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THE FLOWING WELLS OF ENNISKILLEN, AND THE IMPORTANCE OF FINDING A MARKET FOR CANADIAN PETROLEUM IN EUROPE.

The successful tapping of the great subterranean sources of Petroleum in Enniskillen, has imparted a new and permanent interest to this extraordinary branch of industry and commercial enterprise. A great problem has been solved with respect to the sources of supply. Theoretically, the existence of deep-seated reservoirs of petroleum, occupying fissures and cavities in the rocks several hundred feet below the surface, has been predicted for some time past, but it was reserved for the energy and endurance of one or two individuals to prove their existence by actual and most successful experimental borings. Three "flowing wells" are now in operation, with a constancy and abundance of supply which surpasses the most sanguine expectations; and as yet we see but the beginning of these extraordinary fountains of oil, for there can be but little doubt that future borings in the vicinity of natural springs will reach the sources from which petroleum has been slowly oozing for centuries, perhaps for thousands of years, throughout the so-called oil region.

When the first petroleum spring was tapped at Titusville, Pennsylvania, in 1859, few persons conceived the vast importance of the discovery, or the astonishing commercial activity to which it would give rise in less than three years' time. In 1859, the Philadelphia and Erie Railroad carried 325 barrels of petroleum; in 1860 the amount swelled to 21,794 barrels, and in 1861 the seemingly enormous number of 134,927 barrels were transported along that line alone. This large quantity is exclusive of the supplies conveyed by the Atlantic and Great Western Railroad, and by the flat-boats, which float heavy cargoes to the Alleghany River, and thence to Pittsburgh. Large as these results appear to be, yet they fall into the shade when compared with the present yield, which in the Pennsylvania oil region is estimated at 75,000 barrels a month. No diminution has as yet been observed in the flowing wells; and so abundant and cheap is the yield from this source, that nearly all the pumping wells are now idle, and must probably continue so, unless the demand becomes greater than the flowing wells can supply at a very cheap rate.

The Canadian wells now rival those of Pennsylvania. The difficulty that the "oil men" have to contend with is to control the astonishing abundance of the yield, and to store it until a market can be found. The question of supply having been most satisfactorily solved, men are puzzled to know what to do with the treasure they have been so industriously seeking, now they have secured more than the most sanguine ever hoped for. The same energy and determination which sought and won it, must now be exerted to find a remunerative market for the unexpected and rather embarrassing abundance with which it has suddenly come upon them. The European markets alone are promising, and it is to Britain, France and Germany that they must look for aid to help them out of their present dilemma.

The question naturally arises, to what uses can petroleum be applied? We propose to glance at some of the most important practical applications of this abundant natural product, and shall endeavour to show that its general introduction for many purposes in the arts, merely requires time for its properties to become widely known, and the certainty of an unfailing supply firmly established in the minds of those who will become our largest consumers.

Before proceeding to enumerate the different uses to which petroleum can be applied, let us examine the nature of those products which can be obtained from it by destructive distillation.

The following analysis of Canadian petroleum was made by that distinguished practical chemist, Dr. Sheridan Muspratt, a notice of whose able chemistry, in its application to the arts, will be found on another page.

Dr. Muspratt finds 100 parts of Enniskillen oil to yield, upon distillation,

Light-colored naphtha (S. G. ·794)	20
Heavy yellow naphtha (S. G. ·837)	50
Lubricating oil, rich in paraffine	22
Tar	5
Charcoal	1
Loss	2
	100

The specific gravity of the crude oil is ·835, the standard of specific gravity required in England for the best petroleum being ·830.

The light-colored naphtha is the Benzole of the manufacturer. The heavy yellow naphtha is the illuminating oil.

The specific gravity of the Enniskillen oil is very nearly that of the standard. The Pennsylvania oil is considerably lighter, and does not yield so much illuminating oil on distillation. The Canadian oil contains considerably more paraffine than the American, as might be expected from its greater specific gravity. An idea of the comparative value of the Enniskillen petroleum may be obtained by comparing it with Young's patent paraffine oil, of which not less than 8,000,000 gallons are yearly manufactured, chiefly from the distillation of the Boghead coal. Canadian petroleum is twenty-five per cent. (25 p. c.) better adapted for illuminating purposes than the crude oil from the Boghead coal. The royalty on each gallon of Boghead coal oil is 3d.; the price at which one gallon of the Enniskillen petroleum can be furnished is 2½c., or about equal to the royalty on the Boghead coal oil paid to Mr. Young for his patent, without the addition of the price of the coal, and all the expenses of the distillation of the oil. Under the disguised name of Belmontine oil, a vast quantity of petroleum illuminating oil is made in England from crude Burmese petroleum. It pays the enterprising proprietors of the Belmontine works to fetch from the far distant coast of Burmah the crude petroleum of that country. Will it not richly pay them to fetch the crude petroleum of Enniskillen? No doubt if they knew of the supply, and believed in its constancy, they would gladly seize the opportunities presented to them.

Its Use as a Burning Fluid.

The extraordinary cheapness of petroleum as an illuminator is too well known in Canada to require any special notice. Notwithstanding the comparative dearness in this country and the United States of the chemicals (sulphuric acid and alkalies) which are required to purify, deodorize, and fit it for burning in lamps, yet it is, at 45c. a gallon, incomparably the cheapest illuminator which has yet been manufactured; and it threatens, for domestic purposes, to drive all other means of illumination out of the field. But in Britain, France and Germany, where acid and alkalies are abundant and cheap, and where all the by-products—such as benzole, tar, &c.—can be utilized with profit, the preparation of purified petroleum can be effected at so much cheaper a rate than on this continent as to nearly make up the difference in the cost of the raw material which freight and insurance would add to it. We may then confidently look for the gradual introduction of petroleum as an illuminator throughout Britain and a large part of the continent of Europe, in rural districts where gas is not accessible.

The distillation of bituminous shales for burning purposes has long been practiced in France on a very extensive scale; as also the distillation of coal for the same object in the United States. Petroleum has arrested the production of coal oil or kerosene on this continent; it will soon arrest, if proper steps are taken, the production of shale oil in France and Germany. One ton of cannel coal produces from 50 to 100 gallons of crude coal oil;—the flowing wells in Enniskillen could yield, if they were allowed to pour forth their contents *ad libitum*, as much oil in 24 hours, at a nominal cost, as the distillation of 1,000 tons of cannel coal could be made to produce. The production of the valley of Bear Creek, in the Township of Enniskillen, is equal to 10,000 barrels a day if means of storage were in existence. In Northern Germany coal oils are very largely used for street illumination, on the railroads and most exposed localities. They are largely manufactured in Hamburg; but if crude petroleum were laid down in that city, at the cost at which it can be supplied from the Canada wells, freight, insurance and profit added, the manufacture of coal oils would cease. In Saxony and in Prussia the same results would follow; in order to obtain a cheap illuminator the bituminous shale oil works so common in those countries would be soon abandoned; for it must be borne in mind that such manufactures in Europe yield but small profits, even with all the skill and science of the German and French practical chemists.—The poor shales are cheap, the coals dear, and it is of the utmost importance to notice that, if crude petroleum were imported it would not occasion any material change in machinery, for the by-products are the chief sources of profit in Europe, all of which, in common with coal, petroleum is capable of producing. These products are—1st. Naphtha; used as a solvent for Caoutchouc, and different resins and gums. 2. Benzole; a valuable substitute for alcohol, ether and turpentine, it dissolves fats, and is largely used in woollen, cotton and silk manufactures; it restores faded colors; removes tar, paint, oils, grease and resin, and is the source of numerous dyes. 3. Illuminating oil; respecting which nothing further need be said. 4. Heavy lubricating oils; which, when mixed with a certain proportion of other fatty materials, are much used in Europe. 5. Napthaline. 6. Tar, which, when mixed with a certain proportion of crude oil, is used for the manufacture of gas, or when mixed with saw-dust, as stated hereafter, for fuel. 7. Refuse carbon; suitable for fuel, as shewn in the following paragraphs.

Its Use in the Manufacture of Gas.

Where coal is abundant and cheap it is not probable that in towns or cities gas manufactured from petroleum will be a successful competitor for public favour, notwithstanding its superior illuminating power and the agreeable softness of the light which it produces. The manufacture of gas from coal has attained such excellence that where the material can be procured at 6 shillings sterling a ton, the value of the coke and other by-products is sufficient to pay all expenses, and many companies in England could afford to let their customers have the gas at a mere nominal price. But in districts where coal is dear and in large buildings not within reach of gas works, petroleum will become the cheapest source of illumination, and it has been satisfactorily shown in the city of Toronto that it can be manufactured with the utmost ease to burn without smoke or smell, and to give a light three times as brilliant as ordinary coal gas, and is capable of being produced at one half the cost. One gallon of petroleum, converted into gas by the process adopted in the works of Mr. J. E. Thomson of this city, produces more than 150 feet of gas possessing a very high illuminating power, a soft and agreeable light, with perfect immunity from smoke or smell. One gallon of petroleum weighs 8 lbs. 6 oz. and produces from 150 to 200 cubic feet of gas—a proportion considerably greater than that obtained from coal, even of the richest and best quality. Hence, there is every reason to believe that the manufacture of gas from petroleum will become general in large establishments, in rural districts, and in towns where coal is dear, not only in England but more particularly in France and many parts of Germany. In one town in Germany they manufacture gas from the fat they extract from soap suds, which are daily purchased throughout the town. It is easy to conceive that the crude petroleum of Canada would soon arrest this ingenious and expensive process.

As before remarked, a large number of patents have been taken out in France for the manufacture of patent fuel, and there can be no doubt that a very valuable if not an inexhaustible market may be found in France for the crude petroleum of Canada, so admirably adapted to form the means of utilizing combustible products which, without admixture with tar or similar substances, are wholly valueless. No doubt the facilities now presented for procuring an abundant and cheap supply of petroleum, would make numerous other products serviceable which are at present lost as waste, or bereft of half their value for the want of a medium to render them capable of being utilized.

Its Use as a Fuel.

Few but those who have visited France can form any idea of the high price of fuel in that country, or of the vast variety of methods which are employed to economize this necessary of life. Patents without number have been granted in France for the manufacture of "Artificial fuel." In order to explain this subject more thoroughly we subjoin one or two of the processes which are largely employed not only in Europe but also among the half civilized Orientals.

In the neighbourhood of the Caspian Sea, where petroleum springs are abundant, the inhabitants manufacture a fuel by impregnating clay with the combustible fluid ; the clods are afterwards burned on an ordinary hearth. The Norwegians have long economized the sawdust of their mills by incorporating it with a little clay and tar and moulding it into the form of bricks. Of late years in England much attention has been given to artificial fuel in many districts, but not with much success, owing to the want of a suitable combustible, which petroleum is above all others best adapted to supply. In France charcoal is prepared from the refuse of the charcoal furnaces by mixing it with charred peat or spent tar and then adding tar or pitch. The materials are ground together and subjected to heat in close vessels to expel volatile gases. From seven to nine gallons of tar is mixed with two hundred weight of charcoal powder.

Gas used as fuel for culinary purposes is daily becoming more common in Europe. It is easy to understand why this source of fuel should be preferred where civilization and luxury have converted mere comforts into actual necessaries of life, which are always secured if money can purchase them. In rural districts, where common fuel is often very expensive, gas manufactured in portable works would be largely used for culinary operations, as it now is where the supply of gas is constant and cheap. But there is no necessity to convert petroleum into gas in order to use it as fuel. Stoves have been constructed for the combustion of this substance without the use of a glass chimney and without the production of smoke. It will necessarily, from its cheapness, supersede alcohol, which is commonly used as fuel for cooking purposes during the summer months. And we may soon look for its adoption as fuel for the generation of steam in our ocean steamers, where economy in bulk and weight is so great a desideratum. Petroleum is, at it were, the essence of coal, and the question of its adoption as a steam generator is dependent upon the abundance of the supply, to which a satisfactory answer has recently been given by the "flowing wells" of Enniskillen.

Its Use as an Antiseptic or Wood-preserver.

The cost of relaying the wooden ties and sleepers of railways is enormous. Our readers are familiar with Kyanizing and similar processes. Wood steeped in petroleum, or what is better, having petroleum forced into its pores by pressure, is proof against decay for many years.

Its Use as a Lubricator.

Even the crude oil is sought for with eagerness for this purpose in many workshops in England where swift motion is employed. When mixed with fat or resin it acquires greater consistency, and it is more generally applicable to ordinary purposes, but it is the Lubricating oil which is one of the results of the destructive distillation of the crude product that is and will be most extensively used. Even should the heavy lubricating oil be not used for the purpose its name implies, the paraffine can be extracted by cold and pressure, and candles made from it, so that, under all circumstances, there is no waste or loss.

Enough has been said to show that the Enniskillen petroleum is admirably suited for many different purposes—as an illuminator, as a fuel, as material for the manufacture of gas, as a lubricator, an antiseptic, and to these may be added its use in the practice of medicine. We now turn to the difficulty and obstacles which oppose its introduction into the European market. At the beginning of this enquiry we are staggered by the fact that the present charge on the Great Western Railroad of Canada is, we are assured, three times as great for petroleum as for cattle. A car load of 55 barrels of oil from Wyoming to Toronto costs $75—a car load of cattle from Windsor to the Suspension Bridge costs $25, or ONE-THIRD the freight of the oil. It is of the highest importance that a reduction in freight should take place, or that a tramway from the springs to Lake St. Clair be constructed without delay. If it should be found advisable to make Toronto the port of discharge and thus escape the delays of the Welland Canal and cost of transport to Lake St. Clair, Railroad freight must come down, or it will be the interest of the "oil men" to make Lake St. Clair their point of departure for Europe.

It is of the highest importance that information respecting the nature and extent of the supply in Enniskillen should be widely distributed not only in England but in France and Northern Germany. Practical illustrations must be afforded the public in Europe that Canadian petroleum can do all that is promised for it. No better opportunity than the present could offer itself for effecting this object. A display of its properties, say in the manufacture of gas as being the most important, at the Great International Exhibition held at London the present year, would prove infinitely more valuable in making it generally known than any number of advertisements. We are assured that it is the desire of the Canadian Commissioners that the Canadian Department at the International Exhibition should be illuminated with gas manufactured from Enniskillen petroleum, and Mr. J. E. Thomson of Toronto will send one of his portable Petroleum Gas Retorts, with purifiers and gasometers complete for this purpose. The Canadian Commissioners could not have devised a better plan for directing public attention in England and elsewhere to this new and remarkable source of wealth to Canada. The illumination of the Canadian Department by this means will be attended with considerable expense, and if it should be beyond the limited resources of the Commissioners, no doubt the public spirit of private individuals will not be wanting in providing the necessary funds. Practical men like to see and judge for themselves. They receive with many doubts any statements which may be made without practical demonstration. Make petroleum gas before the practical men of Britain and they will believe their own eyes; tell them all that is true about it, without illustration, and they will turn the cold shoulder to statements not accompanied by practical results.

Some idea of the enormous interests at stake in the manufacture of illuminating oils from coal, shale and Burmese petroleum in Britain may be formed from the announcement made in evidence at a late trial, that during the year 1861 not less than 350,000 lamps for burning fluids were made by one firm alone. Paraffine oil, amongst other fluids, is sold at 3s. stg. a gallon to burn in these lamps, and if we assume that gas can be produced at 5s. per thousand, the cost of the light from the paraffine oil is 20 per cent. dearer than that of gas. But suppose that Canadian pretroleum could be laid down in England at 12d. sterling or 25 cents a gallon, petroleum light would be far cheaper than gas, the least expensive illuminator in England. Is not this universal field for enterprise a sufficient inducement for the "oil men" of Enniskillen to put their shoulders to the wheel and open for themselves a boundless market in England, France and Northern Germany? Sir Roderick Murchison, in his address on the progress of Geology, recently delivered at Manchester before the British Association, called attention to the "*important discovery of a resinous shale* in Tasmania termed Dysodile, which, like the Torbane mineral of Scotland, promises to be turned *to great account in the production of paraffine.*" We have the paraffine ready formed and associated with rich illuminating oils and other substances in our Canadian petroleum, which shows only two parts of waste in every hundred part by weight. Scottish Torbane mineral, Australian Dysodile, French, bituminous shales, German lignites and Brown coal, Cuba and Porto Rico asphaltum must all give way before Canadian petroleum; how soon! depends upon the spirit, activity and energy of the Enniskillen 'oil men.' The markets of England, France and Germany are open to them if they will take steps to make their "treasures of oil" widely, thoroughly, and truthfully known to the manufacturers of Europe.

EXPLOSION OF A LOCOMOTIVE ON THE GRAND TRUNK RAILWAY.

The explosion of a locomotive on the Grand Trunk Railway, at the Queen Street crossing, near the Asylum, Toronto, on the morning of February 21st, was attended by some singular phenomena which are worth recording. All the details of this unfortunate catastrophe have been given in the daily papers, we shall therefore be content to notice some of the curious facts connected with the occurrence.

