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FOR UPPER CANADA.

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THE USE WE MAKE OF OUR MINERAL RESOURCES.

Although it is well known that the mineral resources of Canada are both varied and extensive yet they do not figure in the annual returns of the productive interests of the province, as growing in the ratio we should expect from the increasing productive power of the country. The value of the produce of the mine for the years 1859, 1860 and 1861 was as follows:—

1859.	1860.	1861.
$468,512	$558,306	$454,963

The year 1861 was for all interests except those of agriculture an unproductive year.

The produce of the Fisheries fell from $832,646 in 1860 to $663,700 in 1861; manufactures fell from a value of $502,037 in 1860 to $289,130 in 1861, but the products of the farm rose on account of the splendid harvest of last year, from $14,259,-225 in 1830 to no less than $18,244,631 in 1861. These numbers refer only to the value of exports, and although they afford an approximate indication of the condition of the several industries of the country, there is good reason to suppose that the consumption in Canada of home manufactures is considerably on the increase, and consequently the utilization of the mineral resources of the country may be rapidly augmenting at home although our exports exhibit a decline. No doubt the present condition of the United States afford some explanation of this state of things. The Descriptive Catalogue of the Economic Minerals of Canada by Sir W. E. Logan, F. R. S., furnishes us with the best data at command for obtaining information respecting the present products of the mine, and we avail ourselves of this admirable guide in the following examination:—

First, then with respect to Iron, as one of the oldest mineral manufactures in the country. The St. Maurice forges were established so far back as 1737, at a time when Lower Canada did not contain more than 60,000 inhabitants, and Upper Canada was a complete wilderness from the Ottawa to the St. Clair.(1)

The St. Maurice forges were in operation until 1858. They were supplied with bog iron ore from the seigniory of St. Maurice, and the smelting company employed between 250 to 300 persons in 1831. The smelting operations were performed with charcoal, but in 1858 the establishment of the Radnor forges in the seigniory of Cap de la Madeline, on a tributary of the Champlain River, where ore and wood are still abundant, threw the St. Maurice forges out of blast. The chief manufacture of the company consists of cast iron car wheels, which cost at the forges 2⅝ cents a lb. A rolling mill has recently been erected at the establishment for the rolling of scythe iron at 3½ cents a lb., and of nail rod iron at 5½ cents a lb. Limestone for a flux for smelting the ore is obtained near the works, and sandstone for furnace hearths at the Gres Rapids, on the St. Maurice. It belongs to the Potsdam formation, largely developed in Lower Canada. The ore occurs close to the surface in a multitude of patches, distributed over the country, and is brought to the furnaces partly by the workmen of the company and partly by farmers on whose land it occurs. It is washed at the smelting works and contains between 40 and 50 per cent. of iron. The quantity used annually is between 4,000 and 5,000 tons, producing about 2,000 tons of pig iron, and the number of workmen employed varies from 200 to 400. Charcoal burners form an important part of the companies' employées.

The furnaces at Marmora, in the rear of Belleville, Upper Canada, were in operation many years ago, and iron of superior quality was manufactured from a succession of single beds of the black magnectic oxide of iron, one of them one hundred feet thick. The ore contains between 60 and 70 per cent. of iron. Different companies have from time to time renewed smelting operations for short periods, but the distance from a shipping port has proved an obstacle to success.

About 4,000 tons of magnetic ore were exported in 1859 from a bed 200 feet thick, situated on Mud Lake, a part of the Rideau Canal. It is supplied at Kingston for 2½ dollars a ton, whence it is taken to the smelting furnaces at Pittsburg, in the State of Pennsylvania. It is found more profitable to take the ore to the coal than the coal to the ore. In 1858 a company of smelters at Pittsburg opened a mine in the township of Hull, on the Ottawa, and up to 1858 they had exported about 8,000 tons to Pittsburg, but since the opening of the rich bed on Mud Lake they now obtain their supply from the latter. A bed of ore was formerly worked in the township of Madoc and smelted close to the deposit; also, one has been recently opened in the township of South Sherbrooke, and conveyed to the Rideau Canal for

(1) The population of Lower Canada was 26,904 in 1714 and 65,000 in 1759, showing an increase in 45 years of 38,096 souls. —Bouchette.

exportation. The troubles in the United States have, however, so far diminished the exportation of iron ores that while their value in 1859 amounted to $25,765, in 1861 they fell to $2,430. The same influences diminished the exportation of pig and scrap iron to the United States, most, in all probability, originally of foreign origin, from $75,373 in 1859, to $5,759 in 1861.

Copper.

The Bruce Mines, on Lake Huron, opened in 1847, have yielded about 9,000 tons of eighteen per cent. The quantity obtained in 1861 was 472 tons, containing 17 per cent. of copper. Smelting furnaces were erected at this mine in 1853, the fuel used being the bituminous coal from Cleveland, on Lake Erie. After a trial of three years the Montreal Mining Company ceased smelting, and leased their works. The Wellington Mine belonging to the West Canada Mining Co., is going on much more favourably. In a report of a meeting of the shareholders, held in London, in May last, a profit for the year 1861 of £7,501 sterling was announced. If the American markets at New York and Baltimore should show no depreciation, this mine will become very valuable, and the copper of the North Shore of Lake Huron may yet grow to be of great importance to the country. The number of workmen at the Wellington and Copper Bay Mines is supposed to be about 260. The already celebrated Acton Mines, in Lower Canada, had exported to the end of 1861 about 6,000 tons, holding on an average 17 per cent. of copper. In a recent number of the English *Mining Journal* the following paragraphs have appeared :—

"The Acton Mines, Canada.—With reference to these mines, concerning which much interest is felt in this country, Messrs. Willson and Robb write that the ore, in consequence, apparently, of complicated dislocations of the strata, occurs at the surface in a series of bunches of exceeding richness, which have now, for the most part, been extracted by open quarrying ; but on tracing this ore in depth, these bunches appear to be connected with regular viens, which afford promise of being permanently productive, although by a different and more satisfactory mode of working. In the absence of full official returns, it may be safely estimated that the Acton Mine has, up to this date produced not less than 6,000 tons of ore, averaging 17 per cent. produce, worth about $400,000, at a cost of about one-fourth that sum. Although as yet, with the exception of Acton and Harvey Hill Mines, no very great progress has been made in the production of ore for the market, the results so far have amply justified the anticipations. Deposits of the sulphurets of copper, more or less promising, have been found to exist on upwards of 150 distinct lots in the various townships. On nine or ten locations, at great distances apart, shafts have been sunk to a considerable depth, and in as many instances large sums have been expended in costeaning and trenching; and in almost all cases the deposits, when traced in depth, have been found rapidly to improve in all the qualities requisite for permanent and profitable mining; and we have at the present time, many setts which appear only to await the application of a moderate capital to become permanently productive."

In 1859, the total value of the copper ores exported from Canada amounted to $340,686 ; in 1861 it reached $440,130, shewing a favorable increase in this ore, and one which promises to become rapidly augmented.

Lead.

Of Lead the yield has yet been small in Canada. At Indian Cove, Gaspè, about six tons of ore, of sixty per cent. value, have been obtained. At the Ramsay Mines, in 1858, twenty-six tons of ore, which yielded eighty per cent., were raised. A fifty horse power steam engine has been erected at the mine, and the works are progressing. In Lansdowne, a vein of Galena was opened in 1854, but the results were not satisfactory ; other veins in the same locality have been struck, and works are prosecuted. At Bedford shallow trial shafts have been made, but the results are not publicly known. Of lead in sheets we imported $12,262 in 1861, so that the home production is probably very insignificant as yet.

Gold.

The auriferous area of Eastern Canada is estimated to be about 15,000 square miles. Authentic details respecting the profits of the different gold mining companies which have been formed since 1851, are very difficult to obtain. The workings of the Canada Gold Mining Company in 1851 and 1852, yielded 4987 dwts 30 gr. of gold : the value being $4323.15 ; but the wages of the company amounted to $3532, so that the profit was only $690.

Peat.

Our importation of Coal and Coke for fuel is very considerable ; and, in the neighbourhood of large towns, wood is becoming expensive. We paid for Coal and Coke in 1861, not less than $732,212, or nearly equal to double the entire value of the exports of our minerals. It is gratifying to know that a very considerable area of peat exists in Canada, which may one day become very valuable. The peat at Chambly was at one time cut pressed, and sold, as fuel ; but in consequence of the cheapness of wood and coal, it was not remunerative. There are about 100 square miles of peat on the Island of Anticosti. Large peat bogs occur between the Ottawa and the River St. Lawrenee, and also on the south side of the last named river.

Miscellaneous.

Plumbago.—The workable beds of this mineral occur chiefly on the north side of the Ottawa. Little has yet been done with them.

FRIABLE SANDSTONE.—A bed of crumbling sandstone 20 feet thick occurs in the Township of Pittsburg. It is in much demand for iron foundries, and is shipped to the foundries at Montreal for $3, and to those at Toronto for $2 50 a ton. About 1500 tons are consumed in the foundries of these cities.

FIRE CLAY.—In Dundas and Hamilton the foundries use fire clay from the Clinton formation, which is exposed along the great Niagara limestone escarpment, west and north of Lake Ontario.

BUILDING STONES.—See June number of this Journal.

SLATE, FLAGSTONE, LIME, BRICK AND DRAIN TILES, GRINDING AND POLISHING MATERIALS, &c., &c.—See June and July number of this Journal.

PETROLEUM.—See July and other numbers of this Journal.

Although the mineral wealth of the country is vast, as yet is comparatively undeveloped.

The proportion borne by the exported produce of the Mine to the total value of our exports in the three past years was approximately as follows:—

1859 as 1 is to 50 nearly.
1860 " 1 " 55 "
1861 " 1 " 60 "

The absence of coal is an immense drawback, and with the exception of the Iron mine of Radnor, no attempt appears to be made to use wood charcoal, probably on account of the expense. A very considerable increase in the price of Iron will have to take place, or some new process for smelting it discovered before we can expect the manufacture of this all-important material to assume important proportions in Canada. In contrast to this not very encouraging statement, the estimates for the Lake Superior Iron Trade for 1862 amount to 150,000 tons, which will be shipped from Lake Superior ports.

THE AGRICULTURAL CENSUS OF 1861.

The Census of the Origin and Religion of the people of Canada, and of the Agricultural Statistics of Upper Canada, is at length published without comparison, note or comment. The late Mr. Hutton prefaced the Census Report of 1851-2 with some very valuable and interesting comparisons between the progress of Canada and the United States. Perhaps a similar series may be supplied by the Board of Registration and Statistics when the Agricultural Census of Lower Canada is published. Meanwhile, we cull from the Census Report of 1851 and that of 1861 the following interesting tables which will show in a very striking manner the progress which has been made in Agricultural Industry during the last ten years in Upper Canada. It is much to be regretted, that so far as the data before us serves as the basis of an opinion, manufacturing industry as represented by fulled cloth, flannel and linen has not progressed in a proportion in the least degree commensurate with the general progress of the country.

Comparative Table of the Agricultural Products, &c., of Upper Canada in the years 1851 *and* 1861.

		1851.	1861.
Population of Upper Canada		952,004	1,396,091
Occupiers of land		99,906	131,983
Wheat	bushels	12,682,550	24,620,425
Barley	"	625,452	2,821,962
Rye	"	318,429	973,181
Peas	"	3,127,681	9,601,396
Oats	"	11,391,867	21,220,874
Buckwheat	"	579,935	1,248,637
Indian Corn	"	1,688,805	2,256,290
Potatoes	"	4,982,186	15,325,920
Turnips	"	3,110,318	18,206,959
Carrots	"	174,686	1,905,598
Mangel Wurzel	"	54,206	546,971
Hay	tons	693,727	861,844
Flax or Hemp	lbs.	59,680	1,225,934
Tobacco	"	777,426	....
Maple Sugar	"	3,669,874	6,970,605
Cider	gallons	742,840	1,567,831

It will be observed upon inspection of the foregoing table that in every item enumerated an increase has taken place, in some instances of a very favourable character, indicating progress in the true principles of farming practice.

The cultivation of root crops is progressing with extraordinary rapidity as shown by the production of eighteen million bushels of turnips in 1861 against a little over three million bushels in 1851. The production of mangel wurzel has increased ten-fold; wheat has doubled itself; barley shows more than a four-fold increase; peas three-fold, and the production of flax and hemp in 1861 is twenty times greater than in 1851. The cash value of the farms of Upper Canada reaches the enormous sum of two hundred and ninety-five million dollars. We now turn to the live stock as shown in the following:—

Comparative Table of Live Stock in Upper Canada in the years 1851 *and* 1861.

	1851.	1861.
Bulls, Oxen and Steers	192,140	99,605
Milch Cows	297,070	451,640
Calves and Heifers	255,249	464,083
Horses(1)	201,670	377,681
Sheep	1,050,168	1,170,225
Pigs	571,496	776,001
Total value of live stock	———	$53,227,486

(1) Including Colts and Fillies.

The remarkable diminution in the numbers of bulls and oxen arises, probably, from the more general use of horses for farm work. The small increase in the number of sheep is surprising, but from the wool returns the fleece must be much heavier than formerly, for while the increase of the number of sheep is only 120,057, the excess of the wool crop of 1861 over that of 1851 exceeds one million pounds.

The third comparative table to which we now turn relates rather to manufactures than to agriculture, it exhibits the mode in which the raw material was utilized, and the progress made in domestic manufactures.

Comparative Table showing the number of Yards of Fulled Cloth, Flannel and Linen Manufactured in Upper Canada in 1851 *and* 1861 *respectively.*

		1851.	1861.
Fulled Cloth	yards	531,560	497,520
Linen	"	14,711	37,055
Flannel	"	1,157,221	1,595,514

In the manufacture of fulled cloth a marked diminution is perceptible, but a considerable increase has taken place in the production of linen and flannel, yet far from being so large as might reasonably have been anticipated from the remarkable progress of the country in agricultural industry.

THE PROVINCIAL EXHIBITION.

In less than two months the largest and most complete exhibition of Canadian Industry will be held in Toronto. Preparations on a very extensive scale are fast drawing towards completion. It remains for the manufacturers and artizans of Canada to show that progress in every department has been made, commensurate with the rapid increase of wealth and population which has taken place since our annual exhibition was last held at Toronto. We say to all, in whatever branch of industry you may be engaged, send some illustration of your work to the next Provincial Exhibition, even though it may not be attended with any immediate personal gain, yet it will be of advantage to the country at large; it will assist in convincing the stranger that we embrace within our own limits, all the elements of an independent people, and that we are not tied by leading strings to the foreign manufacturer either in Europe or America. It is, moreover, the duty, and it should be the honest endeavour of every manufacturer to send the best productions of his skill to be seen by his countrymen, in order that their confidence and trust in the land which secures them safety, freedom and maintenance may be increased and strengthened. Canada has done well at the Great International Exhibition. She has sustained the reputation she won in 1851 and 1855, and the fruits of her energy in making the display she did are already beginning to be felt. There is one feeling of regret, however; we all know that little aid was given Canadian Exhibitors by the late government to display the rich resources of the country to the best advantage. We all know that although much has been done, much, very much more might have been accomplished if encouragement suitable to the occasion had been offered at an earlier date. With respect to our own forthcoming exhibition, exhibitors are altogether independent of external aid, they must rely upon themselves, and if a patriotic spirit is aroused men will come forward with their works of art, skill and industry and produce such a collection as will surpass the hopes of the most sanguine, and astonish those who do not live in our midst with the abundance of the resources of the country, and with the manner in which they are utilized and displayed. It is anticipated that the influx of visitors from all quarters, both in Canada and the States, will be unprecedentedly large, and we cordially hope that the opportunity for making an ample and complete display of what we can do, and of the condition of our civilization, will not be allowed to pass unheeded by any one who has the welfare of his country at heart, and posesses the power to increase it.

THE ECONOMIC MINERALS OF CANADA.

(*Continued from page* 203.)

MINERALS APPLICABLE TO THE FINE ARTS.

Lithographic Stone.

MARMORA.—At Marmora the Laurentian rocks are overlaid by about twenty feet of brownish-grey and light brownish-buff unfossiliferous compact limestones, with a conchoidal fracture, several beds of which would be well suited for the purposes of lithography, were it not for small imbedded lenticular crystals of calcareous spar, which, when abundant, unfit the stone for such an application. One of the beds, however, which is two feet thick, and of impalpable grain, is a lithographic stone of excellent quality. The lower half is much better than the upper, which is somewhat affected by the lenticular crystals of calcspar. The upper inch, which is just above the thus marked part, fits upon it in tooth-like projections, having columnar sides at right angles to the bed, of an inch long in some places; and usually covered with a thin film of bituminous shale. The same tooth-like forms occur in the lower part, but they are there more obscure. The band to which the bed belongs, presents occasional exposures of a different character, all the way from Hungerford to Rama, a distance of 100 miles; but though the stone has been highly commended by all the lithographers who have tried it, no one has attempted to quarry it for use. The stone exhibited, presents the *fac simile* autographs of all the governors of Canada, both French and English, from the time of Champlain in 1612 to that of Lord Monck in 1862; with the exception of two of the French governors in the seventeenth century.—*Birdseye and Black River Formation, Lower Silurian.*

BRANT.—These are specimens of magnesian limestone of a yellowish drab color and fine texture, with conchoidal fracture. The locality is a bed of a small stream, on lot 31, between ranges 1 and 2, south of the Durham road, Brant, and about half a mile south of the village of Walkerton. About fifteen beds of stone, apparently of the same character as the specimens, occur in a vertical section of nine feet, the thickest being eleven inches. Layers of dark coloured shale separate some of the beds. The band is underlaid by about sixty-five feet of soft clayey strata, constituting the bank of the Saugeen River, at the top of which it occurs. The existence of this stone being a very recent discovery, only a preliminary trial of it has been made. The beds from which the specimens were taken, are intersected by a number of parallel joints, which render the specimens procured somewhat narrow; but the geological place of the band having been ascertained, it is probable that wider slabs may be found on the strike, in some other locality.—*Onondaga formation, Upper Silurian.*

OXBOW, SAUGEEN RIVER, BRANT.—This stone is of the same character and from the same formation as the last. The locality is at the edge of the river, on the east side of the lot indicated in Brant. Two beds, of four and five inches respectively, occur here, but they were covered with water at the time the place was visited.—*Onondaga formation, Upper Silurian.*

MISCELLANEOUS MINERALS.

Peat.

CHAMBLY.—Peat occurs near Chambly, on the south side of the St. Lawrence, and was some years ago cut, pressed, and sold as fuel by the late Mr. Scobell. The consumption, however, was scarcely sufficient to encourage the industry. As Canada is deficient in coal, when wood becomes scarce in the progress of settlement, peat will gradually assume some importance as a fuel in many parts of the country. Peat occurs in great abundance in many places in the province; about 100 square miles of it extend along the south front of the Island of Anticosti. Successive areas of it are met with on the south side of the St. Lawrence, from Rivière du Loup to Ste. Marie de Monoir, opposite Montreal; on the north side it occurs at La Valtrie and other places. Large peat bogs occur between the Ottawa and St. Lawrence, and there are many of the same character to the westward. The peat which is sufficiently matted to hold together when dried, usually supports a growth of prairie grass, or ericaceous plants, or of tamarac trees. That which occurs in cedar swamps is deficient in the fibrous plants which give it cohesion, and it falls to powder when dried.

