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THE INTERNATIONAL EXHIBITION.

OPENING OF THE INTERNATIONAL EXHIBITION OF 1862.

The State opening of the International Exhibition of 1862 took place yesterday, and was in every respect a great success. The Commissioners appointed by Her Majesty to conduct the ceremony were:—His Royal Highness the Duke of Cambridge, K.G., His Grace the Archbishop of Canterbury, the Lord High Chancellor, the Earl of Derby, K.G., the Lord Chamberlain, Viscount Palmerston, K.G., G.C.B., and the Speaker of the House of Commons.

Address of the Royal Commissioners and Reply.

When His Royal Highness and the other Commissioners had taken their seats, Earl Granville said:—

"In the name of the Commissioners of the International Exhibition of 1862, I have the honour to present to your Royal Highness, your Lordships, and Mr. Speaker, our humble address to Her Majesty. In it we respectfully offer our condolence on the irreparable loss which Her Majesty and the nation have sustained, and we express our gratitude to Her Majesty for having appointed your Royal Highness and your colleagues as Her Majesty's representatives, and we thank the Crown Prince of Prussia and Prince Oscar of Sweden for their presence on this occasion. In it we describe the rise and progress of the Exhibition, and the manner in which we propose to reward merit. We express our thanks to the Foreign and British Commissioners who have aided us in the work, and we express a humble hope that this undertaking may not be unworthy to take its place among the periodically recurring exhibitions of the world."

Lord Granville then handed to the Duke of Cambridge the following address, of which his speech was a brief summary:—

"May it please your Royal Highness and my lords Commissioners:—

"We, the Commissioners for the Exhibition of 1862, humbly beg leave to approach Her Majesty through you, Her illustrious representives on this occasion, with the assurance of our devotion to Her Majesty's throne and Royal person.

"And first of all it is our melancholy duty to convey to Her Majesty the expresssion of our deep sympathy with Her in the grievous affliction with which it has pleased the Almighty to visit Her Majesty and the whole people of this realm in the death of Her Royal Consort. We cannot forget that this is the anniversary of the opening of the first Great International Exhibition 11 years ago by Her Majesty, when His Royal Highness, as President of the Commissioners of that Exhibition, addressed Her Majesty in words that will not be forgotten. After stating the proceedings of the Commission in the discharge of their duties He concluded with a prayer that an undertaking 'which had for its end the promotion of all branches of human industry and the strengthening of the bonds of peace and friendship among all nations of the earth might by the blessing of Divine Providence conduce to the welfare of Her Majesty's people, and be long remembered among the brightest circumstances of Her Majesty's peaceful and happy reign.'

"When we commenced our duties, and until a recent period, we ventured to look forward to the time when it might be our great privilege to address Her Majesty in person this day, and to show Her Majesty within these walls the evidence which this Exhibition affords of the soundness of the opinion originally entertained by His Royal Highness—evidence furnished alike by the increased extent of the Exhibition, by the eagerness with which all classes of the community have sought to take part in it, and by the large expenditure incurred by individual exhibitors for the better display of their produce and machinery. We can now only repeat the assurance of our sympathy with Her Majesty in that bereavement which deprives this inaugural ceremony of Her Royal presence; and, while bearing mournful testimony to the loss of that invaluable assistance which his Royal Highness was so ready at all times to extend to us, we have to offer to the Queen our dutiful thanks for the interest evinced by her Majesty in this undertaking by commanding your Royal Highness and your Lordships to represent Her Majesty on this occasion.

"Our respectful thanks are also due to their Royal Highnesses the Crown Prince of Prussia and Prince Oscar of Sweden, the presidents of the commissions for those countries, for the honour which their Royal Highnesses have done us in coming to England for the purpose of attending this ceremony. In the attendance of his Royal Highness the Crown Prince of Prussia we recognise a cordial deference to the wishes of our Sovereign and a tribute of affection to the memory of his illustrious and beloved father-in-law.

"It now becomes our duty to submit to her Majesty a short statement of the circumstances connected with the realization of the scheme for holding a second great International Exhibition in this country, the necessary powers for conducting which were conferred upon us by the Charter of Incorporation graciously granted to us by her Majesty in the month of February, 1861.

"In the years 1858 and 1859 the Society of Arts, a body through whose exertions the Exhibition of 1851 in great measure originated, had taken preliminary measures for the purpose of ascertaining whether a sufficiently strong feeling existed in favor of a decennial repetition of that great experiment to justify an active prosecution of the scheme. Although the result was stated by the Society of Arts to be satisfactory, the outbreak of hostilities at that moment on the continent necessarily put a stop to further proceedings.

"The restoration of peace in the summer of 1859, however, enabled the consideration of the question to be resumed, though at a period so late as to render it necessary that the Exhibition should be deferred till the present year; and the Society of Arts obtained a decisive proof of the existence of a general desire for a second great Exhibition in the most satisfactory form, namely, the signatures of upwards of 1,100 individuals for various sums of from £100 to £10,000, and amounting in the whole to no less than £450,000, to a guarantee deed for raising the funds needed for the conduct of the Exhibition.

"The Commissioners for the Exhibition of 1851, mindful of the source from which their property and their continued existence as a corporate body arose, and of one of their earliest decisions, that any profits that might be derived from that Exhibition should be applied to purposes strictly in connection with the ends of the Exhibition, or for the establishment of similar Exhibitions for the future, without hesitation placed at our disposal, free of all charge, a space of nearly 17 acres on their Kensington Gore estate, which was at first considered sufficient for the purposes of the Exhibition, but to which at a subsequent period a further area of upwards of eight acres (being all the land which could be made available for those purposes) was added on our application, when the original space proved to be insufficient. For this grant of a site we have to express our thanks.

"To the Governments of Foreign States and of Her Majesty's Colonies our acknowledgements are justly due for the manner in which, with even greater unanimity than in 1851, they have responded to the appeal made to them to assist in this undertaking. In this cordial co-operation we find another proof that the time had arrived when a repetition of the Exhibition of 1851 had become desirable in the common interests of all nations.

"A similar tribute is due from us to those of her Majesty's subjects who appear as exhibitors, or who have placed at our disposal many valuable works to illustrate the various branches of British art, and in this respect our grateful thanks are especially due to her Majesty.

"About 22,000 exhibitors* are here represented, of whom about 8,000 are subjects of her Majesty, and 14,000 of foreign States. The arrangement and design of the building is such that the exhibited articles have been generally arranged in three great divisions:—

"1st. Fine arts, in the galleries especially provided for that department.

"2nd. Raw materials, manufactures, and agricultural machinery, in the main building and the eastern annexe.

"3rd. Machinery requiring steam or water power for its effectual display, in the western annexe.

"Within these divisions the classification adopted is in most respects similar to that employed in 1851, the British and Colonial articles being kept separate from those sent by foreign countries, and each country having its own portion of the several departments allotted to it. The catalogues now presented by us for the purpose of submission to her Most Gracious Majesty will be found to contain all the necessary particulars respecting the articles exhibited.

* These numbers are only approximate, the returns not yet being all made.

"In the selection and arrangement of many of the more important branches of the Exhibition we have been materially assisted by the cordial co-operation and advice of persons of all ranks in various local, class, trade, and other committees, whose services we gratefully acknowledge.

"Following the principle adopted in the case of the Exhibition of 1851, we have decided that prizes, in the form of medals, shall be given in all classes of the Exhibition, except those in the fine arts' section; such medals, however, being of one kind only—namely, rewards for merit, without any distinction of degree. Those medals will be awarded by juries appointed for the several classes, and composed of both British and foreign members.

"We are happy to be able to acquaint her Majesty that foreign nations have selected persons of high distinction in science and industry to act as jurors; and we have to bear testimony to the cordial readiness with which eminent manufacturers of this country and other persons distinguished in the State, as well as in the various branches of science and art, have consented to serve as jurors, and accept the responsibilities and labour entailed upon them by so doing. We feel assured that the eminence of the jurors, both foreign and British, thus selected will satisfy exhibitors that the objects displayed by them will be examined by competent as well as by impartial judges. It is certain that the meeting of so many leading men on such a duty, from all parts of the world, must exercise a favourable influence on agriculture, manufactures, and commerce, by disseminating valuable and practical information respecting the condition of science and industry in their several countries, as well as by making known to all that which they need and that which they can supply.

"The articles now exhibited will show that the period which has elapsed since 1851, although twice interrupted by European wars, has been marked by a progress previously unexampled in science, art, and manufacture.

"It is our earnest prayer that the International Exhibition of 1862, now about to be inaugurated, and which it is our privilege to conduct, may form no unworthy link in that chain of International Exhibitions with which must ever be connected the honoured name of Her Majesty's illustrious Consort."

The Duke of Cambridge read the following reply:—

"We cannot perform the duty which the Queen has done us the honour to commit to us as Her Majesty's representatives on this occasion without expressing our heartfelt regret that this inaugural ceremony is deprived of her Majesty's presence by the sad bereavement which has overwhelmed the nation with universal sorrow. We share most sincerely your feelings of deep sympathy with her Majesty in the grievous affliction with which the Almighty has seen fit to visit her Majesty and the whole people of this realm. It is impossible to contemplate the spectacle this day presented to our view without being painfully reminded how great a loss we have all sustained in the illustrious Prince with whose name the first Great International Exhibition was so intimately connected, and whose enlarged views and enlightened judgment were conspicuous in his appreciation of the benefits which such undertakings are calculated to confer upon the country. We are commanded by the Queen to assure you of the warm interest which her Majesty cannot fail to take in this Exhibition, and of her Majesty's earnest wishes that its success may amply fulfil the intentions and expectations with which it was projected, and may richly reward the zeal and energy, aided by the cordial co-operation of distinguished men of various countries, by which it has been carried into execution. We heartily join in the prayer that the International Exhibition of 1862, beyond largely conducing to present enjoyment and instruction, will be hereafter recorded as an important link in the chain of International Exhibitions, by which the nations of the world may be drawn together in the noblest rivalry, and from which they may mutually derive the greatest advantages."

The procession then passed along the north side of the nave to the Eastern dome, where the special musical performance took place. The music, specially composed for this occasion, consisted of a grand overture by Meyerbeer; a chorale by Dr. Sterndale Bennett (to words by the Poet Laureate), and a Grand March by Auber. The orchestra, consisting of 2,000 voices and 400 instrumentalists, was presided over by Mr. Costa, except during the performance of Dr. Sterndale Bennett's music, which was conducted by M. Sainton.

At the conclusion of the special music a Prayer was offered up by the Bishop of London. The Hallelujah Chorus and the National Anthem were sung. His Royal Highness the Duke of Cambridge said, "By command of the Queen I declare the Exhibition open."

This declaration having been made, it was announced to the public by a flourish of trumpets, and the firing of a salute on the site of the Exhibition of 1851. The procession then proceeded to the Picture Galleries, and the barriers were removed.

The military bands were those of the Grenadier, the Coldstream, and the Scots Fusilier Guards, conducted by Mr. Godfrey, and were stationed in the centre of the western dome.

About 25,000 persons were present.

THE INTERNATIONAL EXHIBITION.

(Extracts continued from "The Mechanics Magazine.")

The Western Annexe.

"We now beg to direct public attention to a pair of marine engines exhibited by Messrs. John Penn and Son, of Greenwich. These are excellent exponents of the workmanship of Messrs. Penn. They are on the direct acting principle, and are intended for a screw steam-ship. The engines are of the collective power of 600 horses, and have been manufactured for the Spanish Government. The cylinders are 78 inches in diameter, and the length of the stroke is 3 feet 6 inches. The connecting rods are 9 feet long. Several pairs of engines of a nearly similar character have been made for the respective navies, and they have been found to work with perfect smoothness and regularity. Much of this latter is due to the system of counterpoising the crank shaft pursued by Messrs. Penn; and we may say in passing, that it would be well if more attention generally were paid by engineers and machinists to the proper balancing of running machinery. Much of the jarring and tremor, so disagreeably felt on board steamers, and so hostile to the stability of buildings, is due to the want of a proper mode of balancing those parts of the engines or machinery which are of unequal weight.

"Returning to the engines of Messrs. Penn, it may be further said that each condenser is provided with a double acting air pump 23 inches in diameter, the length of stroke being the same as that of the piston. The engines occupy a space 28 feet in breadth by 18 feet in the direction of the length of the vessel.

"Engines of the same kind of construction as these, but of 1,250 H.P., are in course of construction by the firm named. These are intended for H.M.S. Achilles, now being built in Chatham dockyard, and one of the cylinders of the Achilles' engines is exhibited in the annexe. It is a fine and clean casting, well bored out, and its weight is 18 tons. The inner diameter is 42 inches, the stroke will be 4 feet."

"Messrs. Penn also exhibit, in near neighbourhood to the cylinder, a massive wrought-iron crank shaft for the same engines, as also a connecting-rod, fitted complete with brasses. The Warrior and Black Prince were furnished with engines of which those of the Achilles will be duplicates. Before advancing further through the annexe, we may state that Messrs. Penn are at present engaged, also, in making two pairs of engines for the new iron sided ships Northumberland and Minotaur. A cylinder cover belonging to one of these is shown, as are some iron castings from the mould, and others which have passed under machine tools.

"Models of a pumping-engine and safety-balance valve, as erected and used at the Leabridge branch of the East London Water-works, are exhibited by Messrs. Harvey and Co., of Hayle, Cornwall. Having seen the originals of these we can vouch for the fidelity of the models. The Leabridge engine, which was erected by Messrs. Harvey some five or six years since, was at the time of its erection the largest in or near London. When working full-power it pumps 9,000 gallons of water per minute to a height usually of 140 feet. The water thus raised is conveyed into London by means of cast-iron pipes 36 inches in diameter. The whole of the system of pumps, reservoirs, filtering beds, sluices, &c., at Leabridge is well arranged, and everything there is on a gigantic scale.

"In 1858 Messrs. Harvey and Co. erected, for the Southwark and Vauxhall Water Company, at Battersea, a pumping-engine, the cylinder of which is 112 inches diameter, and weighs 36 tons. This engine, though the largest and most powerful ever built for such a purpose, is of the most simple construction. The steam valves are all on the equilibrium principle, and the arrangement of parts is throughout, such, that this colossus of engines, so to speak, is as completely under the control of a pigmy, but intelligent engine-man, as is the small engine in a factory.

"The quantity of water pump-d up for the supply of London daily, amounts to 115,000,000 gallons. Of this enormous quanty 79,000,000 gallons are pumped by means of single-acting engines on Harvey's plan. In fact, the reputation of this firm for gigantic pumping-engines is world-wide. Those who have time to visit Battersea and Leabribge, where the originals of the models referred to exist, would find that they were amply repaid for their trouble by an inspection of them.

"Speaking of water-works we are reminded of the fine specimens of fire-engines exhibited in the Western Annexe. And after the experience of the past year or two in the Metropolis with respect to fires, and the recent report of the Select Committee which has sat on the subject, he must be a bold man who will say that fire-engines are not an important feature in the world's show at Kensington. Every witness examined, including the managers of the Brigade, has admitted—what we long since asserted—that the present state of the staff, engines and stations, is totally inadequate for the protection of London from fire.

"An altered and expanded arrangement in respect to the London Fire Brigade, will unquestionably demand a commensurate improvement and increase in the number of fire-engines. Of steam fire-engines the metropolis has but a scanty supply and we may suggest that attention should be paid to the subject by engineers and others interested in it.

"Messrs. Shand and Mason, Roberts, Merryweather, and others, figure the most largely in this department, but, as we have said, the display is meagre. The American steam fire-engine, forwarded by Mr Hodges, of the Lambeth Distillery, we have before spoken of, but why it should be placed in a corner, where it is difficult for its merits to be disclosed, is a question for the Commissioners, whose ways are difficult to comprehend or account for.

"We come now to a consideration of some of the manufacturing machines and tools. Cotton spinning machinery is largely represented, and Messrs. Dobson and Barlow, of Bolton, contribute a fair quota of the whole. They exhibit, in fact, a series of machines for opening and cleansing, preparing, and spinning cotton. The whole of these are replete with the most modern improvements of detail, and they may be briefly mentioned in the order in which the operations named follow each other in ordinary working. The first is named a cotton-spinner, and is adapted for spinning and cleaning long or short shaped cotton. The feeding parts and the inside gratings, are of a novel construction, the object in view being to open out and clean the cotton without injuring the staple. The second is called the single scutcher, and is supplied with feeding rolls, which have been patented by the firm in question. The merit of the rolls consists in their holding the cotton sufficiently firm without breaking the seeds or shells. Then follows the breaker carding-engine, which is a combined patent machine; Wallman, of the United States of America, and Dobson and Barlow, each having a hand in it. Its chief merits are that the cotton is well opened and cleaned by the working rollers, before the upper rollers will allow it to pass the self-stripping top flats. These flats can be taken out at pleasure by the attendant, and re-adjusted without the use of a screw key. A finisher carding engine stands next, and it works automatically—an improvement on the plan of stripping flats by hand as is usually done. Ashworth's patent lap machine is used for making laps for the finisher carding engine, and combing machine, and a grinding apparatus is so contrived as to grind two rollers and a flat at the same time.

"Then follow five frames, known respectively as the drawing frames, with forty-four spindles, each ten inches by five inches; the intermediate frame with fifty-four spindles, each eight inches by four inches; the roving frame of seventy spindles, each seven inches by three and a half; and the jack frame of eighty-eight spindles, five inches by two and a half.

"The patent self-acting mule, of Dobson and Barlow, makes the total of the cotton-spinning arrangements at the exhibition of that firm. This last presents numerous peculiarities, and the whole of the machines are well fitted up.

"Platt, Brothers, & Co., of Oldham, figure most extensively in the same branch of manufacturing industry, the space devoted to their machines and contrivances being very large. As the Illustrated Catalogue, Part III, however, does elaborate justice to their cotton working machinery, we need not further refer to it than to say it reflects the highest credit upon the firm, who must have gone to very great expense in forwarding the whole to London, and keeping a large staff of workmen and girls to attend it.

"The cotton machinery of Messrs. Hetherington, of Vulcan Works, Manchester, is not inferior in many parts to that we have already referred to, and, indeed, it will not be the fault of the great firms of the Midland districts, if visitors to the International Exhibition do not gather much valuable information as to the treatment of that vital element of industrial labour—cotton.

"The paper making and paper cutting machines of Messrs. Bryan, Donkin, & Co., of Bermondsey, are suggestive of the immense consequence of the material with which those machines have to deal. This firm have earned a well-established reputation for the excellence of their paper making and dressing machinery, and the gigantic well-finished specimens of their work in the Western Annex prove that they are likely to maintain their fame.

"The Western Annex is, as we stated on a former occasion, extremely rich in specimens of engineering tools, and, perhaps, in this respect Messrs. P. Fairbairn & Co., of Leeds, make as distinguished a show as any. The radial drilling machines exhibited by this firm are excellent specimens of their productions in the too. department, and their universality of application, must make them invaluable in the erecting shops of the engineer and millwright. Of lathes, planing, and slotting machinery, too, they contribute excellent examples.

"In engineering tools of a, generally speaking, less massive kind than those of many of his neighbours, Mr. Whitworth, of Manchester, is largely represented. His lathes, which are so generally used by engineers, not only at home, but abroad, are to be found in every variety at the Exhibition.

There are numerous specimens, also, of drilling and slotting machines, all of which are distinguished by the excellence and exactitude of fitting, which have obtained for Mr. Whitworth a world-wide fame. The wheel cutting machine exhibited calls for especial remark. Those who are aware of the tediousness which attended the operation of chipping and trimming wheels by hand, and the chances which there were, after all, of the teeth being out of pitch, cannot but appreciate the value of this contrivance. It may be made to deal with either metal or wood, and with both spur and bevel gearing. It will cut the teeth or cogs of wheels up to ten feet diameter, and those of pinions down to the smallest size and pitch, and with the certainty of truth and uniformity.