As regards the effect produced by the explosion itself, the most diverse opinions were formed by persons at different distances. One observer, at a distance of a mile and a half from the scene of the explosion, saw a column of steam suddenly shoot up, in the form of a pointed cone, to the height of about 400 feet, or considerably above the dome of the Lunatic Asylum, which from its neighbourhood afforded a fair means of comparison. As soon as the cone had attained that altitude it began to swell or expand, and finally assumed the form of a pear-shaped white cloud, which gradually dissolved from view. Persons living within half a mile from the spot thought that an earthquake had happened, the concussion was so violent. Doors were burst open, windows violently shaken, and the impression produced that the chimneys had suddenly fallen. At the distance of two miles, the report sounded like that produced by a piece of ordnance, and people turned round and looked in different directions to see where the noise proceeded from. In some instances it resembled a gun being fired in the neighbouring street, or in the yard attached to the house, or in a neighbour's yard, inducing people to go out and enquire the cause of the unusual explosion, apparently in their immediate vicinity. In other instances, persons quietly sitting in rooms on the upper story thought that some heavy object had fallen in the room below, and ran down stairs to see what was the matter. The effect produced upon the locomotive was most remarkable; the entire shell of the boiler, consisting of half inch plate, was torn into shreds like a piece of rotten cloth. The force appears to have affected equally every part of the boiler, as every part of the half inch plate, from the fire box to the smoke box, was similarly torn into shreds or large detached pieces, many of which were carried three and four hundred yards by the force of the explosion. Some of the copper tubes were bent, some torn off at one end and forced at an angle of 30 to 45 degrees in the air. All the screws of the fire box and smoke box appeared to retain their original position; the half inch plate had been torn from them. But perhaps the most singular effect produced was on the rails on which the locomotive stood. Those immediately under the driving wheels were indented and bent downwards to the depth of about one inch and a half. One of the rails was broken. The force seems to have been exerted in all directions, but much of its intensity appears to have been downwards, like the recoil of large pieces of ordnance. The driving wheels, after the explosion, were not more than a foot or eighteen inches from the deep indentation in the rails. The pressure of steam was not more than 100 lbs. to the square inch, and the steam would blow off at 120 lbs. In most cases of locomotive explosions the event happens at a stopping place, after some delay, and seems to occur just as the steam is turned on. In the present instance, as in many others of a similar character, the cause is apparently inexplicable if it be not ascribed to over pressure. No doubt this same locomotive has been hundreds of times in similar circumstances as regards pressure of steam (95 lbs. to the inch) at the commencement of motion, and yet no untoward event happened. While, however, if we accept the finding of the coroner's jury, we are justified in saying that, with our present knowledge of the conditions under which the locomotive was put in motion at the time, the explosion is inexplicable, we must bear in mind the results of long experience in England, as embodied in the late annual report of the Manchester Steam Boiler Association, extracts from which we subjoin as bearing upon these unfortunate occurrences. It may be well to state, however, that the evidence at the inquest tended to prove that a piece of bark was placed on the lever of one of the safety valve, so as to prevent it from acting; and in the opinion of several witnesses the explosion arose from over pressure. The jury exonerated the company and the engineer from all blame, and recommended the sufferers to the consideration of the company.

"The Manchester Association numbers 430 members, and had under inspection, in 1861, at 535 factories and other works, 1454 boilers and 1030 engines, representing approximately a total of 127,065 indicated horse power. No explosion had occurred to any boiler under the inspection of this Association during the past year, while no less than 20 explosions were known to have happened in various parts of the kingdom, from which 27 persons had been killed, 47 wounded, and considerable damage done to property. 5612 boiler inspections had been made, 52 boilers being found in a dangerous state; while, with regard to 226 others, it was necessary in 145 that the furnaces should be strengthened by hooping; in 52 that the shells should be strengthened by additional stays; and in 29 that the load on the safety valves should be reduced. The Association have been in the habit, on the occurrence of any explosion within a reasonable distance of Manchester, of having a special examination and report made upon the boiler in question, so that the members should have the advantage of the information; and after alluding to the whole of the cases which have been examined in the course of the year, it was stated that it had been found that due care and periodical inspection, with the application, where necessary, of the hydraulic test, would have prevented every one of these explosions, and thus the word accident could not correctly be applied to any one of them. The report recommended the application of steam casings or jackets to cylinders, and the adoption of superheated steam, stating the commercial advantages derived from these arrangements in other parts of the country. After the adoption of the report, Mr. Bazley, M.P., moved the following resolution:—'That the meeting considers the system of voluntary periodical inspection to be worthy of the confidence of all steam users, and that this view is borne out by the fact that no explosion has occurred to any boiler under the inspection of this Association during the past year, while no less than twenty explosions are known to have happened in various parts of the kingdom. Also this meeting wishes promptly to call attention to the fact that in every case where exploded boilers have been examined and reported on directly to this Association, it has been found that the explosion resulted from the simplest causes, and might have been prevented by the exercise of due care. This meeting therefore considers that the labours of this Association have established the following principle, namely, that the causes of explosion have been shrouded in unnecessary uncertainty and mystery, and takes this opportunity of expressing its conviction that explosions are considered far too frequently to be accidental, and that by due attention to correct principles in the construction of boilers in the first place, added to care in their working in the second, the recurrence of explosions would be prevented.'

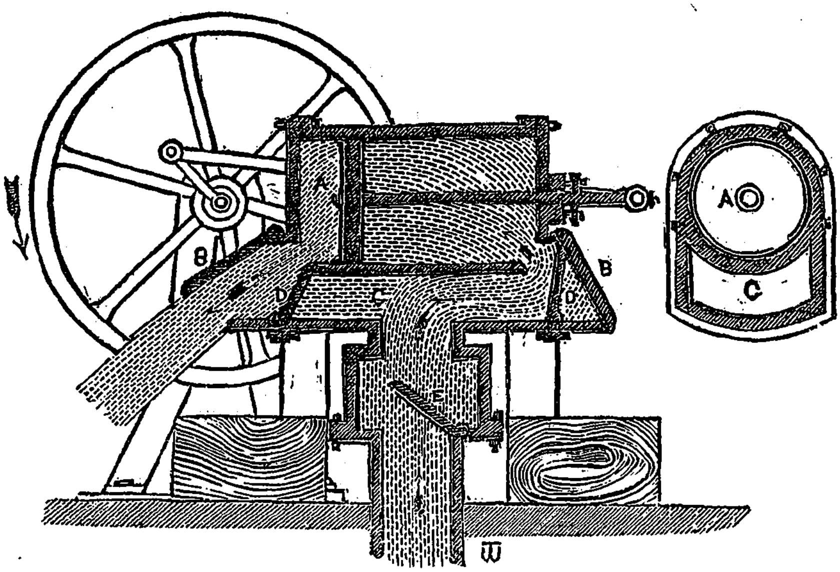
"At the last ordinary monthly meeting of the Executive Committee of this Association, held at Manchester, December 31, 1861, Mr. L. E. Fletcher, chief engineer, presented his monthly report, from which the following are brief extracts:—'During the past month 256 engines have been examined, and 364 boilers, 10 of the latter having been examined specially, 4 internally, 38 thoroughly, and 312 externally, in which the following defects have been found:—Fracture, 5 (1 dangerous); corrosion, 22 (3 dangerous); safety valves out of order, 9; water guages, 4; pressure guages, 2; blow-off taps, 13 (1 dangerous); fusible plugs, 5; furnaces out of shape, 6; total, 73 (5 dangerous). Boilers without glass water guages, 22; pressure guages, 4; blow-off taps, 18; feed back-pressure valves, 38. No explosion has happened to any boiler under the inspection of this Association during the past month, nor in fact throughout the whole year. A few cases of injury to furnaces have occurred, arising from deficiency of water consequent on the derangement of the glass water guages, which would have been prevented had there been two guages to each boiler, so frequently recommended. In another case, injury arose from the attendant lighting a fire in his boiler when empty, while, in another, from a defective blow-out tap. There has however come to my knowledge, in a casual way, the occurrence in various parts of the kingdom during the past year of no less than 20 explosions, from which 27 persons have been killed and 47 wounded, the boilers in question being of every variety—factory, colliery, marine, locomotive, agricultural, &c. Relative to economy in the raising and use of steam, I have brought before the attention of the members during the past year the importance of surface blowing out, and the advantage to be derived from the use of steam jackets, as well as from superheating. Surface blowing out is in very general use elsewhere, and found successful; it is not monopolised by patents, but is free to all. The use of steam jackets and superheated steam, aided by surface condensation (a subject on which I shall take an early opportunity of communicating with the members), are now working a perfect revolution in marine engine economy, and are extensively adopted by various large steam navigation companies. In the report of the last annual meeting of the Peninsular and Oriental Steam Navigation Company, the chairman stated that a new vessel called the Mooltan, of 2,600 tons burthen. having engines of 400 nominal horse power, in which the use of steam jackets and superheated steam had been adopted, the consumption of fuel had been reduced to rather less than one-half the usual amount; and the chairman added that the shareholders would readily perceive the importance of such a reduction in the consumption of fuel, when he reminded them that they had paid as much as £800,000 for coal in one year.'"

Atmospheric Disinfection.

Dr. Stenhouse, in a letter to the "Society of Arts Journal," says:—From time immemorial it has been a well-known practice to light large fires in marshy and other districts, in almost every quarter of the world, as it has been invariably found that this proceeding produced a very beneficial, though temporary effect on the salubrity of these districts. This result has hitherto been attributed to the influence of the heat evolved, by which a strong current of air is induced, and consequently, the stagnant atmosphere is set in thorough circulation. Now, however, that the absorbent and oxidising effects of charcoal on deleterious gases and vapours are so well understood and generally admitted, I think the true cause of the beneficial action of great fires in such situations is owing to the large quantity of minutely divided charcoal, which in the shape of smoke, is carried up into the atmosphere. These particles of charcoal absorb and destroy the deleterious gases. Since this is the case, I think it is clear that the object in these operations ought to be to make as much smoke as possible, and that green wood, or other moist fuel, will be found the more suitable for this purpose.

The British Navy.

An official return, issued under the authority of the Lords of the Admiralty, embodying full details relative to the condition and stations of the vessels of the British Navy has just been published. "The number of vessels in commission on the 1st of January was 856, of all rates and classes. There were, besides, 150 line-of-battle and other sailing ships stationed at the various ports in England and the colonies, for harbour duty, thus swelling the total to upwards of 1000 vessels of all descriptions. Of the 856 vessels actually in commission, or building or repairing for the service, only 154 are sailing ships, the whole of the remainder being propelled by steam power. The list of vessels is made up of 81 line-of-battle ships, each mounting from 74 to 131 guns; 22 vessels each with an armament of from 60 to 70 guns; 44 51-gun frigates, the whole, with the exception of about ten of that number, being screw steamers; 57 ships, each mounting from 22 to 50 guns, and the majority of which have a tonnage as large as ships of the line; 29 screw corvettes, or frigates, each mounting 22 guns, and 185 screw gunboats, each provided with two Armstrong guns.



THE PATENT DOUBLE-ACTIONED "FLOOD PUMP."

The following notice of this novel pump is from the *Mechanics' Magazine*, a deservedly popular monthly periodical published in London:—

Except for the purposes of a force-pump or fire-engine, the horizontal principle has not, we think, been applied with anything like a good practical result in the manufacture of pumps. Various applications of so desirable a motion have been made to the ordinary lift or bilge pump; but, from the fact of power being in all the instances required to drive out the water from the cylinder, from the misplaced position of the outlets, and the extreme difficulty, amounting almost to an impossibility, of getting to the valves—a fatal objection to a good working pump,—but little success has attended their introduction. These objections, however, have been removed in the double-actioned pump, illustrated in the accompanying sketch.

A shows cylinder, with a packed piston working through stuffing-box, motion to which is given by means of cross-head, parallel slings, crank, and fly-wheel. *BB* are the outlet valves, placed as low as possible in end covers of casting for egress of water by its own gravity, on "suction" being destroyed by reversal of stroke. *C* is a water-course entering cylinder by valves *D. E,* foot valve, the seating flanged on as shown, the valve-box, water-course, and cylinder, being all one casting. The end covers of the casting are also flanged on, by which means access may be readily had to the piston; while access to the valves *D* is obtained by simply raising or lifting off the outside valves *B*.

This is a pump, in the use of which stoppage is rendered very difficult, all the working parts being as it were on the surface, and under immediate control; while, as a ship's pump, it is of importance, bearing in mind the repeatedness with which ships, having valuable cargoes, have been abandoned owing to the inefficiency of the pumps, from their tendency to get choaked, and the impossibility, from the position of their working parts, of keeping them clear.

A small pump of 4-inch bore, with a 6-inch stroke, worked by a man at 45 revolutions of the wheel a minute, discharged, from a well 16 feet from the surface, a quantity of water equal to 1,455 gallons per hour, being within a fraction of the measured capacity of the cylinder filled twice every revolution: while a pump with a 12-inch cylinder and 18-inch stroke, with two men making 30 revolutions per minute, is capable, it is stated, of discharging, within the hour, 26,400 gallons; a result that cannot be arrived at with the ordinary two-barrel contractor's pump, with about four times the amount of power in the same time.

THE PORT DOVER WOOLLEN FACTORY.

The factory is located in the town of Port Dover, on Patterson's Creek, a short distance above its junction with Black Creek, the stream being navigable for ordinary lake crafts from the lake to a point near the buildings. The fall of water obtained is about thirteen feet (13), and the stream a most durable one, affording ample power, not only for all the machinery the buildings will contain, but leaving a large amount of power available for any other business. The mill is a frame building 90x50, of four stories, each one twelve feet high, and an attic, the whole covered with shingles laid in mortar. At the south end, and attached to this main building, is another structure of wood thirty feet square, two stories high. On the east, and attached to this latter building is a dye house 30+35, one story high, both covered with a felting and gravel roof. On the north end of the main building is a brick attachment 25+30, two stories high, also covered with a felting and gravel roof. Attached to the north side of this is a drying house 110+25, two stories high. It is a frame building covered with shingles. At the extreme north end of the drying house is the chimney, built of brick, fifty feet high. The foundations of all these buildings are piles, driven into the ground to a depth of sixteen feet, with oak timber laid on the piles, and a stone wall five feet high built on these timbers.

The building on the extreme south end, 30 feet square, contains the water wheel, which was made by Messrs. Kelbourn, Lincoln & Son, of Fall River, Mass., and is a Turbine wheel, 68 inches in diameter, and is of sufficient power to drive seven complete setts of machinery for the manufacture of woollen goods. This flat also contains turning lathe, work bench, etc., and the scouring tub and rinse box. The second flat is for sorting wool into the different qualities, and contains bins for wool. The building east of this, 30+35, is a dye house, with ample dye vats.

The main building, on the first flat, contains the fulling mills, giggs, presses, shearing and brushing machines.

The second flat contains, at present, six narrow and four broad Crompton looms, of the most improved construction, and contains ample room for forty looms.

The third flat contains two complete setts of carding machines, card grinder, and three jacks of two hundred and forty spindles each.

The fourth flat is not used at present, but is intended for the spinning room.

The attic contains the picker and duster and the gauze room, and bins for storing wool, with spouts running down for the conveyance of the wool to the carding machines. The gauze room is fire proof.

The brick structure at the north end of the main building contains, in the first flat, a steam boiler, and a hot water tank, and a force pump for supplying water to the boiler, and a blue vat.

The upper story contains spoolers and warping machines.

The long building, 110+25, contains, on the first flat, wool racks for drying wool; the second flat, twelve bars for drying cloth; it is heated by the smoke pipe, which is made of iron 22 in. in diameter, and running the entire length from the boiler to the brick chimney in the rear, a distance of 110 feet.

All the other buildings are heated by steam pipes, so arranged that the whole or only any particular portion can be heated, as may be desired.

The dye vats, scouring tubs, etc., are all heated by steam. An iron pipe also leads from the boiler to the gauze room, by which the steam from the boiler can be conveyed into the gauze room to extinguish fire, should it occur.

The machinery in the buildings is only about one-third they are capable of containing.

In addition to the several structures mentioned, a storehouse, 50x30, two stories high, is erected at a distance of 120 feet from the other buildings, for storing wool.

The whole is leased by J. N. Pett, Esq.

THOS. FOGG'S IMPROVED BALLASTING CAR, FOR RAILWAY AND OTHER PURPOSES.

The complete, economical, and expeditions unloading of ballast has hitherto proved a practical difficulty, of which numerous experiments have been tried and repeated failures encountered.

It is believed that the application of "Fogg's Patent Ballast Car" will be found a remedy for defects that have arisen from imperfectly constructed cars.

The object of this invention is to equalize and distribute the gravel inside and outside the railway track, as required, and to do away entirely with the gang of men that is necessary in the present cars.

In Mr. Fogg's Patent Car there are no men required but the two brakesmen and the conductor, as two men can unload a train of ten cars in from five to eight minutes. The cars are constructed to hold eight cubic yards, and, as stated by the inventor, can be unloaded one yard at a time, and put either inside or outside the railway track, or the whole can be unloaded at once.

In the present cars there is in some places from 50 to 100 per cent. of the ballast lost down the embankment, as the whole of the ballast has to be unloaded on the outside of the track, and then to be shoveled in on the inside of the track again, whereas in this Patent Car it is equally divided inside and outside the railway track, and saves the labour that is required to shovel it in the inside of the track, probably from 10 to 20 per cent. in the saving of Ballast, and if the embankment is only 18 inches from the rail no pebbles will go down the embankment.

It will take 18 or 20 men, 40 or 50 minutes to unload a train of 10 cars, that is the present flat cars, those men are now entirely dispensed with, as the two brakesmen can, it is said, unload the same number of the Patent Cars in from 5 to 8 minutes.

Mr. Fogg's improvement possesses the advantages of simplicity, compactness, less expense and is not liable to get out of order. The present Flat Cars can be altered at a small expense if required. So it will be thereby seen that Mr. Fogg's Car will do away with:

In unloading....	Manual labour.
In locomotive power......	From 20 to 30 per cent.
In ballast....................	From 10 to 20 per cent.
In time.......................	From 20 to 30 per cent.

Still further it is adapted to the common horse waggon, for moving earth, gravel, or other loose material, as a waggon box can be constructed on the same principle, at a small expense, so that the driver can unload the waggon himself without stopping his horse or moving from his seat. Any information with regard to the invention may be obtained from Mr. Thomas Fogg, Brantford, C. W.

PROGRESS OF GEOLOGY.*

Although I have had the honour of presiding over the Geologists of the British Association at several previous meetings since our first gathering at York, now thirty years ago, I have never been called upon to open the business of this section with an address; this custom having been introduced since I last occupied the geological chair at Glasgow, in 1855.

