are circumstances so unusual that they call for special notice, the general average of delivery during the year, except in March, having been about 70,000 tons. As the Cleveland ironmasters have again decided to restrict the output of iron and the stocks are small, except in the stores, there is likely to be somewhat of scarcity—indeed there has been a difficulty already in getting iron at all times on that account, and there has been detention of vessels in the river Tees. The quotations have been with makers 45s. No. 3, and about 3d. less with the merchants. Warrants are about 44s. 6d. No 3. The manufactured iron trade does not show any improvement, and of late it has rather had a declining tendency. The prices are not any better, but even worse, notwithstanding the increased rates of pig-iron. The shipbuilders have lately been buying iron to some extent, mostly plates, and probably they will be inclined to place more orders if they consider that prices are likely to rise, as they almost certainly will do if pig-iron goes on advancing, as manufacturers will have to get more money to meet the extra cost of raw material. The figure for ship plates is £6 12s. 6d. to £6 15s.; boiler plates, £7 15s.; angles, £5 17s. 6d.; bars, £6, less 2½ per cent.; puddled bars, £4 net. The steel nail trade still keeps rather quiet. Prices are low. One good order has been received in the district for foreign account. There is a general impression that coal and coke will be dearer this winter, and hence buyers are endeavouring to purchase forward. Some orders for coke have been placed this week ot 9d. per ton above the rates which have been ruling. There is also about 6d. rise in the price of the best classes of manufacturing coals. Household coals have advanced 1s. per ton. The pitmen of Durham and Northumberland are, as a rule, working pretty steadily, and it is considered probable that they will do. There has been some talk of restriction of output at one or two collieries, but it is doubtful if it amounts to anything.

EAST WORCESTERSHIRE.—Pig-iron continues in fair demand. The number of blast-furnaces at work in South Staffordshire and East Worcestershire is the same as mentioned last week, viz., forty-nine. Current prices are, £3 7s. 6d. to £3 10s. for hot-air, all-mine pig-iron; £2 10s. to £2 12s. 6d. for part mine; and £2 to £2 2s. 6d. for common pig-iron. Extensive lots of foreign crude iron from surrounding districts are still arriving here and going into consumption. The activity mentioned in the local finished iron trade last week is kept up, several firms experiencing a difficulty in getting their orders out fast enough. Active operations continue in the bridge, roofing, and girder departments, which are in full gear; and several additional hands are being employed at sundry of the local yards, the bulk of the work consisting of iron roofing, gasometers, mooring buoys, sugar boilers, and other iron manufactures for the British colonies, and a large bridge for erection over the Macquarie River, in New South Wales. The coal trade in its main features is about the same as last week. As mentioned in last week's report, no advance in the price of fuel has been announced—unless, indeed, the masters should capitulate, as on a former occasion, the improvement in the coal trade not being deemed sufficiently marked to warrant an advance in quotations just at present, and the "list" rates accordingly remain on the basis of 9s. 6d. and 10s. per ton for furnace coal, 8s. per ton for steam (or locomotive) coal, and 4s. to 5s. for slack. Colliers' wages, according to the sliding scale, remain at 3s. 4d. per day, or "stint" for the thick coal miners, and 2s. 8d. per day to the thin coal men. Whilst in some parts of the locality the miners show a wise disposition to bide their time and await that advance of coal prices and wages which is inevitable before long, in one neighbourhood the men evince considerable irritation, and last week this section passed a resolution to "lay down their tools on the 2nd inst. failing an advance of 6d. thick coal men and 3d. thin coal miners." This resolution has, in part, been adhered to by some of the men employed in the Old Hill, Rowley, and Netherton districts; but the miners' agents in other localities have stated that their men would be satisfied with a rise of 4d. and 2d. respectively. Notwithstanding the excited language used at the mass meeting of colliers at Netherton on Monday last, a strike will not, it is thought, commend itself to the great body of miners, and, therefore, no serious or prolonged rupture is feared; which, indeed, would be doubly unfortunate at this juncture. It is just possible that a conference of masters may take place to day (Thursday) on the subject of prices and wages. The local firebrick, baths, and retort trades are very good, all the district firms being fully employed.

FOREST OF DEAN.—The district iron trade, both crude and manufacturing, is maintaining improvement, and the prospects are brighter than have been the case for a long time. In regard to crude iron, there are now practically no stocks and the immediate demand for iron is equal to the output. Quotations have advanced fully 5s. per ton. It is anticipated that the quarterly meetings will be of a favourable character, and therefore the winter will be a busy one. In manufactured iron local makers are well served with orders, and the mills may be said to be fully engaged on home and foreign orders. For tinplate the demand appears to be gathering strength, but an unfortunate trade dispute has arisen by the Lydney-on-Severn puddlers demanding and

standing out for an advance of wages from 7s. 1d. to 8s. per ton, which they state is paid for the same class of work elsewhere, viz., in South Wales, and by another firm in the Forest. The iron ore branch continues fairly brisk, and at any rate there is a decided improvement in the western districts, where best classes of ore are fetching 12s. per ton at the mine banks. The colliery owners have this week advanced their quotations a shilling per ton, bringing the price to 9s. for best block at the pits. There is no diminution in the demand, for last month's shipments at Lydney-on-Severn, 31,105 tons, were the heaviest for several years. Wages have not been advanced, and there is some doubt as to whether with the present prices of fuel the proprietors are disposed to advance them.

GLASGOW.—A decidedly improved tone now prevails in the warrant market, and an impression exists in many quarters that we have now entered upon an era of higher prices than have been ruling for some time past. The general public have recently been paying more attention to pig-iron, and the brokers have been doing an increased business on their behalf. The position of the iron trade in Glasgow seems to be thoroughly sound; there is an enormous demand for the special brands, and makers cannot supply fast enough the pressing wants of their customers. Fair orders are still coming to hand from America, where the stocks of Scotch iron are light, but the Canadian demand is quieter. The Continent continues to take large quantities. The local demand is also on a large scale, and the prospects of a good winter's trade are decidedly favourable, the only drawback to higher prices being paid for iron is the fear of dearer money, which has a tendency to limit operations, more especially if of a speculative nature. On Thursday, business was done from 51s. 3d. to 51s. 7d. cash, and 51s. 7½d. to 51s. 10½d. a month. Next day there was strong buying from 51s. 6½d. to 52s. cash, and from 51s. 9½d. to 52s. 3d. a month. On Monday the market opened strong at 52s., afterwards declining to 51s. 6d. cash, and 51s. 9d. a month. On Tuesday the market fluctuated between 51s. 3d. and 51s. 9½d. cash, and 51s. 6d. and 52s. ¼d. a month. On Wednesday the favourable Middlesbro' returns helped the market, and 52s. cash and 52s. 3d. a month was paid, declining, however, in the afternoon to 51s. 7d. cash, and 51s. 10d. a month, closing with buyers over at these prices; sellers near. There are now 107 furnaces in blast, against 120 at this time last year. Four furnaces have been damped down at Shott's Works for repairs. The shipments of pig-iron from Scotland last week were foreign, 11,380 tons; coastwise, 3643 tons; total, 15,023 tons, against 16,434 tons in the corresponding period of last year. The shipments for the year show an increase in foreign of 54 246 tons, and a decrease in coastwise of 10 948 tons, as compared with last year. The imports of Middlesbro' pig-iron into Grangemouth last week were 7485 tons, against 4845 tons in the similar period of last year. The total imports till September 30, 1882, are 175,234 tons against 222,558 tons till October 1, 1881, showing a decrease for this year of 47,324 tons. The stock of iron in Connal and Co.'s store now amounts to 625,206, being a decrease for the week of 1110 tons. The Scotch makers, exclusive of the Summerlee Company have just issued a return of their stocks, showing a decrease for this year of 86,000 tons, while it is estimated that the Summerlee Company's stock has been reduced at least 10,000 tons within the same period. This return is rather disappointing, as a decrease of from 100,000 to 120,000 tons was generally expected. Briskness continues to characterise the malleable iron trade, and the price of common bars is firm at £6 10s. per ton. An attempt is being made to start a company for making steel on the Basic process out of Scotch iron, and an influential directorate has already been appointed. Shipbuilders and engineers are still very busy, and the coal trade is active in all its branches, an advance of from 3d. to 9d. per ton is generally being obtained. The colliers are holding meetings in regard to the wages question, and it is expected they will get some advance if market keeps firm for a week or two longer.

LANCASHIRE.—Although the weight of business doing for actual consumption in this district is not what may be termed generally large, the iron market maintains great firmness. A large shipping trade is being done, and this is not only absorbing a considerable quantity of iron here, but the activity in the same direction in other iron making centres keeps off the pressure of outside brands. The result has been that a good deal of business has recently been thrown into the hands of local makers and during the past week or so Lancashire smelters have been able to put on tolerably large orders which will contribute considerably towards carrying them well over the remainder of the year. Quoted rates for local brands of pig-iron have not been altered, but they are now exceedingly firm at the full rates of 46s., less 2½, for both forge and foundry qualities delivered equal to Manchester. Many makers of district brands are so fully sold that they are quite indifferent about booking further orders at present. During the week some of the best brands of Lincolnshire iron have been advanced 1s. per ton with sales made at 6d. per ton above late rates, and quotations for delivery into Manchester district now go up to 48s. 4d. for forge, and 49s. 4d., less 2½, for foundry. Some of the Derbyshire makers quote rates which are altogether out of this market, but where they have iron to sell the price runs about the same as Lincolnshire. In Middlesbrough iron a few odd sales are made at about 53s. 4d., net cash, for G M.B. delivered equal to Manchester. In the finished iron trade a very steady business is being done. There have been considerable American orders given out for bars and sheets, with a firm enquiry for hoops, and the general shipping trade is active. The home trade, although still only moderate, shows improvement. Forges throughout the district are fully employed, and prices have a tendency to stiffen. Good local bars delivered into the Manchester district now average £6 10s.; hoops, £7; and sheets, £8 12s. 6d. to £8 15s. per ton. In the engineering trades, some branches, such as locomotive builders, tool makers, and boiler makers continue busily employed; but in other branches, such as machinists, founders, and millwrights, there does not appear to be quite so much work stirring as of late. In the coal trade there has been an almost general advance of prices with the commencement of the month. The upward movement has varied in different districts, but may be said to average from 6d. to 1s. per ton, with an advance of 1s. 8d. in some districts on work going on to the Cheshire side. The average pit prices are now about as under:—Best coals, 10s; seconds, 7s. 6d. to 8s.; common house coals, 6s. 6d. to 7s.; steam and forge coals, 5s. 6d. to 6s.; burgy, 4s 9d. to 5s.; and slack, 3s. 3d. to 4s. 3d., according to quality. With the commencement of the month the pressure of orders coming in has not been quite so great, but colliery proprietors have deliveries to complete on orders already in hand which will carry them in most cases well over the month, and they are not at all anxious to book further sales at present, as it seems pretty certain that the demand for an advance of wages, although temporarily postponed will be resolutely pressed forward by the men at the close of the month. The shipping trade has been tolerably good, and an advance of 1s. per ton has been obtained on steam and house fire coal, both at Garston and Liverpool; delivered at the above ports steam coal now averages about 8s. per ton; seconds house coal, 9s. to 9s. 6d. per ton.

LEEDS AND WEST YORKSHIRE.—Boiler plates and axles are the chief requirements at the Leeds and Bradford forges making best Yorkshire iron. Those parts of such forges in which crucible steel is made are the busiest. They turn out fair quantities of cranks and tires, considering the amount of competition in other districts. A good deal of progress has been made at those Leeds forges which intend to go in for the manufacture of steel on the Siemens-Martin principle. Steam cranes are being fitted up, and the last items in the plant are now rapidly being put in their places. The best Yorkshire iron makers have revived their expectations that during the coming winter they will have to supply a good deal of that kind of rolling stock which comes within the fair view of their operations. For this purpose all hammers which are a little out of repair, or in the least inexact, are being planed, or otherwise put to rights. With regard to the puddling department there is so little stock of both refined iron and of blooms beforehand that the weekly number of working days in that branch should soon be increased from three or four days to full time. Hopes are also entertained of a good winter trade for common iron makers. In this belief considerable stocks of Cleveland pig metal have been bought, and already that the new quarter has opened the business doing in merchant iron is more spirited than before. There is nothing new as regards locomotives for home railways, but one or two Leeds firms are making them for exportation. A Leeds mechanical engineer is engaged in supplying some first-class work in connection with the dyeing department of the Yorkshire College. Agricultural implement makers have full work to the end of the year. A fresh item this week in that branch is an order from South Africa for threshing machines. There is still going on a regular and constant delivery of various mechanical work for exportation to India, China, Japan, South America, and Norway. An unusually large number of perambulators have been exported hence this season to even the most distant parts of the habitable globe. At one well-known ship in Leeds there are above 200 men engaged in bullet machinery for abroad, by means of one of which a hundred rifle bullets can be cast per minute. In consequence of the brighter prospect for the coal trade, which seems to be opening out, there have come into the district enquiries after compressed air locomotives for underground hauling at one or two collieries near home, and from some others further off in the North of England. The rashness of the colliers in persisting upon having an advance of wages, which the coalowners have already intimated they cannot give, may after all cause this much needed opportunity for recuperation to be wasted. The domestic article in Leeds has been advanced 1s. 3d. per ton in price, and engine coal from 6d. to 8d.

LIVERPOOL.—The market is very steady, and a fair amount of business doing, but not quite so much as to satisfy everyone—nothing unusual in fact. Pig-iron is in better request, and even our American cousins are once more dabbling in it, and also making enquiries for scrap and old metal. As regards these last articles our dealers will be mindful of the old proverb "Once bitten, twice shy," for in nothing were losses so heavily incurred as in this quarter just after the "boom," and both the American buyers and Custom House authorities proved extremely unscrupulous. Shearings and punchings, for instance, being taxed as new material, under the plea that they were unused, and therefore new iron. Hoops and sheets are stiffer in price, as works now ask £8 15s. and £7 5s., respectively. These figures, however, seem inclined to check business, and are scarcely warranted. Bars do not move much, and it is difficult to get more than £6 10s. per ton for decent brands. Light plates are in very large request, and are correspondingly difficult to get. Angles and beams on the contrary are little called for. Tinplates are somewhat stagnant, but prices are maintained at 16s. 3d. to 16s. 6d. per box for I.C. cokes.

LONDON.—The metal market here shows a little firmer tone, and prices are stiffer. Iron has steadily advanced the past week. Pigs reached 52s. for Scotch warrants, but the makers' returns being considered a little disappointing, quotations yielded, closing 51s. 3d. Copper strong. Chili bars have been in good demand; £72 was paid for cash. The market closes, however, easier, £71 spot. Tin.—There is a very strong feeling still, fine foreign remains firm at £107. The figures for the past month show a still further reduction, English ingots, £111. Tinplates are in good demand, 16s. 9d. and 17s. 6d. cokes, Liverpool. Lead quiet, £13 17s. 6d. soft Spanish.

NEWCASTLE AND THE TYNE DISTRICT.—The crude iron business is active in this locality, and prices have, in common with Cleveland, risen another 3d. to 6d. per ton since last week. Cleveland No. 3 pig now sells at 46s. 9d. per ton delivered to the Tyne, and No. 4 forge quality is 1s. per ton below that figure; in some cases 47s. has been touched, and the market has an upward tendency. Manufactured iron, on the other hand, is drooping, the supply having evidently got in excess of the demand, which has in no degree slackened. Ship plates are bought at £6 15s. per ton, whilst bars and angle-iron barely realise £6 2s. 6d., and boiler plates £7 12s. 6d. to £7 15s per ton, delivered in the Tyne. Iron ore is coming in good quantity from Bilbao to the Tyne, being shipped at 7s. per ton, with a freight of 9s. per ton to the northern river, and 9s. 3d. to the Tees. With respect to iron shipbuilding there is a slight improvement to note in the frequency of enquiries for vessels to be built next spring and summer. Work in the yards is carried on with all possible pressure, and launches are very frequent, the vacated berths being in all cases taken up very speedily by the keels of other new vessels. Our engine manufactories are highly prosperous at present, and most of them are being enlarged to meet the increasing requirements of the trade. At St. Peter's, about two miles below Newcastle, quite a new town is springing into life in the vicinity of Messrs. R. and W. Hawthorn's new marine engine works. At the great engine-making and repairing works of the North Eastern Railway Company at Gateshead operations are carried on with increasing activity, well nigh 3000 men being employed therein; and the same satisfactory state of things is seen in all the other establishments on the banks of the Tyne and Wear. Forges, foundries, bolt and rivet works, and chain and anchor shops are all very busily employed on remunerative ship and engine work for the most part. Steadiness is the characteristic of our northern coal trade in all its branches. The alarm created in other coal-producing districts by the threatened stand for an advance of wages has a stimulating effect on the coal trade of Northumberland and Durham, both of which counties are under sliding scale agreements between the coalowners and the miners. Steam-coals are firm at 9s. per ton, less 2½ to 5 per cent., according to the extent of transactions. Gas-coals are selling at 6s. 9d. to 7s. 3d. per ton, and manufacturing and smithy sorts at 6s. 6d. to 7s., less 2½ per cent. House-coals are improving in value week by week, but slowly. Chemicals are firm at fully late quotations. Rouen cliff realises 4s. 6d. to 5s. per ton. In the firebrick trade there is a steady feeling for the time of year, and prices are unaltered, Cowen's bringing 55s., Ramsay's 45s., and others 32s. to 39s. per thousand.

NEWPORT.—Trade is steadily progressing in this district, and prices are gradually improving. Pig-iron has advanced 9d. per ton since our last return, and a further rise is not at all improbable. Middlesbrough pigs per ton of 20 cwt., delivered ex ship at Newport, are quoted as follows:—Foundry qualities 51s. 6d. to 56s., and other qualities, 50s. to 51s. Several contracts have been made at the above figures, and one parcel of No. 3 Scotch pig has changed hands at 56s. 6d. per ton, ex ship at Newport. Iron ore is firm at prices quoted in our last, and a fair amount of business has been done during the week outside of contracts. Makers of manufactured iron are extremely busy, and some firms are positively unable to quote at all for either bars angles, or plates, having made engagements to the end of the year. Under these circumstances we need scarcely add that prices have stiffened, and, where quick delivery is required, materially advanced prices have to be paid. There is still a good demand for steel rails, and makers in the district are booking good orders at better figures. The market is very firm, and before the end of the year quotations will be still higher. In tinplates there is a brisk demand, but prices are very slow in advancing to a remunerative figure. The high price of tin, &c. is against the manufacturer. If possible there is more activity in steam coal, and prices have an upward tendency. There is an improved demand for house qualities, and prices have stiffened. The pitwood market is not so firm, consequent upon the large imports, and stocks have been replenished. The total shipments for the week have been as follows:—Coal, foreign, 29,939 tons; coastwise, 25,199 tons against our last returns of 26,383 tons foreign, and 19,519 tons coastwise. Of iron, &c. 3154 tons were despatched to the following destinations:—New Orleans, 2,806 tons; Hennebout, 330 tons; and Halmstadt, 315 tons. The imports comprised 11,444 tons of iron ore from Bilbao, and 5150 tons of ore from other places, 285 tons of pyrites, and 5525 tons of pitwood also came to hand.

NORTH STAFFORDSHIRE.—There is no change in the condition of the finished iron trade. The home market is active, and orders are coming in well. The foreign trade continues good, and among the specifications lately received are some from Russia, and a few from Spain. Less is doing with the United States, and business with the Colonies is about as last reported. Prices are undoubtedly firmer, with an upward tendency, and makers are disinclined to enter new contracts except at an advance of 2s. 6d. upon the ruling rate of £6 10s. for crown bars. This attitude is due to existing engagements and to anticipations of a continued improvement in trade. The merchant mills are well off, and there is a good demand for constructive sections. Almost the only commodity in medium requisition are plates, but there is a slightly increased business in that branch, and hoops find a ready sale. The pig-iron market is animated, but manufacturers are chary of accepting orders for large lots during the present agitation among the miners, which may result in influencing rates on the side of the seller. Meanwhile prices are firm. Ironstone meets with fair sale, and prices remain at 8s. 6d. and upwards, according to quality, with, if anything, a rather forward inclination. There is no change in the coal trade, but as notice for a rise of wages has been given by the miners throughout the district, it cannot remain long in its present condition. If the advance of wages is granted an increase in price will probably be made, but as yet nothing is decided.