"We spoke but now of the importance of paper; and nearly allied to it in importance is printing. Messrs. Petter and Galpin give us, in the Western Annex, an excellent example of what has been done in the shape of printing machines, and an idea of what may yet be expected; but it remained for the "Type Composing and Distributing Machine Company" to furnish visitors to the Exhibition with an apparatus intended for facilitating the work of the Compositor.

"The machines shown are the invention of the late Mr. James Hadden Young; and, as a plea for their use, we are told that while printing from the composing types has, by the improvements in the steam press, been carried to a most advanced stage, yet that setting up by hand is not done more quickly than it was 400 years ago, by the earliest printers. This certainly developes a *prima facia* case for stimulating the creative powers of mechanical inventors; but we are not quite prepared to say that the machines in the Annex are succesful exemplifications of inventors' powers in this direction.

"A suppositious state of things has been assumed with a view of setting forth more clearly the inestimable value of the type composing and distributing machine, and it is this: Let it be imagined that half an hour before usual time of putting to press, news arrives at the office of a daily journal, which would extend in the telling over three of its columns. This would involve the setting of something like 45,000 types, and in order to accomplish it a staff of ninety compositors would have to be employed. Each of them would have a scrap of paper put into his hand to set up in such a manner that it may tally with his neighbour's piece, technically called "making even." This would, undoubtedly, be a heavy piece of work, and one in the execution of which errors would be likely to creep in. Well, if all be true that is told of the machines named, they would make very light work of it. With them the task would be accomplished by six "players," and twenty-two justifiers in the same time, and only six pieces of copy instead of ninety would be required. The chances of error thus would be lessened.

"The type-composing machine is provided, something after the manner of a pianoforte, with separate keys for all the letters of a fount. This admits of each letter being set up in the order required by the compositor's copy, with a speed which is only limited by the eye and fingers of the player. The art of playing the machine, or as we should prefer terming it, working it, is said to be acquirable by a compositor, with the short noviciate of a few weeks' practice.

"As the type composing machine sets up the type in long lines, Mr. Young invented his "justifying apparatus," which is intended to replace the compositor's stick, an implement it, however, resembles. This is fixed to a frame, and is used as follows:—The compositor places the galley filled with the long lines set up at the composing machine. He fixes one of these lines into the proper apparatus, divides it into its proper length, reads it, makes corrections, and having justified it, he moves a handle, by which the completed line is depressed, and room is made for a succeeding line. It is found that a skilful compositor can justify at the rate of 4000 types per hour.

"As we have said, the whole of the arrangements connected with their adjuncts to the printing office are ingenious, as are the calculations and theories suggested. They do not as yet, however, fulfil all the conditions required in practice, and hand labour in this department of industrial art may be said to hold its own.

"Sewing machines of divers forms, and with little peculiarities, which go to make up a considerable amount of difference, are to be found in the Western Annex. These remarkable domestic appliances have been so minutely described in the MECHANICS' MAGAZINE, in time past, that we need not dwell upon them now. There is no doubt that they are working out a social revolution not only in this country, but throughout the civilised world, and it would have been unpardonable to have omitted altogether noticing the specimens exhibited at Kensington. Messrs. Newton Wilson & Co. are the largest exhibitors, and among the ponderous and massive mechanical appliances by which the sewing machines are surrounded, perhaps there are none which are morally speaking, more powerful.*

The Eastern Annexe.

"Perhaps the Eastern Annexe is, as a whole, one of the most satisfactory departments of the Exhibition—industrially speaking. It is well arranged, and taken alone forms an excellent exemplification of the progres and present condition of agricultural and horticultural science in England. The steam-engine, which had already effected so much for the material comfort and moral welfare of the people of this favoured land, by impelling machinery, and in the varied processes of manufacture, and in transporting people and merchandise from place to place—the mighty and yet delicate steam-engine is shown in the Eastern Annexe to have become also the chief cultivator of the soil. To its irresistible power the stubborn globe is now made to yield its richest treasures, and the golden harvests bow in due season to its "its sturdy stroke." The application of steam to the tilling of the ground is, indeed, one of the proudest achievements of modern time. The eleven years which have elapsed since the existence of the glorious palace of iron and glass in Hyde Park, have developed rapidly the arts of husbandry, but

* An unfortunate error, in respect to the dimensions of the cylinder of the Achilles, as exhibited by Messrs. John Penn & Sons, crept into our last week's notice: the real diameter of that noble casting is 112 inches.

whilst in the Eastern Annexe of the present Exhibition, we are made pleasurably aware of the fact, we find there also sure promise of yet further advancement. Machines and implements, eloquently telling of the skill of those who contrived them, are there to be seen in the greatest profusion, and these are witnesses, too, to the mechanical superiority of Englishmen. Among the prominent objects in the Eastern Annexe is a very handsome specimen of an agricultural locomotive engine. This, as its name implies, is a giant labourer, capable of being employed in any operations on the farm, and who will go on puffing and working without grumbling, so long as any work remains to be done, and his employer provides him with his daily water and coals.

"Mr. Aveling, of Rochester, Kent, is the maker of this farmers' assistant, which has embraced in its composition many novel points and peculiarities. It has an extra large boiler fitted with thirty-seven two and three-quarter inch tubes. The external plates are of the best Butterly iron, whilst the fire-box and tube plates are of Bowling iron. The boiler is judiciously "stayed" in a very strong manner so as to resist high-pressure. The fire-grate measures 31 inches by 34 inches, and may be fed with wood where that material is most accessible. The cylinder, of 10 inches diameter, is surrounded by a jacket, and, being placed on the forward part of the boiler, priming, which sometimes occurs in ascending steep gradients, is thus prevented. The crank-shaft is made of the well-known Low Moor iron, which for such purposes has gained especial and deserved fame. The engine is fitted with improved governor, patent tender, and water tank, under foot plate, driving chain and gear, steam-pressure guage, secret, as well as open safety-valve and other minor appliances. The driving wheels are 5 feet 6 inches in diameter, and 12 inches wide. Altogether it is a well arranged and compact machine, remarkable for its simplicity and strength. It is said to be capable of drawing ten tons up a gradient equal to 1 in 6, and is easily managed by an ordinary engine-driver.

"Messrs. Barrett, Exall, and Andrews, of the Kates-grove Iron Works, Reading, present, further on, some admirable specimens of workmanship in the shape of steam, and horse-thrashing machines, engines, mills and agricultural machinery generally. Of reaping, mowing, and thrashing machines, haymakers, &c., Burgess and Key, of Newgate-street, present some excellent specimens. They are placed on the west side of the Eastern Annexe. This firm have, we believe received more prize medals for agricultural implements than any other firm in England, and this fact speaks trumpet-tongued of the excellence to which they have attained.

In the matter of steam ploughs and a great variety of other implements for the cultivation of land and the gathering in of its fruits. Messrs. M. Garrett and Son, of Leiston Works, Suffolk, and James and Frederick Howard, of Britannia Iron Works, Bedford, are large exhibitors. The first-named firm have erected a stand for the display of their wares, and which discloses a considerable amount of artistic skill on the part of its constructor.

"Messrs. Ransomes and Sims, of the Orwell Works Ipswich, are very largely represented on the West side of the Eastern Annexe, both as regards steam engines and apparatus for agricultural purposes, and implements to be worked by horse or manual labour. Indeed, it would be almost an impossibility to barely enumerate the specimens which they have sent to the Exhibition. Perhaps their 15 H.P. horizontal stationary high pressure steam engine is the best exponent of their ability as engineers. The boiler of this is on the Cornish principle, the fire being placed in an internal flue. The flame first passes through, and then along each side of the boiler to the chimney. This arrangement is calculated to generate steam rapidly, whilst any sediment contained in the water used will collect *under* the fire flue—a great practical advantage—because the deposit in that case will not interfere with the generation of steam. There is an air of substantiality about engines of this construction which speaks well for their continuing long in good condition. Mounted on a stone base, to which the bed-plates are firmly bolted, an engine of this kind would be admirabiy adapted for working machinery of almost any kind, but for thrashing machines, saw, or corn mills, it would be especially useful. The improvements made in horse ploughs—the judicious combination of lightness with strength—are seen in the specimens of Messrs. Ransomes and Sims.

"Of traction engines and highway locomotives there are several varieties. Those of Robey and Co., of Lincoln, are not the least excellent of them.

"Of thrashing machines there are many varieties; but one exhibited by Tasker and Sons, of the Waterloo Iron Works, Andover, Hants, calls, perhaps, for especial notice at our hands. It is patented, and known as the Combined Thrashing Machine. It performs, indeed, a number of distinct operations, as separating the corn, straw, caving and chaff, from each other, and depositing them in the place assigned to each. It is, indeed, a favourable example of the ingenuity of the firm who have deposited in the Annexe.

"A double corn mill, fitted with two pairs of stones, is shown by Mr. John Tye, of Lincoln. Its portability is one of its highest recommendations. It may be transparted from place to place easily, and is workable by steam, wind, or water-power. Infinite however, are the treasures of the Eastern Annexe, and many of them must be left unexplored and unexplained until a further opportunity for doing both presents itself."

ECONOMIC MINERALS OF CANADA.

An elaborate descriptive catalogue of economic minerals of Canada, sent to the Exhibition, has been prepared by Sir Wm. Logan, F. R. S. Each substance is arranged under a heading connected with some of its more prominent applications. The locality from which the mineral comes, and the name of the exhibitor, are in every case given. The headings under which minerals are classed, are—metals and their ores; minerals applicable to chemical manufacture; refractory minerals; minerals applicable to common and durative construction; grinding and polishing minerals; mineral manures; mineral paints; minerals applicable to the fine arts; minerals applicable to jewellery;

and miscellaneous minerals. To Sir W. Logan's catalogue there is appended an equally carefully arranged catalogue of the crystalline rocks of Canada, by Mr. T. S. Hunt, F. R. S. The collection is sent by the Geological Survey of Canada; and the specimens are arranged according as the rocks are Laurentian, Huronian, Lower Silurian, or Eruptive. The collection is, doubtless, very complete; and tends materially to confirm the opinion which has long been entertained by those acquainted with the Province, that Canada is destined to become, at no distant period, a great and prosperous mining country.—*Mining Journal.*

PHOTOGRAPHY.

Side Light v. Vertical Light.

A writer in Dickens' *All the Year Round,* says:—"It is perfectly surprising that this has not been more considered by all photographers. Their process is a thing simply of light and shade. It is the light that makes the portrait come into existence at all. The patches of shade, more or less dark, alone prevent a *carte de visite* from being a sheet of blank paper. Surely the shapes of those patches of shade are all-important. It is little known—and when it *is* known we have prettier photographs—that a light coming from above the head of the sitter is the most unbecoming thing in the world, and that a face so lighted cannot by any possibility show to advantage. Now, the ordinary photographer's glass room has a diffused light all over it, but mainly coming from above, so that the eyes show in two dark caverns of shadow, while a black patch appears under the nose, throwing the termination of that feature up to the skies, and making it show as an isolated nob, the full size of which is—and few of us can bear this—done the amplest justice to. This top-light, moreover, scores out relentlessly those baggy marks which many of us have too well developed under the eyes, and which are not characteristics of the human beau-ideal, while—in the case of ladies—a kind of trough on each side of the mouth is joined to the chin-shadow after the fashion of a Vandyke beard.

"In ladies portraits, the elimination of beauty, and not so much of character as in men, is the thing to be borne in mind. Now, the most becoming light is one level with the face, or even, perhaps, somewhat beneath it—it being a great mistake to suppose that the foot-lights on the stage are unbecoming. Such a light as that described above would make any face in the world ugly, and yet it is just such a light which is to be found in most photographers' rooms.

"As much as possible, as may consist with the action of the photographic process, the light from above should be got rid of in taking these portraits, and a light from the side brought into use."

Photography at the International Exhibition.

"About the time these lines will be before our readers' eyes, the first steps will have been taken towards the commencement of the ceremonial for inaugurating the International Exhibition; and as the majority of our readers will clearly not be present, they will no doubt be gratified to learn that, through the aid of their favorite pursuit, they will stand a fair chance of being hereafter eye-witnesses of the scene, by what we may designate a scientific second-sight.

"Many have doubtless already learned, from the pages of the daily newspaper press, that the exclusive right of taking photographs of and in the building during the continuance of the Exhibition has been purchased by the London Stereoscopic Company. It would not be discreet to name the exact amount paid for the privileges conceded, but we may mention that the sum of fifteen hundred guineas was paid down on signing the contract: the total amount the Commissioners will ultimately receive under the arrangement entered into will certainly be upwards of three thousand pounds. For this handsome sum several of the absurd restrictions proposed to be insisted on, and to which we drew attention in a former article, have been rescinded, and every reasonable concession has been made by the Royal Commissioners, to the intent that the work may be thoroughly and usefully performed.

"Most extensive preparations have been made for photographing the opening ceremonial and the chief posts for the execution of this important duty will be occupied by very able and responsible officers of the Stereoscopic Company.

"An erection fifteen feet high is, while we are writing, in course of construction immediately in front of the Portuguese department, for the purpose of commanding a view of the throne when all the exalted personages who will take the initiative part in the impressive ceremony of the inauguration will be grouped together, and the task of obtaining a permanent record of the event will be entrusted to Mr. W. England, whose admirable instantaneous views, which we have recently described, are sufficient guarantee for his peculiar fitness for this very responsible post of honour. Of course he will be attended by an appropriate staff of assistants.

"On either side of the western dome, where the address is to be read, will be stationed Mr. W, Russell Sedgefield and another photographic artist. The selection of Mr. Sedgefield to take a prominent part in the task of securing a photographic representation of this imposing spectacle is a happy and appropriate one.

"Another 'base of operations,' somewhat further removed in the nave, will be situated so as to embrace the orchestra, and give a *coup d'œil* of the whole. This very important post will also be occupied by a highly accomplished and artistic photographer, Mr. Stephen Thompson, with whose photographic works some of our readers are familiar; and we may presume that all are so with his literary productions, seeing that his contributions appear in our columns. Mr. Thompson will likewise be accompanied by his subordinates. From two other 'posts of observation,' one to the extreme right and the other to the extreme left of the orchestra, a sort of cross fire will be maintained in the reverse direction to those already indicated, bearing upon the spectators of the scene, amongst whom we may safely calculate upon a majority of ladies being included. It will be the task of the operators occupying these positions—we ought rather to have said the privilege—to secure a record of such a collection of beauties as perhaps never before for abundance can have been equalled: there is probably no other country in the world than our own where ladies form so large a proportion of the attendants at any public ceremony, and certainly none in which the sweet English faces can be surpassed. Acting as a foil and in curious contrast to these will be the Japanese Ambassadors, with their tawny complexions and splendid costumes.

"The first proofs from the various plates secured are to be immediately forwarded by express to Her Majesty at Balmoral. Orders have already been received by the contractors from one firm alone for fifty thousand prints; and we understand that any attempt at piracy will be stringently prosecuted.

"The time of year is much in favour of photographic success, the actinism being perhaps at its maximum during the month of May. We sincerely trust that the weather will be propitious for the occasion.

"The Jurors selected by the Royal Commissioners to adjudicate upon the merits of the photographs exhibited are Lord Henry Lennox, Professor Tyndall, Dr. Diamond, M. Claudet, and Mr. Thurston Thompson."—*British Journal.*

THE ECONOMIC MINERALS OF CANADA.

A very valuable and interesting descriptive catalogue of a collection of the Economic Minerals of Canada and of its Chrystalline Rocks, sent to the London International Exhibition, has just been issued by Sir W. E. Logan and Mr. Sterry Hunt. This catalogue not only describes the different minerals, and the extent to which they are worked in Canada, but it also points out the exact spot where they are to be found, and the probable extent of the deposit. We propose to insert in the Journal from time to time copious extracts from this valuable catalogue, and we commence with the "Minerals applicable to common and decorative construction."

Building Stones.

CHEVROTIERE.—The Trenton formation, which is the next in succession above the Birdseye and Black River, yields excellent building stone at Montreal, at Chevrotiere, nearly forty miles above Quebec, and at many intermediate places. The best stone at Montreal is derived from a ten feet band of grey bituminous granular limestone, in beds of from three to eighteen inches thick at the bottom, passing at the top, into a black nodular bituminous limestone; which is interstratified with black bituminous shale, in irregular layers of from one to three inches. This grey limestone, which is near the base of the formation, is a mass of comminuted organic remains, which consist largely of the ruins of crinoids and cystideans. The crystallization of these fossils gives a crystalline character to the rock. A considerable number of quarries are worked upon this band of grey limestone, there being four principal ones near Montreal, and the best houses of the city are built of the stone. The quantity of stone annually quarried in the immediate vicinity of Montreal is computed to be:—

313,200 cubic feet of cut stone	28,600	tons.
5,252 toises of rubble	63,024	"
	91,624	"

The prices of good stone in Montreal are:—

Ashler stone, undressed..............$0.13½ ℔ sq. ft.
Ashler stone, dressed.................. 0.30 "
Mouldings, from $0.16⅔ to $3, or for
a fair moulding ....$1.50 ℔ lin'ar ft
Fluted columns 18 inches diameter
for the stone........................$1.00 " rising ft
" " " for cutting...$2.50 "
Heavy rough stone, from 6 to 30
cubic feet, from.........$0.30 to 0.50 " cubic ft.
Very heavy rough stone,
say 60 cubic feet ....$1,00 " "

The strata in the neighborhood of the city are much traversed by trap dykes, which probably have a connection with an intrusive mass extending over 700 acres, and constituting Mount Royal, from which the city and island take their name. Some of the quarries display a number of these trap dykes which run in several directions and intersect one another. In some instances, the limestone, having been removed from among them, the dykes are left standing up several feet above the bottom of the quarries, representing in a marked manner the various details of the cracks they once filled.

In the seigniory of La Chevrotiere, a very excellent limestone for building is obtained between three and four miles back from the St. Lawrence. It usually goes, however, under the name of the Deschambault stone, in consequence of its being put on board of boats at this place. The stone is of a yellower or warmer grey than the Montreal stone; it is more even in its tint, and becomes somewhat less discolored by weathering. It is more granulor and more easily cut, being softer and tougher, but it does not take so fine nor so sharp an edge, nor does it *pick* so well. Three beds of pretty uniform character are worked; the top and bottom ones are eighteen inches thick each, and the middle one three feet. There is said to be a fourth bed beneath, with a thickness of four feet, which has not been quarried. The strata are so nearly horizontal, that it is difficult to determine their dip; it is therefore probable that the stone will spread to a considerable extent in the vicinity. Along the concession line, it is known for twenty-six acres to the S. W., and five acres to the N. E., and on the road across the concession, it is visible for a breadth of ten acres; beyond which, in sinking wells to a depth of twenty feet in blue clay, no rock is met with. The produce of the quarries of La Chevrotière has a deserved celebrity in Quebec, where it has been used in the construction of churches and other buildings.—*Trenton formation, Lower Silurian.*

Dolomites or Magnesian Limestone.