A new bronze is being much used by workers in metals. It is made by melting together 10 parts of Aluminum with 90 of Copper. It is said to be as tenacious as Steel, and well adapted for the bearings of machinery.

THE INTERNATIONAL EXHIBITION.

WESTERN AND EASTERN ANNEXES.

(*Extracts continued from "The Mechanics' Magazine."*)

Steam Traction and Portable Engines.

The first of these which arrests our notice is one exhibited by Bray's Traction Engine Company. This, considering its great capabilities, is a remarkably compact and simple looking piece of locomotive machinery. It was built at the factory of the company, by order of the Government, and when it has played out its quiet part at the great show, is intended for active service in Woolwich Dockyard. It combines many improvements upon the earlier contrivances for the purpose of transporting heavy weights by steam power; but the feathering principle of the wheels, as originally introduced by Mr. Bray, is retained. This principle consists in the circumference of the wheel having a number of small apertures through it. These apertures are the media which allow of the protrusion and withdrawal, by means of an eccentric, of a series of blades, or teeth. The teeth may be adjusted to the nature of the soil, or paving, over which the engine has for the time to travel; that is, they may be lengthened or shortened, so to speak, at the will of the attendant. In many cases the teeth are not required to be protruded at all, the friction of the periphery of the wheel being sufficient for the purposes of traction. In such case the blades may be thrown out at the top, or on that part of the wheel not coming in contact with the road. On the contrary, in the event of the ground being soft or slippery, or of the engine having to ascend a steep incline, the powerful auxiliary aid of the teeth can be brought into action, and the requisite amount of biting ensured.

It has been objected that the teeth may damage the roads over which the engine travels, but as the wheels take a broad bearing thereon, it is difficult to see the force of the objection. Power is transmitted by means of pinions hung on the crank shaft, and which work into rack wheels attached to the arms of each driving wheel near its outer circumference. Arrangements exist for altering the speed and the power, so as to suit the circumstances of the occasion upon which it is used. The engine exhibited is not intended solely for traction purposes, however, for it is fitted with a drum, which renders it available for driving any kind of fixed or portable machinery. It may thus be made available for an infinite variety of duties, in addition to its primary and nominal ones. It is, in fact, an engine of all work, and, in this capacity, is destined, we imagine, to be particularly serviceable at Woolwich Dockyard. Some other special features about this valuable steam appliance deserve notice, and they are, the introduction of an improved mode of steering, and of outside bearings, for the driving wheels, which also are mounted on springs on both inner and outer framings. It may be stated, moreover, that one of the powerful engines of this company was employed in the conveyance of ordinary locomotive engines, heavy castings, and machinery of various kinds from the docks, railway stations, and manufactories, to their destinations at South Kensington. It was thus a potent contributor to the magnificent display of machinery in the Western Annexe. The load conveyed at one time, by this engine, occasionally amounted to 45 tons.

Messrs. Chaplin and Alexander, of Glasgow, also exhibit a traction engine, of a lighter character than that just referred to, but well adapted nevertheless, for many purposes. In addition to this, the same firm supply the contractor's locomotive, which is intended to work on rails or tramways, of a gauge from two feet upwards. This is simple in construction, and the working parts are easily accessible for repair. Portable cranes, hoisting engines, and light portable engines for agricultural and other purposes, go to make up the display of Messrs. Chaplin and Co.

Taplin and Co., of the Traction Engine Works, Lincoln, are exhibitors of a traction engine of a different form to those of other competitors in the same path. This has a singularly light appearance; but it has double cylinders, is of 16-horse power, and has many advantages peculiar to itself. One of these last consists of an apparatus for regulating the height of water when going up or down hill. The mode of steering is simple and effective, and arrangements are made for carrying a sufficient supply of fuel and water for a journey of twelve miles. Fifty tons is the weight it is computed to draw. It is, therefore, well suited to the uses of contractors and others engaged in the erection of buildings, bridges, or other works of magnitude. Messrs. Taplin and Co. also show a 12-H.P. engine on the same principle, and intended for steam ploughing, thrashing, and other operations of the farmer. An 8-H.P. portable steam engine, manufactured by Messrs. Brown, Williams and Charles M. May, of North Wilts Foundry, Devizes, is a very excellent specimen of this kind of machine. From the fact that the cylinder is enclosed when the engine is working in a jacket or belt of steam, the maximum advantage from employing steam expansively is gained. The lower part of the cylinder casting forms a steam chamber, from which the steam is taken off directly into the valve case without exposure to the effects of cold air. This is an important arrangement, because condensation and priming are thereby guarded against to a very considerable extent, if not entirely obviated. The cylinder, and, indeed, all the working parts, are attached to the top of the boiler, and thus, besides being readily accessible for repairs, are constantly under the eye of the driver.

The engine is furnished with an inside crank, which works between the bearings, so that the fly-wheel can be put on either side of the boiler, and a pulley of smaller size may be hung opposite to it if required. One end of the shaft is also prolonged, so that a coupling may be attached for effecting communication with any machinery at a distance, and employed for steam cultivation or other purposes. A steam pressure gauge, on a patented principle, is connected with the boiler, as well as a glass water gauge, and gauge cocks. The bearings are all of gun metal, and the working pins, nuts, and screws, are all case hardened. The boiler is well adapted for the rapid generation of steam, the heating surface being equal to 20 square feet for each horse power. The barrel of the boiler, which is made of Low Moor iron, and in some cases of steel, is clothed with a casing of hair felt and wood, for the prevention of evaporation, and over all is a protecting covering of sheet iron. The ash pan is fixed close round the fire box, and fitted with a door, which may be used as a damper. The greatest care appears to have been taken to prevent live coals or cinders from falling to the ground, so that the chances of accident from that cause are materially lessened. On the whole, there is no doubt that, for compactness of form, and probable economy of working, the engine of Messrs. Brown, Williams and May will bear comparison with any contrivances used in this country for similar objects. Mr. Holman, of Cannon-street, City, is, we believe the agent in town for this firm.

In the branch of agricultural engineering, which is becoming every day of more and more importance, and which is attracting more and more the attention of the general engineers and machinists of the kingdom—in this branch Mr. Burrell, of St. Nicholas Works, Thetford, Norfolk, shines conspicuously at the International Exhibition. Perhaps the combined portable engine and windlass is the most noteworthy of the specimens of agricultural machinery from the Thetford Works, and of this and its mode of action, therefore, we may give a brief description. The cylinder and gearing are placed on the top of the boiler, as it were, but yet independent of it. Any portion of the working parts may thus be removed for repair even while the steam is up. Beyond this there is nothing extraordinary in the construction of the motive portion of the engine, but the mode of communicating motion to the windlass and the windlass itself are worthy of remark. The windlass consists of a single sheave five feet in diameter, and around which the rope is made to take half a turn. The groove into which the rope passes is formed of a series of small leaves, which, on the application of the least pressure, clasp and hold the rope until it takes the straight line on the other side, when the clips open and release it. By this simple and self-acting arrangement, all short bends which are found to be so detrimental to wire ropes are avoided. The small "leaves" referred to are made of chilled cast-iron, which, of course, is not liable to wear rapidly, and they may readily be removed and replaced when desirable. An upright shaft, driven by a bevel pinion on the crank-shaft, puts the windlass in motion.

The plan of working is thus described by the maker of the implement:—"On the headland is placed the engine and windlass, and directly opposite to them the anchor, which is set moving. Between these the plough—if a plough be in use—is pulled backwards and forwards, one end of the plough being alternately in the air, and the other in its work, thus avoiding the necessity of turning on the headlands.

The plough being constructed with patent slack gear, the rope is lengthened or shortened as the irregularity of the field may require, and at the same time both ropes are kept sufficiently tight to prevent their trailing upon the ground. By these means a great saving of draught is effected, and the wear and tear of the rope by friction is obviated." Any other implement than the plough may, of course, be worked in the same manner.

The anchor used with the combined engine and windlass, is a patented contrivance, and is so made that its resistance to side strain is due to disc wheels which cut their way for some distance into the ground. The frame is entirely composed of wrought iron, and a box at the back is intended as a counterpoise to prevent the apparatus being pulled over when engaged on very heavy work. This machine is managed by a boy, who also attends to the shifting of the rope porters. Patent balance ploughs, and cultivating machines, flour mills, and thrashing machines, are exhibited in the Eastern Annex, by Mr. Burrell, together with many other appliances of minor importance.

The well-known firm of Clayton and Shuttleworth, in addition to their various contrivances for facilitating the operations of agriculturists and others, exhibit two specimens of portable engines. These consist of the "improved outside cylinder engine," and the "portable steam engine;" they are both creditable productions, and may be made applicable to numerous purposes, besides those of agriculture.

Messrs. E. R. and F. Turner, of Ipswich, who have been exceedingly successful at the various shows of the Royal Agricultural Societies of this and other countries, exhibit amongst a great number of steam and hand implements for the carrying on of agricultural operations. Amongst these is a small portable steam engine, which has some excellent points about it. The cylinder is 6½ inches in diameter, and the length of stroke 10½ inches. The fly-wheel, which also serves as a driving pulley, is 4 feet 4 inches in diameter, and it is intended to make 140 revolutions per minute. The crank-shaft is of wrought-iron, and admits of the fly-wheel being hung at either end, as may be found most convenient, and of the attachment of an additional pulley when necessary. The strength, simplicity, and cheapness of this appliance, constitute its strongest recommendations, and it is not improbable, we think, that at the present show of the Royal Agricultural Society of England, at Battersea Park, the Messrs. Turner may add another laurel to their chaplets—or at least another medal to the number already won by them.

In the way of traction engines, the Messrs. Robey and Co., of Lincoln, to whom reference was made in a former notice in respect to other contrivances, give us a very good example of their capabilities in this particular department; and Messrs. Richard Hornsby and Sons, of the Spittlegate Iron Works, Grantham, are not behind their neighbours in their display of portable steam engines and agricultural implements generally. The double-cylinder engine of this firm, is, indeed, a well contrived and determined looking machine.

THE AMERICAN COURT.

(*Continued from page* 200.)

Among the many useful inventions from the United States, perhaps the most remarkable is the power loom for weaving tufted fabrics, to be seen in operation in the Western Annexe. This loom is the invention of Mr. Smith, West Farms, New York, and is intended for weaving the Axminster carpets, or any other tufted or pile fabric which requires cutting, and is produced to a pattern. Unlike either the Jaccquard or the old draw loom, the pattern designed is formed by the arrangement of the spools or bobins, which are suspended over the machine to the number of 270. These produce a pattern the whole width of the material and 1½ yards long; and at every throw of the shuttle a piece of mechanism rises up like so many fingers, catches hold of the worsted threads, and weaves them in, across the whole width of the fabric. A knife or shears then passes swiftly over it and cuts off the tufts to any length required. By this means any design can be woven in parts, which, when united, will have the appearance of having been woven in one piece, and the loom will produce twenty-five yards per day. As the mechanism for forming and cutting the tufts is readily adjusted to any desired depth of pile, the loom is equally adapted for the manufacture of rugs and mats, and at a cost much less than such fabrics can be produced by any other method. The Americans are very confident of this loom; it has received great attention from scientific men, and Earl Granville has publicly stated that it is destined to achieve greater results than perhaps any other machine in the building.

A curiosity has made its appearance in the American Court within the last week, in the shape of a machine for milking cows. The idea is not a new one, as we have read of machines for the purpose twenty years ago, but the machine appears to be simple and ingenious in its construction, and requires no adjusting in changing from one cow to another. The teats, either two or four at once, are inserted in as many india-rubber tubes; a vacuum is created by working two small levers, and the milk is drawn at the rate of one gallon per minute, in a way more agreeable to the animal than by milking with the hand, and the milking process is more cleanly.

Mr. L. A. Bigelow, Boston, Massachusetts, exhibits several machines connected with boot-making, which receive, as they deserve, much attention. First of all there is a machine for splitting the leather, or rather, as we would describe it, for paring the leather intended for soles to a uniform or required thickness. This is effected by passing the leather between two rollers, one grooved, and the other smooth, behind which is a knife which may be adjusted in relation to the frame according to the thickness of the leather required. The cutting is accomplished rapidly, and with more precision than can be done by the hand and knife. Then we have a machine for cutting up the leather into soles, which it does at the rate of twenty pair a minute, all fitted exactly to the last, without the use of a hand-knife, and the edges sufficiently smooth to finish. Further, there is a "heel trimmer," that is, a machine which, carrying the boot or shoe on a pivot, subjects it under a circular motion to the action of a cutter, which in a minute pares the rough edges to the form of heel, whatever the thickness may be. And lastly comes the sole sewing machine, illustrated by an engraving, which is much on the same principle as the sewing machines for lighter material, with which the public are now familiar. Of course it is more ponderous and powerful, having a force sufficient to penetrate the thickest leather, or even a board half an inch thick. It uses a heavy waxed thread, drawing the thread more tightly than can be done by hand, and making the work both strong and solid. This machine will sew on the soles of one hundred and fifty pairs of boots or shoes per day, of whatever thickness, and the labour of managing it is a pleasant pastime.

Mr. Bigelow also exhibits Blake's stone breaker, an extremely simple and useful machine for superseding or economising human labour. It is intended for breaking stones for concrete, railway ballast, or metal for roads, and it easily crushes flints, granite, greenstone, and the most obdurate trap boulders to any dimensions required.

It contains two jaws, one, next the end of the machine fixed the other moveable, working upon a pinion at the raised part of the machine just before the fly wheels. Both jaws are armed with teeth, in the form of vertical grooves. The moveable jaw inclines at an angle more or less acute, according to the dimensions it is required the stones should be crushed or broken. This angle is regulated by a simple contrivance behind the moveable jaw, which is put in motion by the action of the fly-wheel working on a crank. The stones to be broken are put into the fore-part, as into a hopper; the moveable jaw advances and recedes from the fixed jaws; the stones descend and are masticated, or "chawed up," and issue from the lower part of the machine in fragments of the size required. The great simplicity and power of the stone-crusher is exemplified in a small working model, where flints, about the size of a pigeon's egg, are crushed into atoms in less than a minute, by a few turns of a crank with one hand. The machine is worked by hand-power or steam-power according to its dimensions. As to capacity, a three-horse machine will crush a stone 10 inches by 5 at the rate of four cubic yards per hour.

Goar's belt shifter is a very happy contrivance for shifting and securing machinery belts. Its utility will at once be admitted by those who understand how frequent has been the occurrence of accidents by the common method of shifting belts.

Another very simple contrivance of great use is a machine for addressing newspapers, exhibited by Mr. Sweet, of New York. This apparatus is in use in most of the newspaper offices in New York, and must greatly facilitate the despatch of journals which are supplied directly from the office and not through the intervention of newsvendors. Of course such a machine would be very useful to English newsvendors.

Two presses, exhibited by Eckel, of New York, are remarkable for power, and of very beautiful construction. One is a cotton or baling press, which will put 600 lbs. of cotton into 18 cubic feet, or 500 lbs. of hay in a common sized bale of 5 feet long, 2 feet wide, and 32 inches high.

The other is an oil or tallow press; the curb is of peculiar construction, being an iron cylinder, cast solid, 38 inches in diameter, heavily banded with tire iron on the outside, and the inside is ribbed every inch. There is an iron lining rivetted to the ribs, perforated with upwards of 11,000 holes, which forms avenues or escapes for the oil on the sides of the curb. This curb is placed on a wrought-iron disc or saucer, 4 feet 6 inches in diameter. There are three or more plates for dividing the material, and a centre tube as follows:—The bottom plate is ribbed, and perforated between each rib, to afford great freedom for the oil to escape from the bottom. It has a seat for the *centre tube*, which takes the oil from the centre of the cheese. The centre tube is a stout iron cylinder, perforated with holes from top to bottom, and passing through the centre of the central and top plates, and thus the oil escapes from all parts almost instantly. It will be observed that this press is very simple, having no blocks, or screws or levers about it; all that is required being to put in the plates and turn the cranks which run down the plunger.

There are many other articles in the American Court well worthy of description. We have selected those chiefly which are remarkable for mechanical contrivance or invention, or from their novelty were worthy of a passing record. The sewing machines will be noticed in a future paper. As we stated at the outset, the United States have, under a distressing peculiarity, done wondrously well; and ere another decade shall have come round, they may be able to show to a greater extent, if not to greater advantage, as regards invention and utility.

CANADIAN TIMBER AT THE INTERNATIONAL EXHIBITION.

"The visitor to the International Exhibition who shall seek for timber will see on his right in the distance, as soon as he enters the Eastern Dome a noble pile reaching nearly to the roof of the transept. When he approaches the pile he will find that its base is surrounded by most admirable examples of what Canada can produce; for he is within our great North-East American Colony, the pride of England, the envy of the United States. There is not such another display from the New World; and when we consider how near is Canada to our own shores, the rapidity of intercommunication between us, and the enormous wealth which this "trophy" represents it is difficult to avoid feelings of something like triumph at such a demonstration of British power. And yet there are those who would pull the trophy down, because, forsooth, it is thought to stand in the way of a painted window. We have not, however, sunk to such effeminacy as to prefer tinsel to iron, or to sacrifice the interests of millions to degenerate taste. For ourselves we own that we admire the work of the Almighty, even in the rude form of timber, very much more than any combination of blue, red, and yellow glass in the Cathedral window. And so does the intelligent part of the public.

To planters in this country the exhibition of timber in Canada, is particularly interesting, because not a tree is represented with which we are unfamiliar. We can grow them all on our own estates if we think it worth the while; and, given time enough, we can grow them as well. More especially does it concern those who already possess old specimens of Canadian trees to study here the evidence what they may come to. Take, for example, Black Walnut, which grows magnificently even near London. There is one specimen (No. 53) which is four feet seven inches in diameter, exclusive of its bark. Such timber can be had at Quebec for £71 per 1,000 feet cube. The specimen to which we now refer must be about 400 years old.

North American Elms thrive perfectly with us. They are, however, we believe, exclusively *Ulmus*

Americana and fulva that have been introduced. We now see that another kind, called the Rock Elm or *Ulmus racemosa,* is superior to them and to our own; the wood being finer in the grain and less brittle. Of this there is a specimen, about 2 feet 8 inches in diameter.

Weymouth Pines are among the commonest of our conifers. They yield the "Pine-wood" of carpenters. Little, however, do our foresters know of the huge specimens that swarm in Canada. "Average height 140 to 160 feet; average diameter 3 to 4 feet; but common near Lake Erie 5 to 6 feet in diameter and 200 feet high; or even in some cases 22 feet in circumference, 220 feet high, bare of branches for 120 feet to the first limb." Such monsters are, however, too big to exhibit, and Canada modestly limits herself to about 2 feet 10 inches. or 3 feet in diameter.

Then there is *Pinus resinosa,* or the Red Pine which dislikes our eastern climate, 3 feet 6 in. in diameter which is about twice its usual size. But there is no encouragement to plant it here.

The Ash of Canada (*Fraxinus Americana*) famous for its toughness and strength, invaluable for the the handles of axes and other implements, is displayed in its small forms as well as in the giant proportions that it assumes when full grown. One round, with 305 circles of annual growth, is 5 feet 10 in. in diameter, an admirable example of timber.