SHEFFIELD.—At last there appears to be a prospect of a revival in the condition of the iron, steel, and coal trades. Prices are advancing rapidly in each line, and as speculators are busy buying for a rise, rapid alterations in the market may be looked for next week. The genuine demand, however, is but little improved, and any attempt to "boom" the market will only be succeeded by a relapse, which must occur in three months' time, when bills on account of present purchases run due. The increase in the value of irons on the fortnight is really about 3 per cent.; speculation above that figure will only result in disaster. Special lots of pig-iron have been shipped heavily from the North-Eastern ports, principally on continental account, but that is always the case at this season of the year, especially where the iron has to be forwarded to Russian, Swedish, and Norwegian customers whose markets are inland, obtainable only per rivers, which are ice-bound throughout the winter. American orders are quiet, the Australian buyers are again holding back. The South African merchants are nearly at a stand-

still, through the heavy failures in the Cape and bank suspension; Levant houses are countermanding orders, and the only really good lines obtainable are from those engaged in home trade, and to a certain extent in the German. The recent heavy losses in the shipping trade is making the dockyards busy, and as iron and light steel plates appear to be preferred by the home shipbuilders, there is a consequent call for these makes. Sheffield houses are benefitting by this. Though there is a rise in the market on iron and steel, its justification rests upon but a slight foundation. Coal masters are bearing the first brunt of the battle. The colliers throughout the country are determined to enforce a rise of wages. In some instances in this district, where large contracts have to be completed, concessions are being made varying from 2½ to 5 per cent. This is because of compulsion rather than that the selling price of coal is higher than a month ago. The colliery proprietors, as a body, are willing to lay their books open to the men, and practically have the matter to arbitration. If this course is pursued, and the men accept a percentage on the increased value of coal during the past two years, there will be very little margin of extra profit shown which can justify any further concessions in wages. That an increased wage to the collier will be given cannot be doubted, because suspension of work in the pits would be the greater loss; but there is sure to be a relapse in the spring. Prices of coal, as given in last week's IRON, to large consumers, remain unaltered. The cutlery branches are recovering after three months' bad trade, and within a month we shall have to report some important alterations in the various branches.

SOUTH STAFFORDSHIRE.—The home trade in hardwares is being helped by the fine weather and the good harvest that has been ingathered. But difficulty is still experienced in getting in accounts from the ironmongers in the rural centres, some of whom are asking for bills to be renewed. The Irish demand is steadily improving, being better in some branches than for a couple of years past. The revival of business with Alexandria is a satisfactory feature of foreign trade, and Australia and South America are buying steadily. The Indian business is under the average, and with the Cape business is unsettled. The japanners are in full employment, and some of them report that the coal vase season is opening well; but is cannot be said that there are as many forward orders on the books as there should be at this time of the year. The vases that are selling are mostly of the cheap sorts, and competition in the trade is severe. In the lock trade there is more doing in the brass cabinet than any other branch. The Wednesbury spring and axle makers are all busy, largely on account of South Africa and India, and prospects are excellent. Most sorts of hardwares are firming up in prices in sympathy with the advance of iron, copper, tin, and brass. The improvement in the iron trade becomes more marked week by week. Since last report some common bar makers have issued circulars announcing a 5s. advance, and other bar firms there are who are offering customers who bought a few weeks ago to abate them 5s a ton if they will accept half the quantity contracted for. On 'Change on Wednesday some makers of thin (stamping) sheets demanded £1 per ton advance for forward orders. Makers of ordinary merchant sheets refused to quote, so busy are they. It appeared probable that at the quarterly meetings a rise of 10s. may be declared in marked bars and plates, making bars £8, and boiler-plates £9 10s. The galvanised iron hollow-ware makers have decided on a rise of say 20 per cent. in general wares, and have fixed the new price of buckets on the basis of 7s. 3d. per doz. for 12 inch 36 lb. sorts.

SWANSEA.—The metal industries remain in a promising condition, and although values are not very high, steelmakers are able to maintain and even slightly to raise their quotations. Iron in particular shows strong indication of further improvement, and all the works are well employed. Common bars are steady at £5 15s to £5 17s. 6d.. There are enquiries for old rails, but prices are as yet not sufficiently advanced to induce holders to operate. Steel rails are very firm. 7317 tons of minerals of various descriptions have been imported. Owing to a scarcity of tonnage, the shipments for the week are a trifle less than those of the previous period; the total coal shipments have numbered: foreign 18562 tons, coastwise 6669 tons. Steam coal is in good demand, and quotations have an upward tendency. The Ocean collieries have concluded another wage sliding scale for two years. There is a brisk business in house-coal, and also in patent fuel. The anthracite trade is dull. Tin-plates are in a progressive state; rates are better, 17s. is paid for fair brands. The new works at the North Dock are approaching completion. The principal continental contracts are said to be finding their way to this port. The Neath Harbour new works will prove a vast acquisition; a satisfactory official inspection has just taken place. The Ogmore dock and railway scheme will soon be *de facto*; the necessary money for the preliminary expenses in connection with it has been subscribed, and the promoters are determined to lose no time in applying for parliamentary powers. A deputation of the promoters are going to wait upon the Great Western Railway Company, to consult them upon the subject, and, if possible, stave off collision between the two bodies. There are no fewer than three new railways afoot in East Glamorgan, to develop the coal-fields of those vast districts.

WEST CUMBERLAND.—The iron trade of this district is very steadily employed, and the demand has increased from several quarters, the enquiry on foreign account especially being well maintained all round. On continental account a brisk state of things exists, and it is reasonable to believe there will be a large trade from this quarter for some time to come. Prices are gradually creeping up. No. 1 Bessemer is quoted at 59s. per ton, and 60s. may be expected as the quotation in a short time, as makers are holding iron firmly. The chances are that the home and foreign requirements of pig-iron will be such as to necessitate the blowing in of the furnaces now out of blast, as stocks are very small, comparatively speaking, and are not likely to increase. The delivery by sea is extensive, the consumption by steelmakers is on the increase, and the general demand is such as makes the future very hopeful. The steel trade is very fully employed, and the major portion of the work on hand is on foreign account. At all the mills in the district there is very great activity, and the tonnage of steel rails and other railway material now on order is so extensive as to indicate most conclusively the importance of this industry being carried on the seaboard, whereby great facilities exist for shipment of material to foreign ports. Prices are firm and steady, but show no progress in the direction of an improvement. Shipbuilders do not occupy a very important position in this district, but the trade during the past year has been fairly developed, and the yards at Whitehaven, Workington, and elsewhere display a state of activity, which is likely to lead the enterprising owners thereof to develop still further an industry which is so peculiarly adapted to the district, and so likely to be commercially successful. Iron ore is quoted at from 14s. to 16s. 6d. per ton at the mines, but as raisers have sold largely forward there is not much on offer at the present moment except at full prices. Coal and coke trade buoyant. Shipping busy.

SCOTCH PIG-IRON SHIPMENTS.

The table below (copied from the *Public Ledger*) is a comparative statement of the weekly shipments of Scotch pig-iron from the beginning of this year and the corresponding weeks of the previous four years, up to last week. The shipments were:—

Week ending	1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan. 7 ..	3,389	6,182	6,689	6,069	6,085
14 ..	5,767	6,677	12,288	6,291	4,532
21 ..	7,742	4,668	7,566	6,331	6,170
28 ..	8,041	8,906	13,383	4,969	6,550
Feb. 4 ..	12,236	7,226	14,190	6,130	5,637
11 ..	10,786	10,072	10,612	7,272	5,722
18 ..	10,528	7,405	15,152	8,996	5,124
25 ..	10,739	11,266	12,603	8,318	7,836
March 4 ..	12,600	9,900	17,968	13,910	6,816
11 ..	13,287	8,261	23,985	10,743	8,662
18 ..	17,544	7,893	20,987	11,167	7,728
25 ..	12,375	12,262	23,598	9,463	11,499
April 1 ..	10,107	10,421	15,822	15,653	7,448
8 ..	12,662	10,647	18,309	12,913	9,441
15 ..	11,694	13,736	15,784	13,228	9,513
22 ..	14,170	11,492	16,279	11,795	8,382
29 ..	18,056	13,147	17,749	12,923	8,853
May 6 ..	11,387	9,461	14,799	13,135	9,348
13 ..	14,982	10,718	13,123	9,919	7,820
20 ..	12,122	9,532	11,036	11,415	10,742
27 ..	9,760	11,943	12,819	15,434	7,362
June 3 ..	9,867	14,509	13,198	8,402	7,008
10 ..	14,270	12,331	11,860	6,156	10,310
17 ..	15,308	13,537	9,502	7,258	6,326
24 ..	10,147	10,977	11,544	7,074	7,175
July 1 ..	15,324	13,095	12,527	8,252	7,416
8 ..	10,474	13,850	10,158	5,619	7,151
15 ..	13,136	11,118	10,478	9,383	8,104
22 ..	13,763	12,805	10,815	3,923	5,010
29 ..	13,116	9,285	10,015	10,670	5,973
Aug. 5 ..	13,579	12,669	12,260	7,504	5,993
12 ..	13,258	11,700	14,252	8,652	6,162
19 ..	13,983	10,965	15,870	7,260	8,700
26 ..	13,151	11,239	13,530	18,312	8,493
Sept. 2 ..	16,076	13,795	15,522	11,795	9,918
9 ..	10,629	14,812	12,546	11,443	9,792
16 ..	10,903	14,079	10,789	15,650	7,956
23 ..	12,933	12,841	8,670	17,935	6,455
30 ..	15,023	16,434	11,725	16,638	10,160
Totals ..	475,033	431,426	529,372	397,020	302,970

CLEVELAND PIG-IRON SHIPMENTS.

The following table contains comparative statements of the weekly shipments of Cleveland pig-iron from the beginning of this year and the years 1881 and 1880, up to last week, as well as the monthly shipments from January to August of 1882 and the previous four years:—

	Weekly Shipments.				
Week ending	1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan. 7 ..	14,992	12,331	14,347	—	—
14 ..	18,128	13,454	21,712	—	—
21 ..	16,125	10,246	19,384	—	—
28 ..	18,648	6,890	15,315	—	—
Feb. 4 ..	14,990	9,761	11,988	—	—
11 ..	15,591	15,035	18,082	—	—
18 ..	14,929	14,681	15,725	—	—
25 ..	16,941	10,116	21,055	—	—
Mar. 4 ..	25,669	19,135	26,546	—	—
11 ..	21,245	13,474	14,322	—	—
18 ..	19,400	17,464	18,295	—	—
25 ..	15,433	19,370	24,241	—	—
April 1 ..	19,850	20,498	12,138	—	—
8 ..	17,530	13,154	22,145	—	—
15 ..	14,934	19,390	18 835	—	—
22 ..	16,406	19,221	17,111	—	—
29 ..	16,286	22,946	20,878	—	—
May 6 ..	14,000	15,537	20,509	—	—
13 ..	16,841	15,195	19,239	—	—
20 ..	17,609	16,480	16,471	—	—
27 ..	16,801	21,426	21,648	—	—
June 3 ..	8,943	17,568	22,400	—	—
10 ..	17,678	19,796	18,368	—	—
17 ..	15,596	21,834	17,078	—	—
24 ..	15,715	21,827	12,312	—	—
July 1 ..	20,803	22,802	24,117	—	—
8 ..	18,473	15,265	18,613	—	—
15 ..	12,349	21,159	19,190	—	—
22 ..	14,218	22,046	17,302	—	—
29 ..	18,477	21,529	17,135	—	—
Aug. 5 ..	22,361	20,983	15,734	—	—
12 ..	21,199	15,982	17,651	—	—
19 ..	20,002	17,980	18,387	—	—
26 ..	18,864	21,923	14,067	—	—
Sept. 2 ..	20,536	15,027	20,609	—	—
9 ..	26,600	22,364	15,375	—	—
16 ..	25,491	16,866	14 472	—	—
23 ..	17,555	17,218	19,165	—	—
30 ..	27,395	19,903	19,657	—	—
Totals ..	704,066	684,076	714,278	—	—

	Monthly Shipments.				
Week ending	1882. Tons.	1881. Tons.	1880. Tons.	1879. Tons.	1878. Tons.
Jan. 31 ..	71,458	47,890	78,941	39,751	47,932
Feb. 28 ..	66,893	58,370	71,573	57,458	51,697
Mar. 31 ..	89,837	81,609	84,375	73,105	61,386
April 30 ..	68,909	78,894	88,018	65,250	69,256
May 31 ..	71,405	75,729	81,826	71,456	74,043
June 30 ..	68,373	91,577	82,186	60.808	68.804
July 31 ..	74,311	87,580	82,306	61,825	78,628
Aug. 31 ..	95,861	84,901	72,665	61,499	73,275
Sept. 30 ..	100,838	78,897	78,928	101,154	66,936
Totals ..	707,885	685,447	720,821	592,306	591,975

THE CONTINENTAL IRON AND COAL TRADE.

BELGIUM.—The Belgian iron market preserves its former activity, which is sustained by a steady inflow of fresh business. There is a very heavy demand for pig-iron. At Charleroi, engagements are already being entered into for the first half-year of 1883, although as a rule this does not take place until January. This is probably owing to the rise in coke. No sales can be effected under 60 fr. per ton. Several contracts extending to March, and representing from 7,000 to 8,000 tons, have been concluded at 61 fr. and 62 fr. Some makers will not go below the latter figure. English foundry pig is slightly higher, at about 66 fr. Finished iron appears to be settling down to a price which has long been aimed at (140 fr.) by manufacturers, but which has not hitherto been generally accepted. There is a good demand from England. Joists and angle iron are steady at 145-150 fr. and 150-155 fr. respectively. Plates are firm at 190 fr. for No. 2, 210 fr. for No. 3, and 280 fr. for fine plates.

BRUSSELS, WEDNESDAY EVENING.—This week has brought no material change in our iron trade. Pig-iron is not very strongly demanded just now, but prices are well maintained, manufactured iron being well bought at the same prices as during the latter weeks. Prospects continue good. English pig is a little higher at 66 fr. The official quotations of the Bourse des Métaux are as follows:—

	Sept. 27 Francs.	Oct. 4. Francs.
Belgian foundry pig	75 ..	75
Belgian forge pig	65 ..	65
Luxemburg foundry pig	57·50 ..	57·50
English foundry pig	65 ..	66
Bars No. 1	140 ..	140
Joists	145 ..	145
Angle iron	150 ..	150
Nailrod	145—150 ..	145—150
T iron	145—150 ..	145—150
Ordinary plates	190 ..	190
Boiler plates	210 ..	210
Sheets	290 ..	290
Steel rails	160 ..	160
Tires	235 ..	235
Axles	245 ..	245

In the coal market the tendency is very hard, and the firmness must surely lead to a rise in a short time. All kinds of coal and coke are very actively treated at quotations as under:—

	Sept. 27. Francs.	Oct. 4. Francs.
House coal	16—18 ..	16—18
Large coal	16—19 ..	16—19
Unscreened coal ..	11·50—14·50 ..	11·50—14·50
Small steam coal ..	10—11 ..	10—11
Small coking coal ..	11 ..	11
Coke	19 ..	19
Half washed coke ..	21 ..	21

FRANCE.—There is no sensible alteration to note in the tone of the French iron market. But pig-iron is more than usually active, and prices are more than firm. In the Meurthe-et-Moselle the price of forge pig is 70 fr., while foundry pig No. 3 sells at 84 fr., and even 85 fr. at furnaces. For manufactured iron the position is unchanged. In the Nord prices are steady, and a fair business is being done. The following are ruling quotations:—

	Sept. 27. Francs.	Oct. 4. Francs.
Merchant bars	190—195 ..	190—195
Angle iron	205—225 ..	205—225
Joists	205—245 ..	205—245
Puddled plates	240—270 ..	240—270
Ordinary plates	235 ..	235
Boiler plates	275 ..	275
Heavy plates	220 ..	220

In the Haute-Marne the former favourable tendency continues, and orders are being booked with deliveries up to June 30, 1883. Forges are less hesitating now to treat, as they have secured their supplies of pig iron. The general quotation for coke iron is 210 fr., and for mixed iron 230 fr. There is no change at Paris, but the market is certainly tending towards firmness. Merchant iron is sold to consumers at 200 fr., plating iron at 210 fr.

The French coal market is very active.

GERMANY.—The firm tendency of previous weeks continues in the German iron market, enquiry being as steady as ever. In Westphalia, the production of pig-iron for the fourth quarter has been disposed of by most blast-furnaces, and those of the latter having still blanks to fill up in their order books are inclined to do so only at advanced rates. In Silesia puddling pig is quiet, but selling steadily at 65 to 66 marks at furnaces. Foundry pig is active, at 73 to 73 marks. There is a brisk demand for charcoal pig, the ruling quotation being 85 marks. Finished iron works are still fully employed, and generally provided with orders up to the end of the year. Next to bar and finer kinds of iron, both heavy and light plates, rolled wire, and the lighter descriptions of profile iron, are in much request. Steel-

makers appear to have as much work in hand as they can well execute, and yet fresh contracts keep coming in, especially for steel rails for home railways. Engineers, iron-founders, and boilermakers are all busy. At Dortmund, the quotations for iron and steel, per 1000 kilogrammes at works (English descriptions per ton at port of shipment), are:—

	Sept. 25. Marks.	Oct. 2. Marks.
White-grained puddling pig	64—66	64—68
Spiegeleisen	76—78	76—78
German foundry pig No. 1	76	76
German foundry pig No. 2	72	72
German foundry pig No. 3	66	66
German Bessemer pig	72	72
English foundry pig No. 3	44—45	44—45
English Bessemer hematite pig	58—60	58—60
Luxemburg pig	47½	47½
Bar-iron	150	150
Fine-grained iron	170	170
Angle-iron	150	150
Joists	150	150
Boiler-plates	220	220
Boiler-plates No. 2	205—210	205—210
Fine Siegen plates	195—200	195—200
Fine-grained plates	250	250
Charcoal plates	280	280
Low Moor plates	310	310
Bessemer steel rails	160—166	160—166
Bessemer steel rails (defective)	135	135
Bessemer steel pit rails	135—143	135—143
Iron pit rails	135	135

We learn from the *Frankfurter Zeitung* that, immediately after the completion of the St. Gothard Railway, a number of prominent proprietors of coal mines in Westphalia sent a proposal to the chamber of commerce at Milan to make an exhibition of their products, in order to show the consumers of coal in Upper Italy the possibility of an active competition of German with English coal. This offer was accepted, and the Milan chamber of commerce has decided to hold an international exhibition of coals from all European countries, as well as of apparatus and appliances for heating. This exhibition will probably be opened in the autumn of 1883. The German mine owners have already formed a special commission at Dortmund, and they hope to carry out their plan of driving British coal from the market in Upper Italy. Great activity prevails in the German coal market, enquiry being most stimulated for household fuel. Export to Italy is increasing, and the quantities sent to and via Hamburg are also growing steadily. Briskness continues in the coke trade. In Westphalia, most coke-ovens have sold their production for the fourth quarter. Prices both of coke and coal are rising. The same favourable reports reach us from the Silesian coal market, where advances are likewise expected. At Dortmund, quotations per 100 cwt. at the pit's mouth or at coke-ovens are as follows:—

	Sept. 25. Marks.	Oct. 2. Marks.
Best coal (Stückkohle)	45—50	45—50
Cobbles	30—40	30—40
Large washed nuts	40	40
Washed smith's coal	34—35	34—35
Washed coking coal	28—30	28—30
Inferior coal	20—24	20—24
Gas coal	36—40	36—40
Mixed coal	32—33	32—33
Prime coke	65—68	65—68
Patent coke	70—78	70—78
Small coke	45—50	45—50

ROUMANIA.—The Roumanian minister of public works recently invited tenders for the supply of 16,500 tons of steel rails, and the *Curieral Financiar* now reports that the following offers have been made:—

	Francs.
Bolckow, Vaughan, and Co.	159·37
Cockerill	162·55
Bochumer, Verein	162·48
Gute Hoffnung- Hütte Westphalia	183.90
Krupp	174·60
Aron Hirsch	185·0
Moss Bay Hematite Iron Company	173·50
Union, Dortmund	162·60

Bolckow, Vaughan, and Co.'s tender was thus distinctly below those of the other competitors, and the *Curieral Financiar*, in noting the result, adds that not only are the English rails the cheapest, but that in quality also they surpass those of any other country.

NEW PATENTS.

ALL the patents are placed alphabetically, with the official numbers attached. The new applications range from No. 4567 to No. 4691, being the entries from Sept. 26 to Oct. 2, 1882.

NEW APPLICATIONS.