OWEN SOUND.—This beautiful and enduring stone can be obtained in unlimited quantities, the formation from which it is derived being here 150 feet in thickness, and divided into beds varying from a few inches to six feet. This stone possesses the very great advantage of being free from any substance producing stains. Its color rather improves with the weather, and the beauty of no building erected of it appears, as yet, to be marred by the growth of lichens. It is especially adapted for heavy masonry, and blocks of any required size can be obtained. The quarries are about half a mile from the harbor.—*Niagara formation, Middle Silurian.*

NOISY RIVER FALLS, NOTTAWASAGA, Lot 3, Range 11.—This stone is from the lower part of the Niagara formation, and is rather more compact than the Owen Sound specimen. The cliff is here about fifty feet high, and might be quarried with the greatest facility. Few of the beds are less than two feet in thickness, and some of them are about five feet, but the locality is not near to any navigable water or railway.—*Niagara formation, Middle Silurian.*

ROCKWOOD, ERAMOSA, Lot 5, Range 4.—This specimen is also from the Niagara formation, which is here more than 100 feet thick. The greater part of it consists of thick-bedded light grey porous crystalline dolomite. The beds vary from a few inches to ten feet in thickness; about thirty feet of it is almost white. Buildings of cut stone obtained from this band, are observed to improve in color after exposure, and at a short distance, have a silvery white appearance. The piers of the long railway viaduct over the valley of the Eramosa, at Rockwook, are built of stone from this formation, and have a very substantial appearance. The axis of an east and west anticlinal, runs under Rockwood, carrying a spur of the Niagara formation several miles to the eastward of the general trend of the outcrop. A north and south anticlinal passes under the same place; being one of a series which produces southward indentations in the outcrops of the palæozoic strata all the way from Kingston to the main body of Lake Huron.—*Niagara formation, Middle Silurian.*

GUELPH, Lot 20, Range D.—This stone is from the immediate vicinity of the thriving town of Guelph. The quarries expose fifteen feet of strata similar to the specimen. The thickest bed is four feet, and the thinnest about three inches. The stone is a light grey crystalline dolomite, like the last, somewhat cellular, but strongly coherent. It is easily worked, is suitable for the best architectural purposes, and appears to be of a durable character. The Guelph formation extends over a large area, and much of it is of the same character as the specimen.—*Guelph formation, Middle Silurian.*

OXBOW, SAUGEEN RIVER, BRANT, Lot 2, Range 8.—The beds are near the summit of the Onondaga formation, and yield probably the best dolomite for fine architectural purposes which has yet been discovered in the country. It resembles the Caen stone in the facility with which it can be worked, but it is closer grained, and by no means so absorbent, and is thus better adapted for withstanding the Canadian climate. Two bands, of about ten feet each, occur here, in the upper part of the Onondaga formation. The higher one is exposed at the surface, in a position offering every facility for quarrying it. The bed from which the specimen was procured, is two feet thick, free from stains, and splits with great precision with the plug and feather. The whole upper band is composed of thick beds of the same character; the thickest one in the lower band measures over three feet. The locality is near a projected line of railway, and is twenty-two miles from Southampton Harbor by the present road. It overlooks the Saugeen River, down which large scows can be floated to Southampton.

The specimen is from a very light grey oolitic bed, seventeen inches thick, immediately beneath the previous bed. It has been used for supporting water wheels, in mills in the neighborhood, and found to answer well, becoming highly polished under the action of a revolving shaft.—*Onondaga formation, Upper Silurian.*

Sandstones.

LYN, ELIZABETHTOWN, Lot 26, Range 2.
NEPEAN, Lots 27, 28, 29, Ranges 5, 6.
AUGMENTATION OF GRENVILLE.
QUIN'S POINT, Seigniory of La Petite Nation.

These stones are derived from the Potsdam sandstone, which constitutes the summit of the lowest group of fossiliferous rocks of Canada. A quarry has been opened on the outcrop of the rock, at Lyn, by Mr. B. C. Brown, and the stone from this, and from a quarry on the property of Mr. Keefer, at Nepean, in the same formation, has been used in the construction of the new Parliament buildings at Ottawa. At Lyn, the beds of sandstone are massive, and are seen resting on the Laurentian gneiss.—*Potsdam group, Lower Silurian.*

PEMBROKE.—This fine freestone is much exposed in the vicinity of the Allumette rapids, near Pembroke. A quarry has been opened on it, on the land of Mr. Peter White, where it occurs in beds varying in thickness from six to eighteen inches. It is easily wrought and carved, and although soft, is tough, and retains sharp angles and corners.—*Chazy formation, Lower Silurian.*

HAMILTON, BARTON.—This fine grained compact greenish-grey sandstone is from a deposit of about ten feet in thickness. Some of the beds are thick, but others are thin enough for flagstones; the stone is free from iron stains, but subject to a growth of lichens in shaded and moist situations.—*Grey band, Medina formation, Middle Silurian.*

GEORGETOWN, ESQUESING, Lot 22, Range 7.—This is from a bed of light grey freestone, which belongs to a band of about twenty feet in thickness. The beds are mostly thick, fine grained and compact; some split into good flagstones; but all are rather hard for grindstones. It has been used in constructing culverts on the Grand Trunk Railway, and numerous buildings in Toronto, among which are the University and other important structures, and it appears to answer well.—*Grey band, Medina formation, Middle Silurian.*

NOTTAWASAGA, Lot 2, Range 6.—These stones are from a band of fine grained soft light grey freestone, supposed to be twenty feet thick. The beds are from two inches to three feet in thickness; some of them *reedy*, or marked by lines of stratification. The stone yields good grindstones, but has not yet been much used for building purposes, although from the specimen A, it would appear to be well suited for such. From the facility with which parallel-faced blocks of the required thickness can be obtained, this stone is well adapted for stove-pipe holes, for which it is much used.—*Grey band, Medina formation, Middle Silurian.*

NORTH CAYUGA, Lot 48, Range 1.—A band of white sandstone runs through Haldimand County in Western Canada, and is largely developed on the Oneida and North Cayuga town-line, north of the Talbot road. Its beds are massive, ranging in thickness from one to three feet, and when fine grained, it is well adapted for building purposes. A quarry has been opened in it, on the land of Mr. William DeCew, from whom this specimen of building stone was obtained.—*Oriskany formation, Devonian.*

Labradorite.

Abercrombie.—The opalescent variety of labradorite occurs in cleavable masses in a fine grained base of the same mineral character, which forms mountain masses. Where these are thickly disseminated in the paste, the stone becomes a beautiful decorative material, applicable to architectural embellishment, and to articles of furniture. Its hardness is about that of ordinary feldspar, and it would, in consequence, be more expensive to cut and polish than serpentine or marble, but it is not so readily scratched or broken, and would therefore be much more lasting. Professor Emmons states that a block of the stone submitted to the action of a common saw, such as is used in sawing marble, moved by the waste power of a common water-mill, was cut to the depth of two inches in a day. This is understood to be one-fifth the amount that would be cut in a block of good marble in the same time, by the same means. It would thus appear that though the operation is slower in the case of labradorite, there is no greater amount of mechanical contrivance required than for marble, and that slabs could be prepared for chimney pieces, for pier tables, and other articles of furniture, at a cost beyond that of marble, not greater than is proportionate to the superior beauty and durability of the material.—*Laurentian*

Gneiss.

St. Charles Reservoir, Jeune Lorette.—This stone has been used for building the dam and reservoir of the Quebec water-works, on the St. Charles river. The gneiss, which is obtained a short distance above the reservoir, is hornblendic, being composed of translucent, colorless quartz, white orthoclase, (the feldspar predominating over the quartz,) and black hornblende, all running in irregular parallel planes, showing the gneissoid structure very distinctly, and having at a little distance, a general grey color. The rock may be split in almost any direction by means of wedges, but most easily in that of the gneissoid layers, particularly when these are even. The layers are occasionally affected by undulations and contortions, but these donot materially affect its dividing by means of wedges. The rock splits and dresses with most difficulty at right angles to the gneissoid layers, but is capable of receiving fine smooth faces, with sharp edges and corners. Masses of almost any size can be blasted out from the rock, and large blocks have been dressed and applied to the masonary work of the reservoir, which will no doubt prove a structure of the most lasting character.—*Laurentian.*

Grenville.—The porphyroid orthoclase gneiss, which this specimen represents, forms great mountain ranges among the Laurentian rocks, rising into the highest peaks of the orthoclase region, and generally constituting the main body of rock, which separates the great limestone bands from one another. These masses of gneiss appear sometimes to attain several thousand feet in thickness, but are divided at unequal intervals, by thinner and less feldspathic bands, in which the stratification is more distinct.—*Laurentian.*

Syenite.

Grenville.

Barrow Island, River St. Lawrence, opposite Gananoque.—The intrusive masses of the Laurentian series consists chiefly of syenite and dolerite. These rocks occur in many parts of the country, but their relative ages have been ascertained principally by the investigation in the counties of Ottawa and Argenteuil. What appear to be the oldest intrusive rocks are dykes of a rather fine grained dark greenish-grey greenstone or dolerite, varying in thickness from a few feet to a hundred yards. Their general bearing appears to be E. and W. These greenstone dykes are interrupted by an intrusive syenite, a mass of which occupies an area of about thirty-six square miles in the townships of Grenville, Chatham, and Wentworth. The specimens 1, 2, are derived from it, and 3 is from an area of a similar character, occurring between Kingston and Gananoque. In Grenville, the syenite is penetrated by dykes of what has been called felsite-porphyry, hornstone-porphyry, or orthophyre, having for its base an intimate mixture of orthoclase and quartz, colored by oxyd of iron, and varying in color from green to various shades of black. Throughout the paste, which is homogeneous and conchoidal in its fracture, are disseminated well defined crystals of a rose-red or flesh-red feldspar, apparently orthoclase, and, although less frequently, small grains of nearly colorless quartz. All of these intrusive masses are cut by another set of dolerite dykes, which probably belong to the Silurian, or perhaps to the Devonian period.—*Laurentian.*

Granite.

St. Joseph Beauce.—This band of granite, which has a considerable proportion of quartz, has been used in the seigniory of St. Joseph for millstones, and would yield a strong and durable building stone, is about fifty or sixty feet thick. It runs with the stratification, near to a band of serpentine, and is supposed to be an altered sandstone, and not an intrusive rock.—*Quebec Group, Lower Silurian.*

Barnston.—An intrusive granite of Devonian age occurs in considerable abundance in the Eastern Townships, and forms many isolated hills, the whole of them of small size, with the exception of Great Megantic Mountain, which occupies an area of about twelve square miles. The rock splits well with plug and feather, and can be obtained in blocks of almost any required size. It forms a handsome building stone, and has been used for bridges on the St. Lawrence and Atlantic Railway. It is composed of white quartz and white orthoclase feldspar, with black mica. An area of this rock occurs in Stanstead, covering six square miles, and there is another in Barnston, from which the specimen now exhibited was obtained. Granite of the same character, and probably of the same age, is widely distributed in the State of Maine, and is traceable to New Brunswick, where it is overlaid by the Carboniferous rocks.—*Devonian.*

Board of Arts and Manufactures for Upper Canada.

BOOKS ADDED TO THE FREE LIBRARY OF REFERENCE DURING THE MONTH.

CLASS VI.

The Art of Illuminating as practised in Europe from the Earliest Times. Illustrated by Borders, Initial Letters and Alphabets. Selected and Chromolithographed by *W. R. Tymms*, with an Essay and instructions by *M. Digby Wyatt.* 4to. 1860.

CLASS IX.

The Steam Engine, in its various applications to Mines, Mills, Steam Navigation, Railways, and Agriculture. 4to. 1861 .... *John Bourne.*

CLASS XX.

Art Journal, with International Exhibition Catalogue of Art Manufactures, monthly .... *London.*
American Gas Light Journal, semi-monthly........ *New York.*
Engineer, weekly .... *London.*
Mining Journal, weekly .... "
Practical Mechanics' Journal, monthly........ "
The Technologist, monthly .... "

BRITISH PUBLICATIONS FOR APRIL.

	£	s.	d.	
Adams (H. G.) Cyclopedia of Female Biography, fcap. 8vo. red. to........	£0	5	0	*Groombridge.*
——— Poetical Quotations, fcap. 8vo. red to	0	5	0	*Groombridge.*
——— Sacred Poetical Quotations, fcap. 8vo. red. to	0	5	0	*Groombridge.*
Albert's (Prince) Golden Precepts; or the Opinions and Maxims of his late R.H., 16mo.	0	2	6	*Low.*
Archer (Thos. Croxen) Vegetable Products of the World in Common Use, ill. roy. 16mo	0	2	6	*Routledge.*
Arnott (Neil) Survey of Human Progress towards Higher Civilization, 2 e. with ad. 8vo	0	6	6	*Longman.*
Artist and Craftsman, cheap ed. cr. 8vo	0	6	0	*Macmillan.*
Auckland (William, Lord) Journal and Correspondence, vols. 3 and 4, 8vo........	1	10	0	*Bentley.*
Bacon (Lord) Letters and Life, including his Occasional Works, by J.Spedding, 2 v.8vo	1	4	0	*Longman.*
Bacon's Essays and Locke's Conduct of the Understanding, 18mo........	0	1	4	*Chambers.*
Beardmore (N.) Manual of Hydrology, containing Hydraulics and other Tables, &c. 8vo	2	2	0	*Waterlow.*
Beeton's Book of Birds, showing how to Rear and Manage them, cr. 8vo........	0	3	6	*Beeton.*
Beveridge (Henry) Comprehensive History of India, ill., vol. 3, roy. 8vo........	1	1	0	*Blackie.*
Blair (Mrs. Fergusson) Henwife, her own Experience, illust. new ed., fp. 8vo. plain 4s. 6d., coloured........	0	7	6	*Hamilton.*
Book of Dates (The); or, Treasury of Universal Reference, new ed., cr. 8vo........	0	7	6	*Griffin.*
Bradshaw's Railways, &c., Through Route and Overland Guide to India, Turkey, Persia, &c., new ed. sq........	0	5	0	*Adams.*
British Empire (The), Historical, Biographical, and Geographical, 3rd ed., cr. 8vo...	0	7	6	*Griffin.*
Brooke (R.) General Gazeteer in Miniature, rev. by A. G. Finlay, new ed., fp. 8vo...	0	5	0	*Tegg.*
Bryce (Jas.) Universal Gazetteer, 3rd ed., thoroughly revised, 8vo........	0	8	6	*Griffin.*
Canton (R.) Art of Illuminating Made Easy, obl........	0	1	6	*Canton.*
Clever Boys of Our Time, and How they became Famous Men, fcap. 8vo. red to......	0	5	0	*Darton.*
Dod (R. P.) Peerage, Baronetage and Knightage of Great Britain & Ireland for 1862, sm. cr. 8vo	0	10	6	*Whittaker.*
Illustrated Catalogue of Stained Glass Windows, 4to........	0	2	6	*Heaton & Co.*
Johnson (Geo. W.) Science and Practice of Gardening, illus., fcap. 8vo........	0	3	0	*J. of Hort. O.*
Jukes (J. Beate) Student's Manual of Geology, new ed., partially recast, illus., cr. 8vo.	0	12	6	*Black.*
Lawson (Wm.) Geography of the British Empire, fcap. 8vo........	0	3	0	*Hamilton.*
Lewin (Thos.) Invasion of Britain by Julius Cæsar, 2nd ed., 8vo........	0	10	0	*Longman.*
London Labour and the London Poor, extra vol. Those that Will not Work, 2 ed. 8vo	0	10	6	*Griffin.*
Marshall (Frederick) Population and Trade in France in 1861-62, post 8vo	0	8	0	*Chapman & H.*
Mayhew (Henry) and Binny (John) Criminal Prisons of London and Scenes of Prison Life, 8vo	0	10	6	*Griffin.*
Mill (John Stuart) System of Logic, Ratiocination and Inductive, 2 vols. 5th ed. 8vo	1	5	0	*Parker & Son.*
Miller (Hugh) Essays, Historical and Biographical, Political and Social, cr. 8vo	0	7	6	*Hamilton.*
Miller (Thomas) Catechism of the Marine Steam Engine, fcap. 8vo. red. to........	0	2	0	*Spon.*
Mursell (Rev. Art.) Lectures to Working Men, 5th ser., v. 2, cr. 8vo., sd. 10d........	0	1	4	*Simpkin.*
——— 5th ser., comp. in 1 vol., cr. 8vo......	0	2	3	*Simpkin.*
Oliphant (L.) Nar. of Earl of Elgin's Mission to China and Japan, 2 v. 8vo. red. to...	1	1	0	*Blackwoods.*
Ranken (Major) Canada and the Crimea, Sketches of a Soldier's Life, post 8vo........	0	7	6	*Longman.*
Read (W. T.) Pop. and Math. Astronomy, with Formulæ of Plane Trigonomy, &c., cr. 8vo........	0	5	0	*Longman.*
Rhind (A. H.) Thebes, its Tombs and their Tenants, ancient and present, sup.-r. 8vo	0	18	0	*Longman.*
Swainson (William) New Zealand and the War, post 8vo........	0	5	0	*Smith & Elder.*
Tarbuck (Ed. L.) New Illustrated London Guide for 1862, with Map, post 8vo..	0	1	6	*Hagger.*
Thom's British Directory and Official Handbook of the United Kingdom, 1862, r. 8vo	0	12	6	*Groombridge.*
Webb (E. B.) on Iron Breakwaters and Piers, 4to........	0	2	0	*Lockwood.*

AMERICAN PUBLICATIONS FOR MAY.

Annual of Scientific Discovery; or Year Book of Facts in Science and Art, for 1862, 12mo	$1 25	*Gould & Linc'n*
Browning (Eliz. Barrett) last Poems, with a Memorial	0 75	*James Miller.*
Harris (T. W., M.D.) A Treatise on Insects injurious to Vegetation, 8vo	6 00	*Crosby & Nich.*
Irving (Washington) Life and Letters of, vol. 1, 12mo	1 50	*G. L. Putnam.*
Life of Arthur Vandeleur, Major Royal Artillery, by the author of "Memorials of Captain Hedley Vicars," &c., 12mo	0 75	*R. Carter & B.*
Lighthill (E. B., M.D.) Popular Treatise on Deafness, with illustrations, 12mo	0 50	*Carleton.*
Mill (John Stuart) Considerations on Representative Government, 12mo	......	*Harper & Bros.*
Taylor (Bayard) Adventures in the Path of Empire, 12mo	1 50	*G. P. Putnam.*
Taylor (Isaac) The Spirit of Hebrew Poetry, with Sketch of the Life of the Author, and Catalogue of his Writings, 12mo	1 00	*Wm. Gowans.*
Wedgewood — A Dictionary of English Etymology, vol. 1, 8vo	3 00	*Sheldon & Co.*
Woolsey (T. D.) The Study of International Law, 12mo	1 50	*J. Monroe & Co.*

Patent Laws and Inventions.

RECENT CANADIAN INVENTIONS.

Fisher's Hollow Bricks.—The Specifications furnished are too lengthy for insertion in our columns, but, with the drawings and models of the bricks, may be seen in the rooms of the Board.

What the inventor claims is, that of hollow bricks of such sizes and form as practically adapt them to economy in the manufacture, and to the building of walls on a new and improved method.

The advantages and superiority claimed for this invention may be thus summarily stated.

1. Economy of Space.
2. Economy of Cost.
3. Improved Sanitary Conditions.
4. Security from vermin and diminished liability to loss by fire.

First—Economy of Space. A wall may be built of eight inches in thickness, more or less, containing continuous air spaces, subserving the purposes of ventilation and preventing the transmission of moisture, heat, and sound, equally well with, if not better, than a solid one of greater thickness; thus admitting of larger apartments on a given space of ground.

Second—Economy of Cost. As compared with ordinary bricks, their manufacture requires a less quantity of raw material, a smaller expenditure in its preparation, less time in drying, less fuel in burning, and less weight in transportation, so that larger loads may be moved for a given sum. In building, these bricks occupy twice the space taken up by ordinary ones in the wall, and their bearing on those beneath being much less than that of ordinary bricks, less than half the usual quantity of mortar will suffice for laying them—no mean saving in localities where lime or sand are scarce and dear; less expense in interior finishing, obviating the necessity for furring and lathing, and economy generally, inasmuch as by the use of these hollow bricks, building works may be carried on at all seasons of the year.

Third—Improved Sanitary Condition. By the use of these bricks, buildings may be constructed with economy of cost and space, and at the same time secure superior Sanitary Advantages in the way of ventilation, with freedom from cold and moisture; not heretofore attainable without increased expense.

Invented by Arthur Fisher, Montreal.

Moodie's Rotary Interest Indicator. — This Invention consists of a hollow case of tin, brass or copper, or other suitable metal, with an opening along the length of the face, on the side or edge of which opening, a graduated column with figures is placed. Within the case are placed two rollers of wood or metal, which rollers are worked by means of a toothed wheel geared into two pinions, which pinions are attached to the end of the rollers. To the rollers is attached a strip of paper, linen, or other suitable material, on which is written or printed the figures requisite for ascertaining by inspection the exact amount of Interest from one day to any number of years, and at the several rates of Interest in use in this Province—or with tables shewing the quantities of timber, earthworks, time tables, and for the general purposes of a Ready Reckoner.