There is oak, too, (*Quercus tinctoria*) red (*Q. rubra*) and white (*Q. alba*) the latter little inferior to British heart of Oak, and not far off 4 feet in diameter. This tree, as much at home with us as with Canadians, is said to be sometimes 21 feet round in Western Canada.

Then we have the Occidental Plane, or Button Wood, 4 feet through; Tulip tree or White Wood, 3½ feet, and Bass Wood or American Lime, more than 2 feet, all excellent for cabinet and joiners' work though unfit to bear exposure to weather.

Add to these numerous specimens of the fair growth of American Chestnut, Hickories, Maples, Beech, Birch, Hornbeam, Hemlock, Spruce, Tamarac, or American Larch, and he who would thoroughly understand the nature of Canadian timber has a field for serious study hitherto unexampled: how serious in a mercantile point of view, may be gathered from the fact, that Canada exports annually about 30,000,000 cubic feet of timber in the rough state, and about 400,000,000 feet, board measure, of sawn timber. The revenue derived by the Province, during 1860, for timber cut in the forests, amounted to about $500,000. It appears that of the 60 or 70 varieties of woods in its forests there are usually only five or six kinds which go to make up these exports so vast in quantity; the remaining fifty or sixty timber trees are left to perish or are burned as a nuisance, to get them out of the way. The Commissioners truly observe that by showing in the markets of the world, that it has these valuable woods, and can furnish them at unprecedently low prices, will secure additional purchasers, a result that the capital display in the Exhibition building is admirably adapted to secure. The Commissioners from the Colony state that in extent, and the value and variety of its woods, the great forests of deciduous trees of North America surpass all others; the most remarkable of this great mixed forest being that grown in the valley of the St. Lawrence. The Western coasts, in high latitudes, furnish only or chiefly the Coniferæ. High summer temperature and abundant summer rains, are, unquestionably, the conditions necessary to produce the deciduous forest trees. Western coasts, in high latitudes, have the necessary moisture, but not the high summer temperature; Western prairies, east of the Mississippi, and the vast deserts west of it, have summer heat but not moisture; hence the absence of all trees in one region, and of the deciduous trees in the other. In this country, we have probably all the conditions, except time, under which the Canadian timber has been produced.

All the hardy trees belonging to the Canadian Exhibition are capitally shown, by the production of both "rounds," or transverse sections, and planks, so that the grain may be examined in each direction; and we only do justice to the Canadian Commissioners when we point out the skill of their arrangements; not forgetting their excellent Catalogue, which has afforded us some part of the information now laid before our readers.—*Gardeners' Chronicle, June 14th.*

Board of Arts and Manufactures

FOR UPPER CANADA.

ENTRIES FOR THE PROVINCIAL EXHIBITION.

Manufacturers and others, interested in the coming Provincial Exhibition, will bear in mind that Monday, September 22nd, is the day appointed for its opening. We republish, for the information of intending exhibitors, the regulations for making entries and delivering articles for exhibition:—

REG. 6—*Horses, Cattle, Sheep, Swine, Poultry.*—Entries in these classes must be made, by forwarding the entry form, as above mentioned, filled up, and member's subscription enclosed, on or before Saturday, August 16th, five weeks preceding the show.

REG. 8—*Grain, Field Roots, and other Farm Products, Agricultural Implements, Machinery, and Manufactures generally,* must be entered previous to or on Saturday, August 30th, three weeks preceding the show.

REG. 9—*Horticultural Products, Ladies' Work, the Fine Arts, &c.,* may be entered up to Saturday, Sept. 13th, one clear week preceding the show.

REG. 10—*Exhibitors are particularly requested to take notice that it is essential that the entries be made at the dates above mentioned. It is intended to prepare a Catalogue of a portion of the Exhibition, and this cannot be done unless the entries are made in time.* Therefore, after these dates for the respective classes, no entry will be received. The entry paper and subscription money will be returned to any person forwarding them.

Reg. 17—All articles for exhibition must be on the grounds on Monday, September 22nd, except live stock, which must be there not later then Tuesday, 23rd, at noon. Exhibitors of machinery and other heavy articles, are requested to have them on the grounds as far as possible during the week preceding the show.

In addition to the prizes published in the April No. of *The Journal*, the following prizes are offered:

MUSIC.

The following prizes are offered for Instrumental Bands:—

For the best Canadian Amateur Band consisting of not less than eight performers, of whom there shall not be more than two professional artists	$60 00
2nd do. do. do.	40 00
3rd do. do. do.	20 00

Each Band will be required to execute the following pieces of music, viz.:—The National Anthem; Rule Britannia; a Quick Step; Waltz; Song; Polka; Set of Quadrilles, and a Medley or Operatic Piece; and to be on the grounds under the direction of the Committee during the continuance of the exhibition. Bands intending to compete will communicate their intention to the Secretary of the Association at Toronto, at least a week before the exhibition commences. The Bands will be required to be on the ground on Thursday and Friday.

CIRCULAR TO MECHANICS' INSTITUTES.

The following circular has been addressed to the Secretaries of the different Mechanics' Institutes in Upper Canada:

Toronto, August 6th, 1862.

Sir,

The undersigned have been appointed, by the Council of the Association, a Committee to secure competent Judges in the Arts and Manufactures Department of the Provincial Exhibition, to be held in the City of Toronto, commencing on Tuesday, the 27th day of September, next.

The plan adopted three years ago, and which has been found to work very satisfactorily, is again proposed to be carried out, namely: to apply to Mechanics' Institutes to nominate certain of their Members, or others, to act as Judges in different Classes of this Department; particularly desiring that, in the first place, efficient men may be selected; and secondly, such as will attend to the duty. The Committee of your Institute is therefore respectfully requested to nominate not more than four persons, the same being non-Exhibitors, and transmit their names to the Secretary by the first of September next; specifying also the Classes in which the parties nominated respectively consent to act. From the lists thus furnished the selections will be made, and the result, so far as your Institute is concerned, will be communicated to you, and the parties selected, forthwith.

The amount of remuneration allowed by the Association to each of the Judges toward meeting expenses, is four dollars.

The following is a list of the classes for which Judges are required:—

ARTS, MANUFACTURES, LADIES' WORK, &c., &c.

Class 38—Cabinet Ware and other Wood Manufactures.
" 39—Carriages and Sleighs, and parts thereof.
" 40—Chemical Manufactures and Preparations.
" 41—Decorative and Useful Arts; Drawings and Designs.
" 42—Fine Arts.
" 43—Groceries and Provisions.
" 44—Ladies' Work.
" 45—Machinery, Castings, and Tools.
" 46—Metal Work, (Miscellaneous,) including Stoves.
" 47—Miscellaneous, including Pottery, & Indian Work.
" 48—Musical Instruments.
" 49—Natural History.
" 50—Paper, Printing, and Bookbinding.
" 51—Saddle, Engine Hose, and Trunk-makers' Work; and Leather.
" 52—Shoe and Bootmakers' Work; and Leather.
" 53—Woollen, Flax, and Cotton Goods; and Furs, and Wearing Apparel.
" 54—Foreign Manufactures.

We are, Sir,

Yours respectfully,

J. Beattie, Jr., *Pres. B. of Arts & M.*
W. Craigie, M.D., *Vice-President.*
W. Edwards, *Secretary.*

BRITISH PUBLICATIONS FOR JUNE.

	£	s.	d.	
Adams (W. Bridges) Roads and Rails and their Sequences, Physical and Moral, p. 8vo	£0	10	6	*Chapman & H.*
Adams (W. H. D.) Men at the Helm, Biographical Sketches of Great English Statesmen, fp. 8vo	0	3	6	*Hogg.*
Aikin (Dr.) Arts of Life, 18mo, red. to	0	1	0	*Griffin.*
Bartlett (W. H.) Nile Boat; or, Glimpses of the Land of Egypt, 5th edit., cr. 8vo	0	7	6	*Bohn.*
Bigg (H, H.) Mechanical Appliances necessary for Treat. of Deformities, Part 2, p. 8vo	0	4	6	*Churchill.*
Bleachers (Hints to) containing Rem. on the Sys. of Bleach. and Fin. Linen Goods, 18mo	0	2	6	*Longman.*
Coins of England (The), with their value in Foreign Money, sheet	0	1	0	*Griffith and Far.*
De Porquet (L. P. F.) For. and Eng. Ready Reckoner of Monies, Weights, &c. 6 e. 12mo	0	2	6	*Simpkin.*
Dresser (C.) Art of Decorative Design, with cold. plates, roy. 8vo	1	1	0	*Day and Son.*
Fowler (Rev. R.) Solutions of Questions in Mixed Mathematics, 8vo	0	3	6	*Longman.*
Galbraith (Rev. J.) and Haughton (Rev. S.) Manual of Mechanics, 6th ed., fp. 8vo. sd. 3*s*	0	3	6	*Longman.*
Hale (Rt.) Handbook of Elementary Drawing, chiefly for the Use of Teachers, cr. 4to	0	5	0	*Longman.*
Hudson (T. Percy) Elementary Trigonometry, with a collection of Examples, fcap. 8vo	0	3	6	*Deighton and Co.*
Jeffrys (Jno. Gwyn) British Conchology, Vol. 1, Land and Freshwater Shells, cr. 8vo	0	12	0	*Van Voorst.*
Jobson (Fred.) Australia; with notes on Egypt, Ceylon, &c., 2nd ed., revised, cr. 8vo	0	6	0	*Hamilton.*
Lewes (Geo. Hen.) Studies in Animal Life, cr. 8vo	0	5	0	*Smith and Elder.*
Pfeiffer (Mad. Ida) Visit to the H. Land, Egypt, & Italy, post 8vo, red to	0	3	6	*Ward and Lock.*
Pre-Adamite Man; or the Story of our Old Planet and its Inhabitants, 4th edit., 8vo	0	10	0	*Nisbet.*
Robinson, (J. C.) Italian Sculpture of the Middle Ages, &c., roy. 8vo	0	7	6	*Chapman and Hall.*
Salmon (George) on the Analytic Geometry of Three Dimensions, 8vo	0	12	0	*Hodges and Smith.*
Templeton (Wm.) Engineer's, Milwright's, and Machinist's Practical Assistant, 18mo	0	2	6	*Lockwood.*
Turner (Thomas) Land Measurer's Ready Reckoner, new edit., 8vo	0	5	6	*Whittaker.*
Tytler (A. F.) Elements of General History, Ancient and Modern, new edit., roy. 32mo	0	3	6	*Simpkin.*
Walker (Wm. Jun.) Memoirs of Distinguished Men of Science of Great Britain, of 1807-8, 8vo	0	7	6	*Walker and Son.*
Walsh (J. H., "Stonehenge") The Horse in the Stable and the Field, 4th thousand, 8vo	0	18	0	*Routledge.*

AMERICAN PUBLICATIONS FOR JULY.

Agassiz.—Contributions to the Natural History of the United States of America, vol. 4, 4to. Plates	$12 00	*Little, Brown & Co.*
Bacon.—The works of Francis Bacon, vol. 4, 8vo	1 50	*Brown & Taggard.*
Mussey.—Health; its Friends and its Foes, 12mo	1 00	*Gould & Lincoln.*

Notices of Books.

THE ART OF ILLUMINATING, AS PRACTISED IN EUROPE FROM THE EARLIEST TIMES. *Illustrated by Borders, Initial Letters and Alphabets. Selected and Chromo-lithographed by W. R. Tymms, with an Essay and Instructions by M. D. Wyatt, Architect, London: Published April 2nd,* 1860, *by G. Day & Son, Lithographers to the Queen. Quarto.*

The reader who opens this volume is instantly struck with the variety, symmetry, and exquisite colouring of the illuminations. The beautiful plates with which this work is adorned, supply us with numerous and sometimes most elaborate examples of the Art of Illuminating, throughout a period extending over one thousand years, or from the 6th to the 16th century. The illustrations are taken from Canons, Missals, Books of the Sacrament, the Holy Bible, Coronation Books of the Anglo-Saxon Kings, "Sacramentaries," Decretals, Chronicles, Choral Books, Psalters, and a few Miscellaneous Works.

Most of the above works are in manuscript, and preserved in the different public libraries of Europe, or in the private collections of the rich and noble.

The subjects of illustration are Initial Letters, Borders, Corners, Figures, Title Pages, &c.

This beautiful and valuable work cannot fail to be acceptable to those engaged in many of the

Decorative Arts. It will always be accessible, with a number of other works of a similar character, to visitors to the Library of the Board of Arts and Manufactures for U. C.

A TREATISE ON THE STEAM ENGINE, IN ITS VARIOUS APPLICATIONS TO MINES, MILLS, STEAM NAVIGATION, RAILWAYS AND AGRICULTURE: *with Theoretical Investigations respecting the Motive Power of Heat, and the proper Proportions of Steam Engines; Elaborate Tables of the Right Dimensions of every part, and Practical Instructions for the Manufacture and Management of every Species of Steam Engine in actual use. By John Bourne. Being the Fifth Edition of "A Treatise on the Steam Engine." By the "Artizan Club." Illustrated with* 37 *Plates, and* 546 *Wood Cuts. London. Longman, Green & Co.* 1861. *Quarto.*

The long title of this work, coupled with the name of the writer, is almost sufficient to satisfy every practical Engineer of its value, as a work of reference. It is, however, a work of considerable interest, beyond mere mechanical details and diagrams, for it contains a vast amount of interesting and useful information respecting the history of the Steam Engine in its different forms: the results obtained by paddle wheel and screw steamers, different kinds of locomotives, pumping engines; indeed, of every form in which steam is applied by machinery to motive purposes. The plates are very well executed, and sufficiently large for practical purposes. In the chapter on the Scientific Principles of the Steam Engine, Gravity, Magnetism, Heat, Nature and Laws of Motion, are discussed at length, and form a capital treatise on Mechanical Philosophy. In the chapter on "Investigation of the Laws and Limits of the Motive Power of Heat," the higher mathematics are used, which place its study beyond many readers, but the results obtained by pure mathematics are very intelligibly given, and illustrations numerous. The Tables at the end of the work are very complete, as well as the Rules and Tables for finding the proper proportions of Steam Engines.

THE PRACTICAL MECHANIC'S JOURNAL. *Complete Series. Vol. I to VI. Quarto. London: Longman.*

The Library of the Board is now supplied with the complete series of this excellent periodical. The monthly numbers of the present year are on the Library Table.

THE PRACTICAL MECHANIC'S JOURNAL RECORD OF THE GREAT EXHIBITION OF 1862. *Parts I, II, and III.*

The value of the work consists in its publishers having secured the services of able men to write the different articles describing the wonderful collection of works of nature and art which constitute the different sections of the Great Exhibition of 1862.

If we turn to Cotton, Wool or Silk, we find the article describing the different forms in which these materials are presented to the public gaze, prepared by P. L. Simmonds, F.S.A., F.R.G.S. The article on Flax, by Professor Hodges. On Paper Materials, by W. Stone, F.S.A. On Agricultural Implements, by the well known John Wilson, F.R.S.E., &c.

These articles are not limited to a mere description of what is visible in the Great Exhibition, but they enter into the history, the mode of preparation, the uses, and condition of the art or manufacture or production in the different countries where the subject under review is an important source of national advantage, or has special claims to notice.

Professor Warrington W. Smyth, M.A., F.R.S., who wrote the article on Mineral Products, says of Canada:—"Very complete in all her exhibition, Canada, through the Geological Survey, has forwarded unusually fine examples of Copper Ores, chiefly variegated copper, and pyrites, some of them from mines now in operation, others from localities waiting for development."

This Record of the Great Exhibition of 1862 will be of great value when completed, as furnishing an immense amount of reliable information on the industries of the world.

Patent Laws and Inventions.

ABRIDGED SPECIFICATION OF BRITISH PATENTS.

3058. J. & W. N. BAILEY. *Improvements in apparatus for indicating the pressure of steam and gases, the amount of vacuum, the flow of fluids, the weight of materials, and the speed of bodies either revolving or traversing, and also the employment of of aluminium or its alloys in the manufacture of the same.* Dated Dec. 6, 1861,

In one of these arrangements of steam pressure and weight guages the patentees use a knife edge crank or pivot attached to a weight or its equivalent so as to act as a lever. They use the ordinary india rubber or metalic diaphragm acting against a piston in the usual way. The piston and weight are connected together by a link, having at the bottom a semicircular bearing upon which the knife edged pivot rests, so that, when the piston rises or falls, the pivot will have a delicate motion on the bearing of the link and thereby cause but little friction. The invention comprises much other detail, which we cannot give space to here.

3069. R. JOLLEY. *An improved apparatus for heating, cooling, or drying, infusing, extracting, or absorbing vapours or gases, for manufacturing, medical, or domestic purposes, and for preserving* *liquids and solids alimentary or otherwise.* Dated Dec. 7, 1861.

This apparatus is made with double or single doors, lids, and covers to shut air-tight, and is wholly constructed upon air-tight and non-conducting principals, with valves to let air in or out, as may be required. In its manufacture the patentee uses a new combination of fibrous, pulpy, and waterproof materials, for preventing the transmission of heat, cold, air, or moisture.

3135. A. V. Newton. *An improved arrangement of fire-escape.* (A communication.) Dated Dec. 13, 1861.

This consists in the use of a flexible or chain ladder applied to a building so that it may be folded in a tilting box, and in case of fire be released in a moment either by an inmate of the dwelling or a person at the outside, and the ladder allowed to descend to the earth, and form a ready means of escape. Also in combining with the flexible or chain ladder an alarm, so arranged that it will be sounded simultaneously with the liberating of the ladder.

3162. R. Shaw. *Certain improvements in carding engines.* Dated. Dec. 17, 1861.

This consists in the use of an endless band or web of open wire work, lattice or woven fabric continously traversing beneath the carding cylinders and used as a creeper for conveying any loose cotton or other fibrous material falling from the cylinders whilst being carded back again to the "licker in."

3202. G. T. Bousfield. *Improvements in machinery for attaching the soles of boots and shoes to the upper leathers.* (A communication.) Dated Dec. 20, 1861.

This consists in a machine which when placed upon the edge of the sole after it is temporarily secured to the last upon which the upper leather is stretched, will on being struck by the blow of the hammer of the operator, make a hole for the reception of a peg, drive a peg through the sole and and upper leather, move itself along so as to be in position for a repetition of the operation, and feed up the peg wood so as to bring another peg into the proper position to be split off and driven. The invention is not described in detail apart from the drawings.

Canadian Items.

SALE OF PUBLIC LANDS IN UPPER CANADA IN 1861.*

Crown Lands.

At the commencement of the year 1861, there were 1,853,121 acres of Crown Lands on hand in Upper Canada, and 456,842 acres were added by surveys of the waste lands; from which substract the quantity sold, 257,933½ acres, and granted gratuitously on Colonization Roads, 30,800 acres, there remained 2,021,229½ acres disposable at its close.

*Report of the Commissioner of Crown Lands for 1861.

The purchase money of the lands sold during the year amounted to $338,153.88; the gross amount of collections, $276,170.10.

Clergy Lands.

There were 74,366 acres sold, the purchase money of which was $184,674.37. The gross amount of the receipts during the year was $298,-129.24, the commissions and refunds $60,099.20, leaving the net proceeds $238,030.04, for appropriation under the provisions of the Clergy Reserves Act. There are 124,608¾ acres of these lands yet undisposed of.

Grammar School Lands.