The addresses of my immediate predecessors, and the last anniversary discourse of the President of the Geological Society of London, have embraced so much of the recent progress of our science in many branches, that it would be superfluous on my part to go again over many topics which have been already well treated.

Thus, it is needless that I should occupy your time by alluding to the engrossing subject of the most recent natural operations with which the geologist has to deal, and which connect his labors with those of the ethnologist. On this head I will only say, that, having carefully examined the detrital accumulations forming the ancient banks of the river Somme in France, I am as complete a believer in the commixture in that ancient alluvium of the works of man with the reliquiæ of extinct animals as their meritorious discoverer, M. Boucher de Perthes, or as their expounders, Prestwich, Lyell, and others. I may, however, express my gratification in learning that our own country is now affording proofs of similar intermixture both in Bedfordshire, Lincolnshire, and other counties; and, possibly, at this meeting we may have to record additional evidences on this highly interesting topic.

But I pass at once from any consideration of these recent accumulations, and, indeed, of all Tertiary rocks; and, as a brief space of time only is at my disposal, I will now lay before you only a concise retrospect of the progress which has latterly been made in the development of one great branch of our science. I confine myself, then, to the consideration of those primeval rocks with which my own reseaches have for many years been most connected, with a few allusions only, to metamorphism, and certain metalliferous productions, &c.

There is, indeed, a peculiar fitness in now dwelling more especially on the ancient rocks, inasmuch as Manchester is surrounded by some of them, whilst, with the exception of certain groups of erratic blocks and drifts, no deposits occur within the reach of short excursions from hence, which are either of Secondary or Tertiary age.

Let us, then, take a retrospective view of the progress which has been made in the classification and delineation of the older rocks since the Association first assembled at York, in 1831. At that time, as every old geologist knows, no attempt had been made to unravel the order or characters of the formations which arise from beneath the Old Red Sandstone. In that year Sedgwick was only beginning to make his first inroads into those mountains of North Wales, the intricacies of which he finally so well elaborated, whilst I only brought to that, our earliest assembly, the first fruits of observations in Herefordshire, Brecon, Radnor, and Shropshire, which led me to work out an order which has since been generally adopted.

At that time the terms of Cambrian, Silurian, Devonian, and Permian, were not dreamt of, but, acting on the true Baconian principle, their founders and their coadjutors have, after years of toil and comparison, set up such plain landmarks on geological horizons that they have been recognized over many a distant land. Compare the best map of England of the year 1831, or that of Greenough, which had advanced somewhat upon the admirable original classification of our father, William Smith, and see the striking difference between the then existing knowledge and our present acquirements. It is not too much to say that, when the British Association first met, all the region on both sides of the Welsh border, and extending to the Irish Channel on the west, was in a state of dire confusion; whilst in Devonshire and Cornwall many of these rocks which from their crystalline nature were classed and mapped as among the most ancient in the kingdom, have since been shown to be of no higher antiquity than the Old Red Sandstone of Herefordshire.

As to Scotland, where the ancient rocks abound, though their mineral structure, particularly in those of igneous origin, had necessarily been much developed in the country of Hutton, Playfair, Hall, Jameson, and McCulloch, yet the true age of many of its sedimentary rocks and their relations were unknown. Still less had Ireland, another region mainly palæozonic, received any striking portion of that illustration which has since appeared in the excellent general map of Griffith, and which is now being carried to perfection through the labors of the geological survey under my colleague Jukes. If such was our benighted state as regarded the order and character of the older formations at our

* Thirty Years Retrospect of the progress in our knowledge of the Geology of the Older Rocks—being an Address to the Geological Section of the British Association at Manchester, Sept. 5, 1862; by Sir Roderick Impey Murchison, D.C.L., LL.D., F.R.S., Director General of the Geological Survey of the United Kingdom, President.

first meeting, great was the advance we had made when at our twelfth meeting we first assembled at Manchester in 1842. Presiding then as I do now over the geological section, I showed in an evening lecture how the palæozoic rocks of Silurian, Devonian, and Carboniferous age, as well as those rocks to which I had assigned the name of Permian, were spread over the vast region of Russia in Europe and the Ural Mountains. What, then, are some of the main additions which have been made to our acquaintance with the older rocks in the British Isles since we last visited Manchester?

Commencing with the oldest strata, I may now assume, from the examination of several associates on whose powers of observation as well as my own I rely, that what I asserted at the Aberdeen meeting, in 1859, as the result of several surveys, and what I first put forth at the Glasgow meeting of 1855, is substantially true. The stratified gneiss of the northwest coast of the Highlands, and of the large island of Lewis and the outer Hebrides, is the fundamental rock of the British Isles, and the precise equivalent of the Laurentian system of Canada, as described by Sir W. E. Logan. The establishment of this order, which is so clearly exhibited in great natural sections on the west coast of Sutherland and Ross, is of great importance in giving to the science we cultivate a lower datum-line than we previously possessed, as first propounded by myself before the British Association, in 1855.*

For hitherto the order of the geological succession, even as seen in the geological map of England and Wales or Ireland, as approved by Sir Henry De la Beche and his able coadjutors, Phillips, Ramsay, Jukes, and others, admit no older sedidiment than the Cambrian of North Wales, whether in its slaty condition in Merioneth and Caernarvon or in its more altered condition in Anglesea.

The researches in the Highlands have, however, shown that in our own islands, the older palæozoic rocks, properly so called, or those in which the first traces of life have been discovered, do repose, as in the broad regions of the Laurentian Mountains of Canada, upon a grand stratified crystalline foundation, in which both limestones and iron-ores occur subordinate to gneiss. In Scotland, therefore, these earliest gnessic accumulations are now to be marked on our maps by the Greek letter *alpha*, as preceding the Roman a, which had been previously appied to the lowest known deposits of England, Wales, and Ireland. Though we must not dogmatise and affirm that these fundamental deposits were in the pristine state absolutely unfurnished with any living things (for Logan and Sterry Hunt, in Canada, have suggested that there they indicate traces of the former life), we may conclude, that in the highly metamorphosed condition in which they are now presented to us in North Western Britain, and associated as they are with much granitic and hornblendic matter, they are for all purposes of the practical geologist "azoic rocks." The Cambrian rocks, or second stage in the ascending order as seen reposing on the fundamental gneiss of the North West of Scotland, are purple and red sandstones and conglomerates forming lofty mountains. These resemble to a great extent portions of the rocks of the same age which are so well known in the Longmynd range of Shropshire, and at Harlech in North Wales, and Bray Head in Ireland.

At Bray Head they have afforded the Oldhamia, possibly an Alga, whilst at the Longmynd, in Shropshire, they have yielded to the researches of Mr. Salter some worm-tracks and the trace of an obscure crustacean.

The Highland rocks of this age, as well as their equivalents, the Huronian rocks of North America, have as yet afforded no trace whatever of former life. And yet, such Cambrian rocks are in parts of the Longmynd, and especially in the lofty mountains of the North Western Highlands, much less metamorphosed than many of the crystalline rocks which lie upon them. Rising in the scale of successive deposits, we find a corresponding rise in the signs of former life on reaching that stage in the earlier slaty and schistose rocks in which animal remains begin clearly to show themselves. Thus, the Primordial Zone of Mr. Barrande is, according to that eminent man, the oldest fauna of his Silurian Basin in Bohemia.*

In the classification adopted by Sir Henry de la Beche and his associates, the Lingula Flags (the equivalent of the "Zone Primordial" of Barrande) are similarly placed at the base of the Silurian System. This Primordial Zone is also classed as the Lowest Silurian by De Verneuil, in Spain; by James Hall, Dale Owen, and others, in the United States; and by Sir W. E. Logan, Sterry Hunt, and Billings, in Canada.†

(*To be continued.*)

Cornish Engines.

The average duty of twenty-eight Cornish pumping engines, reported for August, was 51,200,000 lb., lifted 1 ft. high by the consumption of 112 lb. coal, the duty being equal to 4½ lb. coal per actual (not indicated) horse power per hour.

* See Reports of British Association for 1855 (Glasgow Meeting) At that time I was not aware that the same order was developed on a grand scale in Canada, nor do I now know when that order was there first observed by Sir W. E. Logan. I then (1855) simply put forward the facts as exhibited on the northwest coast of Scotland, viz., the existence of what I termed a lower or "fundamental gneiss," lying far beneath other gneissose and crystalline strata, and containing remains which I even then suggested were of Lower Silurian age. Subsequently, in 1859, when accompanied by Professor Ramsay, I adopted, at his suggestion, the word "Laurentian," in compliment to my friend, Sir William Logan, who had then worked out the order in Canada, and mapped it on a stupendous scale. I stated, however, at the same time, that, if a British synonym was to have been taken, I should have proposed the word "Lewisian," from the large island of the Lewis, almost wholly composed of this gneiss.

* I learn, however, that in Bohemia, Dr. Fritsch has recently discovered strata lying beneath the mass of the Primordial Zone of Barrande, and in rocks hitherto considered azoic, the fossil burrows of annelide animals similar to those of our own Longmynd.

† In completing at his own cost a geological survey of Spain, in which he has been occupied for several years, and in the carrying out of which he has determined the width of the sedimentary rocks of the Peninsula (including the Primordial Silurian Zone, discovered by that zealous explorer, M. Casiano de Prado), M. de Verneuil has in the last few months chiefly examined the eastern part of the kingdom where few of the older palæozoic rocks exist. I am, however, informed by him, that Upper Silurian rocks with *Cardiola Interrupta*, identical with those of France and Bohemia, occur along the southern flanks of the Pyrenees, and also re-occur in the Sierra Morena, in strata that overlie the great mass of Lower Silurian rocks as formerly described by M. Casiana de Prado himself. The southern face of the Pyrenees, he further informs me, is specially marked by the display of mural masses of Carboniferous strata, which, succeeding the Devonian rocks, are not arranged in basin-shape, but stand out in vertical or highly inclined positions, and are followed by extensive conglomerations and marls of Triassic age, and these by deposits charged with fossils of the Lias.

Board of Arts and Manufactures
FOR UPPER CANADA.

PHILP'S PATENT MARINE DROP.

Our advertising columns contain testimonials of Masters of Vessels as to the value of an invention by Mr. Philp, of Cobourg, of a mode of unhooking boats from the davits of sailing vessels or steamboats, of which the following is a description:—

A lever works under the middle shaft of the boat, connected to an upright shaft which passes through an iron plate about six inches long, in the bottom of the boat; to each end of this plate is affixed an iron rod, passing through two eyebolts at each end of the boat, and to which is attached a link for balancing or keeping the boat on an even keel.

By lowering the boat to within three or four feet of the water, and giving the lever a slight pull, it draws the rods out of the further eyebolts into those nearest the plate, leaving the hooks clear, and the boat drops into the water. By putting the lever back every thing is ready for hooking again, which one man can accomplish with ease.

RULES FOR THE DISTRIBUTION OF THE PRIZES AT THE INTERNATIONAL EXHIBITION.

The following are the rules according to which the prizes will be awarded:—

"An international jury will be formed for each class and sub-class of the Exhibition, by whom the medals will be adjudged.

"Each foreign commission will be at liberty to nominate one member of the jury for each class and sub-class in which staple industries of their country and its dependencies are represented.

"The names of the foreign jurors must be sent to Her Majesty's Commissioners before the 28th of February, 1862.

"The British jurors will be chosen in the following manner:—Every exhibitor will name three persons to act on the jury for each class or sub-class in which he exhibits, and from the persons so named, Her Majesty's Commissioners will select three members of the jury for each such class or sub-class.

"Her Majesty's Commissioners reserve to themselves the power of modifying thsee arrangements in any particular case where it may appear to them that the strict application of the principles of these decisions would be attended with injustice.

"The names of the jurors will be published in March, 1862.

"The juries will be required to submit their awards, with a brief statement of the grounds of each, to Her Majesty's Commissioners, before the last day of May, 1862.

"Should the reasons assigned for any award appear insufficient, or should no reasons be given, Her Majesty's Commissioners reserve to themselves the right ef confirming or rejecting it.

"The awards will be published in the Exhibition building, at a public ceremony, early in the month of June, 1862.

"They will immediately afterwards be conspicuously attached to the counters of the successful exhibitors, and the grounds of each award will be very briefly stated.

"If an exhibitor accepts the office of juror, no medal can be awarded in the class or sub-class to which he is appointed, either to himself individually or to the firm in which he may be a partner.

"The medals will be delivered to the exhibitors on the last day of the exhibition."

A SUPPLEMENTARY INTERNATIONAL EXHIBITION COMPANY.

It is proposed to establish an International Supplementary Exhibition Company, for the purpose of affording room for productions which cannot be accommodated in the great Exhibition of 1862, and to furnish means for the sale of articles exhibited at either place. The building is to be completed for opening on the 15th of May. The charge for space will be 12s. per square foot for the floor, and 6s. for the walls, being less than one-half of the annual rental of the London bazaars, and the period will be from the 15th of May to the end of October, The design and supervision of the structure will be by Sir Joseph Paxton, and the trustees are Sir Robert Carden, Alderman Finnis, and Mr. William Jackson, M.P. The company, before taking any steps, ascertained that the project would not be objected to by the Royal Commissioners of the Great Exhibition.

CANADIAN PATENTS.

Bureau of Agriculture and Statistics, Quebec, 20th February, 1862:—

James W. McLaren, of Lowville, in the County of Halton, "An improved feed gear for Straw Cutters."—(Dated 26th November, 1861.)

Alex. Solomon Wallbridge, of Bedford, in the County of Missisquoi, Carpenter, "An improved mode of operating variable expansion steam cut off Valves."—(Dated 28th November, 1861.)

Lewis Comer, of the Township of Hinchinbrook, in the county of Frontenac, Mechanic, "An improved Bee-Hive."—(Dated 29th November, 1861.)

William Chambers, of London, in the County of Middlesex, Engineer, "An improved Carriage Hub."—(Dated 29th November, 1861.)

Augustus E. Taylor, of the Town of Brockville, in the County of Leeds, "An improved Door Bell."—(Dated 29th November, 1861.)

Henry Lawson, of the Town of Peterborough, in the County of Peterborough, "A combined Retort for generating Gas from Carbon Oil."—(Dated 29th November, 1861.)

Thomas Blanton, of Drummondville, in the County of Welland, Carpenter and Joiner, "An improved Broad-Cast Seed-Sower and Drag."—(Dated 29th November, 1861.)

William McDougall, of the Township of York, in the County of York, "A self acting Brake for Sewing Machines."—(Dated 29th November, 1861.)

Thomas Wm. Harper, of the Town of Cobourg, in the County of Northumberland, Turner, "A new Wash Tub."—(Dated 29th November, 1861.)

Edwin R. Langs, of the Township of Brantford, in the county of Brant, Farmer, "A portable and substantial Fence-post and Fence."—(Dated 29th November, 1861.)

Philip Cady Van Brocklin, of the town of Brantford, in the county of Brant, Iron Founder, "An improved combined Grain Drill, Cultivator and Horse Hoe."—(Dated 29th November, 1861.)

Thomas Worswick, of the town of Guelph, in the county of Wellington, Engineer, "An improved Switch for Railroads."—(Dated 29th November, 1861.)

Etienne Henri Parent, of the city of Quebec, Civil Engineer, "For the introduction into Canada of a French invention known as "Air Expansion Motive Power produced by the combustion of Gases, by means of the Electric Spark."—(Dated 30th November, 1861.)

Edward D. Ashe, Lieutenant in Her Majesty's Navy, "A new and improved method of constructing Steam Engines, to be called 'Shaft Engines.'"—(Dated 2nd December, 1861.)

Harry Seymour, of the city of Montreal, Gentleman, "A composition to be named Seymour's Concentrated Fuel.—(Dated 2nd December, 1861.)

John Fleming, of Petrolia, in the county of Lambton, Engineer, "A double Acting Still."—(Dated 4th December, 1861.)

Masa Branch Southwick, of Mont St. Hilaire, in the County of Rouville, Manufacturer of Wool and Flax dressers, "A new and useful machine for separating shives, chaff and dust from the Tow of Flax, Hemp &c., to be called 'Southwick's Tow Cleaner.'"—(Dated 5th December, 1861.)

James Dougall, of the parish of Montreal, Engineer, "A composition of matter for the packing of axle boxes of Locomotive Engines, tenders and railway cars."—(Dated 5th December, 1861.)

Matthew Henry, of the township of Compton, in the County of Compton, Cabinet maker, 'A new Plough, to be called Henry's Complete Plough."—(Dated 9th December, 1851.)

Matthew Henry, of the township of Compton, in the County of Compton, Cabinet maker, "An improved Fanning Mill."—(Dated 9th Dec., 1861.)

William Franklin Hutchins, of the city of Montreal, Machinist, "A Rivet Machine."—(Dated 10th December, 1861.

Thomas H. Hoskings, of the city of London, in the county of Middlesex, Machinist, "A new machine for obtaining Rotary Motion for driving Machinery."—(Dated 16th December, 1861.)

James Howell, of the township of Dereham, in the County of Oxford, Moulder, "An Iron Die for moulding and casting Plough-shares."—(Dated 16th December, 1861.)

William Mohaffy, of the Town of Brampton, in the County of Peel, Blacksmith, "An improved Plough."—(Dated 16th December, 1861.)

Hugh N. Shaw, of Cooksville, in the County of Peel, Merchant, "An improved Dome Petroleum Separator."—(Dated 16th December, 1861.)

Stillman Ray, of the Township of Stanstead, in the County of Stanstead, Mechanic, "Ray's improved Tub and Pail Machine."—(Dated 18th December, 1861.)

George H. Meakins, of the city of Hamilton, in the County of Wentworth, Sewing Machine Maker, "A combined Universal Hemmer and Binder."—(Dated 26th December, 1861.)

James Tomlinson, of the Township of Pickering, in the County of Ontario, Mechanic, "A Bevelled Sawn Hoop."—(Dated 27th December, 1861.)