What the inventor claims is the application of a hollow case furnished with rollers, which rollers are worked by means of a toothed wheel and pinions, and on which is placed paper, cloth, or other suitable material marked with the necessary figures for indicating the amounts of Interest at various rates, and for other purposes above enumerated. Invented by J. W. Dunbar Moodie, Belleville.

ABRIDGED SPECIFICATIONS OF ENGLISH PATENTS.

2474. J. Stewart. *Improvements in the treatment of oils retained by distillation of bones and other animal matters for the purpose of obtaining matters which may be used as pigments and dye stuffs.* Dated Oct. 4, 1861.

This process is to treat common bone oil with hydrochloric acid, or a solution of sulphuric acid;

then to separate the dirty acid, and treat it with alkalis, when a substance is deposited which forms a brown pigment. The oil is then placed in a retort, with certain proportions of oxide of iron, and carbonate of potash, and the whole is distilled over until perfectly dry, the product being refined bone oil, and the residuum left ferrocyanide of potash, and may be used as such or converted into Prussian blue.

2490. W. Rowan. *Improvements in cylinders or drums and beaters for machines for scutching and preparing flax and other fibres.* Dated Oct. 5, 1861.

Hitherto the cylinders or drums employed in the scutching and preparing of flax and other fibres have been rigid, and consequently, the combs, beaters, pins, or teeth fixed thereto or thereon, have been rigid also, and have therefore, acted more or less injuriously on the fibres, Now by this present invention this defect is remedied, and the invention consists in forming the cylinders or drums in segments, and in making one end of each segment fast to the frames, while play is allowed to the other end limited by stop pins or otherwise; the free ends of the segments or those to which play is allowed, carry the combs and beaters or other tools or apparatuses intended to act on the fibres. The rapid rotary motion imparted to the drum causes the combs, beaters, or other apparatuses to be thrown by centrifugal force with a spring-like action into and amongst the fibres. (*See Journal for February.*)

2497. W. Squire. *Improved machinery for planing and shaping wood.* Dated Oct. ,5 1861.

Here the patentee planes the opposite faces of planks, &c., simultaneously, and thereby ensures perfect parallelism, by the use of a combination of machinery, wherein a pair of cutters, rotating in vertical planes, and capable of receiving a nice adjustment, operates simultaneously upon opposite sides of the work, which work is fixed in and carried forward by a travelling carriage. This carriage is so constructed as to hold securely either a single plank or block, and present the vertical sides to the cutters, or a pile of planks may be so packed therein as to present their edges to the cutters. By a slight modification, the machinery may be made to plane inclined faces, or by a change of cutters the machine may be adapted to cut mouldings.

2534. B. Browne. *A new improved spring.* (A communication.) Dated Oct. 10, 1861.

This consists of combination of steel blades or strips of tempered steel, bent in different curves or directions, the said blades being connected together at their extremities, so as to act one upon the other, so that when in use the end portions of the blades pressing upon each other stiffens the springs, and thus adapts them to the load or pressure they are required to bear or carry.

2562. F. B. Houghton. *Improvements in apparatus employed in reducing straw and other vegetable substances in the manufacture of pulp for making paper.* Dated Oct. 14, 1861.

Here the patentee employs a boiler of a cylindrical form with hemispherical ends, and within this boiler a shaft or axis works, passing through a stuffing box at one or both ends. On this shaft are fixed several bent or curved blades, the edges of which are bent up so as to form scoops; these blades are fixed at intervals all round the shaft, and they are of a length to come within a few inches of the inner surface of the boiler. To this shaft rotatory motion is communicated, by which the materials under operation are continously moved and raised out of the alkaline solution in the lower part of the boiler, which is about one-third filled with that fluid. The boiler is heated from the interior by water circulated in closed pipes or tubes, on Perkins' principle. When the boiler and the materials therein are to be cooled, water is pumped into the boiler.

2574. T. Forster. *Improvements in re-working waste vulcanized india-rubber.* Dated Oct. 16, 1861.

Here the vulcanized india-rubber is suitably reduced by crushing rollers, or otherwise, and is then mixed with gutta-percha and sulphur. Pigments may be added to the mixture of vulcanized india-rubber, gutta-percha, and sulphur, if desired.

RESULT OF THE PRESENT CONDITION OF OUR PATENT LAWS.

Board of Arts and Manufactures for U. C.,
Toronto, *May* 13, 1862.

Sir,—I have frequent applications made to me, as to whether Canadians can now obtain Patents in the United States, and on what terms. My impression has been that they cannot, since the passing of the Act of May, 1861; will you be kind enough to inform me if I am correct; or, whether Canadians can still obtain Patents in the United States by paying the sum, formerly paid, of five hundred dollars.

I am, Sir, your obedient servant,
W. Edwards, *Secretary.*

The Hon. the Commissioner of Patents,
U. S.

U. S. Patent Office,
Washington, *May 20th,* 1862.

Sir,—In reply to your communication of the 13th instant, I have the honor to inform you, that as Canada discriminates in her patent laws against citizens of the United States, Canadian subjects are not entitled to the benefits of the tenth section of the Act of March 2nd, 1861, herewith enclosed.* Canadians can obtain patents only on payment of the fee required under the old law of all British subjects, viz., $500 on each application.

I am, Sir, respectfully your obedient servant,
D. P. Holloway, *Commissioner.*

W. Edwards,
Secretary of Board of Arts and Manufactures,
Toronto, Canada.

* See "Proceedings of the Sub-Committee," page 133.

Selected Articles.

LECTURES OF SPECTRUM ANALYSIS.

BY DR. H. E. ROSCOE, AT THE ROYAL INSTITUTION OF GREAT BRITAIN.

In our lecture last Saturday afternoon we investigated the properties of white solar light. We saw that the sunlight which produces upon our eye the impression of whiteness is, in reality, composed of an infinite number of different coloured lights; and we obtained, when we passed this white solar light through a triangular piece of glass, that which we called the solar spectrum—a broad band of variously coloured rays differing from one another in their refrangibility. But we noticed that this solar spectrum is not continuous,—that it is intersected by dark lines which run through the whole length of the spectrum, and which occur always in sunlight. We noticed that these bands occur not only in direct sunlight, but also in reflected sunlight—in the light of the planets, and that these same bands do not occur in starlight. Hence Fraunhofer, as early as the year 1814, stated that these lines observed in the spectra of the sun and planet-light must in some way have their origin in the sun. We then proceeded to notice the properties of the light given off by artificially heated bodies. We saw that, with the exception of phosphorescence, light is given off only when a body becomes heated; and we divided artificial light as given off from heated substances into two great classes,—namely, that kind of light which is given off when a solid or a liquid is heated, and that kind of light which is given off when a gas is heated. We saw that when a solid or a liquid body becomes luminous it gives off light of every kind between certain limits—that its spectrum is continuous; whereas the light given off by a glowing gas is not of every kind—that such light produces a broken spectrum; and thus we learnt that it was possible to distinguish, by examining the light given off by such glowing gases, between the kinds of gas which were made to glow, but that we could not in the case of liquids or solids decide by the examination of the light what substance was heated; and thus we arrived at a knowledge of the possibility of founding the science of spectrum analysis, a science which will teach us what the chemical nature of a substance is by simply looking at the kind of light given off by its glowing vapour.

I propose in this lecture to notice—for I cannot do more than notice—some of the applications of the principles which we laid down in the last lecture, to the analysis of terrestrial matter; for we find that we obtain, by the application of these principles to the examination of the matter which composes our globe, a knowledge which is as perfectly unlooked for and novel as it is interesting—information concerning the properties and chemical composition of the matter constituting the globe which we inhabit.

We must remember that what we require to do in order to obtain such a knowledge of the constitution of terrestrial matter, is to obtain this terrestrial matter in the condition of a glowing gas. Now, we may divide, for the sake of illustration, the matter composing the globe into three classes,—that matter which is made gaseous and which becomes luminous near the temperature of the coal-gas flame: that matter, in the second place, which is volatile at a much lower temperature than that; and thirdly, that matter which is volatilised, and becomes luminous at a much higher temperature than that of the gas flame.

Thus, for instance, if I place a piece of clean platinum wire in this gas flame for a few moments we shall observe that it does not impart any colour to the colourless flame. For a moment it does impart a colour, for a reason which I shall have to explain. The platinum itself does not give any colour to the gas flame because it is not volatile at the temperatare of the flame, and we do not get any platinum gas. But if I place another substance in the flame; for instance, a piece of common salt, we shall see that this flame is coloured of a peculiar tint, owing to the fact that the sodium is here volatilised, and that it becomes luminous, and gives off its peculiar and characteristic kind of light, namely, yellow. Now, by heating the platinum to a much higher temperature, we can get the peculiar light which it gives off. Thus, for instance, I have here a platinum pole, and by passing an intense electric spark through this, I obtain the platinum, as we shall see in a subsequent part of the lecture, in a state of luminous vapour, and then we find that the platinum also gives out the light which is peculiar and characteristic for platinum alone, and which no other body gives off.

That peculiar chemical substances produce in the flame peculiar colours has long been known, and this fact is used by the chemist as a means of detecting such substances. Thus, for instance, I will here show you a number of such differently coloured flames; here we can produce the luminous vapour of a number of these substances. I can here produce the characteristic yellow flame of sodium. If I bring the salts of potash into this flame I can produce the peculiar colour given by all those salts—a peculiar purple colour. Here I have the peculiar colour which is produced by a very interesting body with which we shall have to do in a subsequent part of the lecture—one of the new alkaline metals discovered by Bunsen, *rubidium;* and this is the flame coloured by the other new alkaline metal, *cæsium*, also discovered by Bunsen. Here we have lithium, which produces this magnificent red colour. Here we have the green produced by barium. All the salts of barium tint the flame of this beautiful green colour. Here we have the red produced by strontium. Here we have the orange produced by calcium, and here I will produce a peculiar blue flame by a substance which differs entirely from these in properties—the non metallic element selenium. If I bring selenium into the flame, we shall see that this body imparts to the flame a very peculiar and beautiful blue colour. It is extremely volatile, and only lasts for a few seconds. Further on we have the peculiar blue colours communicated to the flame by copper and by boracic acid.

I can show you the same thing in various ways. Here, for instance, I can produce a much larger flame, and show you the colour of the same salts. [A large gas flame was produced from a perforated jet of about three inches in diameter, and urged by a strong current of air. Pumice-stone dipped in solutions of the chloride of sodium, potassium, barium, strontium, calcium, and lithium, were then held in the flame, the colours imparted by those substances being thereby again made evident.]

I will show you one more illustration of this with these papers. These are papers—gun-papers in fact, which have been soaked in nitric acid, and which have then been steeped in solutions of these various salts. Here you see we shall have rather a quick combustion, but by reflection on the white screen the colour will be shown very well. [The lecturer then burnt gun-paper which had been dipped in solutions of the chlorates of the following substances: sodium, potassium, barium and strontium.]

As I have said, it has been long known—that these various substances produce certain colours when brought into the flame. But if we now examine more closely what goes on when we have these variously-coloured flames burning before us, and what exact kind of light is given off; that is to say, if we examine the spectra of these differently coloured flames, we find that we obtain very much more information concerning the matter than we do in this simple way by looking at the flames themselves. We look through a prism, or we employ Kirchhoff and Bunsen's more perfect arrangement, which you see here in the actual instrument before you, or here in the drawing; and we place a bead of the salt, the colour of whose light we wish to examine, in the flames here in front of this slit, as indicated in the drawing. I here bring a bead of chloride of barium, into one of these flames placed at one side of the slit. The green light thus produced falls upon the small prism placed over the upper half of the slit, and it is thereby refracted so as to pass into the tube and through the large prism. Into the other flame, placed directly in front of the slit, I bring a bead of chloride of strontium, and the red light which this produces passes directly through the lower half of this slit on to the prism. In this way we obtain two spectra, one in the upper half of the field of the telescope, the other in the lower half; and we are thus enabled to compare very beautifully indeed the spectra which we wish to examine. Suppose, for instance, that we want to know whether a substance really is barium: all we have to do is to place the substance which we know to be barium in the one flame, and to place the substance which we suppose to be barium in the other; if on looking through the telescope we find that these two sets of lines actually coincide—that the lines of the substances which we know to be barium coincide exactly with the lines of the substance which we suppose to be barium,—we then arrive at a very distinct knowledge that the substance is really what we suppose it to be. If we examine with such an instrument as this, which is the latest form of Bunsen and Kirchhoff's apparatus, such a flame as any of those we see burning before us, we observe what is represented very faithfully indeed by these painted diagrams. If we look at the yellow sodium flame we notice that the sodium spectrum consists of one single bright yellow line, which, when we examine it more carefully with a larger number of prisms, we find is split up into two lines. Now, all the sodium compounds yield this peculiar spectrum; and nothing we know of, besides sodium and its compounds, will yield it. Potassium, which produced the purple flame we saw here, gives us a spectrum consisting of a portion of a continuous spectrum, with a bright line in the red and another in the violet. One of these lines is known as line *alpha* of potassium, and the other as the *beta* of potassium. These lines are not seen in any other substance, and they are seen in every potassium compound from which we can obtain this luminous vapour. Proceeding onwards, we find that we see the spectrum of lithium, consisting of one bright red and one orange line not so bright; and these three lower paintings—strontium, calcium, and barium—represent the spectra of those three alkaline earths. What we notice when we look at these flames through the telescope is exactly what is represented on that diagram.

Now, we may ask ourselves, "This is all very well but what improvement is this method of analysis upon our ordinary chemical methods? What benefit is it to us that barium gives us these peculiar bands, that strontium yields certain different bands, that calcium produces others again? We know that the reactions of calcium, barium, and strontium are very diffierent, and we can easily detect these substances by the ordinary chemical methods." The answer to this is, that this method is far more delicate than anything which has been hitherto used; that by means of this reaction we can detect such minute quantities that the delicacy of the method is almost past belief. I am sorry to say that I forgot to make an experiment with sodium to show you the delicacy of this process, because I am afraid that we have now so filled the room with that substance that we cannot get the reaction so delicately as I should like. I am afraid the flames will all burn now with the sodium reaction. I want to show you that dust contains sodium,—that we cannot take up a substance which does not contain sodium; and if I heat this platinum wire, we shall see that it contains sodium. The flame becomes distinctly yellow; and if I pass it between my fingers, you will see that my fingers contain sodium, and this you will see by the yellow colour imparted to the flame. I do not know now whether the dust from my coat will show the presence of sodium; it certainly would if the flame were not tinged by the sodium which is already in the atmosphere. I will try my coat. [The skirt of the lecturer's coat was dusted near the flame, and the presence of sodium in the coat-dust was rendered evident.] This is not because it is the coat of a chemist; the dust from a book will show us the presence of sodium. You see that there is sodium in the dust of this book; in fact, every substance contains sodium, and therefore we can understand how Bunsen could recognise the 180 millionth part of a grain of sodium, for this was the small quantity that Bunsen and Kirchhoff found could be easily detected. But not only can we detect such minute traces of substances, but we thus gain important information respecting the distribution of bodies. In illustration of this, I may mention that lithium—the body which gave us that magnificent red flame, and some of which we have here—was only known to exist in a very few minerals; but Bunsen, on examining the spectra of various substances, saw that this red line, indicative of the presence of lithium, exists almost everywhere. He found it in the ashes of plants; and an experiment, which he is fond of showing, as illustrating the wide diffusion of lithium, is that of holding the end of the ash of a cigar in a colourless gas flame, and showing his friends the occurrence of the red lithium line, when the flame is observed by means of this instrument. We thus see that lithium is contained in the ashes of tobacco, in the ashes of many other land plants, in the oldest formations, in granite, and in the blood of animals. Instead of being, as was formerly supposed, a most sparingly-diffused substance, it is one which occurs almost everywhere; but owing to the small quantity of the substance present, it had been overlooked by our rougher and less exact methods of research. The crowning point of this investigation is, however, that of the discovery of two new alkaline metals by Bunsen.

Bunsen, on examining the alkalies contained in the waters of Dürkheim, in Rhenish Bavaria (he had previously separated, by chemical means, all the other bodies from the water, and the substances which were left could only be alkaline substances), saw, on looking at the spectra produced by these, some lines which he had never seen in the spectra of any alkalies before; and he said, "There is a new alkaline metal contained here; this appearance must be produced by some new elementary body;" for no other substance which he knew of, or which he had examined, had ever given these lines before. Now, in a very interesting paper on these two new metals, which he calls rubidium and cæsium,—for reasons I shall explain to you presently,—Bunsen says that from 30 grammes of the mother liquor he obtained only 1·2 milligrammes of the impure salts of these two new alkaline metals. That was all he had to begin with, about the one-hundredth part of a grain; but still, so sure was he of this method, and so certain was he that his spectrum never failed him, that he set to work at once and evaporated down 50 tons of this water to get some more of this substance. 44 tons yielded him only 105 grammes of the chloride of rubidium, and 70½ grammes of the chloride of cæsium; so that out of 44 tons of water he got only about 200 grains of the mixed chlorides of these two new metals. Here I have a small specimen of the salts of cæsium, kindly sent to me by my friend Prof. Bunsen. I have, however, more of the rubidium salts, which now can be obtained in larger quantities from the mineral lepidolite which I have mentioned. Bunsen, then, by the inspection of the spectra of these new alkaline metals determined their presence, and afterwards, having seen these lines, set to work to separate out the metals which caused them.

I will, with your permission, first show you the spectra of potassium and sodium, and afterwards the spectra of the new alkaline metals, Mr. Ladd will be kind enough to show us with the electric light these spectra; but you must not suppose, ladies and gentlemen, that what we get on the screen is exactly what we observe when we look through Bunsen's apparatus, which is adapted specially for analysis; but the results are extremely beautiful and interesting, and, I think, we shall see the distinguishing difference between the salts of rubidium and potassium. I will draw your attention, first of all, to the paintings representing the spectra which we are about to see. Rubidium and cæsium both possess spectra analogous to the spectrum of potassium. The difference in the spectra is but small. The potassium, as I have told you, gives a partially continuous spectrum; rubidium also gives a partially continuous spectrum; and the cæsium likewise gives a partially continuous spectrum; but at either end of all three spectra we find red lines in the least refrangible part, and violet lines in the most refrangible part; the two red rubidium lines are less refrangible than the potassium line, and these red lines [pointing to the diagram] do not exist in the cæsium spectrum. Bunsen has chosen two names for these two metals—cæsium from *cæsius*, a greyish colour, and rubidium from *rubidus*, red, owing to lines of these colours being characteristic of the presence of these two metals.

Here we shall get the sodium spectrum; but I warn you that you will see other lines besides those given by sodium. The bright orange line is due to sodium. The sodium spectrum produces this bright orange line, which is alone seen here when we look at it through the more delicate instrument, and use a finer beam of light and a finer slit. We then see that the sodium spectrum consists solely of two bright yellow lines, which are separated by a very, very slight interval, and each of which is as fine as the finest spider's web. We cannot, unfortunately, exhibit the sodium lines in that way. There you see the splendid spectrum in which the orange band of sodium is very markedly visible. The other lines are not those which we have to attend to at present. It is impossible here, owing to the fact that our carbon points are impure, and contain certain metals mixed with the carbon, to get the pure spectra of the metals; and with this smaller apparatus, unfortunately, we cannot get light enought to throw the spectra on to the screen.

We now have the potassium spectrum, we still see the yellow band of sodium, because, as I have told you, sodium exists everywhere, and it is almost impossible to get the potassium pure; but we shall likewise see two other lines. There is the bright red band at one extreme end of the spectrum, and a violet one at the other end. These two are due to potassium. You notice also that the spectrum is continuous in the centre.