5,729 acres of the 60,412 acres disposable on the 1st of January, 1861, were sold for $8,527.79, leaving a balance of 54,683 acres for future sale. The gross receipts of the year were $22,050.74, the commission $4,372.13, and the net proceeds $17,678.61.

Common School Lands.

The sales of the lands amounted to 4,498¾ acres during the past year, leaving only 12,016½ acres of the million set apart, under the authority of the Act 12th Vic. cap. 200 on hand.

The purchase money of the lands sold amounts to $14,580, the gross collections to $111,514.25, commission, refunds and other disbursements to $22 380.47, leaving a net income of $88,683.78.

The total net amount realized from these lands to 31st December, 1861, is $744,640.44.

CANADIAN MINES AND MINERALS.

Under the new system adopted and detailed in the report of last year presented to the Legislature, many explorations for minerals have been made. Some of the mines already opened have been worked during the year; but the American difficulties have affected this as other branches of trade. There can be no doubt that the copper ore on the Canadian side of the Lakes is equal to that on the southern side. What is wanted is capital, and increased means of communication and facilities for the transport of passengers and goods. These latter will follow, of course, the increase of business, but it is of great importance to Canadian interests that they should receive every reasonable encouragement, and that the wants of the mining district should be supplied from Canada rather than from the United States.—*Ibid.*

ARTIFICIAL OYSTER BEDS IN THE GULF OF ST. LAWRENCE.

The Commissioner of Crown Lands says in his report of 1861 that the experiment (begun in 1859) of transplanting oysters from beds in the waters of New Brunswick, having proved upon examination to give promise of success, it was this fall continued. Those laid down in Gaspé basin during the autumn of 1859, were examined and found to be not only in a good state of preservation, but growing and having every appearance of reproduction. At the trifling expense of $242.80, 300 bushels of carefully picked oysters from the banks at Carraquette, were planted about the same localities. Although the Legislature has made a liberal allowance for testing the possibility of raising oysters along our coasts, the utmost care and strictest economy have been observed in using the money so provided.

COMPARATIVE METEOROLOGICAL REGISTER FOR THE YEARS 1855, '56, '57, '58, '59, '60, & '61.

Provincial Magnetical Observatory, Toronto, Canada West.

LATITUDE, 43° 39′ 3″ North; LONGITUDE, 5h. 17m. 33s. West.—Elev. above Lake Ontario, 108 Feet; approx. Elev. above the Sea, 342 Feet.

	Year 1861.	Year 1860.	Year 1859.	Year 1858.	Year 1857.	Year 1856.	Year 1855.
Mean temperature	44°.22	44°.32	44°.19	44° 74	42°.73	42°.16	43°.96
Difference from average (22 years)	+ 0.10	+ 0.20	+ 0.07	+ 0.62	— 1.39	— 1.96	— 0.16
Thermic anomaly (Lat. 43° 40′ N.)	— 6.78	— 6.68	— 6.81	— 6.26	— 8.27	— 8.84	— 7.04
Highest temperature	87.8	88.0	88.0	90.2	88.2	96.6	92.8
Lowest temperature	—20.8	— 8.5	—26.5	— 7.3	—20.1	—18.7	—25 4
Monthly and annual ranges	108.6	96.5	114.5	97.5	108.3	115.3	118.2
Mean daily range	14.42	14.24	13.66	13.84	16.38	18.29	18.19
Greatest daily range	33.3	30.7	39.8	31.2	37.0	44.2	39.4
Mean height of barometer	29.6008	29.5923	29.6209	29.6267	29.6054	29.5999	29 6249
Difference from average (18 years)	—.0125	—.0210	+.0076	+.0134	.0079	—.0134	+.0116
Highest barometer	30 330	30.267	30.392	30.408	30.361	30.480	30.552
Lowest barometer	28.644	28.838	28.286	28.849	28.452	28.459	28.459
Monthly and annual ranges	1.686	1.429	2.106	1.559	1.909	2.021	2.093
Mean humidity of the air	.78	.77	.74	.73	.79	.75	.77
Mean elasticity of aqueous vapour	.262	.260	.249	.259	.254	.244	.263
Mean of cloudiness	.62	.60	.61	.60	.60	.57	.60
Resultant direction of the wind	N 56 W	N 60 W	N 61 W	N 41 W	N 74 W	N 71 W	N 62 W
" velocity of the wind	2.11	3.32	2.24	1.59	2.54	3.03	2.51
Mean velocity (miles per hour)	7.47	8.55	8.17	7.64	7.99	8.31	8.14
Difference from average (14 years)	+0.70	+1.78	+1.40	+0.87	+1.22	+1.54	+1.37
Total amount of rain	26.995	23.434	33.274	28.051	33.205	21.505	31.650
Difference from average (21 & 22 yrs.)	—3.329	—6.890	+2.950	—2.273	+2.881	—8.819	+1.326
Number of days rain	136	130	127	131	134	99	103
Total amount of snow	74.8	45.6	64.9	45.4	73.8	65.5	99.0
Difference from average (19 years)	+13.17	—16.03	+ 3.27	—16.23	+12.17	+ 3.87	+37.37
Number of days snow	76	75	87	67	79	69	64
Number of fair days	165	174	169	178	171	198	198
Number of auroras observed	43	58	53	59	26	35	46
Possible to see aurora (No. of nights)	180	190	199	198	189	212	204
Number of thunder-storms	27	30	30	19	28	25	38

PROSPECTS OF CANADIAN COPPER MINING ON LAKE HURON.

The *Mining Journal* Correspondent at the Wellington Mines, Lake Huron, (West Canada Co.,) reports in June last as follows:—

"For the present month we hope to turn out a larger pile of clean ore than we did for the month of May. On the 11th inst. we shipped 1,362 barrels of copper ore, making the third cargo for the season; and we are now tramming another cargo, to be ready by the time the steamboats come this way."

As copper is now rising in price these results are gratifying.

In 1846, the copper mines of Lake Superior yielded only £160 worth of copper. Last year they yielded copper worth £600,000.

Selected Articles.

SALINES OR BRINE SPRINGS OF THE VALLEY OF THE KANAWHA. *

(From the Report of Professor George H. Cook.) *

That portion of the valley of the Kanawha in which the Salines are situated lies in the lower coal measures. The river meanders through an alluvial bottom of half a mile to a mile in width, and this is bounded on either side by hills which rise to the height of three to eight hundred feet above the level of the river. These hills are composed of successive beds of porous sandstone, sandy shale and seams of coal, having all a gentle dip to the northwest. The distance along the river where salt springs are known to occur, or where salt wells have been bored, is about ten or twelve miles. The width of the bottom alluvial belt does not appear to affect the production or value of the brines, though the greater number of wells are on the north side, where the the bottom is narrow, and those on the side where it is broader are for the most part near the margin of the river.

The first discoveries of salt water were in springs or licks upon the surface, and from these was obtained the salt used by the earlier settlers. They were, indeed, known to the Aborigines who inhabited the country before its settlement by the whites. In the earlier attempts in the manufacture of salt, the wells were sunk no lower than the solid rock, the depth of alluvium being from twenty to thirty feet. Subsequently borings were carried into the rock, and finally to the depth of fifteen hundred feet or more. It has been found, however, by experience, that the strength of the water does not increase in descending below 700 or 800 feet, but that below this carburetted hydrogen, which often accompanies the brines, increases in quantity. The evolution of this gas from some of the wells was early turned to account in evaporating the water by its combustion, and many wells were bored to greater depth solely to obtain a larger supply of the gas. At the present time, however, it is regarded as of little consequence, and its use almost discontinued. The deeper boring required, and the liability of accidents to the tubes, attendant upon its evolution beneath the kettles, cause it to be regarded as of no absolute value.

The borings of these wells reveal to some extent the character of the strata beneath the surface, and which would be doubtless better studied in their outcrops farther east.

1. Alluvial formation of variable thickness.
2. Hard black slate, mixed with thin seams of coal and coaly matter, 200 to 300 feet.
3. Described as a hard blue rock, sometimes mixed with sandstone, and sometimes sandstone with layers of hard rock; this extends to four or five hundred feet from the surface.
4. Sandstone, usually friable, white on being drawn out, but becoming red on exposure to the atmosphere. This rock is variable in thickness, and often found extending from five to eight hundred feet from the surface.
5. A hard, flinty rock, the particles fine and sharp like flint, thirty to sixty feet thick. This rock, in some of the wells, is one hundred to one hundred and fifty feet thick.
6. A soft, tough, shaly rock, often called "soapstone," and is named the "*long-running rock*," from its containing little silex, and the drill runs a long time without becoming dull. This rock commences at about the depth of 900 feet or a little deeper, at the lower part of the salines, from the dip in that direction. The deepest borings have not passed through this rock, although some of the borings have penetrated it at least six hundred feet.

The brines never increase in strength or quantity after entering this rock, and it may be considered as the impervious floor of the saline accumulation.

All the evidence which we have goes to prove very conclusively the absence of beds of rock salt in the neighborhood. The origin of the brines is therefore to be sought in some other source. The porous sandstone strata forming the coal measures many of which were deposited in shallow ocean waters, undoubtedly retained, as all marine sedimentary rocks do, a portion of chloride of sodium. The percolation of surface water through all the superincumbent beds, has carried down this saline matter in solution to the point where it has found

* In the superintendent's Report for 1847 is a communication from Thomas Spencer, Esq., on the Kanawha salines. He describes these works as being "upon the navigable waters of the Great Kanawha river, fifty miles from its junction with the Ohio, two hundred miles below Wheeling. The average strength of the brine is about 32 per cent. of saturation, while that of our salines is 73. The works are located along the banks of the river on either side, for a distance of eight or ten miles. and on either side of the river, and parallel to it, about half a mile distant, are lofty mountains. which contain an inexhaustible quantity of bituminous mineral coal. which is used as a fuel at the salt works. It costs. delivered at the works, about three cents a bushel; twenty-eight bushels is estimated to the ton. For each bushel of coal consumed. the manufacturer receives in return nearly a bushel of salt. Each manufactory has its own salt well. which is obtained by boring in solid rock to a depth varying in different wells from 1,200 to 1,800 feet.

In boring several wells for brine to supply the works highest up the river, veins of gas were struck. which rushed up through the apperture with such violence as to blow the rods used for boring several hundred feet into the river. It also brought with it a copious supply of brine. The owners of these wells have availed themselves of these accidental circumstances, and applied them to good account, as it saves them the entire expense of pumping brine and supplying fuel. The gas and brine are separated by a simple contrivance, the latter being conducted into capacious reservoirs, and the former into the flues or "furnaces" of their salt works, where, being ignited, it produces an intense heat, exceeding that caused by the combustion of mineral coal."

During the past season Prof. James Hall, State Geologist. visited these works, and procured for me the specimens of salt, brine. &c., which are referred to in the table of analysis. He also furnished me with memoranda for the various details of the manufacture, which are given below, and with the following letter on the geology of that district.

an impervious stratum, where it remains, saturating the porous sandstones and filling the fissures of the surrounding beds. We cannot doubt but the source of these brines is in these carboniferous beds, and that it is widely disseminated in them, and only separated by the slow process of solution by the percolating waters from above.

The lowest point to which the brine increases in strength or quantity, would appear to be at the base of the coal measures themselves, and the hard flinty or silicious stratum may very well represent the conglomerate below the coal, while the shaly beds below the "*long-running rock*" are the fine-grained sandstones and shales which lie beneath this rock.

No rock of an age anterior to the carboniferous period rises to the surface for many miles around the salines of Kanawha.

In boring these wells, they generally go down from 300 to 600 feet, with a bore of from 3½ to 3 inches, and below that to any depth with a smaller bore. The upper part of the boring, for perhaps 250 feet, is then reamed out to a size of from 5 to 8 inches in diameter, and fitted with a corner tube, which is screwed together in joints 25 feet long. At the bottom of this tube the suction or draw-box is to be placed. Before setting it, however, a bag filled with flax seed and tallow is fixed and packed at the point where 3-inch bore ends, from 400 to 600 feet below the surface. A hole from 1 to 1½ inches diameter if then made through this bag, and a tube of the same size passed through it. This tube extends from below the bag of grease and flax seed up to the suction or draw-box. The object of this bag of packing is to swell and fill the opening, so that any fresh water which collects about the tubes above it may not descend and weaken the salt water below. Whenever a well yields too much weak brine, the tubing is taken out, the large opening reamed deeper, and the tubing with the bag reinserted.

The simple boring of a well 800 or 900 feet deep, exclusive of the cost of engine, &c., costs $1,500. These wells yield from 10 to 30 gallons per minute. A well giving 20 gallons of brine at 9°* or 10°, is regarded as a good one. The quantity which will be supplied is limited, and when reached will be regular and fixed. Those which are weakest usually yield the largest quantity, which is owing to the intermixture of fresh water from above. It is a general impression, that the quantity of salt is gradually diminishing, though the quantity and quality differ in wells dug within a hundred yards of each other. Some wells, terminating in a very porous stratum, are found to yield water more copiously than others. In some wells the quantity has greatly increased, and in others the strength has improved, as in one bored last year there has been an increase from 8° to 11½.

Three good wells are needed for one furnace; these cost abont $9,000. The cost of a furnace, and all the preparations for a salt works, is about $30,000.

The brine from the pumps is carried into a capacious cistern, located above the level of the boiler of the salt works, so that it may be drawn from one directly into the other. The boiler which is used in concentrating the brine is made in three sections, each 39 feet long, 8 feet wide, and 4 feet deep, which is equal to one boiler of 99 feet long. These sections are connected by large open pipes, below the level of the brine, so that the communication between them is free. When necessary, either one of them may be shut off, and cleaned or repaired while the others are kept in operation. The bottom of the boiler is made of concave cast iron plates, or shallow pans, each 3 feet long and 8 feet wide, cast with proper flanges and grooves, so that eleven of them may be bolted and cemented together for the bottom of a single section. The sides and top of the boiler are made of thick planks, bolted to the bottom and keyed tightly together. The fire is made under the end of the first section, and the flame and heated air passes under the sections in succession, to the chimney at the opposite end. The brine is boiled till it approaches saturation.

Near the boiler are arranged several open wooden vats, or *settling cisterns*, each 100 feet long, 8 feet wide, and 2 feet deep. Running lengthwise through each of these is a a vertical partition, extending from one end almost to the other. These cisterns are filled about 18 inches deep, and are heated by steam from the boiler. This steam is carried in copper pipes which pass the length of the cistern on each side of the partition, and just beneath the surface of the water. These pipes are from 4 to 6 inches in diameter. The settling cisterns, of which there were four in the work described, are arranged so that the brine passes from the first to the second, and so on in succession. If well managed, the brine will be brought to saturation in the last cistern, and will have deposited all its oxide of iron. Following the settling cisterns is a series of others called *graining cisterns*. These are of the same shape and size with the first, and in them the salt is deposited. They are heated by steam pipes like the others, The saturated brine is drawn into the first of them, where a considerable crop of crystals is deposited, it is then drawn by a syphon into the second, and another crop of crystals is deposited, and so on to the last one where but a very light crop is obtained, and where all the bittern collects. In the works of Dr. Hale, where Prof. Hall obtained much of his information, there were six of these graining cisterns. The specimens of salt in the superintendent's office, and referred to in the analysis, and numbered from 1 to 9, are from these cisterns.

The bittern contains scarcely any salt. From 3,000 to 5,000 gallons are thrown away every day. It contains a large quantity of bromine.

The quantity of salt now made at Kanawha, is from 2½ to 3 million bushels a year, and the furnaces and wells now idle, are capable of increasing the product to half a million bushels without any new wells.

At one time, four years since, there were 43 furnaces in operation, and making about 3½ million bushels annually. But the market was overstocked, and the price of salt fell to 11 or 12 cents a bushel, (50 pounds). By an agreement among the manufacturers, this overproduction is now prevented, and the amount the market will bear is now fairly divided among among the several furnaces. They also agree upon what shall be the price of salt at the works. Some manufacturers find it more profit-

* 25 deg. is saturation.

able to let their furnaces lie idle, and receive their share of the profits, upon the amount of salt they are entitled to make, from those who make more than their proportion. At present 24 furnaces are in operation, and they will make this year 2,800,000 bushels. Salt is worth at the works 16 cents per bushel. The association of manufacturers count it worth 18 cents a bushel, when in barrels of 280 pounds each.

The salt is generally well liked for packing meats Lime is not used in settling the brine; it is considered injurious from experience elsewhere.

The best worked furnaces produce a bushel of salt for a bushel, (70 or 80 pounds) of coal. This is less than the average. Such results will only be produced from water of 9 or 10°.

The general plan of the works at Kanawha, is much like that of the late Calvin Guiteau, Esq., which is described in the superintendents' report for 1845. It is more easily adapted to the Kanawha brines than to those of Onondaga, on account of their being much weaker, and from their not containing any sulphate of lime, which saves their boilers from incrustation or blocking. The brines contain a much larger portion of oxide of iron than ours do, but this does not make a scale; in the boiling brine it collects into little hard pellets like gravel stones, and in the settling cisterns it is deposited as a soft, muddy sediment. It is remarkable that this oxide of iron both in its wet and its dry state, is attracted by the magnet.

The analysis shows that the Kanawha brine contains 9.2 per cent. of solid matter, of which four fifths are salt. Allowing, then, that every hundred pounds of brine to contain 7.4 per cent. of salt, calculation shows that to produce a bushel, 50 pounds, 625 pounds of water must be evaporated. The average yield of salt being 50 pounds for 75 pounds of coal burned, it follows that each pound of coal in burning evaporates 8.3 pounds of water. This is the full value of the coal according to Johnson's experiments; and yet I am assured by those who have visited the works that there is a great waste of fuel, the flame after passing the whole length of the boiler, frequently streaming out at top of the chimney,

A COURSE OF SIX LECTURES

On some of the Chemical Arts, with Reference to their progress between the Two Great Exhibitions of 1861 *and* 1862, *by Dr.* Lyon Playfair, *C. B., F. R. S., Professor of Chemistry in the University of Edinburgh.*

Lecture II.

Distillation of Coal.—Showing how the former Waste Products in the Manufacture of Gas have been Economised. Salts of Ammonia, Benzol, Tar Colours, &c.

I must now make a little recapitulation of our last lecture, and show you the manner in which its waste products are applied to useful purposes. I explained to you that gas was produced by the distillation of coal; that for a long time the thoughts of manufacturers were applied only to the first purposes for which coal was used, namely, the production of the gas; and that all the substances which are accessory products were looked upon in the light of concomitant evils, the tar and water being waste products, which were inconvenient, and to be got rid of by the most ready methods. Long ago, in the seventeenth century, Boyle, wrote an Essay entitled, "Man's Great Ignorance of the Uses of Natural Things; or, that there is no one thing in nature whereof the use to human life is thoroughly understood." This truth of the seventeenth century is still a truism in the nineteenth century, the whole progress of manufacture being merely an illustration of it. Substances which today are the most useless, to-morrow become embraced within the circle of industrial utilities. It is quite true that there is no one substance in nature of which we know all its properties, or all the uses to which it can be applied for the purposes of common life. I take Boyle's old title as the text for our discourse; but I have only time to give it a very limited application, by describing the utilities now derived from tar, although time will not allow me to embrace them all in one lecture.