Samuel S. Martin, of the city of Toronto, in the county of York, assignee of John Angell Cull, the assignee of Edward Lefroy Cull, the Inventor, 'Auxilliary Spring Improvement for Sewing Machines."—(Dated 27th December, 1861.)

George Charters Keachie, of the town of Brantford, in the county of Brant, Gaoler, "An improved Strapless Skate."—(Dated 27th December, 1861.)

ABRIDGED SPECIFICATIONS OF ENGLISH PATENTS.

Full specifications of all English patents issued may be obtained on application to Bennet Woodcroft, Esq., Great Seal Patent Office, 25 Southampton Building, Holborn, London; the price of which—varying from 3d. to 5s. sterling—must be remitted by Post Office order, made payable at the Post Office, Holborn.

Lists of all specifications may be seen at the Free Library of Reference of the Board of Arts and Manufactures, Toronto, as published in the Commissioner of Patents Journal.

1328. M. de Albytre—*Improvements in tallow candles, called "Helioclypse candles."* Dated May, 27, 1861.

In carrying out this invention the patentee takes say 112 pounds of tallow, and melts by steam, water baths or open fire, giving preference to the two latter methods; and when it has been fused, he adds about 13 ounces of alumina, precipitated by ammonia. He then pours in about 1½ ounces of spikenard (lavendula spica), but other essences may be used if preferred. He heats about forty minutes, taking care to keep constantly stirring in order to divide or separate the alumina, and cause it to combine with the tallow. He then adds about 20 ounces of chloride of zinc, which must be perfectly white, and it is prepared in an alembic or matrass, in which zinc cut into very small pieces is placed in a sufficient quantity of acid to dissolve it. To this he adds about 20 ounces of chloride of lead, boiled or in pulp, and then the same quantity of solid chloride of zinc. He then continues to heat for from 40 to 45 minutes, being scrupulously careful to keep constantly stirring the mass with a spatula. He removes the composition from the fire when the scum is nearly black, and the dissolution of the matters complete. He then pours the mass into a trough or tub, or by preference into a glazed earthen pan, well stirring, after which he allows it to rest until he desires to pass it into the moulds. When he is manufacturing candles of 6 to the pound, he uses from 20 to 23 threads for the wick, and for those of 5 to the pound from 28 to 34 threads. By these means he obtains candles, one pound of which will give light for 80 to 85 hours, and which, while in whiteness and consistence almost equal wax, will not cost more than the commonest candles now made.

1442. R. HARLOW.—*Improvements in the fire bridges and tubes of steam boilers, and in the manner of applying the same.* Dated June 7, 1861.

The patentee claims the application and adaptation of a fire or water space bridge to boilers for the generation of steam (constructed after the manner as described), and composed of a series of small thin tubes, with the various modes of connecting the same with the upper and lower bodies of water in a steam boiler. And as regards the fixing of tubes in the interior of flues of cylindrical boilers, he claims only the application and adaptation of two or more portable or movable tubes to the flues of steam boilers, whereby they may readily have their powers increased, and the circulation improved, and the flues materially strengthened.

1507. J. WATT.—*An improved mode of converting vegetable fibrous substances into pulp.* Dated June 12, 1861.

This invention relates to a peculiar mode or process for converting vegetable fibrous substances into pulp, and consists in subjecting the vegetable fibrous substances to the action of proto-carbonate of soda, or bicarbonate of soda, or proto-carbonate of potassa, or of potassa, bicarbonate of soda, or soda ash, in solution in water, by heating the whole to the boiling point, and boiling the same until the fibrous substance has been so acted upon that, on being washed and treated with an aqueous solution of chloride of lime or chloride of soda, it is converted into pulp.

1543. T. GRAY.—*A new method of bleaching coloured rags and vegetable fibres.* Dated June 17, 1861.

The patentee claims the steeping and immersion of the substances to be bleached in a solution of muriatic acid and water, previously to their being submitted to the action of bleaching liquor.

1548. T. ROUTLEDGE.—*Improvements in the manufacture of paper.* Dated June 17, 1861.

This consists in the preparation of half-stuff (paper pulp) and paper from Esparto or Spanish grass (comprising spartum lignum, stipa terracissima, dis or alfa), the same being applicable to straw and other raw fibrous substances. The general details of the process are the same as specified in a patent (No. 274.) dated 2nd February, 1860, the improvement consisting in that portion which relates to the preparation of the leys employed in boiling Esparto or other raw fibres, and in order to preclude the presence of lime in the caustic state, or even to much causticity in the leys.

1578. J. FAULDING.—*Improvements in locomotive engines.* Dated June 19, 1861.

This consists in so combining the mechanical parts of a locomotive engine that all the momentum resulting from the working of the various parts of the engine shall be on the longitudinal central line of the locomotive. To effect this object the patentee places the two cylinders of the locomotive at right angles to each other or thereabouts, and unites the connecting rods of each to one central crank pin on the driving axle.

1852. J. CULLEN.—*Improvements in preserving wood and iron.* Dated June 19, 1861.

Here a composition, consisting of coal tar, quicklime, and charcoal, is used. The charcoal is reduced to a fine powder, and such is the case with the quick-lime; these materials are to be well mixed together and subjected to heat. To preserve wood, the composition is heated, and the wood is immersed therein.

1591. R. A. BROOMEN.—*Improvements in pianofortes, parts of which improvements are applicable to other musical instruments and to apparatuses worked by pedals.* (A communication.) Dated June 20, 1861.

One of the great drawbacks to the perfection of the pianoforte as a musical instrument is the noncontinuity of the sound, which, owing to the arrangement of the hammer, only lasts a stated time. To overcome this defect the inventor adds to the instrument an arrangement somewhat similar to the bow of a violin, which he causes to act separately or simultaneously with the hammer. To the intermittent percusive he adds a continuous action, and produces continuous sounds without in any way lessening the effects usually produced in pianofortes.

1633. M. A. F. MENNONS.—*A new or improved construction of caloric engines.* (A communication.) Dated June 26, 1861.

This invention consists in a new or improved combination of known machinery applied to the construction of locomotive, stationary, marine, and other engines. The essential elements of this combination, in which heated air is the motive agent, are:—1. A ventilating apparatus, by means of which cold air is thrown into the body of the engine. 2. A furnace, composed of a metallic cylinder, provided with a horizontal grate carrying the fuel, with vertical grated apertures, giving passage to the air supplied by the ventilator. 3. A turbine, mounted on a horizontal shaft, and driven by the dilated air mingled with the gaseous products of the combustion. 4. A regenerating apparatus, by means of which the cold air supplied by ventilator is progressively heated to a given point, while the temperature of the hot air escaping from the turbine is reduced in the same proportion.

1679. J. G. WILSON.—*Improvements in the means or apparatus employed for feeding steam boilers with hot water.* Dated July 2, 1861.

This consists in the application of a valve to the said tubes or feeding apparatus, so arranged and connected with the boiler that, when the pump ceases to force the water through the tubes, the valve will open to the water in the boiler, and allow it to circulate in the tubes, and thus prevent explosion or damage to the tube.

1694. J. PETRIE.—*Improvements in machinery or apparatus for washing and drying wool, cotton, and other fibrous materials requiring similar treatment.* Dated July 3, 1861.

This refer, 1, to a method of driving such feed aprons of machines for washing wool, &c., as are caused to travel by rollers, which act independently of those over which the apron passes, and consists in causing the said rollers to bite upon strips of leather, india-rubber, or other flexible material, so as to prevent them from acting upon the said apron direct. Another part consists in drying cotton, by causing a current of air, heated, or at the ordinary temperature, to be driven through the material by the exhausting or blowing action of a fan or fans.

1717. R. A. Smith.—*Improvements in purifying gas.* Dated July 6, 1861.

The patentee claims the purifying of gas from sulphur and its compounds, except sulphurretted hydrogen, by treating it with alkaline solutions of certain metals, in the manner described.

Correspondence.

ACTUAL AND NOMINAL HORSE POWER;

OR,

FIGURES OF ARITHMETIC *versus* FIGURES OF SPEECH

To the Editor of the Journal of the Board of Arts and Manufactures.

Sir,—In the preceding number of this journal there is an article of about three and a half pages, headed "A Standard Horse Power for Steam Engines," in which article the writer states that it is customary to value engines by the conventional unit of horse power. That in Britain the manufacturers have approximated to a common standard, but in Canada and the States nominal horse power, as a commercial unit of capacity, or power of performance, is an exceedingly vague expression. He also says that scarcely two manufacturers will give the same dimensions; that scarcely an individual manufacturer's own practice is uniform, and that it is a desideratum to have a common standard which would enable buyer and seller to deal with greater confidence and certainty, and is therefore a legitimate subject for legislation.

The article being long, even to prove the writer's case, it will be unnecessary to refer minutely to every portion of it, but since it is only to enable buyer and seller to deal with greater confidence, we fancy it is no difficult matter to show that they can deal with equal, if not greater, confidence under the present standard than they would do with the standard he alludes to, by buying by the real, "the actual" or effective horse power instead of the "nominal" one which he recommends.

In the case he refers to, of giving evidence regarding the power of a steam machine, where there were a dozen of witnesses examined, we venture to say that nine of those witnesses were in favor of the present standard, while only himself and another were for the nominal horse power. The nominal horse power advocates lost the case. The writer of that article says no two of these witnesses held the same opinion, farther than that a horse power should indicate the ability to elevate 33,000 lbs. one foot high, in one minute. Now, their agreeing upon this point is all that is necessary, as it is the actual horse power—in reality what a horse can do. It was as much to avoid the difficulty arising from this not having been so universally agreed upon in Britain that the nominal horse power found favor, there being at that time a wide discrepancy of what a horse could do,

Smeaton allowing 22,916,
Desagliurs . . 27,500,
Watt . . . . 33,000 lbs., raised one foot high, in one minute, and because this last was more generally received in Britain than the others it came to be exclusively adopted in this country, and its being so adopted renders it quite unnecessary to bring in any other standard. Any difficulty that may have arisen as to the power of steam engines, between the manufacturers and the buyers, has been instigated by the advocates of nominal horse power, which does not, and we hope never will obtain, in Canada, as a standard; and for this reason, that it is more likely to confuse and mislead the uninitiated than the present standard of "actual" or effective horse power.

He says that a standard horse power is as necessary as a standard bushel or a standard yard. So it is. And 33,000 lbs., raised one foot high, in one minute, is this standard, and better than any number of square or circular inches of piston surface, which he recommends. If pressure and speed were constant quantities, then we could have no objection to that mode of measurement which he recommends, but as these are not constant quantities, to adopt his mode of measurement would be adopting a false measure of power—"a fiction"—a mere figure of speech.

He says the great difference between the nominal and actual horse power, culminated in the Great Eastern, whose engines were nominally 2,600 horse power, but which worked up to 8,300 horse power. If this proves anything, it does prove that 2,600 was a false measurement of the power of the engines of the Great Eastern.

The article under review contains about forty paragraphs, twenty-eight of which are devoted to the steam engine, and the remainder to the boilers for steam engines. In paragraph No. 6 it is stated that actual horse power is liable to many disturbing causes, some of which vary with every change in the dimensions of the machinery, and its final determination can never be arrived at with exactness until the engine is at work and a diagram indicator applied to the determined point at which the force is to be delivered. In reference to this statement we would simply remark that the actual horse power, so far as relates to buying and selling dimensions, is not liable to disturbing causes. The rule holds good in every case, and is always the same. The dimensions, of course, "vary with the pressure and the speed," but the rule does not vary, and by this rule the buying and selling dimensions are so easily computed that the veriest novice in mechanics can generally perform it.

The diagram indicator is quite unnecessary for determining the actual—the buying and selling horse power of an engine. It is desirable, however, to test by a diagram indicator every steam engine, from time to time, in order to find out its efficiency, "if in good working order," and when not in good working order or condition. The diagram indicator will point out where and what the defect or derangement is, so that it can be at once rectified. The application of the indicator will discover some engines working above, and some working below the estimated power. Defects or excellences will cause this variation, but such defects or excellences do not, in consequence of this variation, invalidate the standard of measurement of actual horse power. This must be apparent to every one at all conversant with the subject.

In contracting for a steam engine it is understood that it will be free from any such defects in construction. It is necessary, however, and proper, that the buyer and seller agree, in the first place, as to the pressure to be used in the boiler, and the speed to be given to the piston, these being given the power is easily found from the following simple formula:

Let P = the pressure in lbs. per square inch on boiler,
a = the area of piston in square inches,
v = velocity in feet of piston per minute,

then $\frac{(P \times a \times v \times 2 \div 3)}{33000}$ = actual horse power.

One third of the gross power being deducted for condensation, friction and back pressure. Or, as some prefer the following formula, which gives the same result, take $\frac{2}{3}$ of the gross pressure on the boiler; call this the effective pressure; then:

Let EP = effective pressure—or $\frac{2}{3}$ gross pressure,
a = area of piston in square inches,
v = velocity of piston in feet per minute.

$\frac{EP \times a \times v}{33000}$ = the actual horse power.

It will be seen from the above that there is no necessity for any other standard as a commercial unit, the size of the engine in all cases being determined from the following given quantities:

The number of horse power required to perform the work assigned to it by the buyer.

The pressure to be used per square inch on the boiler.

The velocity to be given to the piston, in feet, per minute.

Let the phrase "nominal horse power" be excluded, as it has hitherto been from the vocabulary of the workshop, and there will be fewer cases of litigation in such matters in future, though not to the pecuniary advantage of the "nominal horse power" advocates, who fatten on such cases, and with whom they generally originate.

In engines with a condenser take the boiler pressure, to which add $12\frac{1}{2}$ lbs. per square inch; call $\frac{2}{3}$ of this the effective pressure, $12\frac{1}{2}$ lbs. being gained from the condenser.

The size of the condensing engine will be determined from the following elements:

The number of horse power required to perform the work assigned to it.

The pressure to be used on the boiler + $12\frac{1}{2}$ lbs. $\times 2 \div 3$ for effective pressure.

The velocity of piston, in feet, per minute.

The writer of said article, so frequently referred to in seeking to establish a standard horse power in this country, might have chosen a much nearer approximation to the actual horse power than the British nominal one, seeing that by his own statement it is fully three times less than the actual horse power when the power of the engines of the Great Eastern were tested by the diagram indicator. From this example it would not be far from the truth to use the following formula:

$NH \times 3{\cdot}2$ = the actual horse power.

NH being the nominal horse power, as per the Great Eastern.

The writer confesses that in the early history of the steam engine the nominal horse power was intended to, and did approximately represent the actual horse power. Now, however, various rules are adopted by the manufacturers in different districts in Great Britain, where they have the "Manchester rule," the "Leeds rule," the "Glasgow rule," and the "Boulton & Watt rule." These rules again vary for condensing as well as non-condensing engines, and in giving an example of the Boulton & Watt rule he says they "assumed" the piston velocity to be 128 feet per minute—multiplied by the cube root of the stroke in feet; the mean effective pressure is "assumed" to be 7 lbs. per square inch (always something assumed), then the nominal horse power will be:

$$\frac{\sqrt[3]{\text{stroke in feet}} \times \text{diam}^2 \text{ in inches}}{47} \text{ nearly.}$$

This formula is very obscure, and does not seem to be constructed from the assumed conditions, as neither the velocity of the piston nor the main effective pressure is discoverable in the formula. Yet, he adds, in the South of England this formula is much used, substituting as the divisor 60 for 47, a difference, we would remark, sufficiently large to set aside this formula. And further, he says the Admiralty formula is somewhat similar, excepting that a different speed for the piston is adopted, according to the stroke of the engine. Thus, when the stroke is 3 feet, the speed is taken at 180, and, when the stroke is $5\frac{1}{2}$ feet, the speed is "assumed" to be 216 feet per minute. The effective pressure is always taken at 7 lbs on the inch, and the formula thus expressed:

$$HP = \frac{\text{area of cylinder in inches} \times 7 \times \text{speed of piston in feet per minute}}{33000}$$

This formula is very different to the preceding one, and when using an effective pressure of 7 lbs per inch, it gives the actual horse power of the engine. Next follows the Manchester rule, with 23 square inches of piston surface; the Leeds rule, with 30 circular inches for condensing engines and for non-condensing engines. The Manchester rule is said to be 10 square inches, and Leeds 16 circular inches of piston surface. The Glasgow rule is said to give the same number of circular inches to that of Manchester's square inches.

It must be very clear to any person conversant with steam engines that to adopt either of these rules, or a medium between them, in Canada, would be to give away something certain for something uncertain—a reality for a fiction—something clearly understood for something indefinite. And from the great uncertainty of getting a more explicit knowledge of the size and power of an engine from any of these rules, than by our present standard of computation, we may safely leave them as so many crotchets of the time when pressure and speed were more uniform than they are now, in being almost constant quantities, when the one was limited to 7 lbs on the inch, and the other to 220 feet per minute.

The writer says that in estimating indicated horse power, neither the power expended in working the air-pumps of condensing engines, the friction of the machinery, nor the force expended in working the valves, has usually been considered, the power in the cylinder being alone expressed by the ordinary formula.