Now, we will take a mixture of potassium and sodium; such a mixture I have here. The mixture contains one part of sodium and twenty parts of potassium, yet the yellow colour of the sodium will cover entirely the purple colour of the potassium; and when we look at the flame with the naked eye we shall see nothing but the yellow flame, which might be produced by pure sodium. [A portion of the mixture was held in the gas flame, to which a bright yellow tint was communicated.] You see this flame is as yellow as if it were pure sodium, yet it consists of one part only of sodium and twenty of potassium. But if we bring this mixture into the apparatus, and if we look at its spectrum, we find that the light of the sodium is kept to its own position. We have the bright yellow line of the sodium which does not interfere with the lines of the potassium, and these come out as distinctly as though no sodium were present at all. By allowing the bright sodium line to appear only where it ought, we see both the potassium lines coming out most beautifully.

Bunsen most eloquently describes, in his Memoir on this subject, the spectra which he sees when he places in the flame a mixture consisting of the chlorides of potassium, sodium, lithium, barium, strontium, and calcium, of each of which substances there is present only the one-thousandth part of a grain. He sees, first of all, the spectra of those substances which are most volatile appearing; the salts of sodium, potassium, and lithium are first seen; their spectra first come out, and these gradually fade away, and the spectra of calcium, strontium, and barium appear in all their vividness. Now, unfortunately, I cannot show you this with the beauty in which it is seen in the instrument when we allow the rays to fall on the retina; but you can see something which is very magnificent indeed. The mixture of all these chlorides together we now place in the carbon cup, and on bringing the upper carbon in contact with the mixture we shall volatilise the compounds, and we shall obtain the super-imposed spectra of all these substances, Mr. Ladd has now placed all the mixed chlorides in the cup, and on making contact we shall have all the lines appearing. There you see what splendid bands we get now, and you will observe that some of the bands will gradually disappear, the light remaining constant; and others will appear with greater brilliancy, because the more volatile of these salts are driven off. There you notice the bright green bands of the barium. That splendid blue line is produced by strontium. Here we have the sodium; that is the green line of calcium; here we have the bright and red line of lithium.

Now, how did Bunsen separate these new metals from one another, and from the old alkaline metals? I must give a moment to this point. In the first place, unless we could examine the spectra of cæsium and rubidium, we probably should never have discovered their existence at all. There is no doubt now that one at least of these newly-discovered substances has been handled by chemists before, but mistaken for potassium, in a certain mineral called lepidolite, which was known to contain lithium, and has now been found to contain a large quantity of rubidium. Rubidium and cæsium are so much like potassium in their chemical characters that, if it were not for this difference in the spectra we should never have succeeded in separating one from the other, or in detecting any difference between these substances when they were present together.

I can show you that rubidium and potassium are closely analogous. Here we take a solution of chloride of platinum. We know that it produces with potassium compounds an insoluble precipitate, and thus we distinguish these from the sodium compounds with which no such precipitate is produced. We shall at once get, as you will see, a quantity of this bright yellow precipitate of the double chloride of platinum and potassium.

Exactly the same thing we shall see will happen with rubidium. Here I have a solution of the chloride of rubidium I add a few drops of this solution of chloride of platinum, and immediately we get a precipitate of the double chloride of platinum and rubidium. We cannot in the outward appearance see any difference between the precipitate formed by the rubidium and that formed by the potassium. This is one of the reactions by which we distinguish potassium from sodium, but you see we cannot in this way distinguish potassium from rubidium. We can make a similar experiment with tartaric acid. If we take some chloride of potassium and some chloride of rubidium, and add to each some tartaric acid, we shall obtain with both a white precipitate of the insoluble bitartrate.

But we can distinguish these new metals from potassium, and separate them by a difference of property which is exhibited by these platinum salts. We can distinguish them in this way: Here I have a solution in water of the double chloride of potassium and platinum. I will place some of this in both of these glasses. You will notice that when I add some of the chloride of potassium to this (the potassium bichloride of platinum) we obtain no further precipitate; it is impossible that we should thus obtain a precipitate; but if we add some chloride of rubidium to the potassium bichloride of platinum solution, we shall get at once a yellow precipitate showing that this double chloride of potassium and rubidium is much less soluble than that of potassium and platinum. This is the way in which Bunsen separated rubidium and cæsium from potassium. Bunsen then investigated the salts; and we now have a Memoir, written by himself and Kirchhoff—the second Memoir on Spectrum Analysis—which contains a very elaborate and beautiful description of their researches on this subject. We are now acquainted with the nitrate, with the sulphate, with the carbonate, with the oxalate, with the hydrate, and even with the two new metals themselves; so that we have a chemical history of those two substances, which we must teach in future in all our classes. I must mention also that both rubidium and cæsium form salts which are isomorphous with the potassium salts; they crystallise in the same form, and they possess an analogous composition. Cæsium can be separated from rubidium by the solubility of the carbonate of the former metal in alcohol. The atomic weight of rubidium is 85·36, that of cæsium is 123·35.

We cannot see the end to which the application of this principal may lead. During the first few months it has led to the discovery of these two new metals, and we have not only their spectra examined, but also are acquainted with most of their salts. Another observation which shows us how rich is the field of inquiry, is, that a new elementary substance has probably been discovered by Mr. Crookes. He has not yet succeeded in preparing a large quantity of the body, and thus proving its chemical characteristics distinctly, but he has prepared a substance which seems to differ in its chemical characters from all the other elements, and gives a totally different spectrum, consisting of one bright green line. Much is not known at present about this substance, but there seems very little doubt that it will turn out to be a new chemical element, to be added to the rather large family of elementary bodies.

James Watt described and sketched a "spiral oar," or screw propeller, in 1770.

A NEW PROJECTILE FORCE.

BY THOMAS M. MESCHIN, D.C.L., F.S.A., OF THE INNER TEMPLE, BARRISTER.

Water may be decomposed into its constituent elements, oxygen and hydrogen gases, either by voltaic electricity, by common electricity, by magneto-electricity, or by thermo-electricity.

Ist. BY VOLTAIC ELECTRICITY.—When the electrodes of a voltaic battery are brought near each other, in acidulated water, or, in other words when water is made part of a galvanic circuit, so that the current of electricity passes through it, decomposition ensues—its constituent elements, oxygen and hydrogen gas, are evolved at the electrodes.

2nd. BY FRICTIONAL ELECTRICITY.—Water may also be decomposed by passing a succession of discharges of common electricity through it. This was accomplished as early as 1789, by Messrs. Dieman Paetz and Von Troostwych. Professor Faraday and Mr. Goodman have also succeeded in obtaining true electro-polar decomposition of water by the action of frictional electricity.

3rd. BY MAGNETO ELECTRICITY.—Water can also be decomposed by a magneto-electric apparatus, for if it be made part of the circuit, as often as the circuit is completed, a current of electricity passes through the water, and the gases are thereby evolved.

4th. THERMO-ELECTRICITY.—Water is very easily decomposed by a thermo-electric pile, the electrolysing action of which is maintained by keeping the ends of the bars of which the pile is composed, the one at a high and the other at a low temperature.

The different forms of electricity known under the above names, may be used either separately or simultaneously for the decomposition of the water in the gas generator.

When this evolution of the gases takes place in a close vessel, or gas generator, a gradually augmenting compression necessarily results, which does not affect the evolution of the gases in the slightest degree. An exceedingly high pressure may thus be obtained in the gas generator or close vessel. Dr. Daniel raised it to the enormous tension of 56 atmospheres, or 840 lbs. on the square inch.

In the "Philosophical Transactions of the Royal Society, 1839," vol. 129, p. 93, 94, Professor Daniel thus describes an experiment:—"The evolution of gas, which was measured at short intervals, took place with perfect regularity, and did not appear to be in the slightest degree affected by the gradually increasing compression. In four and a half minutes, when 19 cubic inches had been collected, the compression tube burst with a loud explosion, and the fragments, which were very small, were scattered all over the laboratory. If we were to calculate that 19 cubic inches were compressed into three tenths of an inch space unoccupied by the liquid, this would be a compression of 63 into 1, and the pressure would amount to 940 lbs. on the square inch; but if we reckon, as was probably the case, that two cubic inches of the gases were kept down by the solvent power of the liquid at this high pressure, then the compression would have amounted to 56 into 1, and the pressure to 840 lbs. on the square inch."

Electric Gas Gun.

The gases evolved at a high pressure from the decomposition of water by electricity, constitute a projectile force of very great intensity. By using them in the same way that air is employed in an air-gun, the greatest conceivable force may be impressed upon a projectile, a force, apparently, only limited by the strength of the materials of which the gas-generator is composed. Gunpowder is itself only a highly inflamable mixture, which, on being ignited, is rapidly converted into gases at a high pressure, and the gases in the electric-gas-gun would act upon the projectile in precisely the same way as the gas resulting from the ignition of gunpowder acts upon a similar projectile in an ordinary cannon; thus the force of gunpowder and that of these gases are analogous.

As to the form of an electric gas gun, it is similar to a breech-loading cannon. Attached to the breech is a reservoir, or gas generator, in which water is converted into the gases at such high pressure as the officer in command may deem requisite. There is a communication between the gas-generator and the barrel or chase of the weapon, which can be opened or closed at pleasure, but which, if not closed before, will close of its own accord, when the full charge of the weapon has passed into the barrel. This is accomplished either by a slightly conical piston or spigot, acting in a small hole through the barrel of the weapon, so placed that when a shot has passed over the point where it is situated, the gases press upon this piston or spigot (which is kept down by a spring,) and raising it by their pressure, it acts by suitable mechanical contrivance upon the apparatus for closing the communication; or by making the shot, when it passes over a certain point in the bore, complete and break an electric circuit, which acts by suitable machinery upon the apparatus for closing the communication.

An apparatus for closing this communication is so constructed, that when it is completely closed, and not by any probability till then, several electric sparks are passed through the gases in the barrel, which result in their explosion, and the discharge of the weapon, for I should have mentioned that these gases are endowed with a second element of force—they may be combined by an electric or other spark; or the gases may be exploded as gunpowder by the percussion of ordinary detonating powder. In combining they expand to fifteen times their volume. When the shot has, by passing from the breech to the muzzle, attained the uniformly accelerated velocity due to the high pressure of the gases, and is on the point of leaving the weapon, if the gases be then exploded the explosion will impress a force upon the shot equal to fifteen times the pressure of the gases. The small portion of pure water, which is formed by the combination of the gases, is condensed like dew on every part of the bore, and serves to lubricate the weapon, or, according to the temperature of the barrel, remains in the form of vapour, and is driven out by the succeeding discharge—the barrel never needs cleaning. At the breach there is an aperture through which the shot is introduced into the barrel with great rapidity after each discharge, by means of a very simple piece of mechanism. The aperture has its edges bevelled outwards to insure the fitting of the piece that fills it up when the shot is introduced; there are several of these pieces accurately fitting this aperture, connected by each other by suitable links, and forming an endless chain. When the weapon is in the act of being discharged, there is a strong band, nearly half the circumference of the barrel, which is so fastened by adequate mechanical contrivances, that on the recoil of a gun after the discharge, the band is loosened by the action of the recoil, and the piece occupying the aperture falls out, and another piece bearing a shot, is brought by the action of the recoil of the weapon up an incline, under the aperture, which piece, by the return action of the weapon down the incline, is, with the shot upon it, forced into the barrel, and the band again fastened by the same return action. The shot is delivered from a hopper or reservoir of shot, (or may be placed by the hand) upon one of the pieces, by means of and during the upward action of the recoil. Instead of the band or in conjunction with it, a strong bar may be used, attached by a sort of hinge to the weapon, near the muzzle, and so arranged, that when the weapon is being discharged, the end of the bar presses, with the whole weight of the weapon, against the piece occupying the aperture so as to resist the force of the gases, and when the weapon recoils, the pressure of the bar against the piece ceases and suffers it to fall out, and the next shot is introduced in the manner before described, whereupon the bar is made, by suitable mechanical contrivances, to resume its pressure against the piece by the return action of the recoil.

It is intended that the weapon shall be loaded, aimed, discharged, and entirely worked by machinery, and that the weapon and its whole working shall be capable of being fought, and controlled by a single man.

The force thus developed would seem to be the best possible force to which a projectile could be subjected—a uniformly accelerated force while moving along a rifled barrel, and then (when it has received from the rifle bore a motion round its axis) an almost instantaneous accession of immense force. It is quite obvious that these conditions are much more favourable for allowing the length of the bore or barrel of the weapon to be increased, and thereby securing greater precision of aim, and are also more favorable for the preservation of the weapon, than when the projectile is, as in the case of gunpowder, subjected to a constantly increasing and then to a constantly diminishing force. It is not, perhaps, too much too say, that a rifled electric gas gun would wear as long as a couple of rifled cannons in which gunpowder was used.

Sir H. Douglas says (p. 47),—"The main principle which should govern our choice of naval guns is, to prefer those which, with equal calibre, possess the greatest point blank range; and the practical maxim for using them should be to close to, or within that range, and depend upon precision and rapidity of fire. This is the most simple and most efficacious use of artillery."

An electric gas gun, if wrought by machinery, would have the greatest possible precision, and its rapidity of fire might rival that of a revolver; and it is perfectly obvious that it might be lengthened to any extent, so as to secure the greatest attainable point blank range.

"It is known, both from theory and practice," says Sir Howard Douglas (p. 96), "that with equal charges, and guns of equal weight, but of different lengths, the velocity of the shot increases with the length of the bore." Now these gases are much more capable of being used in weapons with great length of bore than gunpowder, because shot is driven from the breech to the muzzle, not, as in gunpowder, by a constantly increasing, and then a constantly diminishing force, but by a uniform, or nearly a uniform force, which is perfectly under command, and then is subjected to an explosive force; these are the very properties in a projectile force most favourable to precision, and the greatest point blank range. From practice at Deal, in 1839, with 32 pounder guns, one 9 ft. 6 in., and the other 6 ft. 6 in. long, with charges of 6 lbs., and windage of ·175, the elevation being one degree, the range of the longer gun was 853 yards, while that of the shorter one was only 734 yards.

These experiments show the very important effects resulting from a lengthened bore, but, owing to the nature of gunpowder, the limit to the length that can be used in practice is soon reached; but the case, as respect the gases, is wholly different; there is nothing whatever to prevent that length being adopted, in the electro-gas gun, which will secure the maximum result.

These gases have another great and pre-eminent advantage over gunpowder, viz., that the force impressed upon the projectile may be varied according to the work intended to be done by it. If a *ricochet* is required, only a small quantity of the gas may be admitted into the barrel of the weapon; no time need be wasted in altering the charge, the officer in command may increase or diminish the intensity of every succeeding shot without the slightest difficulty or delay. This would be in the highest degree useful, as well as economical, in finding and altering ranges—useful when a tentative process was desirable; economical, because the angle of elevation which gave the maximum result for the minimum expenditure of gas might be given to the weapon, and the charge varied with the required range.

From the experiments of Robins and others, it appears that when gunpowder is ignited, one-half of it is converted into gases (the principal of which are carbonic acid and azote) and the remaining half assumes the form of solid matter. If the powder be loose, the volumes of the gases are from 236 to 260 times that of the powder; in rammed powder from 480 to 520 times the volume of the powder. As to the expansion of the gases due to the elevated temperature at which they are generated by the ignition of the powder, the estimates are widely dis-similar. Robins set down the absolute explosive force of gunpowder equal to 1,000 atmospheres, that is, a pressure of 14,722 lbs. on the square inch; Hutton put it at 2,200 atmospheres, or 32,388 lbs. on the square inch. It is obvious that a considerable portion of the heat is absorbed by the gun.

With respect to the air-gun, the *Encyclopœdia Metropolitana* remarks, adopting the estimate of Robins, "if the air-gun be condensed ten times, the velocity will be equal to one-tenth of that arising from gunpowder; if condensed twenty times, the velocity would be one-seventh that of gunpowder and so on. Air-guns, however, project their balls with a much greater velocity than that assigned above, and for this reason, that as the reservoir of condensed air is commonly very large in proportion to the tube which contains the ball, its density is very little altered by passing through that tube, and consequently the ball is urged all the way by nearly the same force as at the first instant; whereas the volume of the gas arising from inflamed gunpowder is very small in proportion to the barrel of the gun, and by dilating into a comparatively small space as it urges the ball along the barrel or tube is proportionately weakened, and it always acts less and less upon the ball in the tube. Hence it happens that air compressed only ten times into a large receiver will project its ball with a velocity little inferior to gunpowder."

What is here said of air applies with equal force to the gases. Besides, the ignition of the charge of gunpowder is not instantaneous; it is progressive operation, so that the ball when projected by gunpowder is subject, when passing from the breech to the muzzle, first to a constantly increasing, and then to a constantly diminishing force.

It will be interesting to contrast the cost of gunpowder and of the gases. The length of a 68-pounder is 9·49 feet; the effective length is less by the semi-diameter of the bore, which is 8·12 inches—the length is, therefore, 9·11 feet, and the capacity 4·41 feet. As a ton of zinc evolves 1966 cubic feet of the gases under a pressure of ten atmospheres, and as its price varies from £20 to £30, the cost per round of shot, out of a 68-pounder would be as follows, under the following pressures. At—

10	atmospheres	0s.	9d.	at £20	—	1s.	4d.	at £30.
20	"	1	9	"	—	2	8	"
40	"	3	7	"	—	5	4	"
60	"	5	4	"	—	8	0	"
80	"	7	2	"	—	10	9	"
100	"	8	2	"	—	13	5	"

Now, if the *Encyclopædia Metropolitana* be correct in saying that air, compressed ten times, will project a ball with a velocity little inferior to gunpowder, surely these gases, when compressed ten times, that is, to a pressure of ten atmospheres, and exploded, ought to rival and surpass gunpowder, as they would, in addition to the force due to the ten atmospheres, impress a force on the projectile, at the moment of its flight, fifteen times that pressure. But when contrasting the cost of the gases as a projectile force, and that of gunpowder, it is safer to be under, rather than over the mark, so then, notwithstanding the *dictum* of the *Encyclopædia Metropolitana*, we will base our calculation on the assumption that the gases condensed 20 times, and developing on their explosion a force equal to 300 atmospheres, will produce effects equal to those of gunpowder; the cost for shot will, as we have just seen, be from 1s. 9d. to 2s. 8d.

The cost of gunpowder varies, of course, with the price of the articles from which it is manufactured; it ranges from one to two shillings per lb. A 68-pounder takes 16 pounds for a charge; the cost per shot is therefore from 16s. to 32s., consequently the gases are by far the cheaper force, for even at 100 atmospheres they would only cost from 8s. 2d. to 13s. 5d., scarcely one-half the price of gunpowder, but at 20 atmospheres they would scarcely be one-tenth of the price.

Gunpowder is deteriorated or destroyed by the absorption of moisture; this could not happen to the gases. This absorption of damp is a constant cause of "great and unknown losses of strength," and a little more or less moisture will alter most materially the accuracy of practice. Attempts to protect gunpowder from moisture are a constant source of heavy outlay, which should be borne in mind when comparing the relative cheapness of the forces, and "no degree of care" can altogether preserve it from receiving some injury. (Sir H. Douglas.)

Then the force impressed upon the projectile might be increased *ad libitum*. This cannot be done with gunpowder, for if the charge be increased beyond a certain point, a diminution of force results, as part of the powder is shot away unignited, and the powder ignited acts for a shorter space on the ball, but in the electric-gas gun the pressure may be raised to any point in the gas generator so as to impress the required force upon the projectile; thus, if it was found that a 100-pounder, propelled by a force equal to that of gunpowder had no effect upon an iron-plated vessel, the force might be doubled or trebled until the desired result was achieved! indeed, it is probable that these weapons would settle the question of armour-plates, because if, as Mr. Scott Russell holds, the thickness of the plates cannot be usefully increased beyond 4½ inches, as soon as a weapon is constructed of sufficient force to destroy this armour, it will cease to be a protection, and will only insure the sinking or capsizing of the unlucky vessel it was intended to protect, like the knights of former days, whose armour at last became so heavy that, if they chanced to be unhorsed, they were compelled to lie prone, unable either to renew the fight, or to consult their safety by a retreat.