Advertising.—*S. Puente*, 39, *Abingdon Villas, Kensington, London.* [4616

Aerial and Marine Navigation.—*B. W. Maughan, Cheapside, and S. D. Waddy, Finsbury Park, both of Middlesex.* [4585

Artificial Light Apparatus.—*J. V. McClellan, Glasgow, Lanark, N. B.* [4651

Axles.—A communication.—*W. Clark*, 53, *Chancery Lane, Middlesex.* [4683

Bicycles, &c.—*F. G. Kinnaird*, 13, *Elsworthy Terrace, Primrose Hill, Middlesex.* [4631

Bicycles, &c.—*T. Warwick, Aston, Birmingham, Warwick.* [4597

Bismuth Bronze.—*J. Webster, Solihull, Warwick.* [4636

Boiling Wort, &c.—*D. W. Hamper, and E. Harper, both of Sowerby Bridge, Yorks.* [4611

Boring and Tapping Holes in Boiler Plates.—*R. Davidson, Glasgow, Lanark, N. B.* [4628

Brakes.—*H. Downie, Corstorphine, Midlothian, N. B.* [4657

Buckles for Braces, &c.—*J. B. Brooks, and F. R. Baker, both of Birmingham, Warwick.* [4584

Bulletproof Shields.—*J. B. Parkin, Woolwich, Kent.* [4617

Camp Stools.—A communication.—*J. C. Mewburn*, 169, *Fleet Street, Middlesex.* [4576

Centrifugal Machines.—A communication.—*A. Steenberg, Copenhagen, Denmark.* [4584

Checking the Arrival of Employes.—*W. M. Llewellin, Bristol, Gloucester.* [4653

Churns.—*J. Llewellin, Haverfordwest, Pembroke.* [4667

Cigarettes.—*O. W. T. Barnsdale, Nottingham.* [4624

Clips for Securing Tyres on Wheels of Bicycles, &c.—*F. R. Baker, Birmingham, Warwick.* [4614

Compound Vacuum Pumps.—A communication.—*J. H. Johnson*, 47, *Lincoln's Inn Fields, Middlesex.* [4606

Composition for Imparting a Glossy Appearance.—*E. and A. Wright, both of Rephidim Street, Surrey.* [4670

Construction of Vessels for Mineral Oils, &c.—*G. A. J. Schott, Bradford, Yorks.* [4602

Converting Reciprocating into Rotary Motion.—A communication.—*W. R Lake, Southampton Buildings, London.* [4643

Corset Busks and Clasps.—A communication.—*C. A. Snow, Washington, Columbia, U. S. A.* [4589

Corsets.—*R. A. Young, and R. Neilson, both of Bristol.* [4610

Coupling for Railway Vehicles.—*R. Stone, Bristol.* [4673

Coupling Railway Carriages, &c.—*J. Richardson, and C. Greenwood, both of Harrogate, Yorks.* [4662

Cylinder Glass Stylographs.—*H. L. Callendar, High Street, Saffron Walden, Essex.* [4648

Decomposing Alloys.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4580

Distribution of Electric Energy.—*F. C. Phillips*, 110, *Cannon Street, Middlesex.* [4601

Doubling Yarns.—*E. Dyson, Milnsbridge, Huddersfield, Yorkshire.* [4681

Dredging Buckets.—A communication.—*W. Clark*, 53, *Chancery Lane, Middlesex.* [4578

Dynamo-Electric and Magneto-Electric Machines.—*J. S. Beeman, W. Taylor, and F. King, all of* 110, *Cannon Street, Middlesex.* [4680

Electric Meters.—*S. D. Mott, New York, U. S. A.* [4645

Electric Meters.—*S. D. Mott, New York, U. S. A.* [4646

Electro Motor.—*M. Immisch*, 110, *Toriano Avenue, Camden Road, Middlesex.* [4665

Facilitating the use of Cables.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4601

Fast and Loose Pulleys.—*T. B. Sharp, French Walls, Smethwick, Staffs.* [4595

Fasteners for Ship's Side Lights, &c.—*R. C. Thompson, Sunderland, Durham.* [4647

Feeding Wool to Carding Machines.—*R. Tatham, Rochdale, Lancs.* [4613

Firegrates.—*E. Whillier, Stoke Newington, Middlesex.* [4618

Folding Knives, &c.—*L. Hager, Solingen, Germany.* [4654

Furnace Linings, Firebrick, &c.—A communication.—*S. Pitt, Sutton, Surrey.* [4569

Furnaces for Steam Engine Boilers.—*J. W. Couchman*, 7, *Stanley Villas, Pembury Road, Middlesex.* [4632

Governors for Regulating Speed of Steam Engines.—*P. B. Elwell, Wolverhampton, Staffs.* [4626

Hack Cap.—*J. D. Lampard*, 74, *Mansford Street, and F. Coppen*, 1, *Essex Place, Hackney Road, Middlesex.* [4670

Heating Water.—*A. J. Rilling, Holborn, Middlesex.* [4568

Hydraulic Machines for Shearing, &c.—*R. H. Tweddell*, 14, *Delahay Street, Westminster, Middlesex.* [4574

Ice Making Machinery.—A communication.—*W. H. Beck*, 130, *Cannon Street, London.* [4579

Improved Game.—A communication.—*J. H. Johnson*, 47, *Lincoln's Inn Fields, London.* [4640

Incandescent Electric Lamps.—A communication.—*J. F. Phillips*, 7, *Southampton Buildings, Middlesex.* [4676

Independent Car Wheels.—A communication.—*H. J. Allison*, 47, *Southampton Buildings, Middlesex.* [4593

Keyless Watches.—*T. Waller, Coventry, Warwick.* [4675

Lamps.—A communication.—*W. L. Wise*, 40, *Lincoln's Inn Fields Middlesex.* [4594

Lathes.—*W. Allan, South Dock, Sunderland.* [4685

Lawn Tennis Balls.—*J. Neville, London Lane, Hackney, Middlesex.* [4650

Locks for Bags, &c.—*J. Jackson, jun., and C. Sheeley, both of* 40, *Great Smith Street, Westminster.* [4667

Locomotive Brakes.—A communication.—*W. M. Lendrum, Blatherwicke, Northampton.* [4586

Looms.—*J. H. Pickles, Burnley, Lancs.* [4682

Looms.—A communication.—*J. B. Alliott, Nottingham.* [4666

Machinery for Digging.—*P. Proctor, Stevenage, Herts.* [4656

Manufacture of Gas.—*S. Chandler*, 104, *Newington Causeway, Surrey.* [4572

Mashing Malt, &c.—*D. W. Hamper, and E. Harper, both of Sowerby Bridge, Yorks.* [4610

Material for Removing Ink Stains from the Human Skin.—A communication.—*G. F. Redfern*, 4, *South Street, Finsbury, Middlesex.* [4581

Measuring, &c., Electric Currents.—*S. Z. de Ferranti, Richmond Gardens, Shepherd's Bush, and A. Thompson, Guildford Place, Russell Square, Middlesex.* [4506

Metal Punches.—A communication.—*A. J. Boult*, 323, *High Holborn, Middlesex.* [4689

Metallic Staircases.—*R. Hudson, Gildersome, Yorks.* [4655

Miners' Lamps.—*N. T. Stevens, Wellingborough, Northamptonshire* [4571

Musical Instruments.—*T. Machell, Glasgow, Lanark, N.B.* [4652

Musical Instruments.—A communication.—*H. J. Haddan, Kensington, Middlesex.* [4633

Nut Locks.—A communication.—*A. J. Boult*, 323, *High Holborn, Middlesex.* [4688

Obtaining Artificial Light.—*J. Mayer*, 71, *Great Portland Street, Middlesex.* [4608

Obtaining Mechanical Effect by Electrical Energy.—*E. L. Voice*, 1, *Francis Street, Torrington Square, Middlesex.* [4567

Obtaining Motive Power.—*J. A. Stephan, Worcester.* [4653

Obtaining the Extract from Tanning Materials.—*J. Hutchings, Warrington, Lancs.* [4607

Operating upon the Atmosphere of Apartments.—*W. Nightingale, Southport, Lancs.* [4660

Ornamental Frillings.—*C. Jackson, Nottingham.* [4649

Ornamental Pile Fabrics.—*T. P. Firth, and F. Farrand, Brighouse, Yorks.* [4641

Paper for Bank Notes, &c.—A communication.—*J. H. Johnson*, 47, *Lincoln's Inn Fields, Middlesex.* [4605

Parallel Rulers.—*C. R. Baillie-Hamilton, Grove Park, Kent.* [4642

Pasting Labels to Bottles, &c.—*F. Foster*, 23, *Forston Street, Hoxton, Middlesex.* [4591

Peat Fuel.—*G. Wilson, Elmers End, Kent.* [4672

Photography.—*C. P. Evans, Birmingham, Warwick.* [4671

Planté's Secondary Batteries.—*S. G. L. Fox, Queen Anne's Gate, Westminster.* [4625

Portable Electrical Apparatus for Lighting Gas Flames.—A communication.—*J. Imray*, 28, *Southampton Buildings, Middlesex.* [4573

Preparations of Animal Vaccine.—A communication.—*B. T. Darke, Hemming's Row, Charing Cross, Middlesex.* [4623

Preparation of Crude Earth Wax.—*F. E. Tucker, Peckham, Surrey.* [4582

Preparation of Finings.—*D. W. Hamper, and E. Harper both of Sowerby Bridge, Yorks.* [4612

Presses for Expressing Oil From Seed.—*W. Bushell, and W. T. Haydon, both of Dover, Kent.* [4686

Propellors for Steamships.—*R. Gibbs, Liverpool, Lancs.* [4575

Purification of Alcohol.—A communication.—*A. J. Boult*, 323, *High Holborn, London.* [4658

Purification of Coal Gas.—*C. F. Claus, Mark Lane, Middlesex.* [4644

Railway Brakes.—*J. Buckle*, 26, *Upper Charlton Street, Fitzroy Square, Middlesex.* [4677

Raising, &c., Portable Riveting Machines.—*R. H. Tweddell*, 14, *Delahay Street, Westminster, and J. Fielding, Gloucestershire.* [4600

Regenerating Sulphur from Alkali Waste.—*W. Weldon, Rede Hall, Burstow, Surrey.* [4678

Registering the Supply of Electricity.—*J. H. Greenhill, Belfast, Antrim, Ireland.* [4661

Regulating the Transmission of Power.—*J. Johnson, and R. Talbot, both of Blackburn, Lancs.* [4587

Rolling Mills.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4624

Rotary Pumps and Blowers.—A communication.—*M. Benson*, 52, *Chancery Lane, Middlesex.* [4583

Safes.—*H. Harris, Northampton.* [4620

Safety Hooks for Harness Traces.—A communication.—*H. Lake, Southampton Buildings, Middlesex.* [4690

Secondary or Storage Batteries.—A communication.—*W. Clark*, 53, *Chancery Lane, Middlesex.* [4599

Securing Windows and Doors.—*T. Young, and G. C. Wood, both of Sheffield, Yorks.* [4652

Sewing Machines.—*C. P. Evans, Birmingham, Warwick.* [4615

Slide Valve, &c., for Locomotive Engines.—A communication.—*W. R. Lake, Southampton Buildings, London.* [4621

Spinning Rings.—A communication.—*B. J. B. Mills*, 23, *Southampton Buildings, Middlesex.* [4603

Steam Boiler Furnaces.—*A. G. Fell, Palmerston Buildings, London.* [4634

Steam Engines.—A communication.—*T. J. Handford*, 42, *Southampton Buildings, Middlesex.* [4674

Steam Generators.—A communication.—*W. P. Thompson*, 6, *Lord Street, Liverpool, Lancs.* [4638

Steam Generators.—A communication.—*W. Clark*, 53, *Chancery Lane, Middlesex.* [4669

Steering Gear.—*E. J. Harland, G. W. Wolff, W. H. Wilson, and W. J. Pirrie, all of Queen's Island, Down, Ireland.* [4637

Stoppers for Bottles, &c.—*N. Thompson, Brooklyn, New York, U. S. A.* [4635

Stowing Bags of Wool, &c., Inboard Vessels.—*H. M. Whitehead, Lothbury, London.* [4577

Suspension of Pictures.—A communication.—*W. R. Lake, Southampton Buildings, Middlesex.* [4600

Tobacco Pipes.—*T. R. Quirk, St. Helier's, Jersey.* [4622

Transmission of Power Force.—A communication.—*W. P. Thompson*, 6, *Lord Street, Liverpool, Lancs.* [4687

Treating Leaves, &c.—A communication.—*A. V. Newton*, 66, *Chancery Lane, Middlesex.* [4570

Treatment of Sewage.—*J. Young, Kelley, Renfrew, N. B.* [4659

Treatment of Soap Lyes to Recover Glycerine.—*A. J. Lawson, and H. L. Sulman, both of Bristol, Gloucester.* [4590

Tricycles.—*A. Gibbs, Birmingham, Warwick.* [4629

Umbrellas.—*W. Pickin, Birmingham, Warwick.* [4633

Utilising Heat as a Motor.—*H. Gruson, and R. Handrick, both of Buckau, near Magdeburg, Prussia.* [4598

Velocipedes.—*S. Miller*, 202, *Kennington Road, Surrey.* [4668

Ventilating Appliances.—*H. Blair, Glasgow, Lanark.* [4592

Wagons.—*W. Cook, Glasgow, Lanark, N. B.* [4630

Water Gauge Taps.—*T. Allison, Milnsbridge, Huddersfield, Yorks.* [4588

ABSTRACTS OF SPECIFICATIONS RELATING TO METALS

PUBLISHED DURING THE WEEK ENDING SEPT. 30, 1882.
(Prepared by PHILIP M. JUSTICE, 53, Chancery Lane, W.C.)

Manufacture of Projectiles.—891 (1882).—*T. Nordenfelt.*—The projectiles are coated or covered with a softer metal to enable them to fit closely to the bore of the gun, the coating consists of tin or copper deposited by electricity upon the projectile.

Corrugating Machines.—937 (1882).—*V. B. Daden.*—The corrugating is effected by means of rings or narrow rollers which are mounted upon screws. The plate is inserted between the upper and lower set of rings and rollers, which are then given two motions, the top and bottom set of rollers approaching each other longitudinally by means of the screw, and also approaching each other vertically the motions being equally regulated.

Extracting Metals from Silicon Substances.—969 (1882.)—*J. P. Kagenbusch.* Provisional Protection only.—The siliceous substances are first pulverised, then roasted with charcoal or carbonaceous substance. When the roasting is completed, it is thrown red hot into water. The substance or minerals are then dried and mixed with finxes, such as, soda ash, potash, borax, &c. After the smelting is finished, zinc and copper is added to the molten mass in order to facilitate the separation of the metals from the siliceous substances.

Cutting Screw Threads.—972 (1882).—*J. Whitham.* Provisional Protection only.—To enable a screw thread to be cut on the ends or any other part of the exterior of a tube a sleeve is provided to which is attached a guide screw which has extending from it an arm holding the tool for cutting the same.

Horse Shoe Nails—997 (1882).—*J. Beggs.*—In order to form the point of the nail, inclines are made on one side of the cutting tool. The movable cutter descends twice in the formation of each nail, the first descent forming one side of the point. The second cutting the nail from the plate. Underneath the fixed cutter is a fixed presser by which in conjunction with a movable presser, the sides of the nail are shaped.

Fish Joints.—1003 (1882).—*A. Davy.*—The upper part of the fish-plate bears againts the shoulder under the rail head, and also on the upper and lower side of the rib or flange. At the foot of the rail it also extends below the rail, the two plates meeting together in narrow faces. One strong central bolt and two other bolts arranged on one side of the centre line of the middle bolt secures the two fish-plates together.

Railways—1010 (1882).—*G. M. Minchin, and L. H. Despeissis.* Provisional Protection only.—In order to secure direct communication by electricity between two or more trains on a line of railway when there is danger of collision, an iron rod having several non-conducting pieces let into it, is laid between the lines. A current passes through this. A bell being caused to ring in trains approaching each other when at a specified distance.

Nut Locks.—1070 (1882).—*King*, communicated by L. Gissinger.—In applying the invention to fish-plate joints, a piece of wire is bent round one bolt and passed round another. On this is hung a leaf plate which fits between the two nuts of the bolts, and effectually prevents them turning by the jarring of the rail or otherwise.

COMMERCIAL.

NEW COMPANIES.

ASPHALINE COMPANY, LIMITED.—This company proposes to acquire and work the two letters patent, dated and numbered respectively 11th November, 1880, No. 4643, and 8th June, 1880, No. 2488 the first for a new manufacture of explosive compounds, the second for a new and improved manufacture of compounds. The company was registered on the 25th Sept., with a capital of £12,035, in 2407 shares of £5 each, whereof 400 are called A shares, entitling the holders thereof to one equal sixth part or share of the net profits.

ASTOR CONSOLIDATED SILVER MINING COMPANY, LIMITED.—Upon terms of an agreement of the 19th Sept., this company proposes to purchase from George Robertson Hazewell, of 12, Queen Street, Cheapside, the mining claim known as the "W. B. Astor" lode, situate in Clear Creek, County, Colorado, U. S. A., and also the following lodes in the same county, viz: the "Buckeye" the "Astor Extension," the "A. T. Stewart," the "Sunburst," the "Tunnel," and the "Emmett" lodes. It was registered on the 23rd Sept., with a capital of £200,000 in £1 shares.

GODALMING SCREW STEAMSHIP COMPANY, LIMITED.—Incorporated on the 23rd Sept., with a capital of £24,000, in £100 shares, to acquire and work the s.s. *Godalming*.

HENRIATT MINING AND SMELTING COMPANY, LIMITED.—This company was registered on the 22nd Sept., with a capital of £300,000, in £1 shares, to purchase, work, and develop the Henriett Mine, situate in the State of Colorado, U. S. A.

"KNIGHT OF THE CROSS" TUG COMPANY, LIMITED.—Registered on the 20th Sept., with a capital of £10,240 in 64 shares of £160 each, to purchase and work the *Knight of Cross* tug, now building at the Canada Works, Birkenhead.

NOEL BROTHERS AND COMPANY, LIMITED.—Incorporated on the 16th Sept., with a capital of £4500, in £100 shares, to carry on the business of brick, tile and pottery manufacturers.

SMOKE ABATEMENT APPLIANCES COMPANY, LIMITED.—This company proposes to purchase and work the letters patent No. 4752, dated 21st November, 1879, granted to John Martin Stanley, of Rhyl for the invention of improvements in boiler furnaces and other fireplaces. It was registered on the 23rd Sept., with a capital of £25,000 in £1 shares.

STEAMSHIP "THUNDER" COMPANY, LIMITED.—Registered on the 26th Sept., with a capital of £10,000, in £10 shares, to purchase, own and work the s.s. *Thunder*, of London.

TILLERY COAL COMPANY, LIMITED.—This is the conversion to a company of the business of colliery proprietors, coal and mineral owners, carried on at the Tillery Colliery, Aberystruth, county of Monmouth, under style of, "Basil Jayne and Company." It was registered on the 23rd Sept., with a capital of £50,000, in £100 shares.

LANCASHIRE MAXIM-WESTON ELECTRIC COMPANY, LIMITED.—The agreement referred to in our last issue as unregistered has since been filed with the other registered documents of the company.

PRICE LIST OF IRON AND STEEL.

PREPARED BY

MESSRS. BOLLING & LOWE,

2, LAURENCE POUNTNEY HILL, LONDON, E.C.

STAFFORDSHIRE.

List Brands at Works. Per Ton.

BARS—
- ½ in. to 3 in. rounds and squares £7 10 0
- 1 in. to 6 in. flats 7 10 0

Rounds and Squares,
- 3½ in., 10s. per ton extra.
- 4 in., 20s. ,,
- 4½ in., 40s. ,,
- 5 in., 50s. ,,

Rounds only,
- 5½ in., 70s. ,,
- 6 in., 90s. ,,
- 6½ in., 110s. ,,
- 7 in., 130s. ,,

Round and Squares,
- 7-16 in., 10s. ,,
- ½ in., 20s. ,,
- 5-16 in., 30s. ,,
- ¼ in., 40s. ,,
- 3-16 in. 70s.

HOOPS—
- 1 in. to 6 in. wide by usual guage £8 0 0
- 1 in. wide up to 26 w. g., 20s. per ton extra.
- ½ in. wide up to 20 w. g., 40s. per ton extra.
- ⅜ in. wide up to 20 w. g., 80s. per ton extra.
- ½ in. wide up to 20 w. g., 120s., per ton extra.

PLATES—
- 10 15 feet long by 4 feet wide, not exceeding 4 cwt. £9 0 0
- 4 to 5 cwt., 20s. per ton extra.
- 5 to 6 cwt., 25s. ,,
- 6 to 7 cwt., 50s. ,,
- 7 to 8 cwt., 75s. ,,
- 8 to 9 cwt., 110s. ,,
- 9 to 10 cwt., 120s. ,,
- 10 to 11 cwt., 140s. ,,
- 15 to 20 ft. long, 20s. ,,
- 20 to 25 ft. long, 40s. per ton.
- 4 to 4½ ft. wide, 20s. ,,
- 4½ to 5 ft. wide, 40s. ,,

SHEETS—
- Singles 11 to 20 gauge. £9 0 0
- Doubles, 30s. per ton extra.
- Lattens, 60s. ,,

ANGLES—
- 1 in. by 1 in. to 8 united inches £8 5

TEES—
- 1 in. by 1 in. to 8 united inches £8 10

For each inch above 8 united inches 10s. per ton extra.
Best, 30s. per ton extra.
Best, best, 40s. ,,
Best best, 60s. ,,

STAFFORDSHIRE, MIDLAND, &c.