Indicated horse power thus:

$$\frac{\text{Mean eff. pres.} \times \text{diam}^2 \times \cdot 7854 \times \text{stroke} \times 2 \times \text{no. rev. per min.}}{33000}$$

Now, this is practically correct, and proves the preceding statement to be incorrect. Since all these items then referred to, are included in the reduction of gross pressure, per inch, on boiler, to Effective pressure, which is two-thirds of the former, one-third being deducted expressly to cover these items of resistance. The above formula is the same as that we have already given, only not so concise, which is:

$$EP = \text{effective pressure},$$

$$\frac{EP \times a \times v}{33000} = \text{the actual HP.}$$

It was only in the early days of the steam engine that there was any dispute as to its power, as they could not agree as to the average strength of a horse, one giving 22,916, another 27,500, another 33,000 lbs, raised one foot high, in one minute. There was then show of reason in the attempt to measure by surface of piston. This, however, is quite unnecessary here, since we all agree to the standard of 33,000 lbs. as the actual horse power. It will be observed that the nominal horse power is computed from an "assumed" speed, and an "assumed" pressure. Now, in computing actual horse power, nothing is assumed, the power being computed from the actual conditions laid down. For instance: A new steam engine is required of a certain number of horses power, the boiler not to be pressed above 50 lbs on the square inch, and the piston not to have a velocity beyond 300 feet per minute. These conditions determine the size of the engine. Take another case: A steam engine is required of the same power as the above, but the pressure on the boiler is only to be 30 lbs on the inch, and the piston velocity 250 feet per minute. The conditions, in this instance, will determine that this engine would require to be about twice the size of the former, consequently its cost would be considerably more than that of the former, yet of the same power. A great revolution in the construction of steam engines has taken place since the time when these rules of piston measurement were adopted, "and only partially adopted." The whole field of working steam expansively with increased pressure and speed, and which, with other improvements, the cost for fuel has been reduced in well made engines to a third of what it was at that time, that is, a bushel of coal, with our present well made engines, will raise a weight 3 times heavier, a given height, in a given time, than with the engines of that period—the period of the nominal horse power.

The "mechanical effect" of steam is now better understood and acted upon than at that period. This, however, and the subject of steam boilers, must be deferred until a more appropriate time.

Z.

BRITISH PUBLICATIONS FOR JANUARY.

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Reviews.

Chemistry, Theoretical, Practical, and Analytical, as applied and relating to the Arts and Manufactures, by Dr. Sheridan Muspratt, F.R.S.E. *William Mackenzie, London: Roy. 8vo., 2 vol.*

The name of Dr. Muspratt has so long been before the public as one of the distinguished practical chemists of modern times, that any work to which his name is attached, will be received with favour and confidence by the public. These splendid volumes are got up in a style far superior to that in which scientific works are usually published. Not only are all the more intricate processes of Practical and Applied Chemistry illustrated by excellent wood engravings, but we have admirable likenesses on steel of the most eminent chemists of Europe and America. Life like portraits of Playfair Faraday, Chaptal, Fownes, Gregory, Priestly' Wohler, Bunsen, Chevreul, Leibig, Morfit, Hoff. man and a host of others.

All the new processes as applied to chemistry are given at considerable length and with very complete diagrams. The typographical execution of the work is admirable, and although the price is high yet there are few who are largely engaged in the manufacturing operations in which chemical principles are involved, who will not be tempted to find a place in their library for this handsome addition tion to works of reference in the applied Sciences.

Appleton's Dictionary of Machines, Mechanics, Engine-work and Engineering, illustrated with Four Hundred engravings in wood, in two volumes, Roy. 8vo.: New York, Appleton & Co.

To those who are in possession of the last edition of Ure's Dictionary of Arts, Manufactures, and Mines, edited by Robert Hunt, Appleton's Dictionary will appear to contain almost a reprint of many articles in that excellent work, but with numerous essays on different subjects, not treated of by the learned editor of Ure's standard work. The handsome volumes under review contain very many illustrations and descriptions of machinery which will render them especially attractive to a certain class of readers, but in the article on gas, and those departments of industry involving chemical processes the reader will find all the details in Muspratt's Chemistry, or in Ure's Dictionary. But it would not be doing justice to Appleton's dictionary if we were not to notice many very excellent descriptions of American progress in mechanism and engineering. It is especially in the department of Mechanical Science that these volumes are valuable, and in the descriptions given of the details of great workshops either of a private or public character in the United States, the practical man will find much information, which in these days of progress may be considered as indispensable.

Selected Articles.

THE NEW IRON-PLATED WAR STEAMERS FOR THE BRITISH NAVY.*

The first of them, the *Achilles*, which has recently been begun in Chatham Dockyard, so nearly resembles the *Warrior* and *Black Prince* that a very few words will suffice for her. The chief difference between her and those vessels lies, I believe, in the fact that her beam is slightly broader, and her floor somewhat flatter, than her predecessors; whereby her tonnage is increased from 6,039 to 6,089 tons, and her displacement from 8,625 to 9,030 tons. All her other dimensions, and all her essential features of construction, are exactly like those of the *Warrior*—from which it may be inferred that the method of plating the central part only of the ship, which was introduced by your distinguished Vice-President, Mr. Scott Russell, is still viewed with favour by the Admiralty designers. Mr. Scott Russell did not patent his invention, I believe; perhaps he will kindly tell us whether he has found his rejection of the Patent Law to pay him well in this instance.

In the class of ships which come next, however, the Admiralty have consented to forego the plan of plating amidships only, and purpose plating the ship from end to end with thick iron. But in order to do this it has been necessary to resort to

* Abbreviated from a paper by E. J. Reed, Esq., member and Secretary of the Institute of Naval Architects.

larger dimensions than the *Warrior's*; and hence these six new ships, three of which have just been contracted for, are to be 20 feet longer than her, 15 inches broader, af 582 tons additional burden, and 1,245 tons additional displacement. As the displacement is the true measure of the ship's actual size below the water, or of her weight, it is evident that the new ships are to be considerably more than 1,000 tons larger than the *Warrior's* class. As their engines are to be only of the same power, their speed will probably be less. This diminished speed is one of the penalties which have to be paid for protecting the extremities of the ship with thick plates. Another will probably be a great tendency to plunge and chop in a seaway. The construction of such vessels is a series of compromises, and no one can fairly blame the Admiralty for building vessels on various plans, so that their relative merits may be practically tested.

The cost of this new class of ships will exceed that of the *Warrior* class by many thousands of pounds, owing to the increased size. But it will certainly be a noble specimen of a war-ship. A vessel built throughout of iron, 400 feet long and nearly 60 broad, invulnerable from end to end to all shell and to nearly all shot, armed with an abundance of the most powerful ordnance, with ports 9 feet 6 inches above the water, and steaming at a speed of say 13 knots per hour, will indeed be a formidable engine of war. And, if the present intentions of the Admiralty are carried out, we shall add six such vessels to our Navy during the next year or two. We must be prepared, however, to dispense with all beautifying devices in these ships. Their stems are to be upright, or very nearly so, and without the forward-reaching "knee of the head" which adds so much to the beauty of our present vessels. Their sterns will also be upright, and left as devoid of adornment as the bows. It should also be stated, as a characteristic feature of these six new ships, that their thick plating will not extend quite to the bow at the upper part, but will stop at its junction with a transverse plated bulkhead some little distance from the stem, and this bulkhead will rise to a sufficient height to protect the spar deck from being raked by shot.

It has not yet been decided whether these new iron ships are to have their plating backed up with teak timber, as in the previous ships; or whether plating 6½ inches in thickness, without a wood backing, is to be applied to them. The determination of this point is to be dependent, I believe, upon the results of the forthcoming experiments with the large targets to which I have previously adverted, and partly upon the recommendations of the Iron Plate Committee, to which our President belongs, and which is presided over by the distinguished officer now present, Captain Sir John Dalrymple Hay, R. N. All that has been decided is, that whether the armour be of iron alone or of iron and wood combined, its weight is to be equivalent to that of iron 6½ inches thick. The designs of the ship have been prepared subject to this arrangement, and provision has been made in the contracts for the adoption of whichever form of armour may be deemed best when the time comes for applying it.

All the iron-cased which I have thus far described are built, or to be built, of iron throughout, except in so far as the timber backing of the plates, the planking of the decks, and certain internal fittings may be concerned. I now come to notice a very different class of vessel, in which the hull is to be formed mainly of timber, the armour plating being brought upon the ordinary outside planking. The *Royal Alfred, Royal Oak, Caledonia, Ocean,* and *Triumph* are to be of this class. Their dimensions are to be—length 273 feet, breadth 58 feet 5 inches, depth in hold 19 feet 10 inches, mean draught of water 25 feet 9 inches, and height of port 7 feet. They are to be of 4,045 tons burden and to have a displacement of 6,839 tons. They are to be fitted with engines of 1,000 horse-power. They are being framed with timbers originally designed for wooden line-of-battle ships, but are to be 18 feet longer than those ships were to be. They will form a class of vessels intermediate between the *Hector* and the *Warrior* classes, but, unlike both of them, will be plated with armour from end to end. They will be without knees of the head, and with upright sterns; and will, therefore, look very nearly as ugly as *La Gloire*, although in other respects much superior vessels, being 21 feet 6 inches longer, 3 feet 5 inches broader, and of less draught of water. They will also be quite equal to her in speed.

It will occur to some now present, that in adopting this class of ship, we have, after three years' delay, approximated somewhat to the *Gloire* model at last. And undoubtedly we have done so in the present emergency, in order to compete with the movements which France is now making. At the same time we have not gone to work quite so clumsily as our neighbours. Instead of retaining the old line-of-battle-ship proportions, we have gone somewhat beyond them; and have lifted all the decks, in order to raise our guns higher above the water. We have consequently secured a height of port or battery nearly 18 inches greater than *La Gloire's*—an advantage which will prove valuable under all ordinary circumstances, and incalculably beneficial in rough weather.

Let me now consider briefly the pecuniary phase of this iron-cased ship question. We may fairly assume that the average cost of such vessels will not be less than £50 per ton, and that their engines will cost at least £60 per horse-power. Supposing these figures to be correct, then the hulls of the eighteen ships which we have been considering will cost us £4,681,600, and their engines £1,143,000—together nearly *six millions* pounds sterling. When masted, rigged, armed, and fully equipped for sea, they will of course represent a much larger sum—probably nearly *eight millions*. These estimates will afford some faint conception of the nature of that "reconstruction" of the Navy upon which we may now be said to have fairly entered, in so far as the ships themselves are considered.

Copper.

At Ontonagon, Lake Superior, the National mines yielded 107 tuns, 1078 lbs, of copper in the month of December last. Of this amount there was 123,487 lbs. of it in masses. A French company is going to erect copper smelting works in the Ontonagon district next spring.

RECENT PROGRESS OF THE MAGNETIC TELEGRAPH.

I.—The Pacific Telegraph. II.—The California Telegraph. III.—The Malta aud Alexandria Telegraph. IV.—Telegraph in Europe. V.—Telegraph Extension on the Pacific.

The Pacific Telegraph.

On Thanksgiving day, the 28th ult., says the Rochester *Union*, a large party of the workmen engaged in constructing the Pacific telegraph from the western borders to Salt Lake City, under the direction of Mr. Creighton, arrived at Omaha on their return. The line had been constructed previous to July, 1861, as far west as Julesburgh, which is on the Platt River, 300 miles east of Denver. From that point to Fort Bridger, about 700 miles, the line was constructed by the party of which Mr. Starr was one. Mr. Creighton had from 75 to 80 men employed, and they were divided in three trains. The men of one train dug the holes, those of another cut down the poles and set them, and a third put up the wire. In the three trains there were about 75 waggons and 700 cattle, including a few milch cows, to furnish milk for the men. The waggons contained from 35 to 45 hundred pounds each, consisting of wire, insultators, tools, camp equipage and provisions. The trains were said to be the best that ever started over the plains—the cattle being excellent, the waggons good, and all that pertained to the comfort of the men was in keeping with the rest. Good tents were provided, also cooking stoves, and all the necessary utensils for providing meals, and—what was quite in keeping with these—the best food that could be conveyed over the plains and mountains.

The first pole was set on the 4th of July, at Julesburgh, and the last on this section at Fort Bridger, about one hundred miles this side of Salt Lake City, on the 15th of October. The diggers' went ahead and got along at the rate of about twelve miles per day, digging about twenty-four holes for each mile. The train which put up the poles only made about ten miles per day, and was one hundred and fifty miles behind the diggers when the latter reached the end of the route. On the plains the digging was easy, and the work went rapidly on; in the mountains it was slow, owing to the rocky soil.

The poles were selected, cut, stripped of bark by the men, and were then drawn out by the cattle and distributed along the line. In some localities excellent timber was found in great abundance, hard pine being most plenty, though some cedar was obtained. Dead or dry pines were often found in large quantities, some of which would make three poles each of suitable size. In some localities the poles had to be cut in the mountains, and hauled over one hundred miles. Each pole is twenty feet in length, and is buried four feet in the ground. Through the Rocky Mountain Pass, where the line runs, there are points where the snow is known to cover the ground to the depth of eleven feet.

The line is well put up, and is substantial as such can be. It has a single wire, not exposed to damage from the falling of trees, as care was taken to avoid every thing of that kind.

The route adopted was mainly along the road, across the plains and through the mountains. To shorten distances, where the road ran in a serpentine form, the telegraph takes a direct line, following the general course of the road. The track pursued by the western trains over the plain is very crooked, often made so by the cattle dying in the path. When an animal falls, its carcass is seldom removed from the track, except as the wolves carry it away by piece-meal; and trains which follow turn out to avoid it, thus making a crooked path, for the bones of thousand of animals lie bleaching along the great paths that lead from the Missouri to the Pacific.

The constructors of this Telegraph line met with no hostile Indians, though they saw many of the natives along the way, and sometimes suffered by their thieving depredations. The Indian Agent at Deer Creek, sixty-five miles above Fort Laramie, told Mr. Starr that one of the Sioux chiefs conversed with him about the telegraph project before the poles were set, and said that he understood that poles were to be set sixteen feet high, and then strung with wires closely from top to bottom. As this would make a wire fence, all the buffaloes and other game would be kept from coming to the south. He looked upon the project with disfavor; but when he understood that there was to be but one wire, and that sixteen feet above the ground, he was quite relieved of his fears, and appeared to be satisfied. Speaking of the manner in which the natives regard the telegraph, Mr. Starr says the antelopes were timid and distrustful. Herds of them crossing the plains would stop when they came to the telegraph, and cautiously examine the poles before venturing to pass between them.

The stations of the telegraph operators are chiefly at the stations of the mail company, from fifty to one hundred miles apart. There are usually two or three persons at each station, taking care of the mules of the stage company, and these are all the society the operator has. The work for repairing the same must, for the present at least be performed by the operators going out when they find communication with the next station interrupted. The duty of an operator and repairer is anything but a pastime, and to perform it well requires hardy, courageous men, who are not afraid to be alone, and to contend with snow storms and whatever else they may meet in that vast wild region over which they must sometimes travel. The right men will, in time, be found in the right places; and of the successful working of the telegraph to the Pacific, none are more confident than the men who constructed it, and who, therefore, best know what obstacles are in the way.

California Telegraph Tariff.

The rates as fixed from St. Louis are according to the following table:—

First 10 words,	$4 25
Next 90 words, (each,)	36
Next 400 words, (each,)	24
Next 500 words, (each,)	18
After 1,000 words, (each,)	12

These rates for the lowest amount of matter telegraphed strictly conform to the act of Congress, which limited the maximum to $4 25 for the first ten words, and thirty-six cents for each additional. The rates from New York to San Francisco are

$5 95 for the first ten words, and forty-eight cents for each subsequent word, the difference being the present charges between New York and St. Louis. As yet, through rates are exacted upon all despatches to Salt Lake City, Carson City, and other intermediate stations on the route, no way rates having so far been determined on. This irregularity will, however ,it is said, be of only short duration, as at a meeting of the company, soon to be held in New York, a way schedule will be agreed upon. The impression that the present rates are too high, either for the accommodation of the public or the interests of the company, is one which time may confirm. Such is the opinion of some of the corporators.

The President's message of December, 1861, was telegraphed from New York to San Francisco in thirty-six hours. The cost of this was about one hundred and fifty-six dollars. The difference in time between these two places is about three hours. The ordinary time occupied in the transmission of a short message is about three hours, so that a short message, leaving New York at 9 A. M., will reach San Francisco at 9 A.M., their time.

THE GROWTH OF CORAL REEFS.

A LECTURE BY PROFESSOR AGASSIZ.*

A question which excited the greatest interest a few years since, was in relation to the time at which animals first made their appearance on earth. It was formerly supposed that we knew exactly how many years had elapsed since all animals were created, but on examination it is found that the chronology of Genesis relates only to man, and we now know that the lower orders of animals existed long before man was created. I will give you an account this evening of the animals that build the coral reefs, and will present some facts indicating the periods during which they have been at work.

Coral is not the shell of an animal, but it forms the hard part of his body, just as much as our bones are parts of our bodies. If any of you have seen the jelly-like animal that floats about the docks of our harbors—the Sea Anemone—you can form a very good idea of the coral animal.

The carbonate of lime which forms the durable part of the animal—the part with which we are all familiar—is drawn in by the animal with its food, and is secreted by its organs and deposited on the outer wall of its body and on the radiating divisions thickening them. The soft parts of the polyp are capable of such variations in volume that they may be expanded or contracted so as to be contained in a cavity in the upper portion of the cylinder.

Coral reefs are built in this form. A horizonal line represents the surface of the water, and a lower line the bottom of the sea sloping downward from the shore. The reef is nearly vertical on the sea side, and considerably inclined on the side next the land. They are always commenced in water from 10 to 12 fathoms in depth, never more than 72 feet, never less than 60.

This statement may seem to conflict with that of Capt. Cook, that he brought up corals in the Pacific Ocean from a depth of 2,000 feet. But, though I have no doubt of the truth of Capt. Cook's statement, and though I know that mine is correct, there is no conflict between them. It is ascertained that the bottom of the Pacific Ocean is subsiding, and we know the direction of the subsidence. The corals that Capt. Cook recovered from so great a depth were the limestone remains of animals that had long been dead. They grew at the usual proximity to the surface. and were carried down with the settling of the ocean bed.

There are several species of corals, and each lives at a certain depth beneath the surface; being unable to exist either above or below the zone for which it is adapted. This is not strange when we consider the very soft character of its body, and the rapidity with which the pressure of water increases with the depth. At the surface there is a pressure of one atmosphere, at a depth of 32 feet, a pressure of two atmospheres, and at the depth of 64 feet a pressure of three atmospheres, and this is as great a pressure as any of these animals can bear.