It may be observed that it would be difficult, when the firing proceeded from works in any way extensive, or from masked batteries, for an enemy to discover the precise point where one of these weapons which threw the projectiles was situated, as there would be smoke and no report (for a vacuum would be formed by the explosion of the gases). In most cases this would prove of signal advantage, among others—as not affording a mark for the shot of the enemy, should he seek to disable the weapon. Besides, the absence of smoke would not interfere with the aim of other weapons, and the absence of noise would enable the orders given by those in command to be distinctly heard.

There would be practically no report; the report, such as it would be, could not be heard beyond a few yards—it would be 500 times less than that of a cannon, and 10 times less than than that of an air-gun.

When a cannon becomes heated by repeated discharges of gunpowder, the elasticity of the metal of which it is composed is diminished, and the properties of the weapon are impaired. It is probable that rifled cannon (other things being equal) are liable to be more quickly heated than those with a smooth bore, owing to the fact that the ball meets with greater resistance in moving along a rifled bore than a smooth bore, and consequently consumes more time in reaching the muzzle. The barrel of t e weapon is therefore subjected for a longer period to the action of the highly heated gases evolved by the ignition of the gunpowder. This result could not arise from the action of the gases in the electric gas-gun, for the heat evolved by the detonation of the gas is by no means great. The electric-gas gun is therefore so far as this point is concerned, the more perfect weapon, being capable of more incessant and prolonged work.

The electric-gas gun is eminently suited for being wrought by machinery, thereby securing greater precision of aim, greater rapidity in firing, and enabling one man to accomplish the work of many. The recoil of the gun might also, if necessary, be turned to account, in increasing the condensation of the gases, and for the purpose, when requisite, of forcing water into the gas generator when the weapon is in action, to replace that consumed by discharging the weapon. This may be accomplished by a plunger, similar to that of a Bramah press, moving in the place of the recoil.

An electric-gas gun, if wrought by machinery, might be made to cover an object as accurately and with as much precision as a theodolite, the rapidity of its discharge might be made to rival or surpass that of a revolver, only it would be continuous and not limited, as in a revolver, to half a dozen rounds and it would be as much under the control of one man as the most gigantic of our steam-engines. The machinery for the weapon might be wrought by a donkey engine, the cylinders of which could be supplied from the gas generator in the manner mentioned below. In a fortress or ship defended by a few such weapons, one man might do the work of fifty.

In the interests of peace, it is no small recommendation in favour of these weapons that they are more calculated for defence than for offence.

The steam-gun, as is well known, throws its projectiles with great rapidity. Now if the gases of which I have been speaking were substituted for steam they would be much more efficient; firstly, because a higher pressure could be obtained with much less danger; and, secondly, at the moment the projectile was leaving the tube or barrel the gases might be exploded, thus impressing upon the ball or projectile an augmented force fifteen times greater than that to which it is subjected in the American steam gun; consequently the ball or projectile would be at least fifteen or sixteen times more effective under the action of the gases in an electric gas gun, that is under the action of the steam in the steam-gun.

A cubic foot of water produces at the mean pressure about 1,980 cubic feet of the mixed gases—that is, about 1,320 cubic feet of hydrogen gas, and 660 cubic feet of oxygen gas, or nine pounds of water produce eight pounds of oxygen gas and one of hydrogen. A cubic foot of water produces 1,700 cubic feet of steam at the mean pressure of 212° Fahr. The relative volume of the gases, at that pressure and temperature, would be 2,572 cubic feet, so that the advantages are on the side of the gases in this point very decidedly.

In a fortress defended by these weapons there would be no need to tremble for the safety of the gunpowder magazine, and the apparatus for supplying the electricity might be placed out of reach of harm. And now as to cost, after the first cost of the requisite apparatus has been defrayed, the cost of maintaining the electrolyzing action in the gas generator will mainly depend, if voltaic electricity be used, on the value of the materials consumed in the battery as compared with the value of the products of the battery. If common electricity be employed, its cost will be measured by the amount of mechanical effort necessary for its development. If magneto-electricity be used its cost will depend upon the mechanical force requisite to keep the magneto-electric machines in action. If thermo-electricity be employed its cost will depend on the expense incurred in keeping the extremities of the bars of the thermo-electric piles at different temperatures.

The advantages of these electric-gas guns, as compared with gunpowder guns, are:—

1. The projectile force employed is very much cheaper than gunpowder.

2. Its practice is more certain and uniform, not being liable to be affected by damp, &c.

3. It is more under control; the force with which a projectile is driven may be diminished or augmented at pleasure.

4. It is capable of being wrought by machinery (driven by the gases from its own gas generator), thereby ensuring greater precision of aim, greater rapidity of firing, and enabling one man to do the work of many.

5. It is less dangerous, both to the men who work it, and to the ship or fortress which it defends, as it needs no powder magazine, which might be blown up by shot, shell, or lightning.

6. A force is applied to the projectile more favourably, resulting in less strain upon the weapon, and its greater durability; besides, not being liable to be heated, it is the more perfect weapon, being capable of more incessant and prolonged work.

7. The discharge being accompanied with neither smoke, flame, nor report, it could not afford a marked object for the enemy's shot.

8. Its superior powers of horizontal or point-blank firing at low elevations, "the best test of the real power and value of a gun," "its real service value."

The Electric-Gas Shell.

The gases, evolved by the decomposition of water by electricity, may be forced, at a very high pressure, into metal shells, similar to shells used for offensive operations in war, the shells being so constructed that on striking any body, an electric spark, or detonating spark, could be elicited, which would result in the detonation of the gas and the bursting of the shell.

Then these gases might be used with other bodies in the shell, gaseous, liquid, or solid, that would contribute to augment the violence of bursting.

A NEW MOTIVE FORCE.

When gases are maintained at a high pressure or tension in a vessel, corresponding to the boiler of a steam engine, they will, if admitted into a cylinder, press upon the piston, and perform all the functions discharged by steam in working an engine.

Electric Gas Engine.

Gases generated under a high pressure, by the decomposition of water by electricity, will act fully as effectively as steam when admitted into the cylinder of a steam engine. The pressure may be raised to a point at which it would be perilous to work steam, owing to the facility with which the strength of the reservoir may be increased. Then, no additional cost is incurred by working at the highest pressure; precisely the same electro-motive force is expended in effecting decomposition at all pressures. Thus the strength of the gas-generator is the only practical limit to this enormous force, the real obstacle to its most economical application, an obstacle which doubtless will gradually yield to the ingenuity of engine manufacturers.

These gases may be wrought expansively, which will result in very great augmentation of the work done by the engine, for the same expenditure of electro-motive force.

After the gases, by passing through the cylinder, have impressed upon the piston the force due to the pressure under which they are generated, they may be utilized in either of the following ways:—

I. By detonating the gases after they have expanded; while in the cylinder, they may be combined by an electric spark. In combining they expand to fifteen times their bulk, and consequently impress a force on the piston equal to fifteen times the pressure which the gases exerted. A heavy fly-wheel would prevent the loss of *vis viva* which might attend the suddenness of the application of this force.

When the gases are combined by an electric spark, they are converted into water, and a vacuum results similar to that occasioned in a condensing steam engine by the condensation of the steam. By the vacuum which is thus formed by the combination of the gases, the advantages of the high-pressure and condensing steam engine may be combined in the electric-gas engine.

The sources of force are, therefore, threefold.

1st. The high pressure in the gas generator, which may be taken at 50 atmospheres, or 736 lbs. to the square inch, although in high pressure steam engines it rarely exceeds 120 lbs. There can be little doubt but that the reservoir might be readily constructed sufficiently strong to work safely at a pressure of 60 or even 100 atmospheres, particularly when all the inducements which economy can hold out are on the side of high pressure in the electric-gas engines.

2nd. The expansion of the gases to 15 times their volume exerts a force on the piston.

3rd. A vacuum which will give a useful effect of from 13 to 14 pounds per square inch.

II. The combustion of the gases after passing through the cylinder, may be employed for heating the gases in the cylinder while expanding, and thereby increasing their elastic force; it is obvious that this heating process must be applied while the gases are in the cylinder, for no advantage would accrue from increasing their tension in the gas generator, as they can be evolved at the highest possible pressure there without additional expense, but if they be heated while expanding, it is obvious that the work done by them would be much increased.

III. By burning the gases after paseing the cylinder, for the development of thermo-electricity, to be employed in aid of the electricity used in decomposing water in the gas generator.

IV. By using the gases after passing through the cylinder for the purpose of developing electro-motive force, to go in aid of that employed in decomposing the water in the gas generator, theoretically the electro-motive force developed by the combination of the gases ought to decompose an amount of water equal to their own weight. This is, I believe, the theoretic effect of Groves gas battery.

Thus, then, the gases, after being used in the cylinder, may be employed in one of three ways: —1. For the production of an electro-motive force by thermo-electricity or by voltaic-electricity. 2. For the production of a detonating force, and the resulting vacuum. 3. For increasing by their combustion the tension of the gases in the cylinder.

It may be observed, that in an electric gas engine the gases may be wrought expansively, which will not only result in considerable saving, but will also materially diminish the possible practical inconvenience of the detonation of the gases in the cylinder; if, for example, the gases were wrought at 50 atmospheres, and were allowed, before being detonated, to expand in the cylinder till the pressure was one quarter of an atmosphere, the pressure on the piston when detonated, would be less than one-twelfth of the initial pressure of the gases in the cylinder; what the proper amount of expansion to be allowed is, would very soon be practically determined, when the electric gas engines come into operation.

The strength of the reservoir, or gas generator, in an electric-gas engine, corresponding with the boiler in a steam engine, might be increased to almost any amount required; the difficulties which prevent the strength of a steam boiler from being increased beyond a certain point could not operate as regards a gas generator. One of the main objects kept constantly in view in the construction of a steam boiler, is the securing the largest possible amount of heating surface; now the strength of a boiler is the strength of the weakest part of it, consequently, as its surface is extended, the chances of a flaw or weakness in some part of that surface are increased; then if the thickness of the plates were unduly increased it would interfere with the action of the fire. The rivetting of the plates is estimated to reduce the strength one-third. The highest tension attained in high-pressure steam engines scarcely, if ever, exceeds eight atmospheres, or 120 lbs., per square inch; in an electric-gas engine, the highest pressure may be maintained in the gas generator at precisely the same cost as the lowest; consequently, the higher the pressure the less the expense for equal amounts of work done. With regard to the construction of the reservoir, or gas generator, the form of greatest strength may be adopted, and the thickness of its parts augmented to any conceivable amount.

If necessary, to obviate any danger that might possibly arise from the accidental detonation of the gasses in the gas generator (if such a thing be possible), the gas generator may be divided into compartments, in which each gas may be kept separate, thus rendering such a detonation wholly impossible. With regard to the cylinder, it may, if found requisite, be divided, during the first part of the stroke, into two separate compartments, proportioned in capacity to the respective volumes of the two gases, but so as that during the latter part of the stroke, the gases may become mixed, so as to be, if necessary, detonated by an electric or other spark.

The time must come, if it has not already arrived, when electricity will be produced more cheaply than steam. Every mechanical and chemical change which takes place in bodies, results in setting free some electricity; thus, if two bodies are in contact and they are suddenly removed, there is an electrical disturbance. When water boils electricity passes off in the steam. The fire in the grate and the flame of the gas-lamps are evolving electricity.

Every chemical change in the constitution of bodies results in the development of electricity. A galvanic battery merely collects and applies the electricity evolved by the chemical changes going on in its cells. If some method could be discovered of making the products of the chemical action in the battery as valuable, or nearly as valuable, as the zinc or agents of which the battery is composed, the great problem would be solved, and electricity might take its place side by side with steam as a practical motive force.

In conclusion, I may observe that the proposed electric-gas engine and electric-gas gun are original ideas. It first struck me that electricity might be used as a motive force about 1849, when attending the lectures of a most able and amiable gentleman, whose admirable Treatise on Heat ranks him high amongst modern philosophers.

I may also perhaps mention that I gave notice, before the meeting of the British Association in last September, of my intention of reading a paper on this subject, but was prevented, by unavoidable circumstances, from going to Manchester.

44, Chancery Lane, London.

THE MANUFACTURE OF LEATHER CLOTH.

The manufacture of leather cloth as a substitute for Morocco leather, was commenced in the year 1849, in the city of Newark, U. S. The first specimen of it seen in this country, was exhibited in 1851. The Americans have had the merit of producing many labour-saving machines and articles of domestic convenience, and many of them are becoming increasingly known and extensively adopted in this country. It is certain that this article of leather cloth has superseded the use of leather for many purposes to which the old material has hitherto been applied, besides being put to uses for which leather is wholly unsuitable. Messrs. Crockett, the inventors and patentees commenced the manufacture of leather cloth in England in 1855, and their factory was an old workhouse, situate in one of those dreary, unpicturesque marshes at West Ham, in Essex, a locality somewhat famous for its insalubrious manufactures. The firm was known as the "Crockett International Leather Cloth Company." In 1857 Messrs. Crockett surrendered their business to a company formed under the title of "The Leather Cloth Company Limited," which purchased the entire European business.

The new company, with a paid up capital of £90,000, and having Mr. A. Lorsont as their managing director, began the enterprise with great energy. They erected substantial and extensive premises, which cover ten acres of ground, employing upwards of 200 men. They produce daily 1000 pieces of 12 yards long and 1½ yards wide, or 15,000 square yards; sufficient if laid end to end to reach from their factory to the warehouse in Cannon Street West—a distance of seven miles.

It will be evident that an article intended to resemble leather should be pliant, supple, and not liable to peel off or crack. These excellencies are to be attained by the peculiar ingredients of the composition with which the cloth is covered, and the method of applying it. On entering the factory our attention was first directed to the boiling room, in which there are 12 furnaces, with a large cauldron over each for boiling linseed oil. This process is attended with considerable danger from the liability of the boiling oil to generate gas and explode; hence, a man is stationed at each cauldron stirring gently the boiling mass and watching a thermometer inserted in it, and which at the time of our visit stood at 580°. The oil is supplied to the boiling house by pipes from an adjoining building, where there is a huge tank with nine compartments containing 3,200 gallons each, or 28,800 altogether, amounting to 122 tons of oil. The boiled oil being allowed to cool is conveyed on a tramway to the mixing-house, where, in a puddling machine, it receives several other ingredients, the principal ones being lampblack and turpentine, which being mixed into a composition is ready for use.

The cloth to which this composition is applied is known by the name of "greys," or unbleached cotton. It is of a peculiar manufacture, and made expressly for the company. The store room is a spacious building, and will contain an immense stock; at present it has 25,000 pieces, or 300,000 yards. Here the cloth is calendered, and cut into lengths of twelve yards. The two ends of each length are sewn together to make it endless; two sewing machines are in constant operation at this work. The pieces are then removed to the "milling" rooms, so called because they contain the mills in which the cloth receives the composition. These mills are rough looking wooden structures, having a drum at one end and a roller at the other, over which the cloth is passed, and then tightened by a crank and wheel at one end. A large frame-knife or scraper, is then dropped down close to the cloth, a measured quantity of composition being laid on the cloth along the edge of the knife, the mill revolves, and the cloth receives as much of the composition as can pass under the edge of the knife. The piece is then carried to the heating room adjoining, and hung up on the rack to dry till next morning.

There are on the premises six milling rooms, with three mills in each, and having three men attendant upon each mill. The adjoining rooms for drying are heated by three rows of pipes laid along the wall. These pipes, during the day are at a temperature of about 130°. The temperature is increased towards the evening, and during the night to 160°, and it is the duty of the watchman to open the doors for ventilation and cooling preparatory to the men resuming their work for the next coating.

Of course, in a building so greatly heated, and having so much inflammable material within it, the danger of fire is imminent, but every precaution has been taken which prudence could dictate.

The building is fire proof, the floors are of metallic lava, and the roof, which is flat, is of the same material. A large pipe runs up the outside wall by the partition which divides the drying rooms, into each of which runs a branch pipe with a valve, which can be worked from the outside. A deluge of steam can by these means be poured into the rooms in a few minutes by day or night. There are fourteen fire plugs around the buildings, on the main of the East London Water Works, with hose and turncock at hand, so that ample means of extinguishing fire exist on the premises.

But to return to the manufacture. The coating being thoroughly dry, the cloth is then taken to the "rubbers," whose business it is to remove all inequalities from the surface and make it perfectly smooth. This is done by the "rubbing machine," (an ingenious contrivance of Mr. Eagles, the manager,) by which the cloth is made to pass between two rollers revolving in opposite directions. These rollers are covered with pumice stone, and do the work completely and expeditiously, which, till lately, was done by hand at great expense of labor. The "coating" and the "rubbing" being repeated four, and in the case of heavy goods, five times, the cloth is ready for the "painters." The "painting rooms" contain machines similar to the "mills;" but instead of the drum they have a roller at each end, over which the cloth passes slowly, and a man at each side supplies the paint, "meeting each other half way." Dependant partly on the colours, and partly on the article to be produced, is the number of coats of paint to be applied. Sometimes two will be sufficient, at other times four are necessary. The last coat receives several applications of a peculiar elastic enamel, composed chiefly of copal varnish, to protect it from the action of the atmosphere.

At this stage of the process the edges of the cloth are rough and have to be trimmed, and the seam by which the ends are sown together has to be cut. This is done by a machine called the "Guillotine," and we now follow the cloth to the "grainer." This latter, and to the ordinary leather cloth, finishing process, is done by a remarkably beautiful iron machine, having two, rollers, the upper one being of polished iron cut obliquely on the surface, the other one of paper. Between these two rollers the cloth passes twice, and receives its external resemblance to morocco leather. There are six machines used for this finishing process, and others for embossing from the small diamond to the large mediæval pattern. The latter consumes much more time in passing through the machines. The cloth is now stamped with the trade mark, labelled, and rolled up ready for transmission to the warehouse in Cannon Street West.

On looking at the pieces when finished, one is struck by the extreme cleanness of the inner side after passing through so many soiling operations; this is owing to the practical skill with which the men handle the cloth, and to the agility with which they remove it from the several machines, and carry it to the drying rooms. While watching the process, we thought that in many respects, it was similar to the tanning with sumach, from the leaves and stalks of the *Rhus coriaria*, by means of which skins are made into morocco leather. As the leather cloth can be made permanently soft and elastic by the oily matter combining with the texture of the cloth, as it does with the fibres of the skin, the imitation is complete and successful.

There is another room in this establishment, specially interesting to the artist, where the cloth is printed in gold and colours, in designs which are really chaste and beautiful, and which, when used for the furniture and hangings, adorn rooms with something of oriental splendour. Here, too, there are table-covers with floral borders, rich in colour and choice in grouping, with centre pieces, which, as specimens of decorative art, are very effective. Many of these will be displayed at the International Exhibition, and, we doubt not, will excite both surprise and admiration.

The mixing room is a kind of *sanctum* of the manager's, and we suppose that from the skill with which the colours are prepared arises much of the excellence of the company's manufacture. In a room adjoining there are sixteen colour-grinding mills, constructed on the American principle, and worked by machinery, as in indeed almost everything on the premises seems to be. The machine which sets all in motion is a high-pressure double cylinder engine of 50-horse power made by Woods, of Halifax. There are three immense Cornish boilers by Hill, of Heywood, which have been tested to a water pressure of 130 lbs. to the square inch and represented 60 horse power. One of these is sufficient to work the engine by day and heat the drying rooms by night. We observed that, by the generosity of the company, a part of their premises had been given for the use of the Fifth Essex Rifle Volunteers, the drill room and armoury are magnificent apartments, such as are seldom seen devoted to such a purpose.

A writer in a very useful work on the "Manufactures of Great Britain," asks somewhat triumphantly, "What substitute could be found for leather? a substance at once durable and elastic, affording protection from wet and from cold, capable of being formed into innumerable useful articles, and susceptible of a high degree of ornament, and supplying lining to our carriages and covers to our books." This book was published in 1848, under the direction of the "Committee of general literature and education," and now in 1862, we have a substitute answering all the requirements here specified.