Ordinary Brands (at Works).

	£ s. d.	£ s. d.
Bars	6 10 0 to 7 10 0	
Hoops	7 0 0 to 7 10 0	
Plates	8 0 0 to 8 10 0	
Sheets	8 0 0 to 8 10 0	
Angles	7 0 0 to 7 10 0	
Tees	7 0 0 to 7 10 0	

Best, 10s. to 20s. per ton extra.
Best, best, 20s. to 30s. ,,
Treble best, 40s. to 60s. ,,

CLEVELAND AND NORTH OF ENGLAND BRANDS (at Works).

	£ s. d.	£ s. d.
Bars	6 2 0 to 6 5 0	
Ship Plates to 8 cwt.	6 15 0 to 7 0 0	
Angles	6 2 6 to 6 5 0	

Best, 10s. per ton extra.
Best, best, 30s. ,,
Treble best, 50s. ,,

SCOTCH (at Glasgow).

	£ s. d.	£ s. d.
Bars NB crown	7 0 0	
Hoops	7 10 0	
Ship Plates	8 0 0	
Boiler ,,	8 0 0	
Angles	7 10 0	

Best, 10s. per ton extra.
Best, best, 30s. ,,
Treble best 50s. ,,

WELSH (Newport and Cardiff).

	£ s. d.	£ s. d.
Bars	5 10 0 to 5 15 0	
Plates	7 0 0 to 7 10 0	

Best, 10s. per ton extra.

BELGIAN, (f.o.b. Antwerp).

	£ s. d.	£ s. d.
Bars	5 12 0 to 6 0 10 0	
Hoops	6 10 0 to 7 0 0	
Plates	7 10 0 to 8 10 0	
Sheets	8 0 0 to 10 0	
Angles	6 0 0 to 7 10 0	
Nail rods	6 10 0 to 7 0 0	

IRON ROLLED GIRDERS—
- Narrow flanges £6 0 0 to 7 10 0
- Wide flanges 6 10 0 to 8 0 0

STEEL ROLLED GIRDERS, ANGLES and CHANNELS at proportionate differences.

BEST YORKSHIRE (at Works).

BARS—

	£ s. d.
To 3½ cwt.	10 0 0
3½ to 5 cwt.	20 0 0
5 cwt. and upwards	22 0 0

BOILER PLATES—

	£ s. d.
To 2½ cwt.	22 0 0
2½ to 3 cwt.	23 0 0
3 to 3½ cwt.	25 0 0
3½ to 4 cwt.	27 0 0
4 to 5 cwt.	30 0 0
5 to 6 cwt.	33 0 0
6 to 7 cwt.	36 0 0
7 cwt. and over	39 0 0

Plates over 6 feet to 8 feet wide, 40s. per ton extra.

Sheets	24 0 0
Angles and Tees	22 10 0

	£ s. d.
Tyres to 4 cwt.	19 10 0
4 cwt. to 5½ cwt.	23 0 0
5½ cwt. and over.	26 10 0
Axles to 5 cwt	19 10 0
5 cwt. to 6 cwt.	22 10 0
6 cwt. and over	25 10 0

RAILS (at Port nearest Works).

	£ s. d.	£ s. d
Heavy iron	5 5 0 to 5 10 0	
,, Steel	5 5 0 to 5 10 0	
Light iron	5 12 6 to 5 17 6	
,, Steel	5 15 0 to 6 0 0	

Steel Mining Rails, 10 to 15 lb. per yard, £6 5/0 to £6 15/.
Fish Plates, heavy, 20s. per ton above rails.
Fish Plater, light, 60s. to 80s. per cwt. do.

BOLTS AND NUTS, for fishes—

	£ s. d.	£ s. d.
Heavy	16 0 0 to 20 0 0	
Light	26 0 0 to 28 0 0	

SPIKES—

	£ s. d.	£ s. d.
Heavy	14 0 0 to 16 0 0	
Light	16 0 0 to 18 0 0	

PIG-IRON.

Scotch Warrants (Glasgow) 51s. 7d.
Cleveland Warrants No. 3 (Middlesborough) ... 44s. 9d.
Cleveland No. 1 (Tyne or Tees), G.M.B. ... 49s. 6d.

CASTINGS

(f.o.b. Shipping Port).

SOCKET PIPES (for gas or water)—

	£ s. d.	£ d.
1½ to 2 in.	5 10 0 to 6 0 0	
2 to 3 in.	5 5 0 to 5 15 0	
3 to 8 in.	5 2 6 to 5 12 6	
8 to 20 in.	5 0 0 to 5 11 0	
20 to 48 in.	4 17 6 to 5 7 6	
Chairs	4 15 0 to 5 0 0	
Girders	5 15 0 to 8 0 0	

SCRAP—

	£ s. d.	£ d.
Old rails, Dale	3 10 0 to 3 15 0	
Do. flange	3 0 0 to 3 5 0	
Engineers' heavy scrap	2 18 0 to 3 0 0	
Light do.	2 0 0 to 2 5 0	

WIRE.

Rolled Fencing Wire (at Works)

	£ s. d.	£ s. d
Nos. 0 to 4	7 0 0 to 8 0 0	
5	7 10 0 to 8 10 0	
6	8 0 0 to 9 0 0	

Galvanized.

	£ s. d.	£ s. d
Nos. 0 to 4	11 0 0 to 11 5 0	
5	11 10 0 to 11 15 0	
6	12 0 0 to 12 5 0	

Drawn Fencing Wire.

	£ s. d.	£ s. d
Nos. 0 to 6	9 0 0 to 9 10	
7	9 10 0 to 10 0 0	
8	10 0 0 to 10 5 0	
9	10 10 0 to 11 0 0	
10	11 10 0 to 12 0 0	

Galvanised.

	£ s. d.	£ s. d
Nos. 0 to 6	13 0 0 to 13 10 0	
7	14 0 0 to 14 10 0	
8	14 15 0 to 15 0 0	
9	15 0 0 to 15 10	
10	16 0 0 to 16 10 0	

Drawn Bright Wire.

	£ s. d.	£ s. d
Nos. 1 to 6	11 0 0 to 11 10 0	
7	11 10 0 to 12 0 0	
8	11 15 0 to 12 5 0	
9	12 5 0 to 12 15 0	
10	13 0 0 to 13 10 0	

Drawn Bright Steel Wire.

	£ s. d.	£ s. d
Nos. 1 to 6	12 5 0 to 12 15 0	
7	12 15 0 to 13 5 0	
8	13 0 0 to 13 10 0	
9	13 10 0 to 14 0 0	
10	14 10 0 to 15 0 0	

Galvanised Fencing Strand (B.B)

	7 wires.	3 wires.
No. 0	17 10 0 to 18 0	
1	18 0 0 to 18 10 0	
2	18 10 0 to 19 0 0	
3	19 0 0 to 19 10 0	
4	19 10 0 to 20 0 0	
5	21 0 0 to 21 10 0	
6	21 10 0 to 22 0 0	
7	22 15 0 to 23 5 0	
8	24 10 0 to 25 0 0	
9	24 15 0 to 25 5 0	
No. 0	16 10 0 to 17 0 0	
1	16 15 0 to 17 5 0	
2	17 10 0 to 18 0 0	

STEEL (at Works).

Siemens-Martin or Bessemer.

	£ s. d.	£ s. d.
Plates	10 10 0 to 11 10 0	
Sheets	11 0 0 to 14 0 0	
Bars	9 0 0 to 10 0 0	
Angles	9 10 0 to 11 0 0	
Tees	10 0 0 to 11 10 0	
Spring Stl.	12 10 0 to 14 0 0	
Cast Steel for Tools	40 0 0 to 60 0 0	

GALVANISED IRON ROOFING SHEETS (at Liverpool).

CORRUGATED SHEETS 5, 6, 7, 8 feet long.
Gauges 16, 18, and 20, £14 0s. to £15 0s.
22 and 24 gauge, £15 0 to £16
26 gauge, £17 10 to £18 10s.
28 gauge, £19 10s. to £20 10s.
Sheets 8 to 9 feet long, 20. per ton extra.
Sheets 9 to 10 feet long, 40s. per ton extra.
Sheets 10 to 11 feet ong, 60s. per ton extra.
Sheets 11 to 12 feet, long 80s per ton extra.

LONDON PRICE LIST OF METALS, ORES, OILS, CHEMICALS, &c.

[FOR THE PRESENT AND PAST WEEK.]

Metal Market, City, Thursday Afternoon, 4 P.M.

(*October* 5, 1882.)

METALS AND ORES.

	Sept. 28. £ s.		Oct. 5. £ s.	
COPPER (per ton)—				
Chili, for 96 per cent.	70 5/	—	76 0	—
Wallaroo	73 0/	—	74 0/	—
Burra Burra	72 0/	—	73 0/	—
English Tough	71 0/	72 0	72 0/	72 0/
English Ingot, best	73 0/	74 0/	74 0/	76 0/
Sheets sheathing and rod	76 0/	—	80 0/	—
Bottoms	8 0/	—	85 10/	—
Ore per unit	—	—	—	—
PHOSPHOR BRONZE				
Special Bearing Metal (p tn)	117 0/	—	117 0/	—
Other alloys (per ton	125 0/	140 0/	125 0/	140 0/
TIN (per ton)—				
Straits (Cash)	107 15/	—	107 15/	—
Do. for arr.	—	—	—	—
Billiton	—	—	—	—
Banca	—	—	—	—
English Ingots	111 0/	—	111 0/	—
Do. Bars	112 0	—	112 0/	—
Do. Refined	111 0/	—	113 0/	—
Australian	107 15/	—	107 15/	—
TIN PLATES, per box, I.C. coke f.o.b. London	0 16 9	0 17 6	0 16 6	0 17/6
IX. do.	0 21/0	0 23/6	0 21/6	0 23/6
I.C. charcoal	0 20/	0 22/	0 20/	0 22,
I.X ,,	0 25/	0 27/	0 25/	0 27,
Red lead	16 10/	—	16 10/	—
White	21 10/	—	21 10/	—
Patent shot	17 10/	18 0	17 10/	18
ZINC (per ton)—from No. 9 Gauge.				
Sheets, rolled	19 10/	—	19 5/	—
Do., foreign	19 5/	—	19 5/	—
LEAD (per ton)—				
Soft English pig	14 5/	14 10	14 5/	14 10
Do. W.B.	—	—	—	—
Spanish soft	14 0/	—	13 7/6	—
Do. with silver	—	—	—	—
SPELTER (per ton)—				
Silesian, com	17 10/	—	17 5/	—
Rhenish	—	—	—	—
English	—	—	—	—
QUICKSILVER, bot.	6 0/	—	6 0/	—
ANTIMONY ore (per ton)—				
Australian	—	—	—	—
Spanish	—	—	—	—
French Star	5 0	55 0/	0/	55 0/
Crude (per cwt.)	1 14/	—	1 14/	—
NICKEL (per lb.)	0 3/3	—	0 3/3	—
BRASS (per lb.)—				
Sheets, 48×24	0 0/8	—	0 0/8	—
Tubes	0 0/11	0 1/	0 0/11	0 1/
Wire	0 0/8½	—	0 0/8½	—
Yellow metal	0 0/6	0 0/6	0 0/6	0 0/6
ASBESTOS (per lb.)	0 0/3	0 0/6	0 0/3	0 0/6
PLUMBAGO (per cwt.)—				
Ceylon lump	1 2/	1 5/	1 2/	1 5/
Do. chip	0 10/	0 14/	0 10/	0 14/
Do. dust	0 10/	0 12/	0 10/	0 12/
COALS (per ton)—				
East Hartlepool	1 2/	—	1 2/	—
Lambton	1 4/	—	1 4/	—
Tees	1 4/	—	1 4/	—
Hartley	1 2/	—	1 2/	—
Hetton	1 4/	—	1 2/	—
Hawthorn	1 4/	—	1 4/	—
Tunstall	1 3/	—	1 3/	—
	1 2/	—	1 2/	—

OILS, CHEMICALS, &c.

	Sept. 28. £ s.		Oct 5. £ s.	
OILS (per ton)—				
Olive, Galloli	—	—	—	—
Do. Gioja	—	—	—	—
Do. Levant	36 0/	37 0/	36 0/	37 0/
Do. Seville	—	—	—	—
Do. Corfu	—	—	—	—
Seal, pale	33 0/	34 0/	33 0/	34 0/
Sperm head	74 0/	74 0/	74 0/	74 0/
Cod	31 10/	32 10/	31 10/	32 10/
E.I. Fish	—	—	—	—
Rape, English, brown	31 10/	32 0/	31 10/	31 15/
Do. refined	—	—	—	—
Foreign Refined	—	—	—	—
Ground nut and Gingelly Madr.	—	—	—	—
Palm oil, fine	35 0/	37 0/	37 10/	38 0/
Palm nut oil	—	—	—	—
Linseed oil	22 10/	23 0/	22 12 6	23 0/
Cot onseed (per ton).				
Crude	22 15/	27 0/	22 15/	26 15/
Refined	28 10/	29 10/	29 5/	29 15/
Hull	25 15/	—	25 15/	—
Lard, English	64 0/	66 0/	64 0/	66 0/
Cocoanut, Cochin	35 10/	36 10/	35 10/	36 10/
Do. Ceylon pipes	29 5/	31 0/	29 5/	31 10/
Sydney	—	—	—	—
OIL CAKE (per ton)—				
Linseed, Lndn.	8 5/	8 10/	8 5/	8 0/
American barrels	8 12 6	8 0/	8 12/6	7 15/
Do. bags	—	—	—	—
Marseilles	8 5/	—	8 5/	—
Rapeseed	5 12/6	6 0/	5 12/6	6 0/
Cottonseed	5 15/	5 17/6	5 15/	5 17/6
TALLOW—PYC. old (per cwt.)	51 0	53 6/	51 0/	53 0/
S.American. Beef	—	—	—	—
N. American ,,	—	—	—	—
Australian Beef (fine) (per cwt)	0 /42	0 43/6	0 43 6	0 45/6
Do. Sheep ,, (per ton)	0 45 6	0 46 6	0 45 6	0 47 9
PETROLEUM OIL—(per gal.)	0 0/6½	0 0 6½	0 6½	0 6½
Refined coal oil	—	—	—	—
Naphtha	0 0/7	0 0 8	0 0/7	0 0/8
TURPENTINE—(per cwt.)				
French Spirits	—	—	—	—
American do.	—	—	—	—
WHALEFINS (per. ton)—				
Davis' Straits	900/	1600/	900/	1000/
Arctic	900/	1000/	900/	1000/
BRIMSTONE (per ton)—				
Rough 3rds	6 15/	—	6 15/	—
Roll	10 15/	12 10/	9 0/	9 10/
Flour	10 15	12 10/	10 15/	12 10/
ACID, (per lb.)				
Acetic	0 19/	0 26/	0 19/	0 26/
Second quality (per gal.)	—	—	—	—
Citric (per lb.)	—	1/11½	—	1/11½
Muriatic (sp. salts per cwt.)	0 4/6	0 7 6	0 4/6	7 6
Nordhausen 50 per cent.	0 45/	0 50/	0 45/	0 50/
Nitros	0 0/2½	0 0/4½	0 0/2½	0 0/4½
Oxalic (per lb.)	0 /6	—	0 /6	—
Sulphuric, white	—	—	—	—
Do. Brown	0 0/0½	0 0/1	0 0/0½	0 0 1
Tartaric Crystal	0 1/8½	0 1/7	0 1/8½	0 1 7
Do. Powdered	—	—	—	—
AMMONIA—				
Carbonate, per lb.	0 0/6½	0 0/7½	0 0/6½	0 0/6½
Sulphate, Best White (per ton)	20 5/	21 0/	20 5/	21 0/
ARSENIC—White Lump (per cwt.)	0 24/6	0 25/	0 24/6	0 25/
Powdered do	0 10/5	0 10/9	0 10/6	0 10/9
Bleaching Powder 35 %	0 2/6	0 5/	0 2/6	0 5/
BORAX, Refd., Eng.	0 60/	0 63/	0 60/	0 63/

	£ s.	£ s.	£ s.	£ s.
COPPERAS, green, tierces (ton)	0 45/	—	0 45/	—
PORTLAND CEMENT—				
1st quality in casks 400 lb. gross, including casks, f.o.b., Thames, per cask	0 9/	—	0 9/	—
Do. in sacks, 200 lb. net (per ton)	2 0/	—	2 0/	—
Sacks extra, 1/6 each.				
Charlton White Paint (per cwt.)	1 12/	—	1 12/	—
Calley's Torbay Paint, Brown	0 30/	—	0 30/	—
Do. Red	0 34/	—	0 34/	—
LEAD, Sugar, Eng., white	0 33/0	0 36/0	0 33/0	0 36/0
Brown	—	—	—	—
Red (per cwt.)	0 16/6	0 17/0	0 16/6	0 17/0
White, ground	0 21/	0 21/6	0 21/	0 21/6
LITHARGE (per cwt.)	0 17 6	0 21/6	0 17 6	0 21/6
LIME (per ton)—				
Acetate, Brown	12 5/	12/ 0	12 5/	12/ 0
Distilled	18 5/	18 10/	18 5/	18 10/
POTASH—				
Bichromate (lb.)	0 0/5½	6 0/	0 0/5½	0 6/
Chlorate (pr. lb.)	0 0/5½	—	0 0 5½	—
Pruss. Red (lb.)	1 10/	—	1 10/	—
Do. Yel. lb.	0 10/	0 10/	0 10/	0 10/
Sulphate 80% (per ton)	8 1/ 9 10/		8 1/	9 10/
SALT PETRE (per cwt.)—				
Engl. refnd. kgs.	0 26/	0 27/6	0 26/	0 27/ 6
Do. barrels	0 27/	0 29/	0 27/	0 29/
Do. Bengal	0 19/6	1 1/6	0 19/6	1 1/6
SODA, Acetate (per cwt.)	0 26/	—	0 26/	—
Bicarbonate	0 0/6	—	0 0/6	—
Caustic 60 to 62 %	0/0	11/0	0/0	11 0/
Crystals grw.hts.exship (prton)	3 2 6	3 2 5/	3 2 6	3 6/3
Nitrate	13 /4½	13 0/	13 /0	13 3/

RATES OF FREIGHT.

THE current rates for coal and iron are :—

	Newport, Newcastle Cardiff, or Sunderland, Swansea. s. d.		Newport Newcastle Cardiff or Sunderland, Swansea. s. d.	
Alexandria	—	13 0	Messina	11 6	11 6
Alicante	—	—	Montevideo	23 0	20 6
Ancona	—	—	Montreal	12 0	15 0
Aden	—	19 0	Muscat	—	—
Athens	12 6	—	New York	—	11 0
Batoum	—	16 0	New Orleans	—	12 6
Bombay	19 0	19 0	Naples	4 6	12 0
Bahia	—	19 0	Odessa	10 3	10 0
Barbadoes	—	16 0	Oporto	—	8 6
Barcelona	—	16 0	Penang	—	18 6
Brindisi	—	11 0	Pernambuco	—	19 0
Buenos Ayres	—	24 0	Palermo	—	11 3
Bermuda	—	13 0	Panama	—	22 0
Bussorah	—	—	Para	18 0	18 0
Calcutta	—	14 6	Padang	—	22 0
Callao	—	24 0	Port-au-Prince	—	12 0
Cape Good Hope	21 0	20 0	Porto Rico	—	—
Cape de Verds	—	11 6	Port Said	—	12 0
Cadiz	—	10 0	Reunion	—	27 0
Cagliari	—	12 0	Rio Grande do Sul	—	42 6
Carthagena	—	—	Rio Janeiro	—	20 6
Cardenas	—	11 0	Rosario	—	30 0
Cienfuegos	—	11 0	Seychelles	—	—
Coconada	—	—	Singapore	17 6	18 0
Civita Vecchia	13 3	13 6	Saigon	—	—
Colombo	—	18 0	Shanghae	—	—
Colon	—	18 6	San Sebastian	—	—
Constantinople	10 0	10 0	San Francisco	—	14 6
Corfu	—	12 0	St. Catherine's	—	26 0
Demerara	—	17 0	St. Paul de Loande	—	29 0
Fayal	—	14 0	St. Thomas	—	12 0
Fiume	—	—	St. Jago de Cuba	13 0	—
Galle	—	18 0	St. Lucia	—	13 6
Genoa	10 6	11 3	Santos	24 0	22 6
Gibraltar	—	9 0	Savona	—	11 0
Galatz	—	13 0	Seville	—	11 0
Havana	—	14 0	Smyrna	—	13 0
Hong Kong	—	22 0	Spezzia	—	13 0
Hiogo	—	—	Syra	—	10 6
Iquique	21 0	21 0	Sierra Leone	—	20 0
Jamaica	12 6	13 0	Sebastopol	—	—
Java	20 0	19 0	Taganrog	—	—
Kertch	—	—	Tarragona	—	14 0
Kurrachee	—	—	Teneriffe	—	12 6
Lisbon	8 9	8 0	Tientsin	—	—
Leghorn	12 0	13 0	Trieste	—	11 6
Malta	—	9 0	Trincomalee	—	—
Malaga	12 0	12 0	Trinidad	—	—
Madeira	12 0	12 0	Valencia	—	15 0
Madras	—	—	Valparaiso	12 0	—
Maranham	—	18 0	Venice	22 6	22 0
Martinique	—	14 6	Yokohama	—	23 0
Mauritius	13 0	23 0	Zanzibar	—	—
Marseilles	—	14 cs.		—	—

METROPOLITAN BOARD OF WORKS.