Each coral reef is built by four species of polyps; the bottom being constructed by the species which lives at the greatest depth, and the several parts above by species inhabiting corresponding strata of water. The reef builder lays the foundation at the base of the outer wall; and the growth is more rapid there than it is in the parts nearer the land. For this polyp is adapted to clean sea water, and will not live in the foul water inside the reef. The reef, therefore, soon assumes a form similar to that which it has in its finished state. When the species of polyp that lives in water of 10 or 12 fathoms in in depth has carried the structure up through the zone which it inhabits, his labors cease, and the work is continued by a second species. As the species does not require water so pure as the first he extends his growth towards the shore. Having grown upward through his stratum of water, his growth ceases, and a third and fourth species complete the reef.

It was at one time a mystery to us that one species could thus apparently grow out of another. But in examining the mode of reproduction of these polyps, I discovered facts which explained the mystery. Though the mature animal is attached immovably to the rock, when first hatched he swims through the water, and is confined to the same stratum of depth as in the matured state. When swiming about in this undeveloped state, if he encounters the upper surface of a coral reef which has grown up to his stratum of water he attaches himself to it and then begins to grow; thus continuing the structure.

These polyps multiply and grow by a process of budding. A protuberance appears upon one side of the body, which finally develops into a perfect animal; but is not separated from the parent, making a compound animal of numerous individuals united together. However strange this process may seem to us in the animal kingdom we are familiar with it in the vegetable. Each bud of a tree is a complete individual in itself, but they all unite to form a common plant.

The peninsula of Florida has been formed by these little animals, and they are still extending it southward toward the island of Cuba. In connection with the operation of the Coast Survey I visited the southern part of Florida and I made some ef-

* *Scientific American.*

forts to ascertain the rate of their growth. The foundations of Fort Jefferson, on Tortugas Island, and of Fort Taylor, at Key West, showed that the reefs had risen one inch in Fourteen years. This would give in round numbers, after allowing for inaccuracies, say one foot in a century. This is doubtless more rapid than the actual growth, as the mass near the bottom is crushed together and compressed by the superincumbent weight, and it would probably take at least two centuries to grow one foot But calling it one foot in a century it would take a reef sixty centuries or six thousand years, to rise from a depth of sixty feet to the surface.

Let this indicate the outline of the southern end of Florida. Nearly parallel with the coast, diverging from it toward the west, is a row of small islands, called keys, and beyond these again a row of still smaller islands, which are called coral reefs. On examining the keys, too, they are found to be reefs of coral. Now, as the reef building polyps can live only in the clean sea water, and perish if brought into the muddy water inside the reefs, we come to the conclusion that the keys were built up before the outer reefs were commenced. And if we allow the same rate of growth for them, their foundations must have been laid at least 12,000 years ago.

Along the coast is a marshy tract of land called the Indian Hunting Grounds, and beyond this, still parallel with the coast, is a row of low elevations called hammocks, rising some ten or twelve feet above the surface of the swamp, the mountains of that district; and these, on examination, are found to be still older coral reefs, carrying back our chronology another 6,000 years. Beyond these there is still another row, making 24,000 years.

The distance from the outer reefs to those last named is fifteen miles. I am told by intelligent officers of the army who have explored the country to Lake Okeechobee, sixty miles inland, that it is all formed of series of coral reefs. In fact, the whole peninsula of Florida is a coral formation, and we are brought to the conclusion that hundreds of thousands of years have been consumed in its slow growth.

And yet this is to-day in the chronology of our globe. The polyps that have built up Florida belong to living species. In the divisions of geologists this is the present formation. When we examine rocks formed by extinct species, we are led to a knowledge of periods still more inconceivable, during which nature has been conducting her operations.

HARDWARE IN THE EXHIBITION OF 1862.

The *Ironmonger* says:—Exhibitors in the hardware centres are now manifesting considerable interest in the Exhibition of 1862, and great activity is being displayed in preparing specimens.

It is said, on the authority of the Royal Commissioners, that the total demand for floor space is seven times the quantity of that available. That being the case, the awards of space of floor do not appear liable to dispute, and, admitting that the duties are arduous which the local committees have had to perform, their hands have been strengthened by a most judicious letter which has been issued by the Royal Commissioners, and which is full of information, alike to local committees and exhibitors. In that letter exhibitors are encouraged to endeavour to pile their goods, in the official words, by the "construction of screens or vertical cases, rising above the counters, or objects arranged on the floor. These screens, throughout the building, may be at least 12 feet high, and in some cases 25 feet, or even higher." Very few general hardwares, however, can be so treated, and the exhibiting of them prove of advantage to the exhibitor. For articles which will be suspended over head (not on walls) there is, practically, an unlimited space at the disposal of the Commissioners. Of this mode of exhibition, too, hardware manufacturers will, generally, be unable to avail themselves.

Steps are being taken in Wolverhampton which are likely to revive the great lock controversy of ten years ago. There is now in course of manufacture in that town a new patent keyless lock, having 244,140,125 combinations, to open all of which would take a man—supposing he could live so long—some 130 years! This extraordinary lock, which is based upon the permutation principle, is the invention of Viscount de Kersolon, of Paris, and by him communicated to Mr. Edward Loysel, of Cannon street, London, who is better known as the patentee of the coffee percolator. Although it is termed a keyless lock, it has as many keys as there are combinations, the back parts being the locks and the front parts the keys, which cannot be removed. Every change made in the concentric rings answers the same purpose as the keys, so that a lock which has seven permutations, or 5,040 combinations, has 5,040 keys, and so it is termed a keyless lock, with 5,040 or any number of keys. The specimen has six concentric cylinders, upon the projecting or outer edges of which are twenty-five of the twenty-six letters of the alphabet, and it is only when these letters are brought to a certain predetermined arrangement that the other parts of the lock can be worked as to admit of the bolt being drawn for the purpose of shutting or opening the article to which the lock is applied. It is absolutely necessary, as in the old letter padlock, to know the proper arrangement or combination of letters before the lock can be opened. In order to prevent the particular combination of letters from being discovered by feeling the parts, as is sometimes the case, the inner edges of the moveable concentric cylinders are toothed or serrated, so as to deceive any person who may attempt to tamper with the lock. In the event of the particular combination of letters not being discovered by the person desirous of opening the lock, the exhausting of all the variations which are in that case necessary to the success of the operation would entail an expenditure of the time we have mentioned, supposing the operator to make ten changes a minute, and to manipulate ten hours on every working day. It is intended to place these locks on some iron safes that are also being made in Wolverhampton for exhibition at the forthcoming "World's Fair." In one of the safes it is proposed to place the sum of £500, which is to fall to the lot of the person who may be fortunate enough to effect an opening into the safe. The production of the lock for the market is in the hands of Mr. Aubin, the inventor of the "Trophy lock of ingenuity," which was exhibited in the Hyde-park Palace, and subsequently purchased by Mr. Hobbs. Mr. Aubin, then a working locksmith, is now the proprietor of works in Wolverhampton, where he employs machinery invented by himself, and of equal delicacy with that displayed in the model which made his name celebrated. His ingenuity is being further displayed in the designing and constructing of machinery adapted to the manufacture just described. Mr. Aubin's practical experience also is being brought to bear in making such improvements upon the Count's lock as are required to increase the probability of its success in a financial aspect. The principle of the lock may be applied to every variety of this description of fastening, and when used upon a travelling-bag is a vast improvement upon locks that require keys to open them, and is at the same time a great ornament.

WESTERN AUSTRALIA.—GREGORY'S EXPEDITION.

It is seldom we have, on the departure of the foreign mails, events to report so interesting and important as those which have transpired since our last summary. The safe return of Mr. Gregory and his party from exploring that portion of Australia lying between Shark's and Roebuck Bays, after an expedition which has been not only successful in its results, but also carried out without a single mishap to any of the party, is a matter for congratulation to himself and all concerned in promoting it. The discovery of a very great extent of good country, of easy access, and well watered by large rivers and frequent smaller springs, is too unusual in Australia not to exite great attention in England, particularly as one of the main objects of the expedition was to ascertain whether the country was available for the culture of corn, which we maintain it has proved to be in an eminent degree. Mr. Gregory's journal has not yet been made public, but from the information given by him, we gather that from Nichol Bay, the starting point, the route was generally to the south-west and south-east, until within sight of the Valley of the Lyow, the country generally being fertile grassy plains, crossed by a range of Hills named Hamersley Range; two rivers were met with—the Fortescue, a stream two hundred yards wide, in longtitude 118 deg., 4 min. E., lat. 21 deg. 8 min. S., with steep and strong banks, and the Ashburton, in about 23 deg. S., trending towards Exmouth Gulf. On the return to the coast a more easterly direction was taken, when a third river named the Sherlock was met with and followed to the coast 20 miles west of Depuch Island, much of the country being of a grassy fertile description, which was also its character from thence southwards to Nicol Bay, where the party arrived on the 19th July. A fresh start was made on the 20th, crossing the Sherlock, and taking an E.S.E. course met with a river named the Yute, in 21 deg. 4 min. S., which was followed for two days through a grassy, well-watered but rocky country. An easterly course took them through a hilly country to a river named the Stelley, lat. 21 deg., 27 min. S. long. 119 deg. 23 min. E.; a course still to the E. was continued, and a river named the Shaw was met with in 119 deg., 44 min., E., 21 deg. 15 min. S., flowing north through a good country. The easterly course was continued, passing a river named the De Grey, in 120 deg., 30 min., E., and 21 deg., 18 min., S., and another named the Sakover, running to the north, with very superior country, and still further to the eastward the party was stopped by extensive plains of drift sand, evidently brought by some large river from the interior, and blown from its bed across the plain by strong S.E. winds.

Attempts were made for five days without success to get further eastward, when a return was made by the Oakover and De Grey, through a fine grassy country, extending from ten to twelve miles from the river's banks. The sea coast was made at Broadsea Inlet, where was found a fertile alluvial district. A south-west course was then taken to Nicol Bay. It will be seen that although Mr. Gregory was unable strictly to explore the whole extent of the country comprised in the route set forth by the Royal Geographical Society, an important district has been traversed which before long will undoubtedly become occupied for pastoral and also, probably, agricultural purposes. The country appears to be remarkably fertile, and well watered but wanting in timber, which was only to be met with on the banks of the river; the heat appears to be great, but not so as to distress the party. The rivers abounded with fish, and no alligators were seen in them. Many of the flowers met with are described as being of the most gorgeous colours; fruits of the fig and mango kind are said to be plentiful. Animals were scarce, but several new varieties of birds were found. At Nicol Bay the crew of the *Dolphin* found the large pearl shell of commerce plentiful, and also some very good pearls were obtained, as also four tons of the shells. The rivers discharge themselves into the sea by separating at some distance into several small creeks, and as the tide rises from 16 to twenty feet, it is therefore easily to be understood how it is they were not discovered by the naval surveying ships, which have been at times employed on the coast, The most easterly point reached was long. 121 deg., 40 min.—From the *Perth* (Western Australia) *Gazette*.

EXPLORATIONS IN AFRICA.

At a recent meeting of the Geographical Society, several papers were read relating to discoveries in Eastern and in Western Africa. A letter from Mr. Thornton, who had joined the expedition undertaken by Lord van Deccan, for the exploration of the equatorial region on the east coast, gave an account of the discovery, or rather of the confirmation of the discovery, of lofty mountains capped with snow, within 200 miles south of the equator. The existence of these mountains, when noticed by former travellers, had been doubted, for they were supposed to have been deceived as to their altitude. But it appears, from Mr. Thornton's description, that the height of the principal one had been ascertained by numerous measurements to be 20,000 feet. The summit, as seen from the south-east, presents the appearance of a dome, and about one third of it was covered with snow, which extended in the ravines farther down the mountain. Other mountains towards the west were seen, the height of which was estimated at about 18,000 feet. They had conical summits, and from their general character, Mr. Thornton considered them to be volcanic. These mountains are supposed to be the southern extremity of the range extending from Abyssinia, and that the water courses descending their western flanks from the sources of the Nile. Colonel Sykes eulogised the enterprising conduct of Lord van Deccan, a Dutch nobleman, who, at his own cost, had undertaken several expeditions for the exploration of Africa, and to whose spirited enterprise and liberality the world is indebted for having had set at rest the question of the existence of snow-capped mountains in Africa within a short distance of the equator. Two communications recently received by the Colonial office were then read by Mr, Galton, giving accounts of the assent of the Ogun, in Western Africa, by Captains Burton and Bedingfield, and of an expedition up the river Volta, on the same coast, by Captain Dolben. The country on the banks of the Volta was described as being luxuriant in vegetation, and well adapted for the cultivation of cotton. Captain Hartwright gave an interesting description of a tribe of negroes who inhabit the district of Lagos. They are, he said, remarkably intelligent, and exhibit great aptitude for trade, being on that account called black Jews. They have shops and warehouses, and some of them have their correspondents in England who supply them with goods. The peculiar intelligence of this tribe is observable even when in a state of slavery; and in the Brazils there is a thriving community of them who, having purchased their freedom, occupy an important position among the people, for it is the practice in the Spanish and Portuguese colonies to admit free blacks to all the privileges enjoyed by other citizens. On being questioned as to the probability of obtaining a supply of cotton from the western coast of Africa, Captain Hartwright said that the country was well adapted for the growth of cotton, but until the wars among the tribes, which had been incited by slave-hunting, ceased, there would be no cotton cultivated, and he recommended an armed interference by this country to put an end to the wars among the natives.

THE LAWS OF COOLING.

A warm body, says the *Builder*, loses its heat by radiation from its surface, and by contact with cold surrounding substances. The laws of cooling have been long known, and are expressed in the formulæ of Newton and of Dulong and Petit. From their experiments, confirmed by subsequent researches of others, we learn that the heat lost by radiation varies with the nature of the exposed surface. Polished metal emits caloric much more slowly than wood or any rough material. We learn also that the heat lost by contact varies with the form and extent of the surface of the warm body, and with the excess of its temperature over that of the surrounding medium. A cube cools more rapidly than a globe of the same material, and of equal weight, because the surface of the former is larger in proportion to the mass than the surface of the latter. Red-hot iron becomes cold almost instantaneously when plunged into water; whereas, if left in the open air, it might retain its heat for hours, or even days. When we know the temperature of the surrounding medium, the form of the body, its weight, and calorific capacity, we can easily determine its rate of cooling and its temperature at every instant. In practice, it is seldom, if ever, necessary to take into account the conducting power of the body itself. Bad conductors, when placed in a medium colder than themselves, may be warmer at the centre than on the outside; but this difference of temperature is slight and unimportant. Gold has nearly ten times the conducting power of lead, and nearly three times the conducting power of iron and platinum; but all these metals are subject to the same laws of cooling. The difference in the rate of cooling upon the outside and in the interior of a mass of gold, and of a similar mass of wood or iron, is a matter of no practical moment. The conducting power of a body cannot be measured except in those cases where its heat passes out of itself into surrounding substances.

An inclosed space like a room, office, or house, is subject to the same laws of cooling as a warm body of similar form, or equal bulk, and of equal calorific capacity. A room filled with warm air, and without any openings for currents, would lose its heat slowly through the walls, roof, and floor; so slowly, indeed, that a perfectly air-tight building filled with warm air would retain its high temperature inside for many months, even if carried in the depth of winter to Iceland or any other part of the frigid zone. The cold of winter pierces very slowly through our walls and roofs. It rises still more slowly from the ground. The most of our building stones conduct heat as rapidly as cast iron. The addition of layers of other materials outside and inside, such as mortar, wood, paper, &c., diminishes this conducting power, and reduces it in most cases so far that it may be disregarded. Snow, also, is well known to be a medium peculiarly impervious to cold; a roof covered with a coat of snow, at 32 deg. is warmer inside than when it is exposed bare to the atmosphere at 32 deg. A very thin layer of mould protects vegetables from the frosts of winter, provided only the covering be impervious to the air. So, also, contrary to the ancient practice of raising thick partitions for securing warmth as well as safety, we find that the heat of the interior of a building is affected only in the slightest degree by the nature or thickness of the material which forms its exterior. In regard to our dwellings, where fresh, and, consequently, in winter, cold air is necessary to our existence, the whole subject of their warmth and healthfulness is reduced in practice to the regulation of the currents out and in, or their ventilation. In regard to icehouses and similar places for keeping in and shutting out the cold, the main point in practice is to prevent altogether the entrance and exit of air.

These simple general principles, well known, yet most important at this season of the year, deserve specially the attention of those engaged in the manufacture and preservation of ice.

ON THE GEOLOGICAL PHENOMENA OF THE SOLAR SYSTEM.

BY L. SŒMANN.*

We admit a similar geological (or chemical) constitution for the various bodies of the solar system, and from this conclude that the phenomena which have accompanied their formation and their successive transformations, must have been similar. Thus the planets and satellites whose density is near to that of our earth may be supposed to have passed through the different stages of liquid and solid incandescence, of the successive liquefaction of portions of their gaseous envelopes, and to have finally been the seat of an organic creation.

Of these planetary bodies the best known to us is the moon, and we shall now inquire to what extent our slight knowledge of it is in accordance with the observations made on our earth, and w th the present state of the sun as supposed by Mr. Leverrier. It is well known that astronomers, so soon as they became possessed of good telescopes, discovered mountains and plains (or seas) on the surface of the moon, and the immediate application of these names shews the great resemblance which was supposed to exist between the surfaces of the moon and the earth. It does not appear surprising that the form of the lunar mountains should be met with among only a small number of those on our planet, and physicists easily explain the greater elevation and the steep declivities of the former by the comparatively feeble action of the centripetal force at the moon's surface. But one of the gravest objections to the idea of a common origin of the moon and the earth is the apparent absence of water and air from the surface of our satellite, thus seriously embarrassing those geologists who attribute terrestrial volcanic phenomena to the intervention of these expansible elements.