As to protection from wet and cold, the whole American army is equipped with leather cloth in the shape of capes, leggings, and knapsacks, our upholsterers can vouch for its durability and elasticity. The useful articles into which it can be made, and the degree of ornamentation it can receive, are becoming every day more manifest. We line our railway, our street carriages, and our hats with it; and as to our books, if they are not covered with it they ought to be. Truly our progress in art and science is defying all prediction as to what we may not accomplish, and rendering obsolete many of our familiar proverbs, and none more strikingly so than that "there is nothing like leather."—*Mechanics' Magazine.*

L. Perkins, of London, has an engine of 60-horse power, working with a pressure of 500 lbs, on the sq. inch of piston. The consumption of fuel is only from 1 to 1¼ lbs. of coal per horse power per hour.

GOLD IN NOVA SCOTIA.

The whole of the Atlantic shores of the province of Nova Scotia is bordered, in an unbroken line, by strata of a metamorphic character, and probably of great geological antiquity, frequently broken through by eruptive rocks. These form a coast in some places low and rugged, and in others boldly undulating; their soil is generally rocky and sterile, although there are large tracts well covered with timber, and affording prosperous agricultural settlement. Along the Atlantic shore this district is generally low, gradually rising to a height of some hundred feet as it advances northward. Its coast line has, according to Mr. Dawson, a general direction of south 68° west, whilst its inland boundary, although presenting some considerable undulations, has a direction of south 80° west. The extreme breadth of this band at Cape Conseau, its northern extremity, is about eight miles, whilst in its extension westward it gradually increases until, at the west branch of St. Mary's River, eighty miles west of Cape Canseau, it is known to be thirty miles wide. In the western counties, its width has not yet been accurately ascertained, but here its entire breadth cannot be far short of fifty miles. Its total length corresponds with that of the peninsular of Nova Scotia.

This band, in which almost the whole of the gold discovered has been found, chiefly consists of thick bands of slate and quartzite highly inclined, and having a general north-east and south-west strike. In different localities these rocks, which probably belong to the Silurian epoch, have been penetrated by masses of granite, and in their vicinity the quartzites and clay slates usually present a highly metamorphosed appearance.

Since the gold discoveries in California and Australia have been generally known, and public attention has been directed to the conditions under which deposits of the precious metal usually occur, reports of similar discoveries have from time to time locally arisen in different parts of Nova Scotia. In every instance, however, either mica or iron pyrites would appear to have been mistaken for gold. Some years since, also, a considerable amount of excitement was caused by an article in *Blackwood's Magazine*, in which it was affirmed that gold would be found in the hill to the south of Annapolis, and comparisons were instituted between that locality and the Valley of Sacramento. Many persons were induced, by this article, to leave their ordinary occupations to seek for gold, but their researches having in all cases proved unsuccessful, the fever gradually subsided, and the subject was ultimately forgotten. It is also worthy of remark that Dr. Dawson, so long ago as 1855, when describing the great metamorphic band observes:—"Quartz veins occur abundantly in many parts of this district, and it would not be wonderful if some of them should be found to be auriferous."

There is nevertheless no authentic evidence of the discovery of the precious metal in the province previous to 1860, when some hundreds of persons, tempted by rumours of gold having been found, commenced exploring near the head waters of the Tangier River. The amount of gold obtained in this locality was, however, so small, that the miners ultimately became discouraged, and the excitement gradually subsided. In the month of March, last year, a man who was stooping to drink at a brook, observed a piece of gold among the pebbles at the bottom, and having picked it up, searched and found more. This took place about a mile to the east of the Tangier River.

From this date attention became directed to the locality, numerous claims were taken up, and considerable quantities of gold were obtained by breaking the quartz with hammers, and washing the resulting dust in tin pans.

In June, the discovery of gold was reported at Lunenberg, at a locality called the "Ovens." The veins at this place, although generally small, are frequently highly auriferous, and appear to cross each other in almost all directions, in a metamorphic shale belonging to the great southern band. On these discoveries being made known, numerous claims were immediately taken up, and various companies formed for working the veins presenting themselves numerously in the cliff.

Shortly after the discovery of the auriferous nature of the quartz veins, it was found that the sands on the beach beneath the headland also contained large quantities of gold; here claims were likewise rapidly staked off and worked by means of cradles, so that the aggregate daily yeild, from the several shore operations, soon reached one hundred ounces.

Gold discoveries subsequently followed each other in rapid succession, at Lawrence-town, Dartmouth, and Sheet, and Isaac's Harbours, Sherbrooke, and Laidlaw's farm.

The most remarkable deposit of auriferous quartz hitherto found in Nova Scotia is undoubtedly that at Laidlaw's farm. The principal workings are here situated near the summit of a hill composed of hard metamorphic shales, where openings have been made to the depth of some four or five feet upon a nearly horizontal bed of corrugated quartz of from eight to ten inches in thickness. This auriferous deposit is entirely different from anything I had before seen, and when laid open presents the appearance of trees or logs of wood laid together side by side after the manner of an American corduroy road.

From this circumstance the miners have applied the name of "barrel quartz" to the formation, which, in many cases, presents an appearance not unlike a series of small casks laid together side by side and end to end.

The diagram on the wall will serve to explain the mode of occurrence of this deposit.

The rock covering this remarkable horizontal vein is exceedingly hard, but beneath it for some little distance it is softer and somewhat more fissile. The quartz is itself foliated parallel to the lines of curvature, and exhibits a tendency to break in accordance with these striæ.

The headings and particularly the upper surfaces of the corrugations, are generally covered by a thin barklike coating of brown oxide of iron, which is seen frequently to enclose numerous particles of coarse gold, and the quartz in the vicinity of this oxide of iron is itself often highly auriferous.

The other gold veins of the province present generally speaking, few distinctive peculiarities, and very closely resemble those found in California and Australia. Their general course is north 60°

west, and their dip towards the south, but there are not unfrequent exceptions to this rule.

In addition to gold, the most auriferous veins of Nova Scotia contain variable quantities of iron-pyrites, mispickel, galena, blende, and less frequently a small proportion of argentiferous and auriferous sulphide of copper. Here, as elsewhere, the presence of the sulphides is regarded as a favourable indication of the richness of a vein, and leads containing much disseminated galena almost invariably yeild a remunerative quantity of gold.

The productive veins hitherto discovered have, as before stated, been found in the older rocks on the Atlantic shore, and commonly occur in parallel groups, near the centre of which, and parallel to the productive veins, a large reef of crystallized and comparatively unproductive quartz is in many instances found to run. These large courses are locally called "bull veins," and usually contain small quantities only of the precious metal.

The attention of the Nova Scotian goldminers, has, contrary to the usual practice, been almost entirely directed to the exploration of the veins of gold quartz, and alluvial digging has consequently been all but entirely neglected. There, is however, every reason to believe that a careful examination of the alluvial deposits would lead to the discovery of large quanties of gold.

It would be impossible to form any reliable estimate of the total amount of gold which has hitherto resulted from mining operations in Nova Scotia, as the claims are for most part worked by private individuals who are generally indisposed to furnish information either as to their success or failure, and no official returns on the subject have as yet appeared. It is manifest, however, from the characteristics of the localities in which the precious metal has already been discovered, and the great extent of the gold-bearing portions of the province, that there is every reason to anticipate that further and more important results will be developed by the workings and explorations of the present summer, and that, ere long, Nova Scotia will take an important position among gold-producing countries.

The thickness of its auriferous veins is perhaps less than those of California and some other countries, but they are, generally speaking, richer in visible gold than the average of those I have seen in any other part of the world. It must also be taken into consideration that Nova Scotia possesses many decided advantages over both California and Australia. Each of these countries is situated at a great distance from Europe, and can only be reached after a long and expensive passage, and, as a natural consequence, wages were for a long time exceedingly high and provisions proportionately dear. Nova Scotia, on the contrary, is within an easy distance both from Europe and the United States of America, and possesses a considerable settled population of intelligent, industrious, and sober people, eminently adapted, after a little experience, to become steady and efficient miners. The whole of the gold-bearing portion of the Province also lies within a convenient distance from the coast, which abounds with magnificent harbours, affording ample security to shipping, whilst wood in large quantities is to be everywhere procured for all descriptions of mining uses, and an abundant supply of water is generally to be met with for the purposes of washing and amalgamation.

From these circumstances, it is impossible that wages can ever reach the extravagant rates that mainly led to the failure of nearly all the gold-mining enterprises of 1852, since which period many of the mines have been advantageously worked which were then abandoned on account of the enormous expenditure necessary to carry on the operations.

On the Filtration of Air, and the Influence which it Exerts on Fermentation, Putrefaction, and Crystalization, by M. H. SCHROEDER.

This paper is in continuation of some researches published some time ago by the same author. M. Schroeder found that the ebullition of a fermentescible or putrescible liquid, in a flask closed with a plug of cotton, generally checked fermentation. However, milk, yolk of egg, and broth containing meat, gave him different results.

On repeating these experiments he found that, in order to prevent, by means of a plug of cotton, the putrefaction of the above-named substances, they ought to be previously raised to a temperature higher than that of boiling water. If this precaution were taken, and if the substances were then introduced into a flask, and the liquid boiled during a very short time, the flask being then closed with cotton wool before the temperature lowered no change would be produced.

The same result is obtained by very considerably prolonging the ebullition.

When the liquid is only boiled for a short time, the formation of *mycodermes*, which are produced in the open air, is not noticed on its surface. Fermentation, however, takes place, and it may, therefore, be concluded that the ferment capable of inducing putrefaction is contained in the state of germ, in milk, meat-broth, and yolk of egg, and is not destroyed at a temperature of 100° C.

The author has attempted to transport the ferment which provokes putrefaction into different liquids. He performed this operation with very great precaution under a bell-jar filled with coal gas. He found that this particular ferment was not developed in liquids susceptible of nourishing the ordinary vegetable ferments, such as beer-yeast but that it was propagated, on the other hand, in the presence of albumen, casein, yolk of egg, and urine, and induced the putrefaction of these liquids even when they had been previously heated to temperatures much exceeding 100° C.

After having quoted a certain number of experiments performed on supersaturated saline solutions, M. Schroeder finishes by stating a certain number of conclusions, of which these are the principal:—

There exists a series of phenomena of fermentation and putrefaction which are due to germs existing in the atmosphere; such are the alcoholic and lastic fermentations, mouldiness, and the putrefaction of urine

Animal or vegetable substances contained in a flask closed by a plug of cotton are protected against all fermentation, when the germs which they contained have been destroyed by ebullition.

All germs carried in the air are destroyed by a short ebullition. However, milk, yolk of egg, and ment contain germs which are only destroyed by a prolonged ebullition, or by a temperature higher than 100° C.

The germs contained in these latter substances are susceptible, even after an ebullition which has not been long continued, of inducing putrefaction, by developing and taking the form of *vibrios*, large in size, but sluggish.

This putrefactive ferment is of animal character. It lives at the expense of albuminoid matters, and cannot multiply under conditions which are favorable to the developement of vegetable ferments.

The crystalization of supersaturated solutions is provoked by a kind of induction exerted by the surfaces of solid bodies.

The crystalization of more soluble hydrated bodies is due to a less energetic induction than that which provokes the deposition of less soluble hydrated bodies.

The strongest induction is exercised by the surfaces of crystals of the same nature as the dissolved salt. The inductive force of the films of air formed on the surfaces of solid bodies is less. These films are destroyed by heat or by prolonged immersion, and only re-form very slowly in filtered air.

The crystalization of more soluble hydrated bodies is only induced very slowly by a crystal of the same body introduced into the liquid with all the necessary precautions; whilst the presence of a crystal of a less soluble hydrated body induces an immediate crystalization of the solution.

Supersaturated solutions isolated from the outer air, whilst still warm, by a plug of cotton are preserved a very long time, because the cotton prevents the access of all the solid particles floating in the air. Simple shaking is without action on supersaturated solutions, at least if it does not bring them into contact with certain parts of the flask, which already possess an inducing power.—*Annalen der Chemie und Pharmacie*, cix. 35.

THE EARL OF DERBY ON NOXIOUS VAPOURS.

The Earl of Derby, in moving for the appointment (Friday, May 9th) of a Select Committee to inquire into the injury resulting from noxious vapours evolved from certain manufacturing processes, and into the state of the law relating thereto, said, in the absence of any more exciting topics of discussion, he hoped he might be excused for bringing before their Lordships, as shortly as he could, a subject certainly so far removed from the range of party, or what was commonly called politics, that his only fear was that he should not be able to attract their Lordships' attention to it in a degree commensurate with the real importance of the question. Some time back their Lordships had conferred a great advantage upon the metropolis by passing a stringent measure against what was called the Smoke Nuisance. Their Lordships had also introduced a stringent measure with regard to polluting rivers so as to effect the produce of salmon. But this could not be placed in competition with matters which effect health, or the productive power of land. With regard to the poisoning of the air, and the streams and rivers of the country, the noble Earl stated he had been informed by Dr. Lyon Playfair—than whom no more eminent name need be mentioned—that, on being called on to investigate a case where the water was alleged to have been poisoned by the refuse which had been turned into it from a manufactory where arsenic and lead were largely employed, he had found that though the water did not contain a sufficient quantity of poison to be injurious to health, yet, upon an analysis of one pound of mud, there were from ten to twelve grains of arsenic. The noble Earl next referred to the increase of alkali works, such as alum, soda, potash, and pearlash, and remarked how largely they entered into various manufactures. In Newcastle-upon-Tyne there is one of these manufactories which employs not less than 1000 persons, and covers under one roof sixteen acres of land. Those of their Lordships who had travelled by the London and Northwestern Railway probably recollected near Warrington a most beautiful specimen of brickwork, in the shape of a column 131 yards in height. It was erected by Mr. Muspratt in order to meet the complaint that was made of the injury caused by his works. However, the great height of the tower only had the effect of carrying the vapours further off. The manufacture of soda was carried on by the decomposition of common salt, by means of sulphuric acid; and in most establishments the manufacture of sulphuric acid was also carried on. That was produced by the combustion of nitre and sulphur, and resulted in the most offensive and most noxious vapours. Fortunately, however, it happened that it was the interest of the manufacturers to condense the whole of those vapours, and most of the works in which both soda and sulphuric acid were manufactured, caused no inconvenience in the neighbourhood. Unfortunately, it was not sufficiently the interest of manufacturers to condense the muriatic acid gas caused by the manufacture of soda. The works of Mr. Muspratt were begun in 1831 or 1832. For some years there were great complaints in the neighbourhood of the injury done to crops, fences, and trees; and at last the evil became intolerable. In 1846, the late Mr. Lee, the proprietor of a large proportion of the land in the neighbourhood, obtained a considerable amount of damages from Mr. Muspratt, and another gentleman obtained no less than £1300. damages. The manufacture was nevertheless continued; but in 1851, Mr. Lee, finding that the timber on his estate was either killed or greatly damaged, brought fresh actions against Mr. Muspratt, which were compromised by the latter paying £2000. and costs, and giving a promise, which was punctually performed, to pull down and destroy the whole of his works. There then sprung up at St. Helen's a considerable number of other works, against which, in the same manner, the neighbouring proprietors were compelled to bring their actions. In 1839, Sir John Gerard recovered £1000. damages; in 1846, £2000.; and in 1852, he brought an action for more than £4000., which was suspended by reason of his dangerous illness and subsequent death. In the meantime, additional manufactories had sprung up, and the difficulty of tracing injury home to any particular person was proportionately increased. The consequence of these manufactures was that for four or five miles round St. Helen's, in the direction in which the wind usually blew, there was scarcely a living tree. (Hear.) The landed property had deteriorated to the extent of £200,000. His (the Earl of Derby's) house was five or six miles from St. Helen's, and on the side of his park next that town there had of late been a very considerable decay in the older timber, and to a certain extent he attributed it to the poisonous fumes of the manufactures in question. Now, so far as most of such manufactures were concerned, a perfect remedy might be applied, as the vapours might be condensed in the simplest possible manner. Water would absorb 480 times its own bulk of muriatic acid gas, and consequently a constant flow of water down the chimney would absorb the gas as it rose. Some of the manufacturers already took this precaution, but very many neglected to do so, and in many cases where the precaution was taken the water was allowed to run into brooks, which thereby became poisoned. The water, however, might not only be rendered innocuous, but might be turned into a source of absolute profit. The present law did not afford a sufficient remedy. For the purposes of prevention, the law of England was absolutely silent, except as to very partial provision made by the Public Health Act, which gave a certain power of preventing the erection of nuisances such as he had referred to. There were, therefore, only two courses open—one to individuals, and the other to the public — for remedying the great injury done by these works, viz., an indictment for a nuisance, and an action for damages. In bringing an action for damages one should prove the injury, and the extent of the injury, and also that it was done by the specific work; and although some persons might succeed in getting large damages, still they did not succeed in putting down the nuisance. The noble Earl concluded by saying it was not intended to restrict the operations of trade; the aim of his motion was to inquire how far legislation might be introduced which, without injury to manufactures, might protect the community against the noxious vapours arising from them. (Cheers.) After some discussion the motion, as originally framed, was agreed to.

THE DISCOVERIES OF 1861.*

At the close of each year for several years, David A. Wells, A.M., has published a volume containing an account of all the important discoveries in science and art made during the year. The periodicals of England, the continent of Europe, as well as of this country, are carefully watched, and the mention of every new discovery is extracted. The book usually contains about 400 pages, and a copious index renders it a most convenient work for reference.

Crystalline Structure of Iron induced by Vibration.

The spontaneous change forged and rolled iron undergoes when submitted to continuous vibration is productive of so much critical danger, especially in the case of railway machinery, that an investigation into the best means of remedying the resulting evils has been viewed as an engineering question of vital importance. Among others, Mr. Schimmelbuch, of Liege, has undertaken the subject, and the following is an epitome of his investigations: A bar of pure unalloyed iron was struck by a hammer three times in a minute for six consecutive weeks; at the expiration of this time it broke into three pieces. Before the experiment the bar was a good specimen of fibrous iron; after, on the contrary, its fracture exhibited a brilliant crystallized structure, resembling that of antimony.

A bar of iron alloyed with nickle, submitted to the same treatment, underwent no change.

A very simple means exists of recognizing this changed condition of iron, so dangerous in its consequences. Pure iron, when magnetised by contact, loses its magnetic properties immediately the needle is detached. On the other hand, iron combined with minute quantities of some foreign body, such as carbon, oxygen, sulphur or phosphorus, remains magnetised. The efficacy of this simple test has been established by repeated experiments.—*London Photographic News.*

Under the patronage of the Austrian government M. Bourville has also recently instituted a course of experiments with a view of throwing some additional light on the subject of the induction of a crystalline structure in wrought iron through vibrations.

M. Bourville's apparatus consisted of a bent axle, which was firmly fixed up to the elbow in timber, and which was subjected to torsion by means of a cog-wheel connected with the end of the horizontal part. At each turn the angle of torsion was twenty-four degrees. A shock was produced each time that the bar left one-tenth to be raised by the next. Seven axles were submitted to the trial. In the first the movement lasted one hour, 10,800 revolutions, and 34,400 shocks being produced; the axle, two and six-tenths inches in diameter, was taken from the machine and broken by a hydraulic press, and no change in the texture of the iron was visible. In the second, a new axle, having been tried for hours, sustained 129,000 torsions, and was afterward broken by means of a hydraulic press; no alteration of the iron could be discovered by the naked eye on the surface of rupture, but, tried with a microscope, the fibres appeared without adhesion, like a bundle of needles.

A third axle was subjected, during twelve hours to 338,000 torsions, and broken in two; a change in its texture, and an increased size in the grain of the iron were observed by the naked eye. In the fourth, after one hundred and twenty hours, and 2,588,000 torsions, the axle was broken in many places; a considerable change in its texture was apparent, which was more striking towards the centre, and the size of the grains diminished toward the extremities. In the fifth, an axle was submitted to 23,328,000 torsions, during seven hundred and twenty hours, was completely changed in its texture; the fracture in the middle was crystalline, but not very scaly. In the sixth, after ten months, during which the axle was submitted to 78,732,000 torsions and shocks, fracture produced by a hydraulic press showed clearly an absolute transformation of the structure of the iron; the surface of rupture was scaly, like pewter. In the seventh and final case, an axle submitted to 128,304,000 torsions presented a surface of rupture like that in the preceding experiment; the crystals were found to be perfectly well defined, the iron having lost every appearance of wrought iron.