You will recollect what were the waste products of the coal-gas manufacture. You will find the products of the distillation of coal in the first diagram on the gallery. First, gaseous products were produced, part of which were useful—the diluents and illuminants; part were impurities, and were got rid of by certain processes. Even these impurities are in some cases now applied. After that there was the crude coal oil, which is commonly called tar; and then there was a watery portion which contained salts of ammonia. We, therefore, had the gaseous products, the crude oil or tar, and the watery distillate. All except the gaseous products were regarded as impurities—waste substances which were got rid of, and the getting rid of which was a serious undertaking to the gas manufacturer; and I wish now to show you how all these have been utilised.

We begin with the gas water, the badly-smelling black, ugly gas water of the gas-works, and see what has been obtained from it. The gas water contains salts of ammonia. These salts of ammonia, except in one instance, consist of the base ammonia united with volatile acids, sulphuretted hydrogen, and carbonic acid in the other. A certain quantity of chloride of ammonium, or ammonia in union with hydrochloric acid, is also found in the gas water. The value of these salts of ammonia was long known before they were extracted from the watery waste product of the gas manufacture. In fact, ammonia derives its name from one of the titles given to Jupiter, "Jupiter Ammon," near whose temple in Upper Egypt ammonia was for many generations manufactured from the refuse of camels, which was taken and heated and distilled, and gave off ammonia or some of its salts. Hence its name. Its uses were familiar in this country, and its applications to manufactures were known long before persons thought of extracting it from gas water. After a time chemists found sulphide of ammonium and carbonate of ammonia in the watery portion of the coal gas distillate. This distillate gives a very abundant source of ammoniacal salts, and, in fact, the source from which it is now almost all derived. As, however, the subject of to-day's lecture, when we come to the colours produced from coal-tar, wholly relates to the characters of ammonia and the base which is in these salts, I must be permitted, with the excuse of the many chemists whom I see present, to tell those who are not necessarily chemists what ammonia is, and what are its peculiar characters.

The general character of ammonia is probably known to you all. Here is a vessel containing it. It is, as you will see, a colourless gas. It has a very pungent smell; it has an alkaline character; and it is extremely soluble in water. Mr. McIvor will now agitate a portion of this with water, and then you will see how soluble it is. Its alkaline character I wish to explain to you for a moment. An alkaline character is the character possessed by certain bases, such as soda and potash, and a trivial feature of it, but a very important one, is that it renders reddened infusions blue. I have got here the alkali soda, and if I add it to a reddened vegetable infusion, you see the reddened vegetable infusion becomes blue. This is an ordinary character, and apparently a trivial matter, but still an important one. Now we will agitate this ammonia with water, in which it is partly soluble, and we will admit the water into it, and you will see how it rises. You will observe, at the same time, that this red matter as it rises becomes blue. It is so exceedingly soluble in water, that the water dissolves the ammoniacal gas; and its alkaline character is shown to you very distinctly by the red colour of this red water becoming strongly blue just as this fixed alkali soda or potash rendered it blue. Observe how extremely soluble this alkaline ammonia is. You see the water absorbs it so completely that we are obliged to add more water in order to fill the tube.

It is the character of an alkali to unite with an acid. An acid with which it forms one of the most economical salts of which I have to speak, is muriatic acid. Here I have some muriatic acid—colourless, like the ammonia, but yet possessing very different properties. You see in this case we have got this water blue instead of red, and we will now remove our vessel and agitate it in the same way. We introduce a little of the water and shake it up, so as to dissolve some of the muriatic acid, which is of a different character altogether from ammonia. And now we pass it back into the basin of water coloured blue. The other was red and became blue; but now the blue becomes red, from this gas being an acid—having an acid instead of an alkaline character.

Now, I wish to show the effect when these two gases are mixed. We must allow a little time for the completion of the experiment. I have here some ammonia, and I will place a flame below it; and in the other retort I have an acid, and I will place a light below that also. This is muriatic acid. When both of these are heated we will bring the vapours into contact. You will see then that the muriatic acid will unite with the ammonia, and produce a substance which is exactly the same, although not in such a solid form, as this muriate of ammonia, [referring to a large white block of that substance on the lecture table.] It is hydrochloric acid and ammonia which form this solid cake in the manner in which it occurs in commerce.

How completely, you will see, this shows the deductive character of chemistry. Chemistry, in its present state, is not an inductive science; it is a deductive science. It is a science taught to us by experiment.

These liquids are now nearly boiling, and we will pass the two gases into this large tube. [The vapours of the ammonia and the hydrochloric acid were passed through separate tubes up into a large glass globe, and there allowed to mix]. They are now joining one another, and they are forming this solid white muriate of ammonia by their union. You see how this solid body is formed from two gases, a result which could not have been predicated by any science, and is only taught to us by experience.

Having explained the preliminary points to you, I now desire to show how salts of ammonia are manufactured in the arts. When a ton of coal is distilled, above ten gallons of the watery portion comes over from it—ten gallons from Newcastle coal. This contains sulphide of ammonium and carbonate of ammonia. Now, sulphuretted hydrogen and carbonic acid are both volatile substances. It is, therefore, only necessary to add a strong acid to obtain whatever salt we please from these compounds of ammonia. Muriate of ammonia is manufactured in this way:—The gas liquor is run into a deep cistern. This cistern is connected with a chimney, and there is poured into it muriatic acid. That muriatic or hydrochloric acid expels the sulphuretted hydrogen and the carbonic acid, and forms muriate of ammonia in solution. The bad-smelling gas, sulphuretted hydrogen, which smells like rotten eggs, is passed up the chimney, and removed from the locality of the works, to be given to people living at a distance. The muriate of ammonia is placed in a pan containing about 1500 gallons, and evaporated till strong enough to crystallise. The muriate of ammonia obtained in this way is impure, and has to be sublimed in order to be obtained in this state. This is a piece taken from the top of the retort. After that it is removed to a still of this kind—an iron pot surrounded by a leaden dome; and here a fire is placed below it, and the muriate of ammonia vaporises from its impurities, and condenses at the top as a crystalline solid. About 4000 tons of this muriate of ammonia are made annually in this country from gas water. It is used extensively in making alum, and it is used largely in the process of soldering. For instance, it is employed for preparing tin plates when you are obliged to get the surface of the iron which you are about to tin in a perfectly clean state. You put it in a bath of muriate of ammonia, which dissolves off the oxides which are on the surface, and leaves the iron in a state for soldering. It is also employed extensively in making the more common salts of ammonia.

There is a point in connection with this to which I would direct your attention. I want to show you the peculiar character of ammonium as a metal. Ammonia consists of one equivalent of nitrogen and three equivalents of hydrogen. There seems to be little analogy between this substance and chloride of sodium or chloride of potassium. Chloride of sodium, which is common salt, contains the silvery metal sodium; and chloride of potassium contains also the silvery metal potassium. There seems to be little analogy between a gaseous body consisting of one of hydrogen and three of ni trogen; but I am going to attempt to imprison this body, which consists of four equivalents of hydrogen and one of nitrogen, by amalgamating it with mercury. Here I have a saturated solution of this salt, chloride of ammonium which chemists are compelled to think contains a substance having metallic characters, although it consists of these gaseous bodies, nitrogen and hydrogen. Here I have an amalgam, or a compound of mercury with sodium. Now, if I pour this amalgam of sodium and mercury into the chloride of ammonium, the sodium takes away the chlorine from that compound, and leaves the ammonium to combine with the mercury. This metal is NH_4. It is one of an evanescent character, and I must imprison it by holding it in the mercury in order to show you its presence. As the ammonium acts upon the mercury it will swell up. It is now swelling. You see it growing in bulk before your eyes. We have the ammonium imprisoned by the mercury, and enabling me to show you for awhile that this substance really has metallic properties, although it will soon dissipate again into the gases of which it consists. You see that it has formed an amalgam, as the sodium did, but, from its gaseous character, one of much larger bulk. It is a semi-solid or butyraceous substance. It can be handled, but it soon breakes up into running mercury and the gases. It is now obvious how the salts of ammonium may be readily made analogous to the salts of sodium and potassium. This body, NH_4, or one of nitrogen and four of hydrogen, is in reality a metal which unites with halogens and forms salts.

I must run quickly over the other salts of ammonia, and I will not enter into the details of the manufacture. For instance, this muriate of ammonia is not manufactured only in the way I have told you. It is manufactured in many other ways which it would tire you to describe. One of them is to take the gas water, and, instead of saturating it with strong acids like muriatic acid, to distill it with lime. The ammonia gas goes over, and is very readily condensed in water. It may be condensed in water or acids, and forms various salts. This process is much the best, as the badly smelling sulphuretted hydrogen is retained by the lime. There is another way of manufacturing this muriate of ammonia by acting upon sulphate of ammonia with common salt; but I will not tire you with all these details and modifications of the manufacture. You must ascribe it not to ignorance, but to the fact that I do not think it necessary to enter into them. I now pass to sulphate of ammonium, which is another salt very much manufactured from gas water. About 5000 tons of it are annually made in this country from gas water. It is made in the same way, by adding oil of vitriol to the ammonia of the gas liquid. It is used largely for manure. It is used largely for making alum; and it is employed also for making ammonia, or rather solutions of ammonia in water,—by distilling it with lime, which keeps back the sulphuric acid. Carbonate of ammonia is another salt, and one which ladies use very much in their scent-bottles, and as a diffusive stimulant. It is made by distilling with sulphate of ammonia and chalk. Chalk is carbonate of lime. The carbonic acid goes over to the ammonia and forms carbonate of ammonia. The way this is done in the arts is represented here. I have here a still, or a retort, not at all unlike the retorts which are used in gas making. Here the sulphate of ammonia, or the muriate of ammonia and carbonate of lime are placed, and they are heated together with fires placed under them, and the carbonate of ammonia being a volatile salt, is sublimed and condenses in these chambers. It is afterwards distilled again. It sublimes at 177°, which is below the boiling temperature of water. The stills have got leaden caps, and the water heats the impure salt and sublimes the carbonate of ammonia which is afterwards taken out of the cap. This is also very largely manufactured. About 2,000 tons are made annually of this salt. Various modifications of these plans are also used. For instance, the gaseous ammonia is led into a chamber of carbonic acid. The chamber has water at the bottom. The carbonate of ammonia is formed and crystallised, and afterwards sublimed. The aqua-ammonia of pharmacy, or ammonia water, or liquid ammonia, or hartshorn, is made by introducing a base to keep back the acids, and the ammonia is distilled over. This ammonia is used for a great many purposes—as a diffusive stimulant in medicine. It is also used as an antacid in medicine; and largely employed to saturate carbonate of ammonia in ladies' scent bottles, some aromatic substance being generally mixed with it. Now, look what a transformation is effected by the application of chemical agency: the refuse of camels, the offal of the streets, the fetid water of the gas-works, have become so transformed under the influence of chemistry that ladies preserve them in their scent-bottles as a cherished luxury. You see how these waste products may be used to furnish even luxurious utilities.

(*To be continued.*)

ON ALUMINUM.*

BY J. W. M'GAULEY.

We are on this occasion, specially to treat of a metal which has been a source of great expectations; and, fortunately, there is no reason to consider that these have been disappointed; their complete realisation is only deferred, and most probably for but a short period; and one of our objects in directing attention to it, is to excite a more general inquiry regarding it. The establishment of aluminum amoung the most important of the metals is a mere question of the cheapness of its production; and as, up to this time at least, it is most conveniently obtained by means of sodium, investigations regarding it resolve themselves into a determination of the most economical method of obtaining that metal. On this point our knowledge has also progressed considerably, and hence the price of aluminium has greatly fallen. Not long ago it was 3*l.* per ounce, it is now only about 5s.; and it will, no doubt, be far less, if we are to judge by the extraordinary improvements always made, after a time in chemical processes. How much lower in price are the most useful substances at present than they were a few years ago, because the methods of manufacturing them have been simplified. But even at its present cost, which by weight, is the

* Abbreviated from the *Chemical News*.

same as that of silver, aluminum is really only one-fourth as dear, bulk for bulk; and this, after all, is the test, since bulk for bulk, it is as strong, and even stronger than silver. When there is question, however, of its application to domestic purposes, we must compare its cost with that of pewter or copper; it would chiefly supersede these, which, among other disadvantages, are productive of very noxious compounds, particularly the copper.

The qualities of the precious metals are quite distinct from those of the more common; nor have the two classes hitherto been connected by any intermediate metal—that is, by one possessing the most characteristic properties of each; but it is hoped that aluminium may supply such a connection. Like the precious metals, it is brilliant, and little alterable by chemical agents—scarcely at all, under ordinary circumstances. Like the common metals it is very abundant, constituting one-fourth, by weight, of the most widely diffused bodies. It is malleable, ductile, hard, and tenacious; its compounds are harmless—which is true of scarcely any other metal but iron; and, unlike both the precious and common metals, it has the advantage of being extremely light. It is admirably suited to all ordinary purposes, and is one of the best that can be used for those which are artistic and ornamental. M. Christofle, in 1858, exhibited before the Academy of Sciences a group in aluminum, which had been cast and chiseled, and which afforded an excellent example of its capabilities, though it was its first application to such a purpose.

When we attempt to get aluminum directly from alumina, with potassium, or sodium, we do not succeed; most likely from its being necessary that the potash or soda, which would then be formed, should unite with some of the undecomposed oxide, which does not seem to occur, though aluminates of the alkalies are very easily made. But M. Chapelle, in 1854, procured it by introducing pulverised clay, sea-salt, and powdered charcoal into a common crucible, and heating the mixture with coke, though not to whiteness, in a reverberatory furnace. When the crucible was cold, a considerable quantity of minute globules of aluminium were found at the bottom. It must be admitted that the simplicity of this method, if it could be rendered economical, would make it deserving of preference; and it is not improbable that it may hereafter be so improved as to supersede all others. To obtain aluminum through the medium of a troublesome metal seems at best a clumsy process. It is, however, the most successful that has been yet devised; and we are indebted for it in its present improved state to the ingenuity and researches of Deville, whose method is a modification of Wohler's. He received from the present Emperor Napoleon the funds necessary for making his experiments on a large scale, and in a satisfactory manner, and he first published an account of them in 1854.

It occurred to him that, on account of its smaller equivalent, and the commercial value of its salts, sodium would be better for the purpose of obtaining aluminium than potassium, which had been employed by Wöhler. Other advantages, besides, were found to follow from its adoption. The manufacture of sodium is easier, and even safer, than that of potassium; and when the process goes on well, those carbon compounds which are so annoying with potassium, do not make their appearance, nor is its reduction accompanied by the explosive substances—probably compounds of hydrogen—which are so dangerous in the reduction of potassium. Moreover, the use of potassium in obtaining aluminium is not very safe, it inflames so easily, and often produces such violent explosions; while sodium can be employed without fear, since it may be raised in the atmosphere to a higher temperature than its point of fusion. Indeed, we have reason to believe that it is inflammable only in a state of vapour, though still at a temperature below its boiling-point; and if it is kept very carefully from water, there will be little likelihood of its taking fire.

To get pure aluminium by Deville's method, we require pure alumina, pure chloride of aluminium and metallic sodium; for any impurities present in these will be concentrated in the aluminium, and affect its properties very much, nor, if once combined with it, can they ever be entirely removed. We shall first, therefore, describe how these are to be had.

To Obtain Pure Alumina.

Eight and a-half parts, by weight, of the sulphate of alumina of commerce for every required part, by weight, of pure alumina, are dissolved in an equal weight of water, and precipitated by a concentrated and boiling solution of acetate of lead in slight excess, and the smallest possible quantity of tartaric acid is added to the liquor, which is separated by decantation, to prevent the precipitation of alumina. The acetate of alumina is then supersaturated with ammonia, and the ammoniacal solution, after being treated with hydrosulphuret of ammonia in a closed vessel, is placed in a stove having a temperature of from 122° to 124° F. This determines the precipitation of the sulphurets of iron and lead, which are removed first by decantation, and then by filtering —but without washing the filters. The clear and slightly yellow liquor, which consists of acetate and tartrate of of alumina combined with ammonia, and some hydrosulphuret of ammonia, is rapidly evaporated and carbonised in an earthen crucible. The residual mixture of alumina and carbon is made into a paste with oil, and strongly calcined to expel the sulphur, due to a little sulphuric acid which remains in the alumina, the whole of it not having been separated by the acetate of lead.

To Obtain Pure Chloride of Aluminum.

Some of the mixture of alumina and carbon, just mentioned, is introduced into a porcelain tube that has been fitted with another tube, and is heated to redness in a current of dry chlorine. Chloride of aluminum sublimes, and is removed from the tubes in compact masses, which are composed of very beautiful crystals, that are either colourless or slightly tinged with yellow. If, however, from the impurity of the materials, this chloride is not found to be quite pure, it is heated with nails or iorn turnings, in an earthen or cast-iron vessel, which, when the permanent gases have passed off, is closed; after, which, the heat being continued, a slight pressure results that causes the chloride of aluminum to melt and come in contact with the iron. This changes the volatile per-chloride of that metal into the protochloride, which is comparatively fixed, and the chloride of aluminium, completely purified, crystallises in the vessel itself in large transparent and colourless prisms, and a distillation in hydrogen finishes the process.

To Obtain the Sodium.

Its preparation is founded on the reaction of an alkaline carbonate on carbon; and carbonate of soda, wood charcoal, and carbonate of lime are required in the following proportions:

Carbonate of soda	717
Wood Charcoal	175
Chalk	108

The carbonate of soda should be obtained from crystals dried and pulverised fine; the carbon and chalk should also be reduced to powder, and the whole, as soon as possible after having been mixed, should be made into a paste with very dry oil, and then calcined at a red heat in an iron mercury bottle, that it may occupy a small space, and thus a larger quantity of sodium be obtained by the subsequent process. The calcined mass is subjected to a high heat in an iron mercury bottle, which is not so rapidly destroyed as might be expected, and ought to last for three or four operations. It is kept comparatively cool by the resulting oxide of carbon, and by the sodium assuming an aëriform state, and the heat required is not near so great as might be supposed. An iron tube leads from the bottle, which is inside the furnace, to a receiver, which is outside, and has an aperture for the escape of the gases. The carbonic oxide formed from the chalk assists in carrying the vapor of sodium rapidly into the receiver, and thus prevents it from decomposing any of the gas by which it is necessarily surrounded,—an effect that would be facilitated by its finely divided state as vapour. The receiver, also, is thus kept hot enough to unite the metallic globules without a wasteful after process. One-seventh of the weight of the mixture which has been used, or one fourth of the weight of the carbonate of soda, should be obtained in sodium. If the mixture employed has been such as to melt, it will have prevented a free disengagement of the gases.

To Obtain the Aluminum.

From 3,000 to 5,000 grains of chloride of aluminium are placed in a tube of glass or porcelain, about one and a-half inches of interior diameter, and are insulated by two plugs of asbestus. Hydrogen, purified and dried by being transmitted through sulphuric acid and chloride of calcium, is sent through the tube; and while it is passing, the chloride of aluminum is gently heated by a few coals, to drive away any hydrochloric acid which may have been formed by the action of the air on the chloride, and also the chlorides of sulphur and silicium which are invariably present in small quantities. Sodium previously crushed between two pieces of dry filtering paper, and placed in a boat, is then introduced into one end of the tube while it is still full of hydrogen, and is melted. The chloride is at the same time heated so as to make it rise in vapour, that it may come in contact with the sodium, and be decomposed; and when the sodium has disappeared, and the chloride of sodium that has been formed is saturated with chloride of aluminum, the process is complete. An incandescence which occurs is easily regulated. The boat being taken from the tube, the mixed chlorides, in which the globules of aluminium are suspended, are removed by dissolving in water, and the globules, covered up in a porcelain crucible either with mixed chlorides of aluminum and sodium or with common salt, are fused together by a strong heat.