If however we admit for the earth and the moon an identical and simultaneous point of departure we can understand that their cooling has taken place at a rate nearly proportioned to their volume. That of the moon being about two hundredths the volume of the earth, its temperature, if we admit an equal conductibility, will have decreased w'th a rapidity fifty times greater, so that the geological epochs of the moon will have been in the same proportion shorter than the corresponding epochs on the earth, up to the time when the solar heat began to be an appreciable element. The moon has then advanced much more rapidly than the earth in the series of phenomena through which both must pass, and we may therefore logically suppose that our globe will one day offer the same general characters as are now presented by the moon.

We believe then that the waters which cover the surface of the earth and the air which surrounds it will one day disappear, as a necessary consequence of the complete cooling of the interior of our planet. Rocks, with few exceptions, readily absorb moisture, and the more crystalline varieties are the most porous; we need not, however, consider the quantity of water which rocks may imbibe in this way, for the total amount of this element on the earth's surface is so small when compared with the whole mass of the globe, that the ordinary processes of chemical analysis would not detect its presence. If we take the mean depth of the ocean at 500 meters* (=1968 feet), its weight will be equal to one twenty-four-thousandth of the earth, which being reduced to decimals, would give for 100 parts,

Earth	09·9958
Water	·0043

In the Bulletin of the Geol. Society of France, (2d series, vol. x., p. 131,) Durocher has published a series of experiments made to determine the quantity of water in those minerals which enter into the structure of rocks, such as the feldspars, micas, hornblende and pyroxene, and which are regarded as anhydrous in composition. These minerals were reduced to coarse powder and exposed to moist air, the proportion of water being determined both before and after; it will be sufficient for our purpose to give the amount of water found after exposure. The orthoclase of Utoë absorbed in this way 0·41 for 100 parts, while the mean of seven other varieties of the same species was 1·28, and that of thirty specimens of various substances 1·27. We have already seen that if the whole of the ocean were to be equally distributed throughout the earth this would contain only 0·0042, or 100 times less than the least hygrometric of the feldspars. It is probable that the water of the ocean thus absorbed would enter into chemical combination; at all events it would occupy a space much less than the pores produced by the shrinking of the rocks.

If, now, we attempt a similar calculation for the atmosphere, we find that in supposing a height of eight kilometers, the total volume of the air which surrounds our globe, brought to the density which it has at the surface, would be about four millions of cubic myriameters, the volume of the earth being equal to 1083 millions, or 270 times that of the air, so that a contraction of the primitive volume producing a vacuum of four thousandths ($\frac{1}{270}$) would be more than sufficient to absorb the whole of the atmosphere. (In calculating the volume of the atmosphere we have multiplied the surface of the globe in square myriameters, by 0·8, which gives a sufficiently accurate result, the more so that the density of the air in the interior of the earth will be everywhere greater than at the surface.)

From the preceding considerations, the sucessive absorption of the air and water by the solid portions of the globe becomes in the highest degree probable, and we may conclude that our earth will one day present that same total absence of ocean and atmosphere which we now remark in the moon. It is evident that this progress of the waters towards the earth's centre must have long been in operation, and it becomes interesting to consider the effect which this must have had upon the level of the ocean. Let us suppose that the rocks near to the surface of the earth contain one hundredth of water, a proportion which from the

*Translated for the *American Journal of Science*, by Dr. Sterry Hunt. (Abreviated.)

* This depth is deduced from the comparison of the relative areas of land and water which are taken as 1:3, the elevation and depression of the surface being assumed as proportional to the square roots of their surfaces. (Saigey, *Physique du Globe*, 232.) The depth of the Pacific Ocean, as deduced by Bache from the earthquake wave of December, 1854, was about 13,000 feet.—(Note by the Editors of *Sillimans' Journal*.

above calculation will not be regarded as excessive, and that the water moreover does not exist in this proportion at a depth beyond that at which the terrestrial heat equals 100 degrees centigrade. If we take the augmentation of heat in descending to be one degree for thirty-three meters this will give a depth of about 3000 meters, while one part of water by weight in one hundred parts of a rock whose density is equal to 2·5, will correspond to a volume of one-fortieth. We shall now calculate the volume of this external layer which we have supposed to be thus impregnated with water, regarding it as a prism having for its base the surface of the earth, with a height of 3000 meters, which would give a mass of 1,530,000 cubic myriameters, containing 38,000 cubic myriameters of water. The total volume of the ocean being one forty-eighth thousandth that of the globe, or 225,000 cubic myriameters, it follows that this layer of 3000 meters of earth would contain a volume of water equal to one-sixth of the present ocean. Whatever may be the real value of these figures which we have adopted to render the demonstration more clear, the interest and importance of this inquiry is evident.

Miscellaneous.

THE OIL SPRINGS OF AMERICA AND CANADA.

Petroleum, Kerosene, or Rock and Well Oil.

LIVERPOOL, 15th Feb., 1862,
18 Chapel street.

RAW OR CRUDE.—Several consignments have come to hand, the finest samples showing 90 per cent. of petroline, with the density of American 46°, 790° English, the worst American 25°, 900° English, °90 per cent. of petroline. Water and pitch deposit has been found in several of the casks, which tends to deteriorate the entire parcel. Prices have ranged from £15 to £18 per ton, of 252 gallons, according to analysis and tone of the market. The demand is very large, and any sacrifice in price is met with a current sale. Some of the residuum or dead oil has been sent over, which is readily sold at £5 to £9. Heavy oil, with the burning qualities distilled out of it, but yet containing some of the paraffin or wax, would command a sale at medium prices, and much enquiry exists for the dark lubricating oils, so freely using by the American and Canadian railways.

REFINED FOR BURNING PURPOSES.—Spite of the fiercest opposition from British manufacturers, who have lowered their prices in all directions to deter the development of the American and Canadian, steady and most successful advancement has been effected; for the infinite superiority of the latter over the paraffin oil of this country is being universally admitted. It is requisite, however, to impress upon distillers on the other side the most earnest study of empyreuma, for the sweeter the oil can be made to smell, the more will it recommend itself to our discriminating buyers. Another very important feature must be alluded to also. Most of the oil shipped as white, arrives here tinged, or if not so on arrival becomes so. This proves that before distillation the American and Canadian refiners have not aciddised and alkalied the raw: hence the pitch, remaining unprecipitated, shows itself in a colouring form, as time allows it; or else the oil gets casked! 500 casks of the Portland Kerosene Company's, and 100 casks of the New York Kerosene Company's oil, and many hundred casks of other manufacturers' which I have had to dispose of, all tinged more or less, to the great disappointment of the consignees. Let whatever refinery that is anxious for a European reputation see to this, for although white and tinged are equally saleable, the difference in value is 3d per gallon. It is an accepted assertion on both sides of the water, that a burning oil should not be lighter than American 45°, 800° English, and though I would not dissipate such a theory, yet I have in hand for sale some consignments lighter, not explosive; and some heavier, however, very explosive. Utilize the laws of explosion and inflammability practically rather than theoretically, but err on the non-explosive side, for the sale of the latter qualities is uncertain, and so far, much less remunerative. To-day's quotations for refined kerosine, 2s. for yellow; 2s. 3d. for amber and tinged; 2s. 6d. for white, with free sales.

BENZOLE.—Some parcels with this appellation have arrived, but without a trace almost of English benzole, and evidently from a matrix of quite a different origin. for it is a perfectly antipodal production—etheline I can only christen it, and what its value, and what its adaptation, has yet to be determined. To put Americans and Canadians on the scent of the true benzole, which is selling in Europe at 12s. to 13s. per gallon, I append a few remarks.

From benzole aniline is extracted. Aniline is detected by chlorine, and when obtained is rendered by oxidising into many changes. For example, salt of aniline with

Bichromate of potash gives the fixed mauve and purple dye.
Bichloride of mercury gives the fixed magenta and other reds.
Bibromide of tin gives the first fuchsiacine, &c.
Nitric acid gives the fixed azaleine, solferino, &c.
Arsenic acid gives the fixed reds and purples.
Peroxide of lead gives the fixed rosenine.
Manganese salts gives the fixed pink, red, &c.
(Greens and blues are also extracted, but are as yet to be perfected.)

Each of these are of great value, 3s. to 4s. per lb.,) and only wanting economy, completely to exclude cochineal and other purple dies. The amount of aniline contained in the native or raw petroleum will depend upon the latter's base or matrix, but only abounds in the napthaline, and not in a paraffin one. From all I can gather these things are not understood in America and Canada, or I should apologise for these comments in a commercial circular; but I may perhaps be more excused doing so, when I call the attention of my readers to the words of Mr. Fairbairn, President of the British Association for the Advancement of Science in his inaugural address at Manchester the other day, when he said, alluding to the products of aniline, "it was his opinion that Great Britain, instead of receiving her dye stuffs from all parts of the globe, would, in a little time, supply the whole world."

NAPHTHA.—The American not yet developed, but English is fetching 2s. 6d. to 3s. for mineral, and 4s. 6d. to 5s. for vegetable.

CAOUTCHOUCINE, or INDIA RUBBER SOLVENT, much wanted, and specimens of American anxiously looked for.

PARRAFIN or WAX.—Sellers at 5d. per lb. buyers at 4d. per lb. for unrefined. Refined 8d. to 9d.

In conclusion, and in return for this, I shall be grateful for any American or Canadian pamphlets or circulars relating to the petroleum, and more particularly for any new facts that may present themselves in those countries. Much has to be done, many sacrifices must be made and endured, in introducing these productions ; but by perseverance and merit, undeniable happy results are in the hands of our brethren across the water, and the recipients on this.

As I shall not, in my future circulars, further allude to the chemical component parts, or adaptation of the petroleum, American and Canadian manufacturers and consumers will receive the most interesting and complete information by procuring regularly the past and future numbers of either the London *Journal of the Society of Arts*, or the *London Technologist*.

Most respectfully,
ALEX. S. MACRAE,
Oil and produce dealer, Liverpool.

The Nova Scotia Gold Fields.

The gold of Nova Scotia appears chiefly to exist in certain parallel lines, which probably existed in some instances almost the entire length of the Province, or to the distance of 200 miles in the direction of the strata. The most southerly or seaboard line, embraces the auriferous strata of Wine Harbor, St. Mary's, Tangier, Lawrencetown, Dartmouth, Halifax, the "Ovens,' and Lahave. A more northerly line would touch the first "diggings" near the Tangier lakes, Musquodoboit, Laidlaw's farm, and Gold River. The lines still further north are at present almost entirely unknown, and those here laid down may hereafter require adjustment on the map. The idea must not, however, be entertained that gold exists in all the quartz found upon those lines, or at other sites. There are numerous veins of that mineral everywhere that contain no gold, and it requires a practised eye and careful assay to detect it even in rich varieties of the rock.

The metamorphic group of rocks before mentioned as being extensively developed in the main land of Nova Scotia, also appears in Cape Breton Island, where gold at some future time may meet the eye of the careful observer. The same strata flank the mountains of Newfoundland and Labrador. From samples obtained at those places, the writer is inclined to the opinion that auriferous quartz is diffused along a most extended line of the British North American seaboard, and where the strata have been uplifted and entered by eruptive masses and dykes of Plutonic origin.

ASSAY OF GOLD.

An assay of a sample of gold from Tangier gave the following result from 100 parts:—

Gold	96.50
Silver	2.00
Copper	0.08
Lead	0.06
Iron	0.05
	98.69

The Gold from the "Ovens," Lunenburg:—

Gold	93.06
Silver	6.60
Copper	0.09
Iron, a trace.	
	99.75

A sample of gold assayed by J. F. Baker, Esq., Graduate of the Government School of Mines, London, after separation of the larger parts of visible gold, gave 18oz. 2dwt. 14gr. of gold per ton,

Containing fine gold	97.3
Silver	2.7

equal to 23.35 carats fine and containing, therefore, of fine gold 17oz. 12dwt. 19gr., $352.66, and fine silver 19dwt. 19gr., equal to fifty cents, total $358.16.—*Dr. Gesner.*

More recently Dr. Gesner, the author of the foregoing paragraphs says:—

In the central portions of Nova Scotia there are extensive ranges of granite and other rocks varying in height from 500 to 1,000 feet above the level of the sea. Metamorphic rocks of great thickness lean against the granite, and these are succeeded by the silurian and coal formations and trap rocks. Dr. Gesner informs us that "the gold has only been discovered in the metamorphic rocks which touch the granite on one side and the silurian on the other." At Tangier, gold was accidentally discovered, in 1860, in a small stream flowing into the Atlantic about fifty miles from Halifax. Gold is found in this place in quartzite, metamorphic clay, and greywacke. In form it resembles rough, feathery metal obtained by pouring any molten metal among cold water. The average yield of gold to the ton of ore is not stated, but about 600 miners were employed at this place last summer. Seven other diggings were visited, but the description of Tangier would nearly apply to them all, with the exception of "The Ovens," which seems to be a curious place. The name has been given to the locality on account of large and peculiar excavations made in the rocks by the sea. They are formed in a peninsula which is about one mile in length by a half in breadth, jutting out into Lunenburg Bay. The precipices are about fifty feet in height above the water, and the southern side of the peninsula is principally composed of metamorphic slate containing thin seams of quartz in which the gold is found mixed with sulphurets of iron, mispickel and mica. In one of the caves in "The Ovens" considerable quantities of gold have been washed by hand from the sands on its floor. The amount of gold obtained at this place, without machinery, from June to December, 1861, was valued at $120,000. It varies in size from small spangles up to rough pieces about the size of a walnut. By Dr. Gesner's assay Tangier gold contains 96.50 of pure metal and 2. of silver. The gold of "The Ovens" contains 93.06 of gold, and 6.60 of silver.

Of the gold yielding rocks of Nova Scotia, Dr. Gesner says:—The Province contains an ample amount of the precious metal to warrant most extensive operations and the construction of machinery for its mining and purification.

Overland Telegraph to India.

The last published part of the Proceedings of the Royal Geographical Society contains Sir Henry Rawlinson's communication on a direct overland telegraph to India, from which we gather a few interesting particulars. A telegraph, 1,314 miles in length, is in operation from Constantinople to Bagdad, being no inconsiderable part of a line which the Turkish government erected at its own cost, intending to carry it on to Bussorah. From the latter place, Sir Henry Rawlinson recommends that it should be extended to Teheran, thence to Ispahan, Shiraz and Bunder Abbas, at the head of the Persian Gulf; and from there along the coast, through the territories of the Imaum of Muscat and the Khan of Kelat, to Kurrachi, where the line would meet our Indian telegraph system. "Teheran," as we are informed, "has peculiar advantages as a principal station; first, because a line passing that way would be sure of the favor of the Persian Government; and, secondly, because it would there be connected with other lines of telegraphs. An electric communication is already established between Teheran and Tabriz, while Persian telegraphy seems likely to progress, and to connect itself with the Russian system by way of Tiflis, and even with our Scindian frontiers, by way of Herat." The distance from Bagdad to Bunder Abbas would be 1,302 miles; from Bunder Abbas to Kurrachi, 731, making the whole distance from Constantinople to India, 3,351 miles. There is much to be said for an overland telegraph to the far East. It can be more easily repaired than a submarine cable, and it appears the Arabs are not unfriendly to the presence of English enterprise in the desert in such a form. One of the chiefs said to our consul at Diarbekir, "If in your hands, yes; but if in the the hands of the Turks, we should destroy it, looking upon it but the forerunner of forts and soldiers to coerce us." Should this scheme be accomplished, as we hope it will, London would be able to communicate directly with Calcutta, and we should have a line rivalling that which now stretches all across the great continent of North America, from New York to San Francisco. We notice in the last news from South Africa that a telegraph line is to be set up from Cape Town to Graham's Town, and that extensions to Natal and Caffraria are talked of.—*English Paper.*

The Trade of the Lakes.

The quantity of grain received at Buffalo during the 253 days of navigation, is immense, as the figures will attest, and is divided as follows:

Flour, barrels		2,135,308
Wheat, bushels		26,683,337
Corn,	"	20,986,440
Oats,	"	1,801,240
Rye,	"	356,370
Barley,	"	282,350
		50,109,647
Reducing flour to wheat would give		10,766,540
Making a total of		60,876,187

Add to this the flour and grain received during the year by railroad, and the grand total for 1861 will be over *sixty-two millions* of bushels! No port in the world ever saw the equal of this.

To elevate and discharge this grain, we have seventeen elevators, with capacity of storage varying from 120,000 to 600,000 bushels, and an aggregate of 3,500,000 bushels. Each of these can elevate from a vessel 4,000 bushels per hour. Three new ones, now in process of erection, will give us, next year, storage room for 4,000,000 bushels.

The estimated amount of flour and grain at all the Lake ports west of this State, for the season of 1861, is 113,000,000 bushels; of which there has been received at Buffalo, 62,000,000 bushels; at Dunkirk, 3,500,000. at Oswego, 18,000,000; at Ogdensburgh, 3,500,000; at Montreal, 15,000,000; making a grand total of *one hundred and two millions bushels* sent from the granaries of the West

The quantity in store here is 1,500,000; Chicago, 3,500,000; Milwaukie, 1,500,000; all other Lake ports, about 3,000,000 bushels. Total now in store say 9,500,000 bushels.—*Buffalo paper.*

Commerce of Montreal.

The clearances of sea-going craft from the port of Montreal, for the season of 1861, showed 494 vessels, representing 250,281 tons, against 229 vessels, of 116,748 tons, for 1860. The principal ports to which produce was exported were:

	1860.		1861.	
	Vessels.	*Tons.*	*Vessels.*	*Tons.*
Liverpool	73	68,067	146	126,326
Glasgow	34	22,097	68	45,883
London	19	7,770	57	27,551
Gloucester	14	4,222	20	7,686
Bristol	8	2,392	20	8,532

Ship Canal across the Isthmus of Darien.