* (Scientific American.)

New kind of Electric Current.

When pure water flows through a porous body, an electrical current is elicited; a fact established by experiments, says M. G. Quincke, which may be stated concisely in these terms:—

Some thirty layers of thin silk stuff were placed over each other and attached over one tube of the apparatus; another tube was then adapted against the former; and the part separating them covered thickly with sealing-wax. Owing to the wide pores of the silk, considerably more water flowed through, under equal pressure, than when the clay plate was employed. The linen was used in the same manner.

The other substances were applied in the form of powder, in a glass tube of the diameter of the above tubes. The ends of these tubes, the length of which varied, according to the substance employed, from twenty to forty-five millims., were ground flat, and over them were placed disks of the silk stuff spoken of, to prevent the flow of the fluid carrying away particles of the substance under examination. In the case of Bunsen's coil, the tube was closed with plates thereof.

Platina was made use of in the spongy form, iron as filings. The glass had been reduced to powder on an anvil. Ivory and the various kinds of wood were employed in the form of sawdust. It was endeavored in vain to press water through a porous plate of wood, for the plate had to be luted in dry; and on becoming moist, even if cut perpendicular to the direction of the fibres, it warped so much that it broke the sealing wax or the tube.

The direction of the electric current was not changed by adding acids or solutions of salts to the distilled water, but it was considerably weakened thereby.—*Poggendorff's Ann.*

Electricity Generated by Evaporation.

Mr. Palmiere, in a note in the *Cosmos* (Paris), states that in order to obtain electricity by condensing vapors, he had some water in a capsule of platina, not insulated, made to boil slowly. He collected the vapor upon a platinum refrigerator, at a height of about two feet above the surface of the water, and by means of a condensing electroscope soon convinced himself that the vapor manifested positive electricity. Encouraged by this result, he sought to discover the negative electricity in the capsule of platinum which contained the water in a state of vaporization. Having isolated the capsule, and put it in connection with a condensing electroscope, he concentrated the solar rays on the distilled water in the capsule by means of a lens about a foot in diameter. He thus obtained a superficial ebullition, hardly visible, and also indications of negative electricity in the capsule. He afterward varied the mode of experimenting, and operated on different liquids.

What is Heat Lightning?

The flashes of lightning often observed on a summer evening, unaccompanied by thunder, and popularly known as "heat lightning," are merely the light from discharges of electricity from a thunder-cloud beneath the horizon of the observer, reflected from clouds, or perhaps from the air itself, as in the case of twilight. Mr. Brooks, one of the directors of the telegraph line between Pittsburgh and Philadelphia, informs us that, on one occasion, to satisfy himself on this point, he asked for information from a distant operator during the appearance of flashes of this kind in the distant horizon, and learned that they proceeded from a thunder-storm then raging two hundred and fifty miles eastward of his place of observation.—*Prof. Henry.*

Magnetic Phenomena.

M. Ruhmkorff has the following notice in the *Comptes-Rendus*, vol. 1, p. 166:—"If a stay (bride) of soft iron be pressed against one of the poles of an artificial magnet, the soft iron is observed to become hard, and it is more difficult to file. If the stay be removed, it loses its hardness and resumes all the properties of soft iron."

Miscellaneous.

Air Power with combustion of Gas.*

This power of a new description, has been invented in Paris, two years ago, by Mr. E. Lenoir. Here is the principle on which it acts. If in an air tight receiver, a mixture of combustible gas and air be introduced and inflamed, the gas will burn, generally with explosion, and produce a considerable elevation of temperature. The gas mixture, suddenly heated, will tend to expand, pressing with a heavy weight on the sides of the receiver.

Mr. Lenoir attempted to benefit the manufacturing community with this new expansion of the air by heat. His power has very much the same external appearance as steam power, with the exception of the boiler and furnace, which are dispensed with. It consists of a strong cast iron cylinder, with a corresponding piston and rod attached to the axle of a fly wheel, along with the claps put in motion by excentrics. On each side of the cylinder is a clap, connecting on the one side the cylinder with the gas receiver, and on the other the receiver with the outside, allowing the issue of the air after having performed its work by expansion on the piston.

In order to illustrate the action of the whole machine let us suppose the piston ready to give a full stroke. The gas clap will be then opened, and the piston in moving will introduce the gas along with the air, by openings made in the clap, so that air is supposed to be in the piston in alternate layers with the gas. This arrangement makes its combustion less explosive, meantime the power is increased. When the piston will have advanced one-third of the stroke, the clap shuts, and through an electric spark the mixture is inflamed. The air expanding with a power equal to the high temperature thus produced, will drive the piston at a full stroke, when an outlet is procured to the expanded air, through the particular clap. The fly wheel will keep up the motion and the piston will return, introducing a fresh supply of gas and air, which will be inflamed when the third of the stroke will be performed, and so on at each extremity of the cylinder alternately. As this combustion of gas, kept on for some time, might increase the temperature of the cylinder to a high figure, a double

* *From the "Lower Canada Agriculturist."*

cylinder is used as a covering to the first, leaving a certain distance between the two, so as to allow a constant run of fresh water.

These powers are now extensively used in Paris. A single horse power will give twelve hours work at $1 50. The advantage is in the facility afforded to use the city gas, without the annoyance and expense of a particular man to drive it. By turning the gas the machine is at once ready to work, and it can be stopped with the same facility. There is no danger from either fire or explosion. One of these machines, ½ horse power, has been imported as a model by Mr. E. H. Parent, civil engineer, Quebec, who will receive and answer all communications on the subject, with all dispatch, and due attention.

Uniform Weights and Measures.

Under the auspices of the International Association for obtaining a Uniform Decimal System of Measures, Weights, and Coins, a collection of the weights of the various countries of the world has been made, and these will form part of the curiosities of the International Exhibition. Few persons are aware of the extraordinary diversities in weights and measures which exist in our own country. The price of corn, for instance, will be quoted in at least fifteen different ways, in as many different localities; at so much per cwt., per barrel, per quarter, per bushel, per load, per weight, per bole, per bag, per coomb, per hobbet, per winch, per windle, per measure, per strike, per stone. The word bushel is in some places used for a measure, in others for a weight, and this weight is by no means the same in all places. In different towns of England the bushel means 168 lbs., 73½ lbs., 62 lbs., 80 lbs., 75 lbs., 72 lbs., 70 lbs., 65 lbs., 64 lbs., 63 lbs., 5 quarters, 144 quarts, 488 lbs.; and in Manchester, while a bushel of wheat is 60 lbs., a bushel of American wheat is 70 lbs. The measuring of a stone is almost equally various. An acre of land expresses seven different quantities. These variations are highly inconvenient and prejudicial to the transactions of trade; and the labours of the above-named association are directed to the bringing about a uniformity, of which there is great need. The metrical system employed in France is that which is advocated. This has been already established in Belgium, Holland, Sardinia, Lombardy, Greece, Spain, Portugal, and many other parts of the world. Great Britain and the American States, however, still adhere to their old systems.

It may be trusted that our legislation will, ere long, look this matter boldly in the face, and at a single stroke abolish the inconveniences, absurdities, and annoyances contingent upon the anomalous state of things which at present obtains. The decimalization of weights, measures, and money, is a thing which would immortalize the names of any government accomplishing it, and confer on the British public a boon which they would know how to appreciate.—*Mechanics' Magazine.*

The Prevention of Boiler Explosions.

A correspondent writes to the *Manchester Guardian:*—"The dreadful calamity near Bilston, entailing the violent death of twenty-eight persons, has induced me to trouble you with a few observations on boiler explosions. These so-called accidents arise in the great majority of cases simply from the circumstance that, from original faulty construction or subsequent wear, the material is unable to withstand the requisite pressure. Since the lamentable catastrophe at Mr. Sharp's works, I have uniformly maintained that explosions are always the result of culpable ignorance or negligence—ignorance of the use and necessity of a proper hydraulic test, or neglect of it if known. I am aware that some have pretended that the hydraulic test is injurious to the boiler, and hastens the subsequent explosion. There is no foundation for this opinion. On the contrary, it is certain that if a material, say an iron-wire, has supported a weight for a short time, it may be relied on to support a weight a trifle lighter for a long time afterwards. Besides, I would ask why a test should be refused in the case of steam boilers, when it is applied, as a matter of course, to rifles, cannon, chain-cables, &c. I long ago pointed out, in your columns and elsewhere, a method of testing boilers by hydraulic pressure, in which the conditions of strain under actual work were approximately fulfilled. This method involves scarcely any trouble, and no expense, consisting simply in the use of the expansion of water by heat. Had a pressure one-third greater than the working pressure been so applied from time to time to the Bilston boiler, its weakness would have been long ago exposed, and the loss of life would have been prevented. In suggesting the above test, I was not influenced by merely theoretical considerations. I had repeatedly tested the boiler of a small steam engine employed for scientific researches at Whalley Range. I would ere now have been in the possession of ample details on this subject, so important to humanity, had I not at my present residence met with an unexpected and certainly most uncalled-for opposition to my experiments. However, though unable to show the application of the test to my own boiler, I shall have great pleasure in assisting anyone who may wish to make use of it."

Improved Lucifer Matches.

We have recently had occasion to notice some of the many patented improvements which have of late been introduced into the manufacture of lucifer matches. One of the most novel and important inventions under this head is the "patent special safety match" of Messrs. Bryant and May, of Fairfield Works, Bow. The protection afforded by the use of this match is based upon the circumstance that it will only ignite by being rubbed upon the prepared surface of the box; no ordinary kind of friction being capable of inflaming the combustible materials with which the wooden splints are tipped. The match does not itself contain any phosphorus, but is coated merely with oxydising substances, such as chlorate of potash in conjunction with binoxide of lead or manganese, and the ingredients are in this manner so divided that it is necessary to employ the special friction surface, prepared with amorphous phosphorus, in order to secure the inflammation of the match. The security against accidental conflagration is thereby reduced to a minimum; the splints have, indeed, so little of the dangerous character of the ordinary match that the makers announce that their manufacture enjoys the exclusive privilege of being sanctioned and admitted within the building of the International Exhibition. The matches were at first coated with sulphur in the usual manner; but this practice appears to have been discarded almost immediately in favour of the employment of some kind of fatty matter for impregnating the wood. No phosphorus being employed in the match composition, they are, of course, quite destitute of the unpleasant odour and poisonous character of this substance. The dangerous practice of carrying loose matches about the house, and the common habit among servants of striking them upon the wall to the disfigurement of the paper-hangings, will be altogether avoided by the introduction of Bryant and May's patent special safety match.—*Chemical News.*

Machinery For Printing Calicoes.

An idea may be formed of the extraordinary influence which the introduction of machinery and improvements in engraving have had in cheapening the cost of printed calicoes, from the statement made by Prof. Calvert of the United States, that large furniture patterns, such as are required for some of the oriental markets, and into which sixteen colours and shades enter, would have cost formerly from 7 dols. to 9 dols. per piece, because they would have required sixteen distinct applications of as many different blocks, and would have required more than a week in printing, whereas the same piece can now be printed in a single operation, which takes three minutes, and costs about 1 dol. 50.

The Electric Light.

M. Nadar has recently succeeded in obtaining a series of singular and interesting views of the Catacombs of Paris, by illumining them with the electric light. The French department of the International Exhibition possesses some photographs printed by the aid of this light. Plants, grown under the influence of the electric light alone, are said to assume their green tint as in sunlight.

Interesting Geological Discovery at Hastings.

The fall of the cliff near Hastings has brought to light an interesting slab of stone bearing on its surface the clear impression of the foot of a gigantic bird. It has three toes, each of which is about nine inches long in the tread, with a claw at the end, of perhaps two inches in length. The back of the foot, where the three toes meet as in a centre, does not appear; that part of the foot did not reach the ground. But still further back is the mark made by the point of the spur, or fourth toe. From the point of the middle claw to the mark of the spur it measures twenty-four inches, and in width twenty inches. The whole of the slab is covered with the lines of ripple made by the waves upon soft mud, and there are numerous other impressions more or less perfect of the same bird's claws on other slabs of stone. The bird which has left us this footprint may be supposed to have been at least twelve feet high, and perhaps much more. Mr. Jones, of the Geological Society, Somerset House, suggests that it may not be the footmark of a bird, but probably of the iguanodon. But he has not seen the original slab.—*West Sussex Gazette.*

The Iron Fleet of Britain.

In addition to the iron frigate Achilles, 50, 6,079 tons, 1,250 horse power, building at Chatham dockyard, the following squadron of iron vessels are now under construction by private firms for the Admiralty, several of which are in a very advanced state—viz., the Agincourt, 50, 6,621 tons, 1,250-horse power, building at Birkenhead; the Northumberland, 50, 6,621 tons, 1,250-horse power, and the Valient, 32, 4,063 tons, 800-horse power, building at Milwall; the Minotaur, 50, 6,621 tons, 1,250-horse power, and the Orontes, 3, 2,812 tons, 500-horse power, building at Blackwall; and the Hector, 32, 4,063 tons, 800-horse power, building at Glasgow. The following iron-plated frigates are now building at the several Royal dockyards, the whole of which are intended to be afloat during the present year—viz., the Caledonia, 50, 4,045 tons, 800-horse power, at Woolwich; the Ocean, 50,4,045 tons, 1,000-horse power, at Devonport; the Prince Consort, 50, 4,045 tons, 1,000-horse power, at Pembroke; the Royal Oak, 50, 3,716 tons, 1000-horse power, at Chatham; and the Royal Alfred, 50,3,716 tons, 800-horse power, at Portsmouth. In addition to the above there are no fewer than 31 line of-battle ships and other screw steamers now on the stocks at the several dockyards, most of which are admirably adapted for conversion into shield ships, on Captain Coles's principle. Of these the Bulwark, 91, at Chatham; the Repulse, 91, at Woolwich; the Robust, 91, at Devonport; and the Zealous, 91, at Pembroke, are all in a very advanced state, requiring only a comparatively small outlay to plate them with iron. There are also three first-class 51-gun frigates also building—viz., the Belvidera at Chatham, the Tweed at Pembroke, and the Dryad at Portsmouth,—which are admirably adapted for conversion into armour-plated ships. They would not require the removal of any decks, as would be the case with line-of-battle ships, but would only have to be lengthened and strengthened to enable them to bear the increased weight which would be placed on them. Of the other vessels in progress several are intended to carry 22 guns and upwards. If completed as iron-cased steamers they would be larger and of greater tonnage than either the Monitor or Merrimac. The whole of the hands have been removed from the wooden ships building at the several dockyards, and are now employed on the iron-cased frigates under construction, five of which will be afloat by the end of the present year.—*Times.*

Canadian Copper.

The quantity of ore produced at the Bruce Mines during the past season was 472 tons 11 cwt. 3 qrs. 2 lbs., of 17 per cent., being about 75 tons short of the previous year's production. The production at the Wellington Mine (leased from the Montreal Company by the West Canada Mining Company) was 1,175 tons, of about 19 per cent., being over 100 tons short of the previous year's production. The royalty paid to the Montreal Company from the Wellington was about 58 tons. The quantity produced at the Huron Copper Bay Mine, also in the hands of the West Canada Company, will, it is believed, exceed that of the Wellington, and probably bring last year's produce of the Bruce and Wellington and of the Huron Bay together to about 3,000 tons, a substantial proof of the capability of the district. The value of the ore approaches $250,000 a considerable addition to the exports of the country from one small port, but a mere trifle of what might be done did the Government provide efficient steam communication with the upper lakes.—*Report of the Lake Huron Mining Co.*

Consumption of Timber in England.

Upwards of three million loads of timber and wood were imported into this country, and entered for home use, in 1861; a quantity less by 166,624 loads than in 1860. The computed real value of the entire imports of timber and wood, for the year 1861, fell short of ten millions sterling by seventy thousand pounds only.

Test for Gaseous Sulpurous Acid.

Hugo Schiff employs paper moistened with solution of protonitrate of mercury which instantly assumes a gray colour from reduced mercury; it is requisite to test with lead paper for sulphuretted hydrogen. Both gases are not present at the same time, as they decompose each other.—*Dingler's Journal.*

The British Museum.

The correspondence between the Treasury and the trustees of the British Museum on the subject of providing additional accommodation for the varied collection belonging to the great national establishment has been published. From this it would appear that the trustees are resolved to separate the plethoric contents of the present museum by removing the departments of natural history, including those of geology, mineralogy zoology, and ethnography, to a new building to be erected on the estate of the exhibition of 1851. By the removal of these collections from the museum an area of some 65,000 feet will be left vacant, and this may be appropriated chiefly to exhibition rooms for coins, medals, prints, engravings, &c., &c., and more space for the library, which grows larger at the rate of 30,000 volumes annually. It is understood that the Treasury regards this proposition with favour, and that it is probable a Bill will be introduced to Parliament embodying it.

Revivification of Animal Charcoal.

MM. Leblay and Cuisinier give (*Comptes-Rendus*, t. liv. p. 270) a new process for reviving exhausted animal charcoal. They find that the power of absorbing coloring matter is restored on treating the charcoal with weak boiling solution of caustic alkalies. They also say that the original absorbing power of the charcoal may be very much increased by pouring over it a weak solution of biphosphate of lime.

Chloride of Lime as an Insecticide.

In scattering chloride of lime on a plank in a stable, all kinds of flies, but more especially biting flies, were quickly got rid of. Sprinkling beds of vegetable with even a weak solution of this salt effectually preserves them from the attacks of catterpillars, butterflies, mordella, slugs, &c. It has the same effect when sprinkled on the foliage of fruit trees. A paste of one part of powdered chloride of lime and one half part of some fatty matter, placed in a narrow band round the trunk of the tree, prevents insects from creeping up it. It has even been noticed that rats and mice quit places in which a certain quantity of chloride of lime has been spread. This salt, dried and finely powdered, can, no doubt, be employed for the same purposes as flour of sulphur, and be spread by the same means.—*Dingler's Polytechnisches Journal,* clxi. 240.

Horticultural Curiosity.

"At the present moment," says the *Independance Belge*, "may be seen in a garden at Fexhe-le-Haut-Clocher, Belgium, a fine cherry tree not in blossom, but bearing good-sized cherries. It is true that the tree has been covered every night with matting, and has been for some weeks passed watered with lukewarm greasy water. This is a remarkable instance of precocious vegetation."

To Check the Warping of Planks.

The face of the planks should be cut in the direction which lay from east to west as the tree stood. If this be done, the planks will warp much less than in the opposite direction. The strongest side of a piece of timber is that which in its natural position faced the north.

Coal Tar to Prevent the Potato Disease.

M. Lemaire mixed two per.cent. of coal tar with earth, scattered the mixture over his ground, dug it in eight inches deep, and then planted his potatoes. None of those protected by tar showed any sign of the disease, while more than half of some planted at a short distance on the same day, and left unprotected, were found to be diseased.

A New Lathe.

A new lathe has been recently patented by Messrs. W. Muir & Co., of the Britannia Works, Strangeways. By an ingenious adaptation of two treadles, with alternate action, as much power is obtained for turning metals as with steam power of the same capacity. We believe that this is an entirely new feat in mechanics,—to obtain, without steam, as great a result, in cases in which power is required, as is accomplished by steam. Such a lathe will be of incalculable service on board vessels, and in those colonies—such as India—where labour is cheap. The lathe will be shown at the International Exhibition.—*Manchester Guardian.*

Sex of Eggs.

M. Genin lately addressed the Academie des Sciences on the subject of "The Sex of Eggs." He affirms that he is now able, after having studied the subject for upwards of three years, to state with assurance that all eggs containing the germ of males have wrinkles on their smaller ends, while female eggs are smooth at the extremities.

To clean Marble.

Mix pumice-stone, very finely powdered, into a paste with verjuice; let it stand for two hours; with a sponge then rub it over the marble, and allow it to dry on; then wash it off with clean water, and dry it with soft linen.—*Builder.*