This process answers still better on the large scale; but, instead of the porcelain tube and boat, two cast iron cylinders connected by a smaller tube of iron are employed. The anterior cylinder contains the chloride of aluminium; the posterior, sodium in a tray; and the iron tube, kept at a temperature of from 400° to 500° F., scraps of iron to separate any of that metal which may rise with the vapour of chloride of aluminum, by changing it from volatile per- to fixed proto-chloride.

Œrsted, who was the first to form chloride of aluminum, is said to have obtained that metal by heating the chloride with an amalgam of potassium rich in the latter, and driving off the mercury from the resulting amalgam of alumnium by heat.

Aluminium may also be procured from cryolite, a mineral which exists abundantly in Greenland, though it is found only in small quantites elsewhere.

ON FORCE.*

The existence of the International Exhibition suggested to our Honorary Secretary the idea of devoting the Friday evenings after Easter of the present year to discourses on the various agencies on which the material strength of England is based. He wished to make iron, coal, cotton, and kindred matters, the subject of these discourses; opening the series by a discourse on the Great Exhibition itself; and he wished me to finish the series by a discourse on "Force" in general. For some months I thought over the subject at intervals, and had devised a plan of dealing with it; but three weeks ago I was induced to swerve from this plan, for reasons which shall be made known towards the conclusion of the discourse.

We all have ideas more or less distinct regarding force; we know in a general way what muscular force means, and each of us would less willingly accept a blow from a pugilist than have his ears boxed by a lady. But these general ideas are not now sufficient for us; we must learn how to express numerically the exact mechanical value of the two blows; this is the first point to be cleared up.

A sphere of lead weighing 1lb. was suspended at a height of 16 feet above the theatre floor. It was liberated and fell by gravity. The weight required exactly a second to fall to the earth from that elevation; and the instant before it touched the earth, it had a velocity of 32 feet a second. That is to say, if at that instant the earth were annihilated, and its attraction annulled, the weight would proceed through space at the uniform velocity of 32 feet a second.

Suppose that instead of being pulled downward by gravity, the weight is cast upward in opposition to the force of gravity, with what velocity must it

* Lecture by Prof. Tyndall at the Royal Institution, June 6th, 1862.

start from the earth's surface in order to reach a height of 16 feet? With a velocity of 32 feet a second. This velocity imparted to the weight by the human arm, or by any other mechanical means, would carry the weight up to the precise height from which it has fallen.

Now the lifting of the weight may be regarded as so much mechanical work. I might place a ladder against a wall, and carry the weight up a height of 16 feet; or I might draw it up to this height by means of a string and pulley, or I might suddenly jerk it up to a height of 16 feet. The amount of work done in all these cases, as far as the raising of the weight is concerned, would be absolutely the same. The absolute amount of work done depends solely upon two things: first of all, on the quantity of matter that is lifted; and secondly, on the height to which it is lifted. If you call the quantity or mass of matter m, and the height through which it is lifted h, then the product of m into h, or mh, expresses the amount of work done.

Supposing, now, that instead of imparting a velocity of 32 feet a second to the weight we impart twice this speed, or 64 feet a second. To what height will the weight rise? You might be disposed to answer, "To twice the height;" but this would be quite incorrect. Both theory and experiment inform us that the weight would rise to four times the height: instead of twice 16, or 32 feet, it would reach four times 16, or 64 feet. So also, if we treble the starting velocity, the weight would reach nine times the height; if we quadruple the speed at starting, we attain sixteen times the height. Thus, with a velocity of 128 feet a second at starting, the weight would attain an elevation of 256 feet. Supposing we augment the velocity of starting seven times, we should raise the weight to 49 times the height, or to an elevation of 784 feet.

Now the work done—or, as it is sometimes called, the mechanical effect—as before explained, is proportional to the height, and as a double velocity gives four times the height, a treble velocity nine times the height, and so on, it is perfectly plain that the mechanical effect increases as the square of the velocity. If the mass of the body be represented by the letter m, and its velocity by v, then the mechanical effect would be represented by $m\ v^2$. In the case considered, I have supposed the weight to be cast upward, being opposed in its upward flight by the resistance of gravity; but the same holds true if I send the projectile into water, mud, earth, timber, or other resisting material. If, for example, you double the velocity, of a cannon-ball, you quadruple its mechanical effect. Hence the importance of augmenting the velocity of a projectile, and hence the philosophy of Sir William Armstrong in using a 50lb. charge of powder in his recent striking experiments.

The measure then of mechanical effect is the mass of the body multiplied by the square of its velocity.

Now in firing a ball against a target the projectile, after collision, is often found hissing hot. Mr. Fairbairn informs me that in the experiments at Shoeburyness it is a common thing to see a flash of light, even in broad day, when the ball strikes the target. And if I examine my lead weight after it has fallen from a height I also find it heated. Now here experiment and reasoning lead us to the remarkable law that the amount of heat generated, like the mechanical effect, is proportional to the product of the mass into the square of the velocity. Double your mass, other things being equal, and you double your amount of heat; double your velocity, other things remaining equal, and you quadruple your amount of heat. Here then we have common mechanical motion destroyed and heat produced. I take this violin bow and draw it across this string. You hear the sound. That sound is due to motion imparted to the air, and to produce that motion a certain portion of the muscular force of my arm must be expended. We may here correctly say, that the mechanical force of my arm is converted into music. And in a similar way we say that the impeded motion of our descending weight, or the arrested cannon ball, is converted into heat. The mode of motion changes, but it still continues motion; the motion of the mass is converted into a motion of the atoms of the mass; and these small motions, communicated to the nerves, produces the sensation which we call heat. We, moreover, know the amount of heat which a given amount of mechanical force can develop. Our lead ball, for example, in falling to the earth, generated a quantity of heat sufficient to raise the temperature of its own mass to three-fifths of a Fahrenheit degree. It reached the earth with a velocity of 32 feet a second, and 40 times this velocity would be a small one for a rifle bullet; multiplying three-fifths by the square of forty, we find that the amount of heat depeloped by collision with the target would, if wholly concentrated in the lead, raise its temperature 960 degrees. This would be more than sufficient to fuse the lead. In reality, however, the heat developed is divided between the lead and the body against which it strikes; nevertheless, it would be worth while to pay attention to this point, and to ascertain whether rifle bullets do not, under some circumstances, show signs of fusion.

From the motion of sensible masses, by gravity and other means, the speaker passed to the motion of atoms towards each other by chemical affinity. A collodion balloon filled with a mixture of chlorine and hydrogen was hung in the focus of a parabolic mirror, and in the focus of a second mirror, 20 feet distant, a strong electric light was suddenly generated; the instant the light fell upon the balloon, the atoms within it fell together with explosion, and hydro-chloric acid was the result. The burning of charcoal in oxygen was an old experiment, but it had now a significance beyond what it used to have; we now regard the act of combination on the part of the atoms of oxygen and coal exactly as we regard the clashing of a falling weight against the earth. And the heat produced in both cases is referable to a common cause. This glowing diamond, which burns in oxygen as a star of white light, glows and burns in consequence of the falling of the atoms of oxygen against it. And could we measure the velocity of the atoms when they clash, and could we find their number and weight, multiplying the mass of each atom by the square of its velocity, and, adding all together, we should get a number representing the exact amount of heat developed by the union of the oxygen and carbon.

Thus far we have regarded the heat developed by the clashing of sensible masses and of atoms. Work is expended in giving motion to these atoms or masses, and heat is developed. But we reverse this process daily, and by the expenditure of heat execute work. We can raise a weight by heat; and in this agent we possess an enormous store of mechanical power. This pound of coal, which I hold in my hand, produces by its combination with oxygen an amount of heat which, if mechanically applied, would suffice to raise a weight of 100 lbs. to a height of 20 miles above the earth's surface. Conversely, 100 lbs. falling from a height of 20 miles, and striking against the earth, would generate an amount of heat equal to that developed by the combustion of a pound of coal. Wherever work is done by heat, heat disappears. A gun which fires a ball is less heated than one which fires blank cartridge. The quantity of heat communicated to the boiler of a working steam-engine is greater than which could be obtained from the re-condensation of the steam after it had done its work; and the amount of work performed is the exact equivalent of the amount of heat lost. Mr. Smyth informed us in his interesting discourse that we dig annually 84 millions of tons of coal from our pits. The amount of mechanical force represented by this quantity of coal seems perfectly fabulous. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night with unimpaired strength, for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.

Comparing the energy of the force with which oxygen and carbon unite together, with ordinary gravity, the chemical affinity seems almost infinite. But let us give gravity fair play; let us permit it to act throughout its entire range. Place a body at such a distance from the earth that the attraction of the earth is barely sensible, and let it fall to the earth from this distance. It would reach the earth with a final velocity of 36,747 feet in a second; and on collision with the earth the body would generate about twice the amount of heat generated by the combustion of an equal weight of coal. We have stated that by falling through a space of 16 feet our lead bullet would be heated three-fifths of a degree; but a body falling from an infinite distance has already used up 1,299,999 parts out of 1,300,000 of the earth's pulling power, when it has arrived within 16 feet of the surface; on this space only $\frac{1}{1300000}$ths of the whole force is exerted.

Let us now turn our thoughts for a moment from the earth towards the sun. The researches of Sir John Herschel and M. Pouillett have informed us of the annual expenditure of the sun as regards heat; and by an easy calculation we ascertain the precise amount of the expenditure which falls to the share of our planet. Out of 2,300 million parts of light and heat the earth receives one. The whole heat emitted by the sun in a minute would be competent to boil 12,000 millions of cubic miles of ice-cold water. How is this enormous loss made good? Whence is the sun's heat derived, and by what means is it maintained? No combustion, no chemical affinity with which we are acquainted would be competent to produce the temperature of the sun's surface. Besides, were the sun a burning body merely, its light and heat would assuredly speedily come to an end. Supposing it to be a solid globe of coal, its combustion would only cover 4,600 years of expenditure. In this short time it would burn itself out. What agency then can produce the temperature and maintain the outlay? We have already regarded the case of a body falling from a great distance towards the earth, and found that the heat generated by its collision would be twice that produced by the combustion of an equal weight of coal. How much greater must be the heat developed by a body falling towards the sun! The maximum velocity with which a body can strike the earth is about 7 miles in a second; the maximum velocity with which it can strike the sun is 390 miles in a second. And as the heat developed by the collision is proportional to the square of the velocity destroyed, an asteroid falling into the sun with the above velocity would generate about 10,000 times the quantity of heat generated by the combustion of an asteroid of coal of the same weight. Have we any reason to believe that such bodies exist in space, and that they may be raining down upon the sun? The meteorites flashing through the air are small planetary bodies, drawn by the earth's attraction, and entering our atmosphere with planetary velocity. By friction against the air, they are raised to incandescence and caused to emit light and heat. At certain seasons of the year they shower down upon us in great numbers. In Boston 240,000 of them were observed in nine hours. There is no reason to suppose that the planetary system is limited to "vast masses of enormous weight," there is every reason to believe that space is stocked with smaller masses, which obey the same laws as the larger ones. That lenticular envelope which surrounds the sun, and which is known to astronomers as the Zodiacal light, is probably a crowd of meteors; and moving as they do in a resisting medium they must continually approach the sun. Falling into it, they would be competent to produce the heat observed, and this would constitute a source from which the annual loss of heat would be made good. The sun according to this hypothesis, would be continually growing larger; but how much larger? Were our moon to fall into the sun it would develope an amount of heat sufficient to cover one or two years' loss; and where our earth to fall into the sun, a century's loss would be made good. Still our moon and our earth, if distributed over the surface of the sun, would utterly vanish from perception. Indeed, the quantity of matter competent to produce the necessary effect would, during the range of history, produce no appreciable augmentation in the sun's magnitude. The augmentation of the sun's attractive force would be more appreciable. However this hypothesis may fare as a representant of what is going on in nature, it certainly shows how a sun might be formed and maintained by the application of known thermodynamic principles.

Our earth moves in its orbit with a velocity of 68,040 miles an hour. Were this motion stopped, an amount of heat would be developed sufficient to raise the temperature of a globe of lead of the same size as the earth 384,000 degrees of the centigrade thermometer. It has been prophesied that "the elements shall melt with fervent heat." The earth's own motion embraces the conditions of fulfilment; stop that motion, and the greater part, if not the whole, of her mass would be reduced to vapour. If the earth fell into the sun, the amount of heat developed by the shock would be equal to that developed by the combustion of 6,435 earths of solid coal.

(To be concluded in our next.)

Miscellaneous.

MITCHELL'S PATENT TYPE-COMPOSING AND DISTRIBUTING MACHINES.

In order thoroughly to demonstrate the practical utility of these machines, they are employed in the International Exhibition, Class 7, B, Machinery Annex, in the actual performance of work for the press; one machine is for composition, and another for distribution.

The "compositor" is in shape a right angled triangle, placed horizontally, with a key board at one of the sides, furnished with thirty-nine keys. Each key when pressed, strikes out a type from one of an equal number of brass slides standing at an incline upon the machine in a row nearly parallel with the key board. The type thus liberated is conveyed upon a band, moving in a direction at right angles with the key-board, to another band (forming the hypothenuse of the triangle) which carries it on to its destination. Arrived here, it is placed on end and pushed forward, to make room for the next type, by means of a notched or serrated wheel called the "setting wheel." The words are thus put together with great rapidity, in a long line of about thirty inches, which is afterwards divided by the compositor into lines of the required length. The principle of the machine consists in the combination of bands of lengths and velocities of revolution so varied as to enable the types, at different distances from the wheel, to reach it in the order in which the keys are struck.

The "compositor" is capable of setting up types at the rate of 6 letters per second, or 21,600 per hour; but as the human fingers cannot attain to such rapidity, and allowance must be made for the operations of "justifying" and "correcting," the work of an average trained operator will probably not exceed 24,000 or 25,000 ens per day, which is about equal to the work of two men setting up type in the ordinary mode. As each machine can employ two operators, the daily production is about 50,000 ens.

The "distributor" is a small machine of circular form. The lines of type to be distributed are placed successively in a long channel, in which they are pressed forward towards a vibrating metal "finger," By this finger each type is separated from the line, pushed aside, and dropped on to a grooved brass wheel revolving horizontally. In the grooves of this wheel pins are placed, on which the types are hung by means of nicks, the ends of the types projecting below the under surface of the wheel at distances varying according to the position of the nicks. As each letter arrives over its receptacle it is lifted off its pin and dropped into its place, being pushed a little forward to make way for the next arrival. When the line is filled in this way it is removed by the boy to the "compositor." The "distributor" is self-acting and requires only the attention of a boy. It distributes 8,000 letters per hour.

Both machines have been successfully used with type ranging in size from great primer to brevier. They have been worked for several years in America, and have been recently introduced into the establishments of some of the most eminent printers in England and Scotland. As compared with the present mode of type-setting, the following advantages are claimed for these machines:—1. An economy of labour varying from 30 to 50 per cent., according to the character of the work. 2. Greater facility in acquiring the printer's art, whilst it renders his occupation comparatively light and healthy. 3. Decrease in the wear of type, and a smaller quantity sufficient for a given amount of work.

COAL AND BRITISH INDUSTRY.

An interesting lecture was lately delivered at the Royal Institution, by Mr. Warington Smyth, "On Coal as one of the great Materials of British Industry," on which occasion the Duke of Northumberland took the chair. After remarking on the great importance of coal, socially and politically, as the chief source of the manufacturing superiority of this country, Mr. Smith proceeded to conider its formation, character, and geological relations. He said that though doubts were at one time entertained whether that hard, black, and heavy mineral substance could have been formed from vegetable matter, these doubts have been entirely removed by the abundant fossil remains of trees and plants found in the shales above and beneath the seams of coal, and in some instances in the coal itself. The "coal measures," or series of strata among which coal occurs, consists of successive layers of sandstones and shales, or indurated clay, intermixed with occasional layers of coal, which vary in thickness from less than the eighth part of an inch to ten or twelve feet; few of those seams of coal that are less than two feet thick being at present worth the expense of working. In the shales above and below the coals are generally numerous fosilised plants of great variety, and Mr. Smyth said that on one occassion, after having visited the fine collection of tropical plants at Chatsworth, he descended into a coal mine, on the roof of which he witnessed a collection of tropical vegetation that even surpassed what he had seen a few hours before in the Duke of Devonshire's conservatories. In the shales underneath thick beds of coal are found abundant remains of a plant called "Sigillaria," which are supposed to be the roots of large trees known as stigmata, many of which are upright as they grew, and their trunks pass through the coal into the shale and sandstone above. These plants, and indeed all the fossil vegetation associated with coal, belong to genera that now grow in tropical climates, though none of the same species are extant. The accumulation of vegetable matter at the present day in peat bogs, Mr. Smyth observed, may be regarded as an illustration of the manner in which masses of vegetation were collected during the period of the coal formation, and which it must be supposed were subsequently converted into coal by the action of heat and superincumbent pressure. The fact that large fossil trees, apparently springing from the roots below the seams of coal, penetrate into the rocks above, indicates the rapid deposition of the sand and clay above the vegetable matter, for the strata must have been deposited before the still distinctly vegetable organisation was decomposed. The stems of trees which thus pass through the shales above the coal are not unfrequently the cause of fatal accidents in coal mines, for when the coal has been extracted, the upper parts of the fossil stems having lost their support, fall into the passages of the mine, and the men who are working below are severely injured. Mr. Smyth stated, that in one of the coal mines he inspected the fossil stems of the trees had fallen from the roof in many places, and he saw several still there that might fall at any moment. The relative extents of the coal districts in England, Wales and Scotland were marked on a large map; but as Mr. Smyth observed, the superficial area gives a very imperfect idea of the quantity of coal beneath, for the depths of the coal measures vary considerably, and the thickness and value of the seams of coal they contain vary much more. The depth of the Northumberland and Yorkshire coal measures is about 2,000 feet, and the total thickness of the coal in the various seams is fifty feet. The coal measures of Staffordshire are 5,000 feet deep, and they contain a total thickness of 100 feet of coal; while in Westphalia and at Starbruk the coal strata extend to depths of 6,000 and 10,000 feet. In addition to the principal beds of coal which lie above the carboniferous limestone in the geological series of rocks, there are others of much less thickness and of minor importance, occasionally found below and among the carboniferous limestone, sometimes in the secondary strata, and more abundently in the tertiary formations. The latter kind of coal is often called wood-coal, as it is of a brown colour, and not perfectly mineralised, and it contains very distinct indications of its vegetable origin. It is a remarkable fact that the character of the vegetation of the wood-coal found in Germany closely agrees with the vegetation of North America, and not with that of Europe, from which Mr. Smith inferred that at no very distant geological period Europe and America were united, for it is not probable that the vegetable matter could have floated across the Atlantic and been deposited in Germany. It is from such facts as this that geology is enabled to throw light on the geography of former worlds.—*London Mechanics' Magazine.*

SAFE WORKING PRESSURE OF BOILERS, AND HOOPING OF FLUES.

From the last Monthly Report of Mr. L. E. Fletcher, the Engineer of the Manchester Association for the Prevention of Steam Boiler Explosions.