RETURN *of the Testings made at the Gas Testing Station during the Week ending October* 3, 1882.

Company and District.	Illuminating Power.* (In standard sperm candles.) Max.	Min.	Mean.	Sulphur. (Grains in 100 cubic feet of gas.) Max.	Min.	Mean.	Ammonia. (Grains in 100 cubic fe et of gas.) Max.	Min.	Mean.	Sulphuretted Hydrogen.	Pressure.†
Gas Light and Coke Company.											
Netting Hill	17·4	17·1	17·3	8·3	7·8	8·1	0·3	0·2	0·2	None	In excess.
Camden	17·8	16·4	17·2	14·0	12·5	12·5	0·2	0·0	0·1		
Dalston	18·2	17·0	17·5	11·5	10·1	11·1	0·0	0·0	0·0		
Bow	18·0	16·8	17·4	13·4	10·0	12·0	1·0	0·0	0·4		
Chelsea	17·3	16·7	17·1	13·1	10·0	11·1	0·6	0·0	0·2		
Kingsland Rd.	17·2	16·0	16·9	11·1	9·6	10·3	0·1	0·0	0·0		
Westminster (cannel gas)	22·1	20·5	21·4	9·6	7·6	8·2	0·3	0·0	0.0		
South Metropolitan Gas Company.											
Peckham	16.8	16·4	16·6	11·0	9·3	10·1	0·6	0·3	0·4		
Clapham	16·4	15·8	16·1	12·4	10·5	11·4	0·6	0·2	0·4		
Tooley Street	17·0	16·2	16·6	13·7	9·9	11·8	0·6	0·0	0·3		
Commercial Gas Company.											
Old Ford	17·1	16·9	17·2	13·6	7·5	10·3	0·1	0·1	0·1		
St. George-in-the-East	17·5	16·6	16·9	7·5	5·2	6·0	0·4	0·2	0·2		

W. J. DIBDIN, F. I.C., F.C.S.
Consulting Engineer and Superintending Gas Examiner.

* The standard illuminating power for common gas in the metropolis is 16 sperm candles, and for cannel gas 20 sperm candles. Sulphur not to exceed 17 grains in the 100 cubic feet of gas. Ammonia not to exceed 4 grains in the 100 cubic feet of gas.

† Pressure between sunset and midnight to be equal to a column of one inch of water. Pressure between midnight and sunset to be to be equal to a column of six-tenths of an inch of water.

THE CLYDE RIVET WORKS CO., GLASGOW.

Ship-Boiler Girder Rivets, Railway Spikes, Screws, Screw Bolts, Nuts.

BEST MATERIALS AND WORKMANSHIP. MODERATE PRICES.

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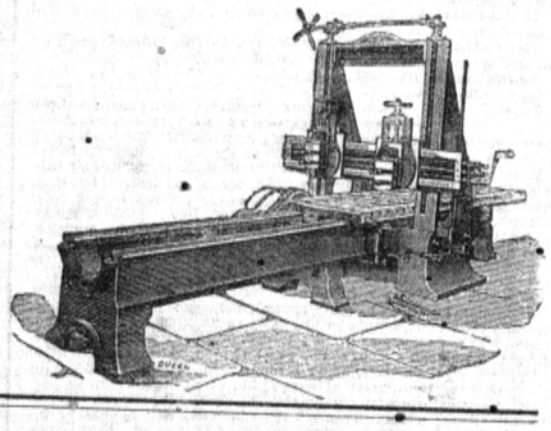

Catalogue for 1882 on application.

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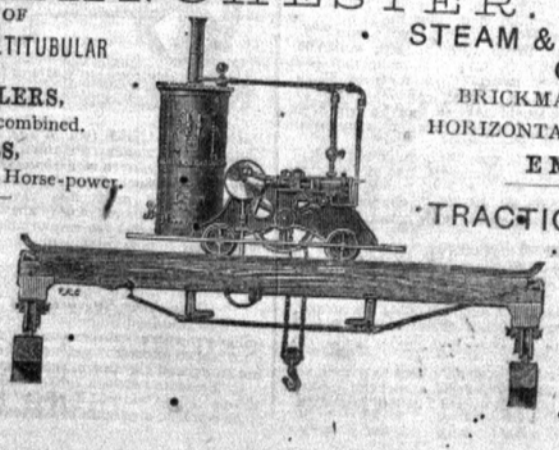
EARTH BORING MACHINES.



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METHOD OF APPLYING THATCH.

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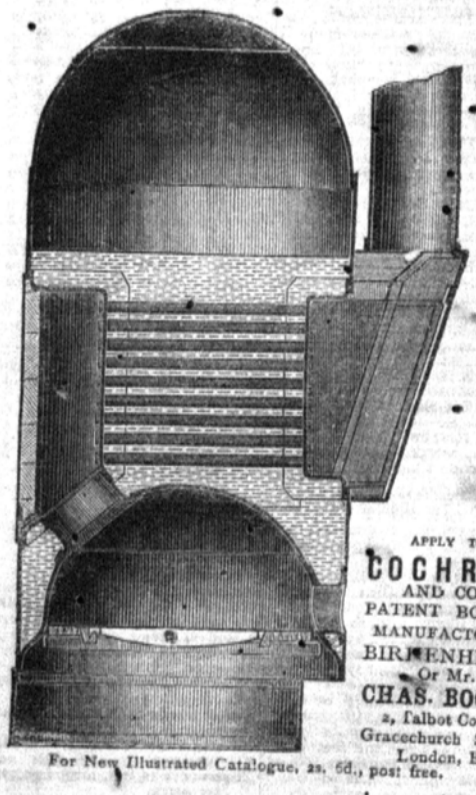

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PRICES CURRENT OF MANUFACTURED GOODS
OF
BIRMINGHAM AND DISTRICT

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The quotations given are manufacturers' average prices, dependent, of course, on terms of payment as well as the quality and quantity of goods ordered, and fluctuations in cost of raw material.

The Prices and Discounts quoted are carefully revised every week, and great pains are taken to render this List thoroughly reliable.

October 4.

Prices generally are unaltered, makers withholding new lists until after the ironmasters' quarterly meetings, which take place next week. With metals rising, and iron very firm, the outlook points to advanced prices in manufactured hardware being declared very shortly, a decided tendency in an upward direction being visible. The home trade is still quiet, but for export there is a good demand, and business altogether is evidently improving.

ABRIDGED LIST.

AMERICAN WIRE HOBS, 1 lb., 42/6; 1½ lb., 36/6; 2 lb., 3/6; 2½ lb., 31/6; 3 lb., 30/6 per cwt.

ANCHORS, common, 1 to 10 cwt. 14/ per cwt.

ANVILS (Common), 18/9 per cwt.; Best anvils, not warranted 20/ per cwt.; Best warranted anvils (bicks tied in 1 to 5 cwt.), 21/6 per cwt.

AUGERS (shell), ½ inch to 2 inch, 11/ to 44/ per doz., less 57½%; (screw), ½ inch to 2 inch, 16/ to 64/ per doz , less 57½.

AXES, ship carpenters', 4½ to 5½ per lb.; Kent and house carpenters' ditto, /4 to /5; ditto, steel polished, 5 to 6, felling axes, 4½ to 4½; bright and blued, solid steel, /7 to /8. American felling or wedge axes, steel, polished, /11 per lb.

AXLE PULLEYS, iron, 8/ to 26/6, 2½ inch; Brass face ditto 26/6 to 46/6, 2½ inch.

AXLES, 35 to 45%

BASINS,—Bright tinned, shallow, 8 inch, 2/6; 9 inch, 2/9; 10 inch, 3/4; 11 inch, 4/; 12 inch, 4/6; 13 inch, 5/; 14 inch, 6/; 16 3/; 17 inch, 3/9; 18 inch, 4/3; 13 inch, 4/9; 14 inch, 5/9; 16 inch, 7/9 per doz.

BASTARD BELLOWS, 52½ %; best extra nailed bastard bellows, 47½%; best improved long Bristol, 42½%; common smiths' bellows, 62½%; best warranted extra double nailed, 45 to 50%; ditto, with movable pipe for shipment, 52½%.

BELLS.—House brass, rough, /8 to /10 per lb.; turned edge, 8½ to /10 per lb.; turned and lacquered on edge, 1/5 to 1/10 per lb.; cattle and sheep bells, with brass loops, 1/1 to 1/3 per lb.; clock bells, 1/5 to 1/6 per lb.

BELL STAPLES (fine tinned) ½ inch, /11; ¾, /18; 1, /24; 1½, 3½; 2, /5; 2½, /6 per gross.

BED SCREWS, London, black heads, 6, and 7-16, and ½ inch, 8/6 to 10/6 per gross; London heads, with bright turned collar, 6 and 7-16, and ½ inch nuts, 11 9 to 12/9; black welded heads, 8/3 to 9/3; common slit heads, 6, and ½, and ¼ inch, 8/9 to 9/9; bright turned notched heads, 6, and 7-16, and ½ inch, 12/3 to 13/3; black notched heads, 10/ to 11/ per gross. Bedsteads, cheap stump, 6 feet by 3 feet 6 inches, 7/6 to 9/6 each; cheap French, 6 feet by 3 feet 6 inches, 8/6 to 10/6 each, rising /6 for every 6 inches.

BOLTS.—Solid end tower, 72½ to 75%; ditto, solid end barrel, 67½ to 70%; best solid tower bolts, 75%; japanned Scotch tower bolts, 55%. Bolts and nuts, black, ¼, and 5-16 to 2 inch and under, 3/6 and 4/, ⅜ 5/6, 7-16 6/7 per gross, ½ and 9-16 23/, ⅝ and 11-16 21/, ¾ to 1¼ inch, 20/ per cwt.; 2¼ to 3 inch, ¼, 4/, 5-16 4/7, ⅜ 6 6, 7-16 7/10 per gross; ½ and 9-16 21/, ⅝ and 11-16 19/, ¾ to 1¼ 18/ per cwt. Square heads, round necks, square nuts, bright engineers hexagon heads, 2¼ to 3 inch, ¼ 22/, 5-16 24/, ⅜ 27/ 7-16 31/ ½ 45/ 9-16 51/ ⅝ 67/ ¾ 69/ ⅞ 126/ inch 184/ per gross. Bright engineers hexagon nuts, ¼ 10/, ⅜ 12/, ½ inch 16/6, ⅝ 14/6, 1 inch 14/6, 1¼ inch 16/6 per cwt. delivered.

BRASS HEAD NAILS, 57½ to 65%; star head, 50%; brass plated countersunk head, 30 to 35%; blacksmith's tongs, 23/ per cwt.; real ℔ Victoria charcoal box irons, 45 to 50%; ordinary charcoal ditto 0 65%; brushes, painters', 50 to 75%; best ditto, 15 to 50%; brass relled, 2 to 12 inche. wide to 30 W.G., /7½ per lb. Brass sheets, 24 and 28 inch, 8 lb. and upwards, or 27 W.G., /8½ per lb.; ship and turret bells, 1/4 per lb. Battery kettles, 125/ per cwt.; brass jelly pans, with bails, /0½ to /9½; without bails, /10½ to /10½; Maslin kettles, cast, 4 to 16 inch, /9 to /9½ per lb. Brass shoe bills, /9 per lb.; brass scale pans, 1/6; brass toddy kettles, 15 to 20%.

BRASS CORNICE POLE RINGS, light, middle and strong, 45%.

BRASS WIRE, /7½ per lb. up to No. 20 W. G.; back bands, 1 lb. and larger, 16/9 per cwt.; ditto, smaller, 2/ per cwt. extra; double swivel ditto, 7/ per cwt. extra.

CART TRACES, 9 to 12 links to foot, 16/3 to 18/9 per cwt.

CHAIN, machine made, Wire, single link, "Iron," 55%; double link ditto, 55%; machine-made Wire Chain, single link, "Brass," 55%; registered ditto, 55%; close link brass chain, 55%; oval link brass chain, 55%; brass clock chain, 55%; short link tested (rigging) chain, 3-16 inch, 19/9; ¼, 17/; 5-16, 15/3; ⅜, 15/; 7-16, 13/6; ½, 12/9; ⅝, 12/; ¾, 11/6; 1 inch, 11/ per cwt.; well chain, twisted or straight link, ¼ inch, 25/3; 3-16, 18/; ¼, 16/; 5-16, 14/9 per cwt. delivered.

CHAIR NAILS (brass), lacquered or gold colour, No. 1 to 12, 2/ to 7/6 per 1000; machine polished, 1/9 to 7/3 per 1000; lacquered or gold coloured, 2/ to 1/2½ per lb.; discount per 1000, 57½%; per lb., ℔, delivered.

CHIPPING CHISELS, solid cast steel, /6 per lb.

COACH BOLTS AND NUTS, round or cheese heads, square necks and nuts, black, 3 inch by ¼, 4/1; ⅜, 4/3; ½, 5/1; ⅝, 5/7; ¾ inch, 6/1 per gross. Bright, 3 inch by ¼, 4/9; ⅜, 5/3; ½, 5/9; ⅝, 6/3; ¾ inch 6/9 per gross. Black, 3 inch by 5-16, 4/9; ⅜, 5/3; ½, 5/9; ⅝, 6/3; ¾ inch, 6/9 per gross. Bright, 3 inch by 5-16, 5/6; ⅜, 6/; ½, 6/6; ⅝, 7/; ¾ inch, 7/6 per gross delivered.

COACH SCREWS.—Patent bright pointed, 2 inch and under, ¼ inch, 3/1; 5-16, 3/8; ⅜, 4/6; 7-16, 5/4 per gross; ½ inch, 26/; ⅝ inch, 23/; ¾, 22/ per cwt.; 4½ to 6 inches long, ⅜ inch, 26/6; 7-16, 25/; ½, 24/; ⅝, 20/; ¾, 18/ per cwt.; above 6 inch, ⅜ inch, 25/6; 7-16, 24/; ½, 20/; ⅝, 18/; ¾, 17/ per cwt.; 1/ per cwt. extra for hexagon heads, delivered.

COACH SPRINGS, 40%.

COCKS.—Brass range cocks, ¼ inch, 30/; ⅜, 42/; ½, 53/6; ¾, 64/; 1 inch, 11/; 5-16, 13/; ⅜, 15/; 7-16, 18/; ½, 23/; 9-16, 34/; ⅝, 38/; ¾ discount, 60%.

COFFIN FURNITURE, registered, 50%; ditto, common, 75%.

COPPER BOAT NAILS, ½ inch to 2 inches and above, 1/8 to /11½ per lb.; copper boat roves, ⅜ to ½ inch and above, 1/6 to 1/ per lb.; cut copper nails and tacks, ½ inch to 1 inch and above, 1/ to /10 per lb.

COPPER WIRE, /10 per lb. up to No. 20, W. G

COMPOSITION Sheathing and Slating Nails, ¾ inch, /8½ per lb. Copper brads and bills, /10 per lb.; round copper kettles, bare rivets, 1/7 to 1/9 per lb.; light round covered rivets, 1/6 to 1/7 per lb.; loaded 1/5 to 1/6; oval copper kettles, bare rivets, 1/10 to 1/11 per lb.; oval bare rivets, raise down, 1/11 to 2/1 per lb. Copper slating nails (cut), 1 to 2½ inch and upwards, /10½ to /11½ per lb.; copper scale pans, 1/9 to 1/10 per lb. Copper nails and tacks (wrought), 1 inch, 1/2 per lb. Chair webbing, No. 9, 4/3; 10, 4/8; Co, 4/1; C10, 4/6 per gross of 66 yards. Carpet rings, 1½ to 1¼ per gross. Cornice poles, 2½ inch, brass, best burnished, 4/9 per foot, less 45%; ½ covered brass poles, 1/2 per foot, less 45%; cornice poles, polished, self or mahogany colour, with ends and rings complete, /8 per foot; 2½ inch real mahogany cornice poles, with ends and rings complete, 1/7 per foot; 2½ inch birch rings, polished, self or mahogany colour, 19/ per gross; 2½ inch real mahogany rings, 28/ per gross net; japanned pillar chains, 1 yard, 16 by 6, 5/8 to 6/6 per doz. Japanned manger chains, 1½ yard, 6, 7/3 to 8/6; japanned rack, 1 yard, 18 by 6, 5/ to 6/; japanned dog, 1½ yard, 12 by 7, 5/6 to 6/6; 2 yards, 14 by 6, 10/ to 11/. Cowties, 6/6 to 8/6; open ring, 6/6 to 8/6; close ring, 5/6 to 6/6 per doz.; japanned watering chains, 14 by 6, 4/ to 5/; tinned ditto, 4/6 to 5/6; bullock chains, ½ inch hook at each end, 14 6 to 15 6; chest handles, improved japanned, 82½%; broad plate, strong and extra strong, 15 to 65%. Curtain rings (brass), 45 to 50%; square box coffee mills, 30 to 60%; common post coffee mills, 30 to 40%; best brass bushed mills 40 to 45%; London mills, 40 to 45%.

CUT NAILS.—Clasp, rose, and clout, 3 to 9 inch, 8/9; 2½ and 2¾ inch, 9/3; 2 and 2½ inch, 9/9; 1¾ inch, 10/3; 1½ inch, 10/9; 1¼ inch, 11/9; 1 inch, 13/9; ¾ inch, 16/ per cwt.

DISH COVERS, blue japanned wire, 1/3 to 5/6 per set of 6.

DOOR SPRINGS, X, 85%; XX, 77½%; XXX, 72½%; XXXX, 65%; brass circular and iron circular, 55 to 65%; brass reliance, 10 to 20%; climax, 20%; universal, 55 to 60%; paragon, 20%; O'Connor's patent lever hinge springs, 10 to 20%. O'Connor's vertical spring hinge door spring, 15 to 25%; Gerish's spring hinges, iron, 20 to 25%; brass 10 to 20%.

FILES, 55% the list.

FLOOR BRADS.—2 inch, 9/3; 2½ inch, 9/; 2¾ inch, 9/; 2¾ inch 11 inch, 5/3; 10 inch, 4/6; 13 inch, 7/3; 14 inch, 8 9; 12 inch, 42 lb., 7/; 10 inch, 8/3; 11 inch, 6/; 13 inch, 8/; 14 inch, 9/6.

GALVANISED WASHING TUBS, oval, 22 inch, 27/; 24 inch, 30/; 26 inch, 34/.

GALVANISED WIRE NETTING, 1½ inch mesh and larger, 67½%; 1 inch mesh and smaller, 72½%, delivered.

GIMP PINS.—Best black iron wire, ⅞ by 18, ½ by 18, ⅜ by 18, all /5½ per lb.; 19 gauge, /½ per lb. extra; coloured, /1 extra; best bright iron panel pins in 1 lb. packets, ½, ⅝, and ¾ by 17 inch, /3½; 1 and 1¼ by 16 inch, /3½; 1½ by 15 inch, /3 per lb.; tinned, /½ per lb. extra; brass panel pins, /9½ per lb., all sizes; copper ditto, 1/1 per lb. all sizes; brass escutcheon pins, ⅝ by 16, ½ by 15, ⅜ by 15, ¾ by 14, ½ by 14, 1½ by 13 inch, /9½ per lb.; brass gimp pins, 19 gauge, 1/ per lb.; ditto, 18 gauge, /11½ per lb.

GRID IRONS, London pattern, fluted, 70%; light ditto, 77½%; hanging round bar, 60%; doublet, 45%; round bar, /1½ per bar, 67½%; best fluted bar, 67½%; flat bar, 67½%; common flat bar, 67½%; common gridirons, /1 /1½ and /2 per bar less, 65 to 75%; gimblets, 50%.