For some time since I have been desirous of touching upon the point of Safe Working Pressures for boilers, since it not unfrequently happens that it is necessary to warn our members, on account of excess.

The scale adopted by the Association as a general standard is as follows:—For shells of boilers 7 feet in diameter, made of $\frac{3}{8}$th plate, the safe working pressure is 50lb.; if of $\frac{7}{16}$th plate, 60lb.; and other dimensions in proportion. This allowance corresponds with the general practice of the manufacturing engineers of the district, is quite as high as the standard in other parts of the country, and considerably in excess of that permitted either in France, Holland, or Belgium, by their respective governments. It must, however, be distinctly understood that this standard should not be applied arbitrarily in every case, without any allowance being made for the attendant circumstances. It is only applicable in cases where the boiler is well made, both as regards materials and workmanship, and where the condition of the plates is good. It would be highly dangerous to apply it to boilers weakened by the wear and tear of years; while, on the other hand, a new and thoroughly well made boiler might for a time be allowed to work at a pressure slightly in excess of that given. But this could only be safe where everything is in first-rate condition.

It is a very common idea that the bursting pressure of a boiler is six times as high as that given above as its safe working pressure. This, however, I am persuaded is a great mistake, and leads in many cases to undue confidence. I am confirmed in this conclusion by the constant examination of the rent plates in boilers that have exploded, where I find that, even where explosion results from thinning of the plates rupture ensues long before they are reduced to one-sixth of their original thickness, and in one case I knew a well made and nearly new boiler, in first-rate condition, to explode, on account of only a comparatively slight increase of pressure, which had accidentally been allowed through an error in the steam guage. In this case, that at which the boiler actually burst did not exceed its ordinary working pressure by more than 50 per cent., the one being about 90lbs., the other about 60lbs. I believe that an application of anything like six times the pressure given in the scale above would burst most of the boilers in Lancashire, and where it has been actually attempted by hydraulic pressure, the steam domes have been found to tear off long before the strain referred to has been attained. I cannot, therefore, think that shells of cylindrical boilers can be worked without risk at a higher pressure than that given in the preceding scale, unless under very exceptional circumstances.

With regard to the furnace tubes which are exposed to external pressure, I am glad to find that the practice is becoming increasingly general of strengthening them either with flanged seams or hoops, the hoops being made either of angle iron, T iron, or other approved form; and since it too frequently happens that flues are not made in the first instance truly cylindrical, on which their strength so much depends, and that other sources of weakness creep into the manufacture unawares, it is extremely desirable that no new boiler should be constructed with flues unstrengthened in the way just described, however slight the working pressure may be.

These hoops are frequently added to boilers after their first construction, and since some of our members have suffered inconvenience from the imperfect manner in which they have been fixed, I may state the method found by experience to be the best, which is as follows:—The hoops, if made in two halves, may be passed in through the manhole, and can then be secured to the furnace tubes when in position. They should not, however, be brought in direct contact with the plates of the tube, but should have ferrules of about an inch thick placed between the two, so as to leave a clear space all round through which the water can circulate. Where this space has been omitted, the plates have been found in some places to crack at the rivet holes, and in others to blister and buckle, in consequence of which many plates have had to be cut out and the hoops removed, from which the system of hooping has been in some cases unfairly condemned. Where, however, the ferrules have been introduced and the water space allowed, no injury has been found to arise to the plates even over the hottest part of the fire. The rivets uniting the hoops to the furnace tube should pass through these ferrules, and be spaced about six inches apart, while the two halves of the hoops should be connected together by butt strips rivetted to their ends at the back. When hoops are applied as an after-clap in this way, angle iron is preferable to T iron, as the flange, being narrower, is less liable to cause overheating of the plate. It may be necessary to vary the size of the angle iron in some cases, but, generally speaking, one three inches in the flange and half an inch in thickness will be found to answer every purpose. It is sometimes the practice to put two angle irons back to back. This is quite unnecessary, and a single one is all that is required. A drawing, to show the arrangement recommended, has been made for the assistance of the members, and can be seen on application at the offices of the Association.

Since writing the above, I have met with some additional cases, where considerable expense has been incurred by having to remove angle iron hoops from furnace tubes, in consequence of the injudicious mode in which they have been fixed, and would therefore impress upon our members the importance of attention to the above, if they wish to prevent the recurrence of disappointment in their own case.

Boring and Winding Machinery.

The advantage of careful exploration by boring previous to making a large outlay in mining operations is generally admitted, but there has hitherto been great difficulty in obtaining a cheap and economic machine. Mr. John Paton, of Govan Bar Ironworks, Glasgow, has, however, succeeded in removing the cause of complaint; he now manufactures a machine, by the use of which the expense of boring is reduced to less than one half of the usual cost. The apparatus has been successfully employed to the depth of 150 fathoms, in the course of which the tools have passed through strata of the hardest nature. Even at this depth the rods and boring-tool were lifted, and wrought with the utmost ease and without strain upon the small engine employed. The services of two men and a boy being all, or indeed more, than is required to carry on the work with speed and efficiency. The rate at which the boring is effected, as well as the extreme facility with which the rods are raised, and the pump lowered to clear the bore, enables the workmen to accomplish a very large amount of work in a given time, as compared with the old system. It is found in practice that one machine will do the work of ten or twelve men. The mechanical arrangement is extremely simple. Upon the foundation frame of the machine is arranged a small engine, which gives motion to the shaft. On the shaft, at the end nearest to the engine is fitted a pinion, which is preferred to be of the angularly-grooved frictional class; this pinion imparts motion to the grooved wheel, which is keyed to the transverse shaft. In fitting this shaft, its journals are arranged eccentrically in the bearings, which are carried in the pillars of the framing, one of the bearings is made to project suffiiciently to admit of the eye of the hand lever being passed on to it and attached thereto, With this arrangement, when the hand lever is raised the shaft is lowered sufficiently to throw the wheel out of gear with the pinion on the shaft, which comes down on a break-block beneath. It is by means of the wheel that the necessary vertical, intermittent, or jumping motion is imparted to the boring-tool. In two of the arms of the wheel are formed radial slots, in which are fitted the adjustable studs carrying the anti-friction rollers. The studs project inwardly from the face of the wheel, so that as the wheel rotates the rollers alternately come in contact with and depress the end of the lever. This lever is fast to a short horizontal shaft, the bearings of which are carried on the upper part of the framing. To the shaft is keyed a second lever, to the free overhanging extremity of which is suspended a swivel, and the brae-head or hand-wheel, for giving a rotatory motion to the boring-rods and the boring-tool at the lower end of the series. The weight of the of the rods on the lever is counteracted to the required extent by an arrangement of a counterweight used in conjunction, if required, with a hydrostatic or pneumatic cylinder. On the foundation frame are arranged the pedestal bearings of the transverse shaft, which has fast to it a lever connected by a chain to the counterweight' In front of the framing is fitted a spring buffer apparatus, which serves to modify the force of the blows, more particularly when a new boring-tool is brought into use, and it is required to make the blows comparatively light. The foundation frame supports the lofty frame, to the cross-beam of which are hung two pulleys; over one of these the chain for lifting the rods is passed, and over the other the wire-rope for lowering and raising the pump. The arrangement of the frame is to facilitate the raising of the rods, to save time and avoid taking the rods apart, except in lengths of 30ft; and the frame is made of a height to admit of the rod being disconnected in such lengths. The shaft has running upon it the drum or barrel, which is put into and out of gear with the wheel by means of a coupling-clutch, actuated by a hand lever. This drum is used for the wire rope for raising and lowering the pump, to afford the necessary convenience for cleaning the bore when required. The rotatory movement of the drum is checked and regulated by a friction strap which is tightened by the handle. The boring-rods are raised and lowered, and other winding operations performed, by means of a chain wound upon a secondary barrel, actuated from the first motion shaft. This shaft has upon it a second frictional pinion, which gives motion to the wheel on the shaft; the journals of this shaft are arranged eccentrically in their bearings, as before described in referring to the shaft. In this way, by means of a hand-lever, the wheel may be instantly put in or out of gear with the pinion. The shaft has fast to it the winding-barrel, on which the rope or chain for effecting the winding operations is wound. With these arrangements either of the winding barrels may be brought into operation as required, or remain quiescent, whilst the wheel is operating the lever and the boring-tool. When the hole has become so choked with the fragments that it would impede the action of the borer, the rods are raised with the greatest facility, and separated in lengths of 27 to 30 feet each; the whole is then cleared with the pump attached to a wire rope, and the rods are replaced, the entire operation occupying but a very few minutes. Mr. Paton's machinery is well worthy of the attention of those requiring boring machinery. A large drawing of this machine is hung in the Machinery Department of the International Exhibition, as sufficient space could not be given for exhibiting the machine itself.

A Large Steam-Hammer.

The following particulars relative to a 15-ton steam hammer (probable the largest in the world) cannot fail to interest many of our readers. It has been constructed by Messrs. R. Morrison and Co., Ouseburn, Newcastle-on-Tyne, for their own use, under Mr. R. Morrison's first patent. It is single-acting and worked by hand, and is similar to a 10-ton hammer made by the same firm for the Elswick Ordinance Works. The cylinder is 46 in. diameter with a clear fall or stroke of 8½ft.; the hammer is forged of the best scrap iron, in one solid piece with the piston and dovetail end for receiving the face, and is finished to 18 in. diameter—its total length being 27 ft. 6 in. The cylinder with its covers and glands, weighs 32 tons; the hammer-bar, 15 tons; the two frames, 34 tons; the anvil-bloc,k bed-plate, and sockets for crane post and bottom foundation-plates, 120 tons: making in all 210 tons. The cylinder is strongly flanged and ribbed, and is securely bolted between the frames by forty-eight bolts, 2½ in. diameter each, thus securing the cylinder and frames together in one solid mass perfectly rigid; and the whole is held down by eight foundation-bolts, each 4 inches square, passing through strong cast iron plates 14 ft. below the surface. The foundation for carrying the whole is composed of concrete, timber, and stonework, and is 44 feet one way, 26 feet the other and 14 ft deep. The frames are cast hollow, measuring 4 feet one way, 3feet 6 inches the other and 2½ inches thick. One of these frames contains the valve and gear for working the hammer, as well as the steam and exhaust pipes; so that there is nothing projecting on the outside to interfere with the workmen or the cranes. The principal features of this hammer are its simplicity, durability, and efficiency. The space around the hammer is such that the workmen go about their work with the greatest facility; the height from the surface of the ground to the underside of the frames is 11 feet 3 inches, so that the largest piece of work that can be got under the hammer can be turned round in every way without being taken from under the hammer; and the moving mass of the hammer itself being of malleable iron, and in one solid piece prevents the possibility of breaking. The length of the cylinder over the top and bottom covers which form the guides is 14 feet; so that whatever may be the size of the forging under the hammer the bar is always guided for the length of 14 feet. The hammer is arranged for the heaviest class of forgings required by engineers or ship builders, such as large crank-axles, screw-frames, and armour plates; and it thus supplies a want which has been considerably felt for this heavy class of work. Some experimental armour-plates of large size have already been forged by it, besides other heavy jobs.

Cheap and Effective Pump.

In the western annexe, between the two great pumps exhibited by Messrs. Gwynne and Co., and Messrs. Easton and Amos respectively, is a small yet not less effective machine, with which our readers are not altogether unacquainted; we allude to the chain-pump of Mr J. U. Bastier. The pump exhibited has a tube of 4½-inch bore, and is worked by a 2-horse power engine only, yet raises with the greatest facility from 450 to 500 gallons of water per minute, the pulley revolving at the rate of from 80 to 84 turns per minute. The entire space occupied by the pump does not exceed 4ft. by 1½ ft., and this space would be sufficient for pumping from, the deepest mine. Since the first introduction of the chain-pump by Mr. Deprony, some 70 years since, it has been acknowledged that the chain-pump offers many advantages, but it is only recently that anything like perfection has been reached. The washers employed by Mr. Deprony, as a packing for the discs, which, as is well known, are provided at short intervals along the entire length of the endless chain, were of leather, which, hardening in the water, caused a large amount of friction upon the interior of the tubes, and these tubes, again, being of the same diameter from the bottom to the top of the column, a considerable proportion both of water and of motive-power was wasted. Since that time India-rubber has come into more extensive use, and Mr. J. U. Bastier has been fortunate enough to hit upon the idea of reviving Mr. Deprony's principle, with the addition of improvement, which brings it as nearly as possible to perfection. For the flat disc employed by Mr. Deprony he substitutes a small cylindrical piston of gutta-percha; for the leather washer he substitutes washers of strong India-rubber; and lastly, instead of a tube of uniform bore, he employs a tube more contracted at one part than another, the effect being to make each disc act as a piston whilst passing the narrow part of the tube. The pump acts as a force-pump, or as a suction-pump, according to the depth of the water in which it is immersed. It acts as a force-pump when the level of the water to be pumped exceeds 40 in., for then as, by the well known laws of hydrostatics, the water will rise in the interior of the tube to the same level as on the exterior, the disc entering the tube will force the water already in the tube before it. But should the water in which the pump tube is immersed be less than a yard in depth, the suction principle comes into play; in this case the disc entering the tube after moving upwards about 4 in. (for we should say that the bottom of the tube is trumpet-shaped, to facilitate the flow of the water), reaches the contracted portion of the tube, and draws the water after it, ready to be forced onward by the following disc. It will be seen that in this compressed space the discs becoming packed by the slight compression of the India-rubber, play the part of a piston, the suction and forcing going as long as motion is given to the pulley over which the endless chain passes, such pulley being fixed on an axle, made to rotate either by a driving band and steam-power, or any other motor. Mr. Bastier's pump has attracted much attention since the opening of the Exhibition, and we understand the inventor has already received orders for all quarters of the globe. We have never seen an equal quantity of water raised by a pump with a tube of equal diameter, and, therefore, unhesitatingly direct it to the attention of all using pumping machinery. The power of the pump may be increased to any extent, since the greater the speed of the pulley the greater is the number of the discs which pass through the tube, and the greater the quantity of water raised. the power of the pump, however, is not its only recommendation; the space it occupies in the shaft is extremely small, and as the descending part of the chain counterbalances the rising portion, balance-bobs and all similar contrivances are unnecessary. A framework of wood or iron supports the axle upon which the disc pulley is fixed, the strength, of course, depending upon the depth from which the water is to be pumped, and the weight of the tubes, whilst the action of the pump is regulated by an adequate fly-wheel. In addition to the improvements above referred to, the different forms of disc, the substitution of India- rubber washers for leather, and the contracted tube, we may mention that the upper disc-pulley is provided with indentations into which the discc fall; they are thus kept always uninjured, whilst the motion of the chain is smooth and uninterrupted; and at the lower end of the pump-tube a small wooden pulley, placed slightly behind the tube, is provided, which guides the chain and discs into the mouth of the tube.

Impregnable Locks.

That such eminent locksmiths as Hobbs and Co., would be represented at the International Exhibition would, of course, be anticipated, and that they would exhibit something extraordinary would likewise be expected. There will be no disappointment in either particular. A little to the west of Bessemer's steel trophy, in the south-eastern transept, and just upon entering the hardware department, Messrs. Hobbs and Co's collection will be found. The locks are of first-class workmanship, and well illustrate the perfection to which the locksmiths art can be brought. The variety exhibited is great, and each form of locks has doubtless its attractions, whether it be a machine-made common lock (a class of fastenings which Messrs. Hobbs and Co. manufacture to a great nicety) a protector, or an indicator lock, but the changeable key bank lock is a master piece; it is justly described to be unaproachable as a security of the repositories of treasure, and impregnable against every practicable method of picking, fraud, or violence. The "bits" or steps on the "web" of the key, that act on the levers inside the lock, are separate, instead of being, as in other keys, cut on the solid metal. These moveable "bits" are fastened by a small screw on the end of the shank of the key, when it has the appearance of any other lever lock key. There are, besides, spare "bits" to change when desirable. The lock has three sets of levers, and is so constructed that, whatever arrangement the "bits" on the key may have when acting on the lock, the latter immediately adapts itself to the arrangement, and will lock and unlock with perfect facility; but it cannot be unlocked by any of the "bits" except that which locked it. The great advantage of this arrangement is that a banker can defy even the maker of the lock to open it, and in the event of any suspicion that the key has been fraudulently copied he can change it in a couple of minutes, and have all the advantage of a new lock; and as a lock with eight "bits" would admit of some 40,320 changes, it will be apparent that the greatest possible security is ensured. By simply increasing the number of "bits" the changes may be increased *ad libitum*, though for all practical purposes half-a-dozen "bits" giving, 720 changes, would probably be deemed ample. Ten "bits" would give no less than 3,628,800 changes, yet so simple in the arrangement of the lock that but little extra expence would be incurred in manufacturing a lock to make the changes of which it would be capable occupy a century. Messrs Hobbs and Co's locks have received prizes in almost every instance in which they have competed, and an inspection of them will give convincing proof that they have deserved them.

Age of the Gold Fields of Nova Scotia.

A paper was read last month by the Rev. Dr. Honeyman, "On the geology of the Gold Fields of of Nova Scotia," before the Royal Geological Society. The strata passed through from Laidlaw's and Allan's farms to Mount Uniacke, and thence onward in the same direction were described, the paper being prefaced by an interesting sketch of the history of the discovery and working of gold in the province. In the course of the discussion which followed, Sir. W. Logan said that he believed the the granites of Nova Scotia to be of Devonian age; they had the same in Canada. In Canada it was certainly of newer age than that which they gave to the gold-bearing rocks; this formation is traceable through Maine to New Brunswick, and thence westward. They had found gold in Canada, and at the International Exhibition they had now two nuggets, weighing respectively 8 and 4 ozs. He would be glad if Dr. Honeyman could tell them whether chrome iron has been found in the gold-bearing rocks of Nova Scotia, because he had observed that it was usually found in rocks of that character.—Sir. R. Murchison thought that gold was seldom found in great or even appreciable quantities except in the Lower Silurian rocks; he might say between the bottom of the Lower Silurian and the end of the palæzoic. Dr Honeyman said that he had received the specimens of serpentine from Dr. Dawson, and they were said to have been got from that region. He did not know that there was any chrome iron; the gold principally occurred in the chloritic slates.—The President said it was contended that the gold-bearing drifts were derived from Lower Silurian strata; but the question was were they spread out over countries where the Lower Silurian did not occur?—Sir William Logan thought the drifts were, no doubt, derived from the Lower Silurian.—The president was bound to admit that there was much in the hypothesis that gold is found in the Lower Silurian formation, and there might be something to be learnt in connection with them from the hypothesis propounded by the author of "Ore in Mineral Veins."

The third paper by Mr. J. W. Salter, comprising notes on some fossil crustacea from the lower coal measures of Nova Scotia, on Eurypterus, and on some Tracks of Crustacea in the Lower Silurian Rocks, was of an exceedingly interesting character but as it was profusely illustrated a satisfactory abstract is scarcely possible. An interesting discussion followed, at the conclusion of which the President observed that some of the speakers had appearently somewhat misunderstood Darwin's hypothesis, which he considered supposed change but not necessarily progression.—The meeting then separated.

Factories and Factory Workers.

A return has been made respecting the cotton, woolen, worsted, flax, hemp, jute, hosiery, and silk factories in the United Kingdom, subject to the factories Acts. It shows a number no less than 6,378, with 36,450,028 spindles and 490,866 power looms, and motive power equal to 375,294 steam and 29,339 water. 775,534 persons are employed in these factories, 308,273 males and 467,261 females; 69,593 are children under 13, about half boys and half girls. Taking the cotton factories, we find that in 1850 they were returned 1932 in number, with 20,977,017 spindles, 248,627 power looms, and 82,555 motive horse power; but the cotton factories now are 2887 in number with 30,387,467spindles, 399,992 power looms, and 294,130 horse power. The people employed in the cotton factories in 1850 were but 333,924; they are now 451,569. The males under 13 have increased in this interval from 9.482 to 22,081; and the females under 13 from 5,511 to 17,707; of the workers above 13, the males have increased from 132,019 to 160,475, and the females from 183,912, to 251,306. So that in the period since 1850, according to returns laid before Parliament then and now, the motive horse power in the cotton factories is described as having increased no less than 256 per cent., which is very much faster than the increase either in raw cotton imported or cotton goods exported; the persons employed increased only 36 per cent.; but the number of those under 13,163 per cent.

Curious Railway Experiment.

Another discovery threatens to change our railway plant perhaps our railway system. M. Girard, under the patronage of the Emperor, has constructed an experimental railway, on which the carriages are impelled after the manner of a sledge. The runners of the sledges rest on a species of hollow clogs, between which and the rails water is introduced. Thus the carriages slide on a thin layer of water, and friction is almost annihilated. The success of the experimental railway is stated to be so decided that the Emperor has appointed a commission to report on the system.—*Athenæum.*

The Colony of Victoria.

The colony of Victoria excited great interest for its gold in the Exhibition of 1851, being at that time only a dependency of New South Wales, and having a population of 77,000 inhabitants. It has since become an independent colony, and has now a population of 540,000. It appeared from the Custom-house returns that the export of gold in 1851 amounted to 145,000 ounces—equal to £580,000; whilst in 1860 it was 2,156,000 ounces—equal to £8,626,000; and the aggregate of the export in ten years was 24,000,000 ounces—equal to upwards of £95,000,000. In addition to this, there was an amount which did not appear in the returns, estimated at 2,000,000,ounces more, so that the whole export was 26,000,000 ounces—equal to £103,941 000. There were now 46 thriving towns. In 1851 there were 39 places of public worship, against 874 at the present time; 30 institutions for charitable relief, and a flourishing university. There were 860 schools, with 52,000 scholars; a public library of more than 30,000 volumes, with 117,000 readers in nine months. In the exhibition of 1851 there were 37 trades represented in that department, and now there were 236. More than £5,000,000 had been spent in roads and bridges, and £3,000,000 in public buildings. There were 100 miles of Government railway open, and 182 more in course of construction, involving an expenditure of £8,000,000; 15,000 miles of electric telegraph, costing £163,000. Thus it would be seen that, in ten years, greater progress had been made in that colony than would have been the case, under ordinary circumstances, in a century in an old country.

On the Igniting Point of Coal Gas.

In consequence of the recent explosion in Holland, Dr. Frankland has experimented on this subject, and the results arrived at are thus summed up:—1. Coal gas cannot, even under the most favourable circumstances, be inflamed at a temperature below that necessary to render iron very perceptibly red-hot by day-light in a well lighted room. But this temperature is considerably below a red-heat visible in the open air on a dull day. 2. This high igniting point of coal gas, under all circumstances is due in a great measure to the presence of olefiant gas and luminiferous hydrocarbons. 3. The igniting point of explosive mixtures of the gas of coal mines is far higher than that of similar mixtures of coal gas; consequently, degrees of heat which are perfectly safe in coal mines, may ignite coal gas; hence also, the safety-lamp is much less safe in coal gas than in fire-damp. 4. Explosive mixtures of coal gas and air may be inflamed by sparks struck from metal or stone. Thus an explosion may arise from the blow of the tool of a workman against iron or stone, from the tramp of a horse upon pavement, &c., 5. Explosive mixtures of coal gas may also be ignited by a body of a comparatively low temperature, through the medium of a second body, whose igniting point is lower than that of coal gas. Thus sulphur, or substances containing sulphur, may be inflamed far below visible redness; and the contact of iron below a red heat with very inflammable substances, such as cotton waste, may give rise to flame, which will then, of course ignite the gaseous mixture.

Grease and India Rubber.

If some means could be found to prevent the action of grease on india rubber, the discovery would be hardly less valuable than that of the vulcanizing process. When india rubber is dissolved in any volatile liquid, such as spirits of turpentine or benzole, the solvent may be expelled by heat, but when it is dissolved in any of the animal or vegetable oils there is no method known by which it may be separated. India rubber is soluble in all the fatty oils, and this property interferes with its use in many places where it would be otherwise exceedingly valuable; for instance, fishermen would wear india rubber overalls in preference to any other material, were it not for the fact that they are soon ruined by the oil of the fish; and india rubber belts have been frequently brought into discredit by the circumstance of a few being injured by their careless exposure to the contact of grease.

We do not regard this field as very promising, for it has been explored by many learned chemists, and it seems to be the nature of india rubber, in all combinations and under all circumstances, to yield to the solvent power of fat; still, in organic chemistry there is no known limit to the variety of combinations and of results.—*Scientific American.*

The Suez Canal.

The gigantic works in connection with the Suez Canal scheme are being pressed forward with a vigour worthy the undertaking. The Egyptian Government have furnished a great number of hands for the service of the company—In fact, nearly 22,000. It must not be imagined, however, that these comparative slaves will exert themselves as would as many English or French labourers. The intention is to employ, indeed double that number, if they can be got from Egypt. At present the work is almost exclusively concentrated upon the cutting to be made upon the sand heights of El Djiser, and the engineers promise that what they call the *rigole de service,* or elementary canal, shall within the next two months carry the waters of the Mediterranean into the basin of Lake Tismah. This canal, or cutting, as we should prefer calling it, will be about 15 feet wide, and 18 inches deep. Some twenty dredging machines are to be employed in clearing out a channel, which, completed last year, has realized the prophecy of the late Robert Stephenson, and has now become choked by sand. There is no doubt that the company have undertaken a task which it will require all the talent of their engineers and all the muscular force of their 40,000 assistants to accomplish.

The Eye Photographed.

At the meeting of the American Photographical Society last Feburary, Dr. Henry D. Noyes exhibited a negative showing the optic nerve and interior of a rabbit's eye. The impression was obtained by a newly invented instrument devised by himself and Mr. Grunow, a practical optician. Such a photograph has never been obtained before in this country, although it is said to have been done in France. The interior of the eye, namely, the retina and optic nerve, has been disclosed to observation in the living person, by an instrument invented in Germany, called the opthalmoscope. This has been in use for ten years, but it is only now that the interior of the eye has been photographed. Dr. Noyes explained the working and principles of the new opthalmoscope, by the aid of diagrams and the presentation of the instrument itself. Through it diseases of the eye can be studied with greater facility, and scientific records of them kept. The instrument displayed, in its elegant and finished workmanship, the highest mechanical skill. The discourse of the doctor was listened to with close attention, and the audience expressed their approbation by applause.

Canadian Mica.

The value of Mica depends upon the size of the sheets and their transparency; the clear, ruby-tinged being the finest, and the cloudy grey the least valuable. With regard to the mica from British possessions, it appears that the sale of Canadian has been much damaged through the carelessness of those shipping it. The first parcel, of about ¼ ton, which Messrs. Nash and Liénard received was sold at 2s. 1d. per lb.; and the second, of about ¾ ton, realised 2s. Since this the quality has not been kept up; the third parcel, of about 1 ton, required careful sorting after arriving in this country, to render it marketable at all, and then sold one-half at 2s. and the remainder at 7½d., the nett amount cleared and transmitted to Canada being only 144*l*., or about 1s. 1d. per lb. The same firm has since undertaken to import mica from Calcutta, and the quality is so much superior to that from Canada that the latter is now saleable only at a very low price. The Calcutta mica is indeed, about equal to that from Siberia, and is at present readily saleable at from 2s. 6d. to 4s. per lb. according to quality, and the quantity taken. Owing to varying quality the price of mica varies considerably: Canada mica will range from 3d. to 2s., and Calcutta from 6d. to 4s., per lb.—*Mining Journal.*

Cog-Wheels Superseded.

A new system of transmitting power from a horizontal to a vertical axis, without cog wheels, is exhibited by Messrs. Fontainemoreau and Gilbre, of Finsbury, in the western annexe. The machine is the invention of Mr. L. Thirion, of Belgium, and consists of a helicoidal spring, having two axes at its two extremities. If these two axes are placed in a relative position with regard to one another, so as to make either a right acute or obtuse angle, and if motion is given to one of them by means of a crank arm, water wheel, or steam-engine, the motion will be transmitted to the other axis without noise or shock, and only with the friction of the bearings. The power transmitted by this means is, therefore, limited only by the strength of the bars composing the springs. The inventor has successfully applied this new power to a windmill having no cog-wheels, and which is composed of a hollow wooden or iron upright, on the top of which is placed a flexible spiral spring with its two axes, one of which passes through the standard and the other rests on a support forming the vane of the mill. By the aid of this invention motive power may be secured continuously, and at a very slight expense.

Artificial Stone.

The *Suffolk Chronicle* contains a notice of the manufacture of artificial stone in large masses, upon a plan lately discovered by Mr. Frederick Ransome, of Ipswich. The composition of the stone is not given, but it appears that the principal binding material is the indestructible silicate of lime. Blocks weighing a ton and a-half may, it is stated, be completely solidified and hardened in the brief space of two hours, whereas by Mr. Ransome's original process, only small blocks could be made, after a long period for drying and hardening in the kiln. The *Chronicle* quotes a report by Dr. E. Frankland, F. R. S., of St. Bartholomew's Hospital, who says the "patent concrete will be found equal to the best of Portland, Whitby Hare Hill, and Park Spring stones in its power of resisting atmospheric degradation, and if the newness of Ransom's stone (the specimen experimented upon not having been made a fortnight) be taken into consideration, together with the well-known fact that its binding material, silicate of lime, becomes harder and more crystalline by age, I am induced to believe that Mr. Ransome has invented a material which, with the exception of the primary rocks, is better capable of giving permanency to external architectural decorations than any stone hitherto used." We are informed, moreover, that such is the confidence entertained in the imperishable properties of this material, it has been selected by Mr. Fowler, the engineer, for the facing of the Stations of the Metropolian Railway now in progress. We may also state that its capabilities of resisting strain and sustaining pressure have been found to be nearly three times that of Portland stone; thus, it may be fairly assumed that these qualities, combined with facility of production and the inexpensive nature of the materials used, must ensure for it general adoption in the construction, as well as in the embellishment, of buildings generally, and in works of art. Mr. Ransome has made enlargements and introduced fresh machinery at his works to carry on an extensive manufacture, but it should be observed that the process is so simple that the stone can be manufactured on the spot where the demand arises.

Thallium.

Mr. Crookes, whose discovery eighteen months ago of this new element by the spectroscope we have already announced, has since prepared numerous compounds of it, some samples of which are to be seen in the Chemical department of the International Exhibition. We were shown some time since a specimen in its pure metalic state, obtained by Mr. Crookes, but as no detailed statement of its characters, nor of the nature and actions of its salts, have been as yet published, although a short abstract has been displayed with the specimens since the opening of the Exhibition, it may be interesting to our readers to know what this new element—the only one discovered by an English chemist since Sir Humphrey Davy's detection of the metallic bases of the alkalies—is like. It is a dense heavy, rather lustreless metal, very like lead, to which metal it is also very similar in its physical properties, but is a trifle heavier, and tarnishes perhaps a little quicker. Its colour, however, is not identical. In chemical properties it is similar to mercury, lead, and bismuth. Mr. Crookes is continuing his researches, and we are glad to state that the Royal Society has voted him a grant of 50*l.* towards the expenses of these costly investigations.—*London Review.*

The Atlantic Telegraph.

The paddle-wheel steam surveying vessel *Porcupine,* 3, Master Commander Hoskyn, at Devonport, appointed on the application of the directors of the Atlantic Telegraph Company to take soundings in the Atlantic, will be provided with a donkey-engine on deck to assist the men. The machines which will be used are those called the "Bull-dog" machines. They are constructed on the principle best adapted for bringing up portions of the bottom. Brooke's apparatus will also be employed. The *Porcupine,* it is expected, will, in the first place proceed to that part of the Atlantic where there is what is popularly called a cliff in the bed of the Ocean, at which point it is supposed the former cable was broken. At the head of this declivity, about 200 miles from Ireland, there is a depth of 550 fathoms, and at the foot 1,750 fathoms, showing a difference of 1,200 fathoms. But this decline extends over a distance of eight miles, so that the fall is only one in eight. Other portions will, no doubt, be sounded. It is stated that in the event of a second attempt to establish telegraphic communication across the Atlantic, some place on the coast of Ireland, further north than Valentia harbour, will be selected for the purpose of obtaining a more convenient bed for the reception of the wire.

Effect of Small Elevations on the Mean Temperature of the Air.

M. Becquerel shows that there exists a vast difference between the temperature of the atmosphere close to the ground, and that measured at an altitude of 60 to 70 feet above it. The soil, its nature, colour, and the objects which cover it, all influence the temperature within the above limits. It had long been observed that vegetation varies according to height, and that certain plants which cannot be cultivated in the valleys, will thrive very well on the tops of the adjoining hills. Often, also frost will injure the flower of the vine, and respect that of the almond tree close by, which grows at a higher altitude. The director of the Botanical Gardens at Montpelier, has observed that laurel, fig, and olive trees die away in the lower parts of his garden, but are spared a few metres higher up, though in both cases protected by the same contrivances. M. Becquerel states that the mean temperature of the air at the "Jardin des Plants," during the year 1861, increased regularly from one metre to 33 metres above the soil, and this circumstance has prompted him to endeavour to fix the altitude of which the temperature represents the real average at a given spot. He has remarked the curious fact that at 6 a.m., all the year round, the temperature is the same at any altitude not exceeding 21 metres; 6 o'clock a.m. is, therefore, a critical period of the day, the temperature of which must stand in a certain relation to that of the month or year, and this relation he expresses by certain co-efficients, which vary according to the different seasons, and reach their maximum in summer, and their minimum in winter. These co-efficients and the mean temperature at 6 a.m , will determine the temperature of the air at a given hour and altitude.

Jottings from the International Exhibition.

Had it not been for the watchfulness of the officials, the International Exhibition would have lately stood a good chance of being burnt down on very philosophical principles. In the Japanese Court, Messrs. Baring Brothers exhibit two extraordinary quartz spheres, four or five inches in diameter, ground and polished with mathematical nicety. These spheres stood side by side on a mahogany stand in the Japanese Court, attracting but little attention from the public, until one very sunny day a visitor suddenly rushed to the office of the department with the alarming intelligence that "the two glass globes had caught fire!" The officials, on going to the spot found the stand in a blaze, the sun having shone directly through the globes, which, of course, acted as burning-glasses, setting the woodwork on fire. There are now two holes in the mahogany stand large enough to insert the top of the finger. These holes are very interesting, as they are each double, showing perfectly the double refracting properties of the quartz. The spheres have been removed into the Chinese Court, that part of the building being quite in the shade.—*Chemical News.*

A Black Varnish for Zinc.

M. Bœttger describes a process for covering zinc with a chemical, adherent velvet-black varnish. Dissolve 2 parts by weight of nitrate of copper, and 3 parts of crystallized chloride in 64 parts of distilled water; add 8 parts of hydrochloric acid of 1.10 density; into this liquid plunge the zinc, previously scoured with fine sand; then wash the metal with water and dry it rapidly.

This coating constitutes a kind of metallic alloy. It is M. Bœttger's opinion, that characters in relief may be executed on a sheet of zinc by using this composition, and by employing dilute nitric acid (1 to 10), as the black coating resists the acid which attacks only the unpreserved metal.—*Scien. Amer.*

Ozone.

In a letter to Professor Faraday, Schönbein writes:—"After many fruitless attempts at isolating ozone from an ozonide, I have at last succeeded in performing that exploit; and have also found out simple tests for distinguishing with the greatest ease ozone from its antipode, 'antozone.' As to the production of ozone by purely chemical means, the whole secret consists in dissolving pure manganate of potash in pure oil of vitriol, and introcing into the green solution pure peroxide of barium, when ozone, mixed with common oxygen, will make its appearance, as you may easily perceive by your nose and other tests. By means of the ozone so prepared, I have rapidly oxidized silver at the temperature of 20°C., and by inhaling it produced a capital 'catarrh.'"

A New Telegraphic Instrument.

A new instrument, remarkable for rapid transmission of messages through long currents, has been exhibited at the Royal Society. It can transmit messages wlth the utmost ease and fidelity through 2,000 miles of continuous wire.

Best Grain at the World's Fair.

At a late meeting of the Bath and West of Eng. Ag. Society, Lord Portman, one of the jury on Agricultural Products at the London International Exhibition, stated that the best oats were from Nova Scotia: the finest samples of wheat from Australia, weighing 68 lbs. 7 oz per bushel; The best flour also came from Australia. He attributed the excellence of Australian wheat to the climate of that country. The grain from the Zollverein States of Germany, with that also from Hungary, in the Austrian department, was represented as remarkably good.

Australian Gold Statistics.

A blue-book for 1861 published in Victoria states that the number of European alluvial miners in the colonies is 61,516; of Chinese, 24,536; quartz miners, 14,303 Europeans, and only 9 Chinese. The number of persons, miners and and those dependant on them, residing in the gold fields is 233,501; the value of machinery employed in alluvial and quartz mining, 1,411,012*l.* The prices of quartz crushing vary from 7s. to 1*l.* 10s. per ton, and prices of gold vary from 3*l*, to 3*l.* 19s. per ounce. The quantity of gold received by escort in 1861 was 1,832,887½ ozs., and the total quantity exported in same year was 1,967,420 ozs.

The Mount Cenis Tunnel.

Recent accounts of the gigantic tunnel through Mont Cénis state that the works are progressing favourably. It is ascertained that the tunnel will exceed eight English miles in length, and will pass under the ridge of the mountain at a depth of a full English mile below the surface. Shafts being out the question, the tunnel will be ventilated by compressed air, driven into it by machinery worked by water-power, which it is calculated, will drive about 51,000 cubic feet of compressed air into the tunnel daily. According to the present rate of working the tunnel will not be finished under six years; but we believe it is intended to increase the power of the boring machines, and to make them work more expeditiously.

Paris Permanent Universal Exhibition.

The project of the Paris Permanent Universal Exhibition has received the approbation of Napoleon III. and the ministers of Finance. Applications for space must be made on or before the 20th July next, to Messrs. J. Studdy, Leigh, & Co., of Leadenhall street, who are the appointed agents for Great Britain. The rental for goods or products of the first class, which will comprise all products and manufactures, whether open or in glass cases, will be 50 francs or £2 per annum per square metre; and for the second class, to which wall surface will be devoted, will be 25 francs or £1 per annum per square metre of wall space. Five square metres are equal to six square yards English.

Belgian Iron Paint.

The Belgium "minium," or iron paint, made at Anderghem, is a pure iron oxide mixed with about 1-4th its weight of silicious clay. It is said to contain no acid, and is now extensively used in this and other countries for painting ships' ironwork, gasholders, &c.—*Ironmonger.*