HAMMERS.—Cast steel stone breaking and quarry, per cwt.; solid cast steel engineers' hand, 1½ lb. each and above, /8 per lb.; solid cast steel boiler makers' hand hammers, 1¼ lb. each and above, /8½ per lb.; iron and steel boiler makers' sledge hammers, 6 lb. and above, 18/6 per cwt.; solid cast steel sledge, 28/ per cwt.; platelayers' keying, 28/ per cwt.; holdfasts, japanned, 18/ to 20/ per cwt.; common Kent hand hammers, 55%; patent hasps and staples, 20 to 25%.

HINGES.—Patent, edge butts, 60 to 70%; patent Scotch butts, 55 to 60%; broad and narrow same discounts; patent table, bed, and back-flap hinges, 57½%; patent chest hinges, 55%; patent strap hinges, 55%; H hinges, 55%; HL hinges, 55%; japanned and Garnett hinges, double washered, light and strong, 40%; best best, London or Lancashire patent tees, 67½%; patent light japanned Scoth tees, 67½%; light patent hook hinges on plate and to drive, 30 to 35%; weighty Gothic, 20/ to 24/; scolloped edges, not japanned, 22/ to 24/; Scotch japanned tees, double washered, 20/ to 23/; Gothic Scotch japanned tees, 19/ to 22/; Gothic Scotch ees, self colour, 17/ to 21/; light "patent" broad Butts, polished joint, No. 200, 50%; ditto, No. 564, 35%; box hinges, 50%; light Parliament hinges, best strong 45%; best best ditto, 35% off list. Wrought hinges, common, 55%; best best, 52½%; best best, 50% off list. Heavy wrought hinges, common black, 13/6 per cwt.; ditto, common bright, 18/ per cwt.; filed edges, 17/6; japanned Gothic fancy, 15/6 to 18/; common bright, broad eye, 17/ to 18/; japanned, broad eye, fancy, 18/6; best bright, 21/ to 21/; best broad eye, 21/ to 23/ per cwt.; cast hinges, polished joint, light patent tariff butts, 200, 50%; 333, 42½%; 564, 35%; pressed hinges, common, 65 to 70%; best, 57½ to 62½%; common brass butt hinges, 1½ inch, 14/ per gross pairs net; very light, 8/6.

HOLLOWWARE.—Best, 45%; common, 55 and 50%; enamelled ditto, best, 30%; common, 35%.

HORSESHOES.—Fullered fore, 16/ to 18/; fullered hind, 17/ to 19/; stamped fore, 16/6 to 18/6; hind, 17/6 to 19/6.

IRONFOUNDRY, GENERAL.—Ash grates 7/9 to 9/ per cwt., air bricks, 2/9 to 3/6; half-single, 3/3 to 3/6; double, 5 6 to 6/ bars and bearers, 7/3 to 8/3; barrow wheels, 8/; bake pans, 8/6 to 9/6; camp ovens, 9/; cooking stoves, 9/ to 10/6; cellar grating, 8/6; clock weights, 7/6; Dutch stoves, 8/6 to 10/; dumb bells, common, 7/ to 9/; best best japanned, 15 to 17/6; furnaces up to 50 gallons, /3½ to /4; galvanised ditto, /7 to /9 per gallon; furnace doors, 9/6 to 12/; furnace grates, 8/6; heaters for box irons, 6/6 to 7/6; heaters for urns, 8/6 to 9/6; oven doors and frames, 8/6 to 10/6; three legged pots, Danish and plumbers' 9/; plumb bobs, 10 6; pudding pans, 10/6 to 11/6; pump spous, 10/6 to 13/; sash weights, 4/6; ditto, with pulleys, 7/ to 8/6; shoe anvils, 8/6; Italian irons, 50%.

MELTING LADLES, 2 inch to 6 inch, 2/ to 16/ per doz., less 15%; Pitch Ladles, 3 inch to 6 inch, 3/6 to 12/ per doz., less 10%.

NAILS.—Patent forged nails, "Iron or Steel." Strong rose flat points), 1 inch, 4 lb., 45/6; 1¼ inch, 6 lb., 38/; 1½ inch, 7 lb., 36/, 1¾ inch, 8 lb., 34/6; 2 inch, 10 lb., 32/6; 2¼ inch, 12 lb., 31/; 2½ inch, 17 lb., 28/6; 2¾ inch, 20 lb., 28/; 3 inch, 23 lb., 27/9 per cwt. Fine Rose (flat points), 1 inch, 2½ lb., 72 6; 1¼ inch, 3½ lb., 58/6; 1½ inch 4 lb., 54/6; 1¾ inch, 5 lb., 48/6; 2 inch, 7 lb., 43/6; 2¼ inch, 8 lb 41/6; 2½ inch, 10 lb., 37/9; 2¾ inch, 14 lb , 34/; 3 inch, 17 lb., 32/ per cwt. Coopers' rose (sharp points), 1½ inch, 7 lb. per m., 2/4; 1¾ inch, 8 lb., 2/7; 2 inch, 10 lb., 3/; 2¼ inch, 12 lb., 3/5; 2½ inch, 17 lb., 4/5½; 2¾ inch, 20 lb., 5/1; 3 inch, 23 lb., 5/11 per m. Fine Clasp (sharp points), 1½ inch, 4 lb. per m., 2/11; 1¾ inch, 5 lb., 2/4; 2 inch 7 lb., 2/10; 2¼ inch, 8 lb., 3/03; 2½ inch, 10 lb., 3/52; 3 inch, 14 lb., 4/63 per m. Best Canada (sharp pointed), 1½ inch, 4 lb. per m., 2/ 2 inch, 7 lb., 2/9; 2¼ inch, 8 lb., 3/03; 2½ inch, 12½ lb., 4/03; 3 inch 14 lb., 4/43 per m. Pound Nails, 6dy, 2¼ inch, 28/6; 8dy, 2¾ inch, 27/; 10dy, 3¼ inch, 23/6; 20dy, 4 inch, 23/ per cwt., discounts 52½% off iron, 47½% off steel. Nails, cast lath, 9/ per cwt.; wall nails, cast, 8/6 per cwt.; cast headed bills, ⅜ by 8 oz., 12/ to 14/; fine round cast bills, ⅜ inch, 11/ to 15/; strong round ditto, ⅜ inch, 12/6 to 14/; cast slate pegs, 10/ to 12/; black coffin nails, 55 to 60%; white ditto 45 to 55%; black coffin bullens, 50 to 55%; white ditto, 40 to 45%.

PICKS, iron and steel excavators, /3 to /5 per lb.

PLANES, 45% off the list.

PLOUGH TRACES, 9 to 12 links to foot, 17/3 19/9 per cwt.

RAILWAY BEATER PICKS, /3 to /5 per lb. delivered in London or Liverpool. Rakes, light garden, 50 to 60%; light solid end rakes, 47½ to 52½%; bo:stered teeth garden rakes, 50%; solid end, bolstered teeth garden rakes, 40 to 45%.

RATCHET BRACES, improved, 8 inch, 20/; 10 inch, 22/; 12 inch, 24/; 14 inch, 28/; 16 inch, 32/; 18 inch, 36/; 20 inch, 40; 22 inch, 44/; 24 inch, 48/ each, less 65% off list; ditto, with eccentric levers, 8 inch, 22/; 10 inch, 24/; 12 inch, 26/; 14 inch, 28/; 16 inch, 30/; 18 inch, 33/; 20 inch, 36/; 22 inch, 39/; 24 inch, 42/ each; drills for above, 15/ per doz., less 40% eccentric lever braces.

RIDDLES, common, ½ inch by 18, 21/ per doz.; do foundry or gravel, ½ by 18, 27/ per doz., less 55%.

RIVETS.—Copper hose, ⅞ by 8 and above, at /11 per lb.

RIVETS, Machine-made Wire, No. 6, 18/ per wt.; iron boo rivets, 23/6 to 24/6 per cwt.; brass ditto, /9 per lb. Ship, tank and girder Rivets, ¼ inch, 17/; ⅜, 13/6; 7-16, 13/; ½ inch, 12/6 per cwt.; Best Boiler Rivets, 1/ per cwt. extra. Ship scrapers, black stee blades, 50 to 55%; bright, 47½ to 52½%; cast steel black, 47½ to 52½%; bright, 42½ to 47½%; best cast steel black, 40 to 45%; bright, 30 to 40 p.c.; sash chain, copper, 55 p.c.; zinc, 55 p.c.; iron prepared ditto, 50 p.c.

SAD IRONS, common, 7/6 to 8/ per cwt., delivered; best japanned, 12/6 to 13/6 per cwt.; best best opanned, 15/6 to 18/6 per cwt

SCALES, copper, 72½ to 77½%.

SCREWS, iron wood screws, 70% brass ditto, 60%; copper wood screws, 35%; stove ditto, 65%; do wo. ditto, 70%; brass headlock screws, 40%.

SCREW STOCKS and DIES, 57½% off list.

SHOE BILLS, in 1 and 5 lb. parcels, extra strong, and strong, 9 to 13 W.G., /1/3; middle, 14 W.G., 11/3; fine, 15 W.G., 11/3; extra fine, 16 W.G., 12/3 per cwt Shoe heel, York, No. 1, 2/6 to 2/9 No. 2/1 to 3/3; No. 3, 6/9 to 7/6 per gross net; Dundee bet turned, 4/9 to /53 bright edge imperial or solid Scotch, 8/ to 8/9; bright York, 6i B, 6/9 to 7/3; bright solid, 6/3 to 6/9 toe plates, 8/3 to 8/9 per gross

SHOVELS, common iron, round back, dust, 4 inch to 8 inch, 1/9 to 6/ per doz., less 25%; socket handles, 1/ per doz. extra; Bell mouth Shovels, 7 inch to 10 inch, 2/ to 4/ per doz., net; ditto, japanned with wood handles, 3/4 to 5/6 per doz. net. Shovels, all steel, crutch handles, No. 2, 17/ No. 3, 18/3; No. 4, 19/9 per doz.; No. 5, 20/9 per doz.; eye-handles, 2/ per doz. extra; riveted ditto, 2/ per doz extra; Spades and bovels, common, 62½%; second, 52½%; Best, 42½% discount off the list

SIEVES, brass and iron, 55% off list; Wove wire, brass and iron, 55% off list.

SOFA SPRINGS, "Bright," 8 by 5 inch, 10/8; 8 by 6 inch, 10/9 8 by 7 inch, 12/6; 8 by 8 inch, 13/6; 8 by 9 inch, 15/3; 8 by 10 inch 19/ per gross, less 15 per cent. "Coppered," 1/ per gross extra in to 8 by 8; all above 1/6 per gross; coiled, /6 per gross extra.

SPOKES.—Steel bicycle and perambulator, tinned, cut to lengths, and headed, No. 6, 29/9; 7, 30/3; 8, 30/6; 9, 31/; 10, 31/6; 11, 32/; 12, 32/9 per cwt. Bright, 9/ per cwt. less.

STAIR RODS, turned ends, 85%; ditto, solid fancy ends, 85½%.

STAPLES, Wire fencing, 1½ to 2 inch, No. 6, W.G., 12/; No.

STEELYARDS, 65%.

TACKS, fine cut, in 1 and 7 lb. parcels, ½ inch, 29/6; ⅝ inch 28/6; ¾ inch, 19/9; ⅞ inch, 18/3; 1 inch, 17/6; 1¼ inch, 18/9; 1 inch 26/9 per cwt., tinned, 8/ per cwt. extra; in ¼ cwt. bags, 1/ per cwt, less.

TUBES, iron gas, 70%; fittings, 75%; galvanised iron gas tubes, 55% fittings 60%; lap welded boiler tubes, 50%, delivered; bell tube, zinc 33/ to 35/ per cwt.; patent cased tube, 57½ to 62½%, cut to lengths if required; polished and lacquered twisted brass tube, 40%; patent cased taper iron tube, 40 to 45%; patent taper iron tube, 40 to 45%; parallel iron brased tube, 40 to 45%; twisted iron parallel tube, 40%; patent cased parallel tube, 40%; Brass Tubes, plain, rough, ⅛ inch and above, /9; other shapes /80 to /11 per lb. Bell copper tube, ⅛ inch and upwards, /11 to 1/ per lb.; brass ditto, 1/1 to 1/3; locomotive and marine boiler tubes, seamless, 1½ to 3½ outside diameter, to 14 W.G., /11 per lb.

VICES, best warranted, "Black" staple, solid box, 26/ per cwt.; Best warranted, "Bright" staple, solid box vices, 28/ to 30/ per cwt.; vice boxes and pins, 66/ per cwt.

WASHERS.—Light iron, 77½%; heavy washers, 13 to 16 W.G 12/ per cwt.

WIRE.—Iron, bright, 0 to 6, 10/; 7, 10/6; 8, 10/ 9, 11/3; 10/, 11/9; 11, 12/3; 12, 13/; 13, 13/6; 14, 14/; 15, 14/9; 16, 15/6 17, 16 6; 18, 17/; 19, 18/ per cwt.; galvanised, 0 to 6, 3/1 per cwt. extra; best annealed drawn fence wire, oiled, 0 to 6, £9 5; 7, £9 15; 8, £10; 9, £10 10/ per ton; galvanised, 0 to 6, £12 10/; 7, £13; 8, £13 10/ 9, £14 per ton. Steel fence wire, round or oval, £2 per ton extra Black rolled fence wire, 4 or 5, £7 per ton. Tinned bottling wire, No. 22, 31/; 23, 33/; 24, 35/ per cwt., cut in lengths and made up in 7 lb. parcels. Fine galvanised iron wire, No. 23, 4/3 per stone of 14 lb.; cast steel wire, /5 per lb.; charcoal iron wire, 4/ per cwt. extra; tinned ditto, 9/ per cwt. extra, delivered in London; 5/ per tonsel in Liverpool.

WROUGHT, best, countersunk clout and cone head Nails 1 inch, 20/3; 1½ inch, 24/9; 2 inch, 22/; 2½ inch, 19/9 per cwt.; Best fine Swedish iron countersunk horse nails, stamped, 6 lb. per m., 53/ per cwt.; 8 lb. per m. 40/; 10 lb. per m. 45/9 per cwt.; 12 lb. per m, 43/6 per cwt., or subject to 45% Derby list. Wrought rose and deck head spikes, 4 inch, 12/3; 5 inch, 11/; 6 inch, 10/3; 7 inch, 10 per cwt.; galvanised, 4/9 per cwt. extra; Wrought rose nails at or sharp points, 2 inch, 21/9; 2½, 20/9; 2¾, 19/; 3, 17/6 per cwt. Wrought nails, May 1826 list, 40 to 45%; wrought Bromsgrove nails March 1878 list, 30 to 35 p.c.

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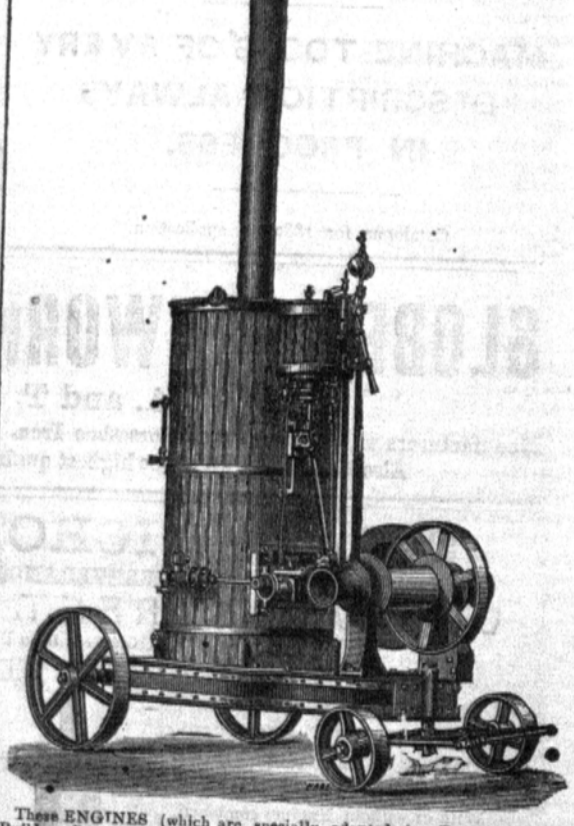

These ENGINES (which are specially adapted for Farmers' Builders, Contractors, Printers, small Work-hops, Warehouses, or any other purpose to which motive power can be applied) possess very great advantages over ordinary stationary Engines and Boilers, as they occupy much less space, and require no brickwork or masonry foundations. They are also suited for shipment as they can be packed without any of their working parts being removed, while their compactness, a great saving is effected in freight.

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IRON.

No. 509.

LONDON, FRIDAY, OCTOBER 13, 1882.

THE IRON TRADE OF THE PAST MONTH.

WITH the shipments of pig-iron from Cleveland during September, reaching over 100,000 tons—the largest quantity, we are informed, which has been shipped in any one month for three years—it might have been expected that the total exports of iron and steel for that month would have made a better show than they do. It is only comparatively speaking, however, that they may be described as slightly disappointing, for, according to the Board of Trade Returns they amount to the very respectable total of 383,369 tons, thus placing September as the third best month of the year in respect of the tonnage exported. Both July and August exceeded this quantity considerably; but it must be remembered that during these months the shipments were exceptionally heavy. The course of our exports during the first nine months of this and the two preceding years, will be rendered clear by the following table.

Total Exports of Iron and Steel for Nine Months ending September 30.

	1880. Tons.	1881. Tons.	1882. Tons.
January.. ..	275,979	197,112	317,390
February ..	264,252	192,870	299,911
March	387,305	290,198	376,206
April ..	444,991	329,100	345,704
May	360,603	356,664	377,418
June	361,865	362,263	378,210
July	315,904	356,422	403,333
August ..	294,586	361,271	432,972
September ..	297,013	376,517	383,369
Total ..	3,002,498	2,822,417	3,314,513

It will thus be observed, that while, as compared with the deliveries for August, the shipments for last month have fallen off by 49,603 tons, yet, as compared with those for September 1881, they show an increase of 6852 tons, making the total improvement for the nine months of this year 492,096 tons. This represents an increase in the amount which our foreign and colonial customers have paid for their purchases of iron and steel goods of £3,668,629. The difference in the value of the exports for the two months September 1881 and September 1882 is £13,185, indicating that it is principally in iron of the cheaper classes that the shipments have been larger, and accordingly it will be found that the exports of pig-iron for last month, amounting to 186,081 tons, and second only to those for August, are 24,129 tons in excess of those for September 1881. Bar, angle, bolt, and rod iron represent an increase of 3815 tons; hoops, sheets, &c., of 1583 tons; and cast or wrought manufactures of 4137 tons; while, on the other hand, the quantity of railway material exported has declined by 18,703 tons, and that of unwrought steel by 7692 tons.

If we turn to the shipments of iron to the United States we find at once an explanation of the large falling off in this country's exports for September as compared with August, and of what might be considered the small increase as shown in the shipments for last month when set against the ones for the corresponding month of last year. The deliveries in August amounted to the large aggregate of 122,263 tons, whilst last month they reached only 84,265 tons, or a difference against the latter period of 38,000 tons. As was shown in our last month's review of the Board of Trade Returns, the decrease in the consumption by the United States of the iron and steel productions of Great Britain during August, 1882, compared with August, 1881, amounted to the very trifling quantity of 1,366 tons; whereas, it will be seen from the figures given below, that exports to America during September last were 27,435 tons under those for the same month of 1881. Had it not been for this large decrease, therefore, on the part of one only of our customers, the total deliveries for last month would have exhibited the very respectable increase of 34,287 tons in comparison with the shipments for September, 1881. Notwithstanding the very serious contraction which is taking place in the volume of business in the iron and steel trades between this country and the United States, the fact that the shipments thither amounted in September to upwards of 84,000 tons, is sufficient to demonstrate that they are still of enough importance to demand special attention. It is to be feared that business between the two countries will suffer yet further diminution, as owing to the extremely low price at which steel rails are selling in the States, to which fact allusion was recently made in these columns, there is an entire cessation, for the time being, of fresh orders from that quarter. It remains to be seen whether the great activity which there was in the construction of new railways has expended itself for the present, or whether the low prices ruling will not induce capitalists to launch fresh enterprises, which may create a demand sufficient to raise prices to a point that will permit of English-made steel rails being imported. It is impossible to say whether the 7096 tons of railway material which were shipped last month to the United States were in reality for use within the Union, or were merely shipped to one of the southern ports for conveyance to Mexico. That there are grounds for suggesting this will be apparent from the following facts. Out of 4367 tons of rails dispatched last month from ports in the Bristol Channel to the United States and Canada, only 235 tons can be without doubt credited to the account of the former. On the other hand, 2621 tons were shipped to New Orleans, and there is every reason to suppose that this quantity was dispatched thither merely for its more convenient transport to its ultimate destination in the north of Mexico. But if there is reason to fear a further diminution in the actual consumption within the States of our iron and steel goods, there are grounds for hope that the exports from this country to Canada and Mexico will be well maintained during the next few months. The construction of the Canadian Pacific Railway is being pushed on from the western side of the Continent, and there is this convenience in working from that end, viz. that the importations of permanent way material can be carried on on the Pacific coast without hindrance from the winter. The capabilities of Mexico do not appear yet to be exhausted, and we hear of further large quantities of railway material being probably wanted in the near future for this destination. We close this part of our examination of the Board of Trade statistics with the following:—

Comparative Statement of the Exports of Iron and Steel to the United States during the Months of September, 1882 and 1881.

		Tons.	Increase. Tons.	Decrease. Tons.
Pig-iron	1881 ..	43,046		
,, ...	1882 ..	42,935	—	111
Railway material ..	1881 ..	26,321		
,, ..	1882 ..	7,096	—	19,225
Hoops, sheets, &c. ..	1881 ..	5,522		
,, ,, ..	1882 ..	4,670	—	852
Tinplates	1881 ..	16,074		
,, ...	1882 ..	15,578	—	496
Steel (unwrought) ..	1881 ..	12,632		
,, ..	1882 ..	5,316	—	7,316
				28,000
Bars, angles, &c. ..	1882 ..	1,390		
,, ..	1881 ..	1,090	300	—
Cast or wrought manufactures ..	1882 ..	416		
Cast or wrought manufactures ..	1881. ..	323		
Old iron	1882 ..	6,864	93	—
,, ...	1881 ..	6,692		
			172	565
	Net Decrease ..		..	27,435

Turning to look briefly at the more general aspects of our exports, we find that the improvement in the quantity of pig-iron shipped has been very widespread. There are, in fact, only two exceptions, viz. Russia, which has taken 3132 tons less than last year, and "other countries," with 982 tons less. All our other customers for this class of iron have required more than during September, 1881; Germany to the extent of 6360 tons; Holland, 3056 tons; Belgium, 5924 tons; France, 2375 tons; and British North America 10,639 tons. Under the head of bar, angle, bolt, and rod iron there is also a favourable balance displayed, the exports to Holland being 295 tons more; to Turkey, 507 tons; to British North America 1587 tons; to British India, 2300 tons; and to Australia, 406 tons more; while Italy and "other countries" have imported 363 tons and 965 tons less respectively. The most striking alteration as regards railway material is a decrease in the deliveries to British North America of 12,895 tons; on the same side follow Australia, 3370 tons; British India, 942 tons; Holland, 755 tons; and Sweden and Norway, 732 tons. Against these losses there are to be placed however, improvements in the shipments to "other countries" of 6794 tons; to Italy of 4795 tons; to Brazil of 2886 tons; to British possessions in South Africa of 2807 tons; to Spain of 877 tons; and to Chili of 721 tons. In cast or wrought manufactures Australia leads the van with an increase of 5763 tons, while amongst the other less important changes may be noticed an increase to British North America of 1330 tons; to "other countries" of 1254 tons; and to Holland of 684 tons; and a decrease to British India of 2172 tons; to Russia of 1178 tons; to France of 815 tons; and to British possessions in South Africa of 725 tons. The exports of hoops, sheets, &c., are mainly favourable to this year; British India having taken 1397 tons; Germany, 1162 tons; British North America, 834 tons; and Holland, 480 tons more, amongst other minor improvements; but Australia's consumption has fallen off by 390 tons, and the quantity shipped to "other countries" by 1188 tons. As regards tinplates, the deliveries to British North America have diminished by 691 tons; and those to Australia by 568 tons. It only remains now to append a comparison of the total exports to each of our principal customers.

Approximate Aggregate Exports of Iron and Steel.

	August 1882. Tons.	Sept. 1882. Tons.	Sept. 1881. Tons.
Russia	33,984	27,503	32,029
Germany	33,307	41,111	34,032
Holland	30,748	24,336	20,579
Belgium	8,791	11,179	5,255
France	17,752	17,625	16,004
British North America ..	42,567	36,959	36,155
Italy	7,865	10,399	5,747
British India	19,936	18,229	17,646
Australia	22,104	21,997	20,156
Sweden and Norway ..	135	453	1,285
Spain and Canaries ..	2,175	2,392	1,704
Mexico	2,569	7,015	6,824
Brazil, Chili, and Peru ..	7,957	6,498	2,258
South Africa (B.P.) ..	5,210	4,761	2,679

IRON TRADE SUMMARY.

A REVIEW of the course of the English iron market during the past week reveals a certain amount of hesitation in the development of the improvement which it has been our pleasant task to record for some little time back. The prices of pig-iron in Glasgow have fluctuated a good deal during the week, but by Wednesday last they had recovered, and stood at practically the same figure as at the time of our last report. The very favourable returns published would appear to have been to a certain extent discounted, while the dread of dearer money has had a depressing effect on the market. The tone of the trade at Middlesbrough has been quieter also, but the like weakness has not been manifested there that has been observable in Scotland, and prices have been maintained at the same level. In some instances, indeed, makers have asked for more money. Contrasting with the state of the pig-iron trade, the hematite iron markets all round show a continuance of the firm tone exhibited of late. At Barrow and in North Lancashire the demand is well maintained, and there is an improved enquiry for export, but prices are not appreciably higher. The same remark is applicable to West Cumberland and the Forest of Dean, where the condition of things is very healthy. As a rule, the reports from the various centres of the manufactured iron trade indicate the prevalence of a steady feeling, but all the advices are not equally confident. On the Tees there is little or no improvement noticeable; prices of ship plates remain about £6 12s. 6d. per ton, and of angles and bars about £6; but from the Tyne firmer prices are reported, ship plates being £6 17s. 6d. per ton, with an upward tendency. From West Yorkshire a very hopeful state of things is advised, the output being very large; the Lancashire forges are likewise full of work, the price of bars being fully £6 10s. per ton, and hoops £7, while even these figures are not being taken by some makers. On the other hand the more cheerful feeling entertained at Sheffield towards the latter end of September would seem to have disappeared, and orders are scarce. But in North Staffordshire matters wear a very different complexion and business continues very brisk. Although prices have not risen yet, the tendency appears to be decidedly towards an advance. Crown bars are quoted £6 10s. as a minimum. Matters are in much the same position in the southern districts of the county, where marked bars are very firm. The finished iron market is very steady in East Worcestershire, while in Birmingham the hardware trades have improved yet further, there having been an influx of good orders on foreign account. The tinplate trade is without change, and prices are maintained at former quotations. Steel rail makers on the north-west coast are very busy, and prices are fully upheld. In South Wales, makers are by no means anxious, sellers being well supplied with orders for railway material.

CONTINUOUS BRAKES.

ALTHOUGH considerable progress has been made both at home and abroad in the application of efficient continuous brake power to trains, recent events point out that there are still quarters in which this precautionary measure has been either only partially taken or is still utterly disregarded. The events to which we refer are railway accidents of a more or less serious character. The most painfully distressing of these was that which happened at Hugstetten on the Baden State Railway on the 3rd of last month. Here was a train carrying about 1200 passengers, and composed of engine, tender, and twenty-eight carriages, of which seven had hand brakes, but only six were provided with brakesmen, and the result of the accident was that no fewer than sixty-three people were killed, while seventy-two were seriously injured, and a large number of others hurt. The weight of the engine—a goods engine—was 35½ tons, of the tender 18 tons, and the train weighed 325 tons, making a total weight of 378½ tons. The accident occurred on a falling gradient of 1 in

COLD DRY-AIR MACHINES.

BY MESSRS. J. AND E. HALL, DARTFORD.

(*For description, see page 309.*)

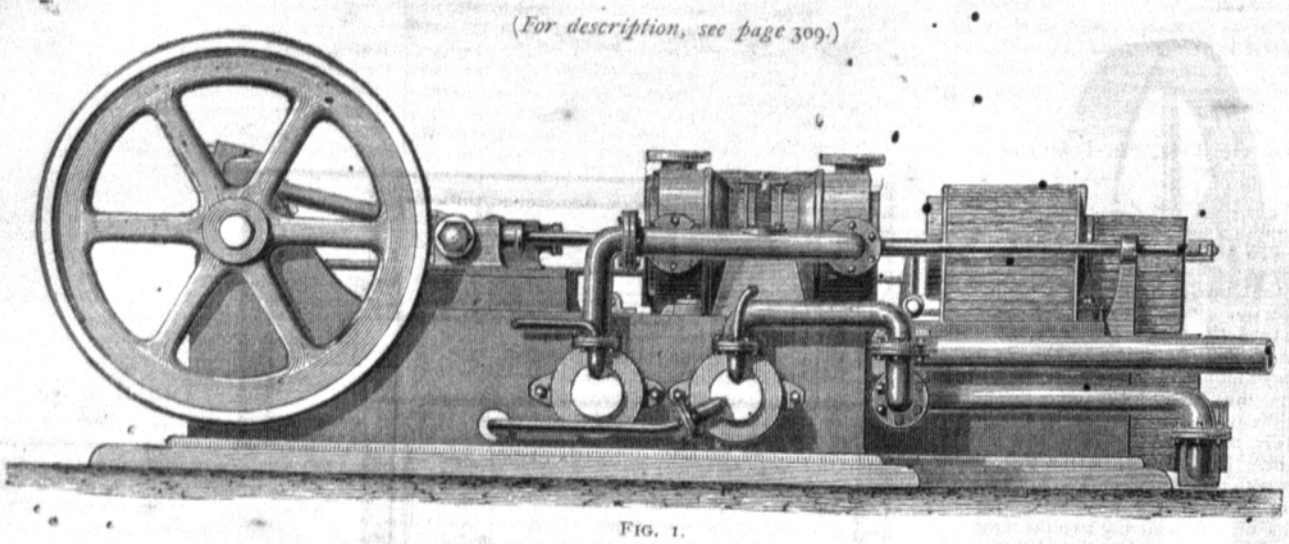


FIG. 1.

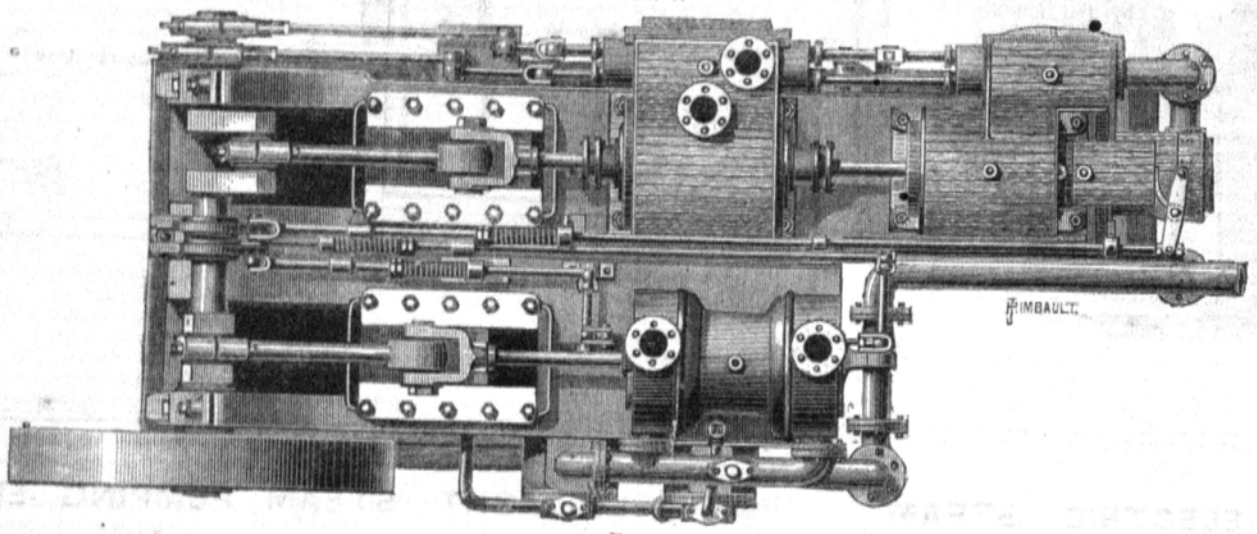


FIG. 2.

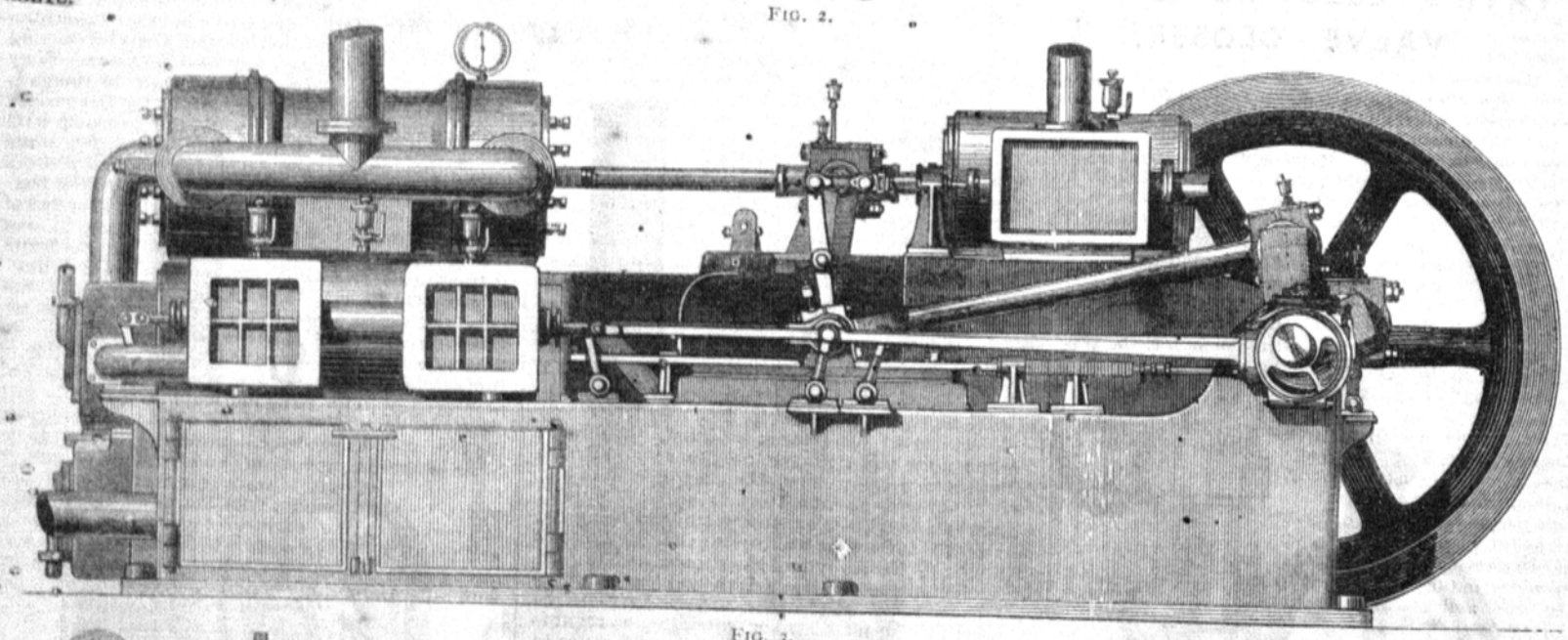


FIG. 3.

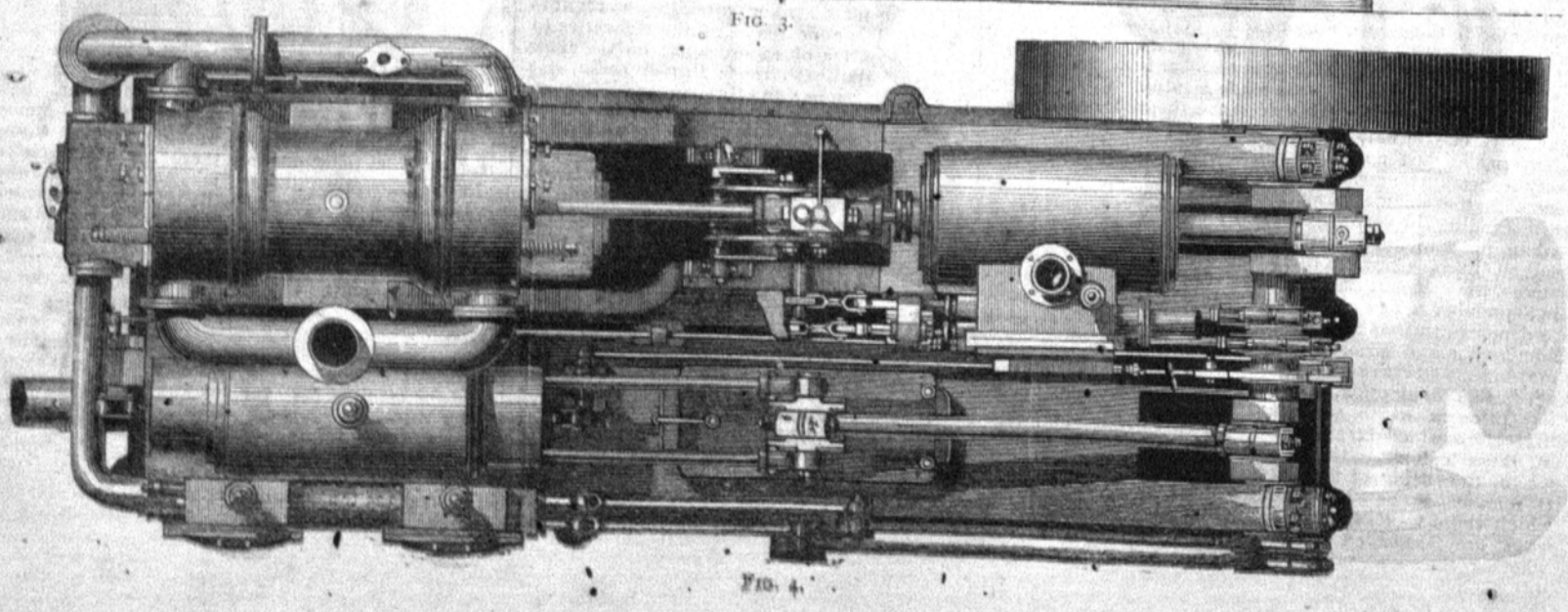


FIG. 4.

COLD DRY-AIR MACHINES

BY MESSRS. J. AND E. HALL, DARTFORD.

(*For description, see page* 309.)

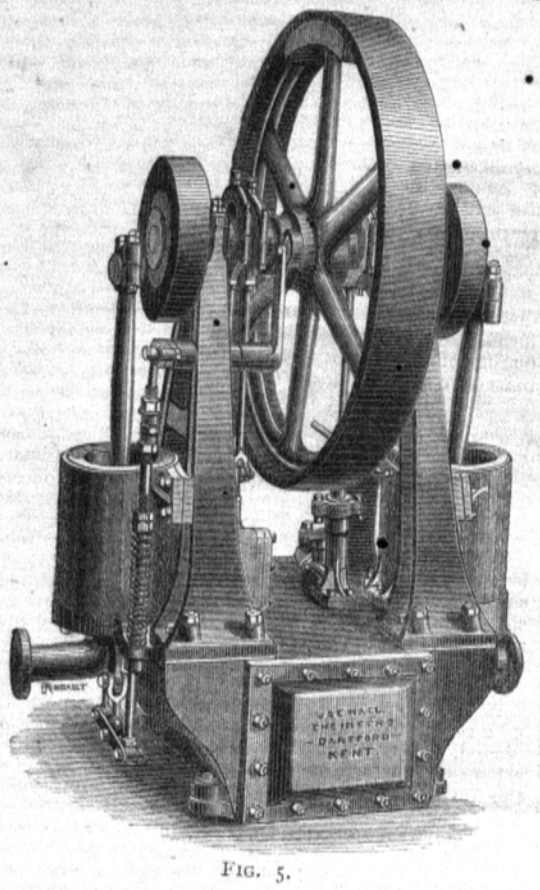


Fig. 5.

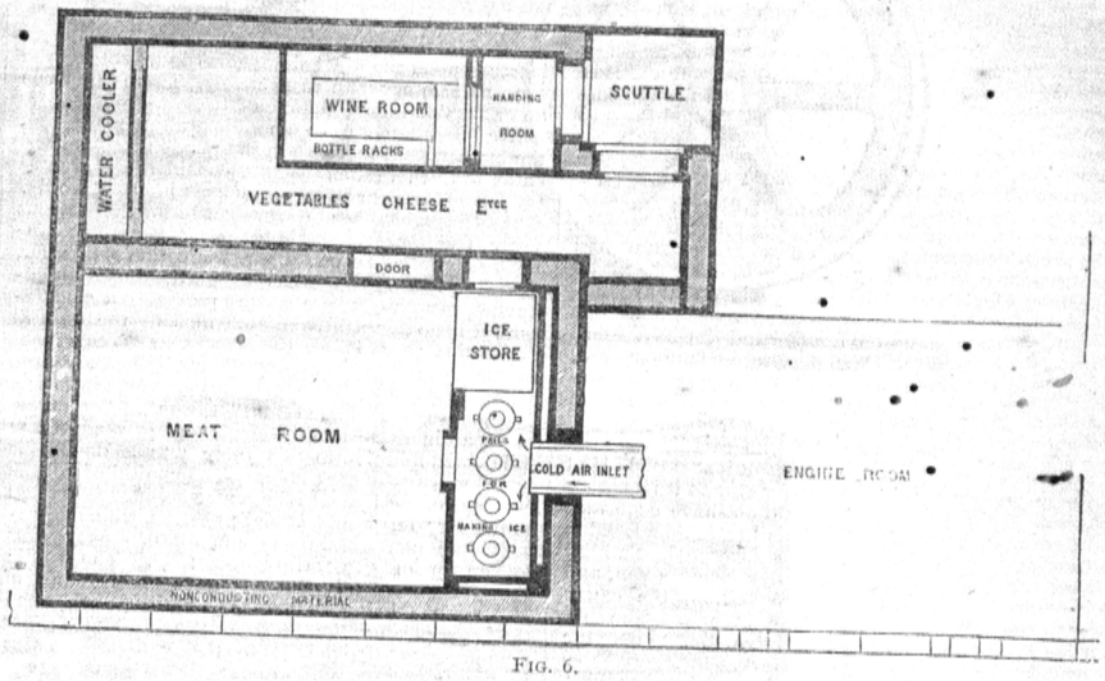
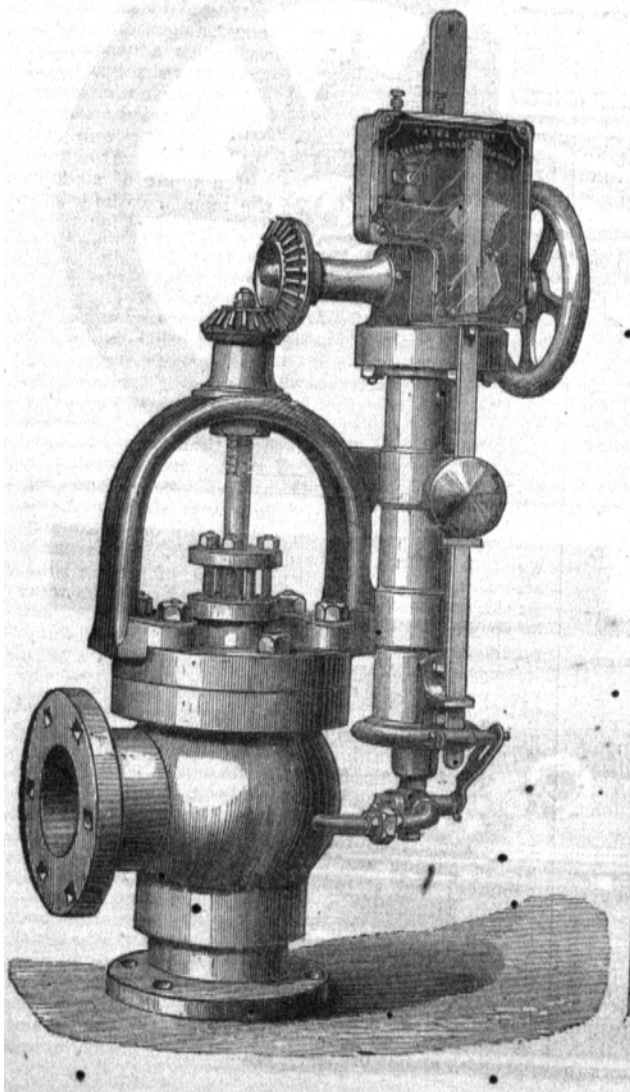


Fig. 6.

TATE'S ELECTRIC STEAM VALVE CLOSER.

(*For description, see page* 310.)



PORTABLE LIGHT STEAM PUMPING ENGINE.

(*For description, see page* 311.)

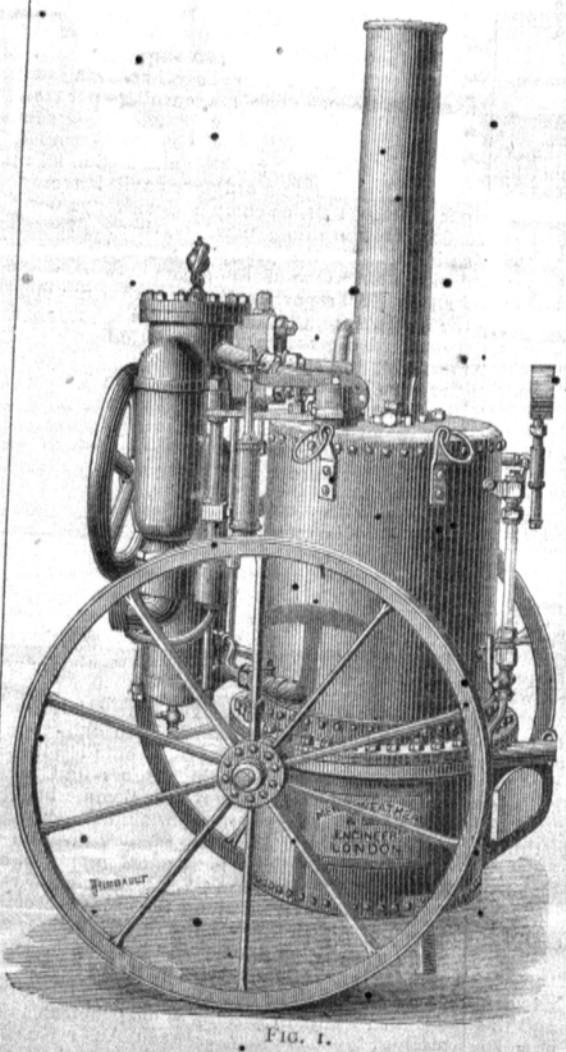


Fig. 1.

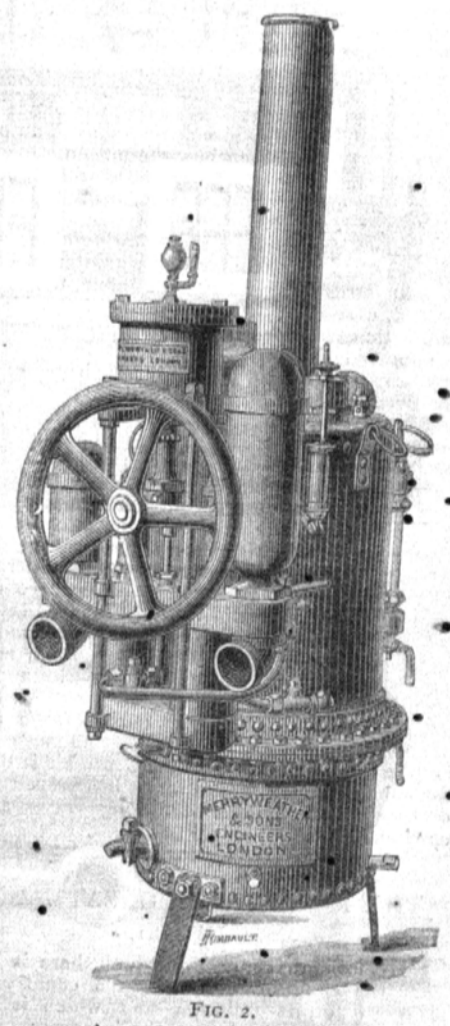


Fig. 2.

146, after running down four or five miles of 1 in 86, and 1 in 111; and that the speed was considerable may be inferred from the position of the engine, which ran more than 40 yards across some very marshy land. The fatal results of this and all such accidents are caused by the rear portion of the train, with undiminished momentum, overrunning the front part which has been arrested. It follows, then, that to be of the greatest service at such times a brake must be, first, exceedingly rapid in its action before the train parts, so as to get the brake on at the rear as well as at the front; and, secondly, automatic action is required to keep it on afterwards, or it may be, to apply it before the driver has time to do so. That there are brakes fulfilling all the necessary conditions is well known, and it is also equally well known that there are railway companies whose foresight and prudence has led them to adopt these brakes on their lines, and they have never had cause to regret so doing. There are also brakes which profess to fulfil these necessary conditions, but which are constantly failing in practice, and we had these in mind when we referred above to quarters in which the precautionary measure had only been partially taken. This is exemplified by accidents which have happened since that at Hugstetten. For instance, on Saturday week a serious collision occurred on the London and North-Western Railway at Crewe, fourteen passengers being injured, some very seriously. An excursion train from London to various seaside resorts in the north arrived at Crewe Station, and drew up. A train from Nantwich, due at the same time, ran rapidly into the excursion carriages, with the result just stated. Had the incoming train been properly braked it is highly probable that the collision would not have occurred. Then again we hear of a Midland train from London running into the Central station, Liverpool, at a high speed, wrecking the platform, destroying a van, and otherwise doing havoc to the station, the cause assigned being the failure of the vacuum brake.

In this connection it may be interesting to note the wail of sorrow in a contemporary, which emanates from one who states that he is a Midland shareholder. He first refers to the accident at the Central station, and then goes on to bring a long string of charges against the vacuum brake on the score of its frequent failures on the Midland line, on which he is a frequent traveller. He at last had such a knocking about that he has decided to transfer his patronage to the London and North-Western line. Whether he will find matters greatly mended there it is difficult to say, for although the trains are provided with continuous chain brakes, they are never used except in emergencies, the old fashioned hand brakes being used for ordinary work. But, with all this neglect and indifference to the security offered by an efficient continuous brake—and we use the word "efficient" advisedly—it is refreshing to find that progress still continues to be made in the right direction. During the recent run on the Continent with the Iron and Steel Institute, it was satisfactory to us to find that on some of the Austrian and other lines the Westinghouse system is meeting with increasing adoption. Again, in Holland decisive measures are being taken to prevent the recurrence of accidents which are due to the absence of a good automatic brake. A Royal decree has there been issued, and will come into force in May 1883, with the commencement of the summer service of trains on the railways. Article No. 84 of the General Regulations is thereby superseded by the following order, viz.:—"For express trains running at a greater speed than 60 kilometres—37½ miles—per hour the engines, tenders, carriages, and vans must be provided with automatic continuous brakes of a system prescribed or approved of by the Minister of Public Works." Similarly "automatic brakes of such prescribed or approved system will have to be fitted to the engines, tenders, carriages and vans of those passenger trains which do not run at a greater speed than 60 kilometres—37½ miles—per hour, as the Minister of Public Works may order." It will be seen that this is no permissive decree, but renders it absolutely necessary to provide all trains with a good brake, as should be done in this country. We are glad to see this, and commend it to the careful consideration of all those whom it may concern, including our legislature, and we do this in view of the fact that in this country we run crowded excursion trains of equal, and even greater length than that which met with such a sad fate at Hugstetten, and with an equally inefficient provision of brake power. There is no doubt that one of the reasons for the large amount of favour bestowed upon the Westinghouse system both in this country and on the Continent is that it is the only continuous brake which has proved capable of being worked upon such long trains as thirty carriages.

THE RAILWAYS OF GREAT BRITAIN IN 1881.

The intimate connection which there is between the condition of trade in a country and the prosperity of its railways—and which is now so generally recognised that the progress or retrogression exhibited by the traffic returns is regarded as one of the best indices to the direction in which the tide of trade is setting—is illustrated by the report of Messrs. Henry G. Calcraft and R. Giffen on the capital, traffic, working expenditure, net earnings, and dividends of the railways of the United Kingdom for last year. In comparing the results of the working during 1880 with those for 1879, throughout the greater part of which year trade was in a most depressed condition, a very marked improvement was manifested, the increase in the receipts from passenger traffic having been 5 per cent., and that from goods traffic 6·8 per cent. That during 1881, although it was not a year of uninterrupted prosperity, the ultimate tendency was for the improvement to broaden and deepen is proved by the fact that the receipts from passenger and goods traffic show an increase upon the preceding years' figures of 1·8 per cent. and 2·9 per cent. respectively. There cannot be an expansion in the volume of trade without a more active interchange of commodities taking place, and the 2·9 per cent. increase in the goods receipts indicates that there has been a considerably greater turnover of wares and merchandise; in other words, that business has been brisker than during the previous year. The improvement in the passenger traffic cannot be regarded as such a sure indication of this, for, although it may be taken as partly due to an enhanced spending power on the part of the population, it is no doubt attributable also to the natural inclination there is for the masses to make a more frequent use of railways. Some of the figures given in Messrs. Calcraft and Giffen's report are suggestive. The length of line open in 1881 was 18,175 miles, being an increase upon the preceding year of 242 miles. In addition to this there was a double (or more) mileage of 9873 miles. The capital of all the railways of the United Kingdom combined amounted to the very large sum of £745,528,162, which represented an increase in the amount of money thus locked up of £17,211,314 over 1880. The traffic receipts from all sources gave a revenue of £67,155,000, being an increase of £1,663,375 upon the receipts for the previous year. The former amount was derived from the various sources in the following proportions:—From passengers, £27,692,000; from goods, £36,801,000; and from miscellaneous items, £2,662,000. That the working expenditure should show a considerable growth was only to be expected; but it is a little disappointing to notice that the increase amounts to 3·9 per cent., or a greater ratio than that by which the receipts have expanded. The actual amount, however, is smaller, being £1,298,876, so that there is an increase in the net earnings of the railways of £364,499, equal to 1·1 per cent. That the growth in the working expenditure is due to the increased train mileage made is demonstrated by two facts. First, notwithstanding the increase in the traffic earnings, there is a diminution shown in the receipts per train mile of 0·97 pence, the figures having been 61·74 pence per train mile in 1881 against 62·71 pence in 1880. On the other hand, calculated in the same way, the expenditure actually shows a slight decrease, having been in 1881 32·26 pence per train mile, against 32·37 pence in 1880. The net earnings per train mile, however, were 0·86 pence less. The percentage of net earnings on capital was 0·05 less than in 1880, the figures being 4·33 in 1881 and 4·38 in 1880; while the dividend paid on ordinary capital averaged 4·66 per cent. in 1881, as compared with 4·72 per cent. in 1880. On the whole, however, there is reason to be satisfied with the progress made by our railways during 1881. One of the most noteworthy points set forth in this report is the fact that the increase in the receipts from passenger traffic is entirely derived from third-class tickets and periodical tickets. In fact, first and second-class tickets yielded together £225,000 less than in 1880, but the increase upon third-class tickets was more than sufficient to compensate for this loss. There is a great lesson here, although by no means a new one, which we could wish the directors of our railways would sufficiently lay to heart.

THE IRON AND STEEL INSTITUTE VISITS.

Having last week given our readers particulars of the excursion to Buda-Pesth, we now proceed to notice that to Styria, which was headed by Mr. I. Lowthian Bell. The party left Vienna at 7 a.m. by express train for Mürzzuschlag, which was their first halting place. The route lay through the Semmering Pass, and the visitors had an opportunity of seeing the works of the Semmering Railway, which is the oldest of the continental mountain lines, and of viewing the charming scenery through which it passes. This railway is 25 miles in length, and was constructed by Karl von Ghega at a cost of 15 million florins. It is carried along the face of precipices by means of fifteen tunnels and fifteen bridges and viaducts, some being of considerable length. The largest of these is near Semmering, and is 575 yards long and 90 feet high. The summit level (2890 feet) occurs in a tunnel 1 mile in length, which penetrates the Semmering, the boundary between Austria and Styria, and from thence the line descends to the picturesque valley of the Mürz, *en route* for Mürzzuschlag. From this place a short run brought the visitors to the ironworks at Neuberg, which were then inspected. These works date back to 1327, and are noteworthy as being one of the first in Styria at which the Bessemer process was introduced. They are now running two 4½-ton converters with a circular pit. The metal is run direct from the blast-furnaces and the steel is made from charcoal pig, the output being 15,000 tons of steel ingots per annum. As a rule, neither spiegeleisen nor manganese are required to be added. The pit crane is rotated and the ladle manipulated by hand; but they are raised and lowered by hydraulic power, by which means also the converters are worked. At Neuberg are also two Siemens-Martin furnaces of 5 tons each and served by two heating-furnaces, the yearly production from these being 8,000 tons. During the visit, runs were made from both the Bessemer and the Siemens-Martin plant. At these works very high-class plates are produced for boilers and tinplate, and the metal for this purpose is taken direct from the Bessemer pit to the Siemens-Martin furnace and undergoes the double process, a splendid quality of metal being the result. There are two blast-furnaces of moderate size, each being 43 feet 6 inches high and 5 feet 11 inches diameter at the base, 9 feet 4 inches in the bosh and 3 feet 3 inches at the top. The annual production of the pair is 12,000 tons of Bessemer pig, produced from calcined spathic ore, with charcoal as a fuel. The plate and bar mill is driven by water-power, of which there is a plentiful supply along the valley. The visitors saw a plate for boiler purposes 30 feet long, rolled, after which they inspected a collection of samples of steel, produced at the works, all of which showed a very high quality. On return to Mürzzuschlag, the visitors were entertained at luncheon by the Styrian Iron Trade, after which they were conveyed by train to the ironworks at Donawitz.

At these works two Siemens-Martin furnaces of 5 and 7 ton capacity respectively, are employed, the ladle being run over the ingot moulds in a long pit, the arrangement being similar to that of the Steel Company of Scotland. The waste gases from the puddling furnaces, of which there are eighteen, are conducted to very high vertical boilers of small diameter, in which steam is generated for driving the wire mill engines. In this department some good work was being done, considerable smartness and dexterity being shown in wire rolling, which contrasted favourably with the slower movements of the operatives in the other departments. The total produce of the puddling furnaces in 1881, is stated to have been 15,022 tons, whilst that of the Siemens-Martin furnaces is placed at 4,100 tons for the same year. The ironworks of Donawitz are remarkable for the large quantity of iron puddled from each furnace. This is owing to the composition of the pig used (Styrian), which only contains ·13 per cent. of silicon. Its composition is:—Carbon 3·28, silicon ·13, sulphur ·03, phosphorus ·02, manganese ·71, and copper a trace. The furnaces are worked by four men, three of whom only are engaged in puddling, and the fourth at wheeling coal, ashes, &c. The work done, which is as follows, varies according to quality, viz., first quality, ten charges of pig weighing 250 kilos each; second quality, eleven charges of pig weighing from 275 to 300 kilos; third quality, twelve to fourteen charges of pig weighing from 300 to 350 kilos. The waste of pig is only 6½ per cent., owing no doubt to the small amount of silicon present. The earnings of the men may be taken at 6s. per day of twelve hours for the first man; for the second man, 4s. 5d.; for the third, 4s.; and for the fourth, 1s. 8d. The coal used is the brown-coal, which contains a considerable quantity of water. The consumption of coal varies from 25 cwt. per ton for the first quality of iron to 15 cwt. per ton for the third quality. Ore is not used in fettling, and the bottoms last for sixteen weeks. The only material used for mending the bottoms is mill slag. The average make of a furnace is 1500 tons per annum, or from two and a half to three times as much as is made in a Middlesbrough furnace. A pre-heater, or "dandy," is used, one being attached to each puddling furnace, the waste heat from which is employed for raising steam. Six furnaces go to one hammer, which is worked by one man per shift. Six furnaces also furnish employment for one set of puddle rolls. At the conclusion of the inspection the visitors went by special train to Leoben, where they were warmly received by the local reception committee, of which Professor Ritter von Tunner was president, and in the evening were entertained at a dinner given by the Styrian Iron Trade, at the Hotel Post, a very pleasant evening being passed.

On Friday morning, a special train conveyed the visitors to Trofaiach, where the blast-furnace works were inspected. These works are well laid out, being of modern construction, and were built in 1872. The blast-furnace is 52 feet high, the diameter at the base being 5 feet 2 inches; at bosh, 8 feet 5 inches; and at top, 3 feet 7 inches. The furnace is built with double walls, which gives an air space between the two, the result being that there is only a variation of 9 deg. Fahr. in the temperature between winter and summer. The blowing engine, which is horizontal, has two cylinders, each 50 inches in diameter, with a 3-feet 10-inches stroke, and driven by an overshot water-wheel, 25 feet in diameter and 10 feet 5 inches breast; the buckets being 20 inches