Several French engineers, under the direction of M. Bonardiol, have made a partial exploration of the Isthmus of Darien, and are to sail for Darien, again, to make a detailed survey of the line for a ship canal between the Atlantic and Pacific Oceans. There is thus, at length, a prospect of this grand project being carried into execution. The line about to be surveyed, which was discovered by Dr. Cullen, in 1849, after several long and perilous explorations in different directions through the forests, extends from the gulf of San Miguel, on the Pacific, in a direction N. E. by E. ½ E. by compass, to Caledonia Harbour and Port Escoces on the Atlantic. The Gulf of San Miguel receives numerous rivers, the largest of which are the Tuyra and the Savana, which unite together just before falling into it. The Savana is navigable for the largest ships up to the confluence of the Lara with it, that is for fourteen miles towards the Atlantic. From the confluence of the Lara with the Savana, at which point the future canal will commence, the line extends to the Chuquanaqua, a distance of 12 miles. From the Chuquanaqua the line follows the bed of the Sucubti, one of its tributaries, up to the confluence of the Asmati with the Sucubti, a distance of nine miles; and then continues along the bed of the same river Sucubti to a point nine miles higher up. From that point to the Atlantic the distance is six miles. The whole length of the projected canal will therefore be 35 nautical, or nearly 41 English miles.

Improvements in Candles.

It is said that if the cotton wick be steeped in a solution of nitrate of potassa, or chlorate of potassa, and then thoroughly dried before the tallow is melted around them, a purer flame and brighter light are obtained than when made in the ordinary manner. Snuffing is not so frequently required, nor do the candles, thus prepared, run.

The Allotropic State of Phosphorus and Iron.

Perhaps the most valuable use that is made of the power of putting substances into an allotropic state, is in the manufacture of friction matches. Phosphorus takes several allotropic conditions, in one of which it is known as red phosphorus. In this state it does not take fire from friction, nor does it emit the deleterious vapors which have produced such frightful effects upon persons employed in match manufactories. The phosphorus is, accordingly, by exposure to light under certain conditions, and other manipulations, passed into the allotropic condition of red phosphorus, when it can be transported or handled with impunity. In this state it is used for making matches; and it then slowly returns to its normal conditions.

By several processes iron can be thrown into an allotropic condition, which has been called the passive state. In this state it is not acted upon by nitric acid, and its properties vary in several particulars from those which it ordinarly exhibits. If a piece of iron is put into nitric acid of specific gravity of 1, 3, it dissolves freely with effervescence, but if a piece of platinum wire be placed in the acid, and then the iron be introduced in contact with the platinum, the acid will not now act upon the iron, even if the platinum is withdrawn. Another piece of iron put into the acid in contact with the previous piece, will become effected in the same way, and so on with a third or more pieces. Another mode of making iron passive is to oxidize one end of the piece in the flame of a lamp. It may also be effected by making it the positive pole of a battery, by a blow, and in other ways. A piece of passive iron can be restored to its normal condition by rubbing it, or by bringing it in contact with active iron.

The allotropic state of substances is a comparatively new and very inviting field for chemical research.

Marine Disasters.

The British Board of Trade report for the year 1860 gives the per centage of disasters as compared with voyages, as follows:—For the eight years, from 1852 to 1860, $\frac{47}{100}$ of one per cent, or one accident in every two hundred and thirteen voyages; and for the year 1860 alone $\frac{53}{100}$ of one per cent., or one in every one hundred and eighty-eight voyages. This per centage includes accidents of every kind, great and small, and the voyages include over-sea and coasting. On the other hand, the proportion of accidents to American ships to the number of voyages is, as near as can be estimated with the imperfect data at command, for the year 1860, 1 $\frac{33}{100}$ per cent., or one accident of some kind in every seventy-five voyages. This, it will be seen, is more than double the per centage for English ships.

International Cattle Show, 1862.

The Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland have jointly arranged to conduct an International Cattle Show in London next summer, and Battersea-park has been granted for the purpose, where the necessary enclosure and buildings will be made. The show will take place during the week commencing the 23rd of June, 1862.

Permanency of the Steam Engine.

At present it seems improbable, so long as motive power is to be obtained through the intervention of heat, and until a cheaper fuel than coal can be found, that the steam engine will be superseded by any other machine.

Electric magnetic machines are perhaps the least likely of all inventions to supersede the steam engine. The consumption of a grain of zinc, as Mr. Joule has shown, though much more costly than a grain of coal, does not produce more than about one-eighth of the same mechanical effect.

It would not, however, be at all safe to predict that considerable improvements may not yet be made in the steam engine, or in engines to be worked by coal.

The consumption of fuel in the best steam engines has been reduced to 2½ pounds of coals per horse-power per hour; but such an engine does not utilize one-fifth part of the absolute mechanical value of the coal consumed, and so long as this is the case, it would be unwise to assume that we have attained the utmost limits of improvement.

Improvements in Screw Steamers.

In 1848, the fastest screw line-of-battle-ship in the navy could not steam more than seven and a half knots, or eight miles and two-thirds per hour, whereas the *Warrior*, though clothed with an outer coat of iron armour four inches and a half thick, at her trial in October last over the measured mile in Stokes Bay, attained an average speed of 14·356 knots, or 16·533 miles per hour, beating the *Howe*, which previously had attained the highest trial speed of any of Her Majesty's line-of-battle ships.

A new Atlantic Telegraph.

It is proposed to renew the attempt to cross the Atlantic with an electric cable. The government of the United States are to pay one half of the cost and supply their share of necessary vessels if the government of Great Britain will be responsible for the other half of the expenses incident to this difficult undertaking.

Galvanizing Cast Iron.

The *Moniteur du Commerce* says that all the difficulties of coating cast iron with copper by the galvanic process have been overcome by Mr. Oudry, of Paris, by the simple process of varnishing the iron before placing it in the bath. The *Moniteur* states that there are in the *Bois du Boulogne* three kinds of candelebra, the first in bronze, the second in cast iron painted, and the third in cast iron covered with copper by M. Oudry's process; and those of the last kind alone have preserved their lustre. "They are as brilliant and perfect as at the moment of coming from the workshop." The kind of varnish employed is not given.

Dianium.

Dianium is the name given to a new metallic element discovered by M. von Kobell. In March, 1860, he found a new metallic acid, which he termed dianite, in extracts from the tantalites of Tammela. From this, by chemical reactions, he has obtained dianium, the fourth new element, the preceding being cæsium, rubidium, and thallium.

Gold in Nova Scotia and New Brunswick.

His Excellency the Governor of New Brunswick, states in his speech at the opening of the New Brunswick Parliament, that the Imperial Government were agreed to sanction any "well considered" arrangement for facilitating commercial intercourse between the different provinces of British North America, and promises to lay the correspondence which has taken place upon the subject before the House. The extensive discoveries of gold are noticed, and the Parliament informed that the geological formation of the country not unreasonably induces a belief that similar discoveries may be made in New Brunswick. His Excellency therefore recommends the consideration of such amendments as "may be needed in the existing laws relative to mining operations, in order to meet the requirements of such a contingency.

The Great Underground Treasury.

The wealth of England is so intimately connected with her mineral resources, that like a careful trader she annually "takes stock" of all her operations, and publishes the returns—having no reason to be ashamed of them—for the information of the world. Our capital, our machinery, our skilled artizans, might all emigrate, if our home-born supply of coals and iron were to fail. The materials could, indeed, be brought to us from abroad, but it would be cheaper still, as the prophet found it of old, to go to the uncomplying mountain. When we visited Swansea in 1848, there were ships in her docks laden with Australian copper ore, and ship-loads encumbered the quays. Cottages ornamented their window-sills with malachite and azurite, and bordered their garden-plots with the green and blue mineral. It is not so now; the colonists import our coal instead of sending us their ores, and the produce of the Burraburra is smelted at the mines. Sir Henry de la Beche, in the Inaugural Discourse at the opening of the School of Mines, in November, 1851, valued the mineral produce of Great Britain and Ireland at twentyfour million pounds per annum, or about four-ninths of that of all Europe, including these islands; an amount more than three times greater than the mining produce of Russia and Poland, and four times that of France. In Mr. Hunt's "Mineral Statistics for 1860." the returns exhibit a total amount of thirty-seven millions, exclusive of the building-stone, brick earth, and similar materials, estimated in the statistics of the previous year at nearly eight millions sterling. The coal returns for England and Wales, during the year 1860 show an extraordinary increase. It may be remembered that in Mr. Hull's "Coal fields of Great Britain," the coal raised in 1858 was stated to be 57 million tons, and the *present and future* produce was estimated at 60 millions. Upon this assumption, the coal fields of England and Wales, it was calculated, would last 1,000 years; whereas upon our estimate of the present rate of *annually increasing* consumption, we should exhaust all our available coal in the space of a century. The actual produce of 1859 was 61½ millions of tons; and last year it mounted up to 69 millions, or with the addition of the Scottish coal mines, to 80 millions; besides which, there were four million tons of small coal left useless on the pit banks. At this rate there can be little doubt we shall raise 90 million tons of coal by the year 1862; and the only check we can anticipate is the overgrowth of the mining population already estimated at half-a-million by Professor Morris in his recent lectures on coal. The total amount of coal exported in the year 1860 was 6,788,060 tons, being little more than the total of the preceding year; while the exportation to France has experienced a slight falling off. Next to coal, the most important articles are copper, iron, lead, and other metals, the value of which will be shown most readily by Mr. Hunt's summary of the mining produce of Great Britain and Ireland for two years.

	1859.	1860.
Coal	£17,994,951	£20,010,674
Iron	11,138,712	12,703,950
Copper	1,734,700	1,706,291
Lead	4,410,095	1,417,415
Tin	929,390	871,382
Silver	159,507	151,173
Zinc	75,782	89,537
Other minerals	95,000	170,927
	£33,538,027	£37,121,318

The Critic.

Gold in the Saskatchewan.

The Red River *Nor-Wester* states that gold has without doubt been discovered on the eastern slope of the Rocky Mountains as low down the North Branch of the Saskatchewan as Carlton. Parties are organizing for a journey to the Rocky Mountains and British Columbia, at Selkirk Settlement, in many parts of Canada, and Minnesota. No doubt this summer will witness an attempt to establish an overland route through British territory *to the gold fields* of our sister colony.

Wood for Shipbuilding.

Professor Crace Calvert is now making an investigation for the Admiralty of different kinds of wood used in ship-building. It appears that the Professor is at no loss to explain why so many of the fleet of recently-constructed gunboats became rotten and others escaped untouched. He finds the goodness of teak to consist in the fact that it is highly charged with caoutchouc; and that, if the tannin be soaked out of a block of oak, it may then be interpenetrated by a solution of caoutchouc, and thereby rendered as lasting as teak. A few years ago an enterprising individual spent £30,000 in trying to introduce a new wood for shipbuilding purposes from South America, where it is known by the name of Santa Maria; but the dockyard authorities could not be persuaded to take it into use, and the imports were entirely neglected. This is one of the specimens investigated by the Manchester professor; and he finds it to be sound and resinous, and but little inferior to teak. Of the durability of teak there can be no question.

It is proposed to erect a Crystal Palace in Paris on the plan of that at Sydenham, A company with a capital of 25,000,000fr. is in course of formation: Sir Joseph Paxton is at the head of the architectural department, Mr. Edwin Clarke is appointed consulting engineer, and Mr. Thomas Brassey is to be the contractor. The building is to be erected in the Bois du Boulogne.

To Ascertain the Weight that may be safely borne by Columns of various Dimensions and Materials.

RECTANGULAR COLUMNS.

Cast Iron, $\frac{16000\, l\, b^2}{4\, b^2 + \cdot 18\, l^2} = W.$

Wrought Iron, $\frac{18000\, l\, b^3}{4\, b^2 + \cdot 16\, l^2} = W.$

Oak, $\frac{4000\, l\, b^2}{4\, b^2 + \cdot 5\, l^2} = W.$

SOLID CYLINDERS.

Cast Iron, $\frac{10000\, d^4}{4\, d^2 + \cdot 18\, l^2} = W.$

Wrought Iron, $\frac{11200\, d^4}{4\, d^2 + \cdot 16\, l^2} = W.$

Oak, $\frac{2500\, d^4}{4\, d^2 + \cdot 5\, l^2} = W.$

HOLLOW CYLINDERS.

Cast Iron, $\frac{16000\, D^4 - d^4}{4\, D^2 + \cdot 18\, l^2} = W.$

Wrought Iron, $\frac{11200\, D^4 - d^4}{4\, D^2 + \cdot 16\, l^2} = W.$

Oak, $\frac{2500\, D^4 - d^4}{4\, D^2 + \cdot 5\, l^2} = W.$

l represents the length in feet, b the breadth, and D and d the diameter in inches, and W the weight in pounds.

EXAMPLE.—What are the crushing weights that may be safely borne by a cast iron, wrought iron, and oak rectangular column 2 in. square and 5 ft. in height?

$$\frac{16000 \times 5 \times 2^3}{4 \times 2^2 + (\cdot 18 \times 5^2)} = \frac{16000 \times 5 \times 8}{32 + 4{\cdot}5} = 17534 \text{ lbs.}$$

for the cast iron.

$$\frac{18000 \times 5 \times 2^3}{4 \times 2^2 + (\cdot 16 \times 5^2)} = \frac{18000 \times 5 \times 8}{32 + 4} = 20000 \text{ lbs.}$$

for the wrought iron.

$$\frac{4000 \times 5 \times 2^3}{4 \times 2^2 + (\cdot 5 \times 5^2)} = \frac{4000 \times 5 \times 8}{32 + 12{\cdot}5} = 3596 \text{ lbs.}$$

for the oak.

Table exhibiting the Relative Value of various Woods, their Crushing Strength and Stiffness being combined.

Spanish Mahogany	2571	American Spruce	2522
Teak	6555	Walnut	2378
English Oak	4074	Yellow Pine	2193
Ash	3571	Larch	1897
Elm	3468	Sycamore	1833
Beech	3079	Poplar	975
Quebec Oak	2927	Cedar	700

Comparative Strength of Long Columns of various Materials.

Cast Iron	1000	Oak	108·8
Wrought Iron	1745	Pine	78·5
Cast Steel	2518		

Artizan.

STEAM ON COMMON ROADS.—On the 21st ult., a heavy marine boiler was successfully removed from the works of Messrs. John Laird, Sons, and Co., Birkenhead, to the large crane situate on the margin of the Great Float, by means of Taylor's (Britannia Engine Works) "steam elephant," and a second boiler was removed on the 24th ult. This is the first instance in this neighbourhood in which steam on common roads has been employed for such a purpose. Judging from the easy manner this machine was guided over roads in a very indifferent state, and the distance it had to travel, it promises to become a most useful agent for transporting heavy loads, and it is equally applicable for discharging timber out of ships and afterwards drawing it upon the quay or from place to place, as required. One of these engines, manufactured by Messrs. J. Taylor & Co., of Birkenhead, has been at work for this purpose in her Majesty's dockyard at Devonport, for upwards of two years, with great success.—*Artizan.*

BRITISH SHIPS AND BRITISH SEAMEN.—The mercantile marine of the British Empire consists of 35,501 vessels, measuring 5,710,968 tons, and navigated by 294,460 seamen. The various divisions of the United Kingdom, and the British Possessions abroad, furnish the annexed figures in connection with the preceding statement:—

	Vessels	Tons.	Crews.
England	21,007	3,709,615	168,415
Scotland	3,486	623,791	31,682
Ireland	2,271	253,336	14,109
Guernsey, Jersey and Isle of Man	899	71,045	5,591
British Possessions	10,338	1,052,281	74,663
Total	38,501	5,710,968	294,460

Of the above vessels, 2,337, with 500,144 of tonnage, are propelled by steam.

Lucifer Matches.

Mr. Gore, a recent writer on this subject, gives some interesting statistics respecting this branch of manufacture. The firm of Messrs. Dixon employ 400 workmen, and generally have on hand £8,000 or £10,000 worth of timber. Each week they consume one ton of sulphur and make 43,000,000 matches, or 2,160,000,000 in the year. Reckoning the length of a match at two and a quarter inches, the total length of these would far exceed the circumference of the earth. Another calculation has been made, that the whole length of waxed cotton wicks consumed every year by one London manufacturer in the production of "vestas," would be sufficient to reach from England to America and back again. The magnitude of the figures relating to the English manufacture of matches is, however, insignificant, when we turn to the Austrian production. Two makers alone, M. Pollak, at Vienna, and M. Furth, in Bohemia, produce the amazing number of 44,800,000,000 matches yearly, consuming twenty tons of phosphorous, and giving employment to 600 persons. The low price at which these necessaries of life are produced is equally astonishing. M. Furth sells his cheapest boxes at one penny per dozen, each containing eighty matches. Another maker sells the plain boxes at two pence per 100, and 1,400 matches for one farthing; whilst a third maker sells a case of fifty boxes, each containing 100 lucifers, for four pence. The imports of matches into the United Kingdom are of the value of £60,000 yearly, representing the enormous number of 200,000,000 daily. The daily consumption is 50,000,000 more than the above number, or upwards of eight matches each day for every individual in the kingdom.

How to Pack Fruit.

The following is the method of packing fruit and flowers employed by Mr. Kidd, the gardener of the Marquis of Breadalbane, in England. He says:—"A box is chosen, in size, according to the quantity to be sent. A layer of dry bran is put at the bottom; then each bunch of grapes is held over the centre of a sheet of soft paper; the four corners of the paper are brought up to the stalk and nicely secured; then laid on its side in the box, and so on, until the first layer is finished. Then fill the whole over with bran, and give the box a gentle shake as you proceed. Begin the second layer as the first, and so on till the box is completed. Thus, with neat hands, the bloom is preserved, and may be sent to any distance; but, with clumsy hands, quite the contrary, and often an entire failure, as the putting in and taking out of the box are the most important points to be observed."

He has pursued this system of packing fruit for twenty years, and it was sent five hundred miles by inland carriage from England to the highlands. He has invariably packed sixty or eighty bunches of grapes and fifty or sixty dozen of peaches or apricots in one box, and they arrived as safe and fresh as when taken from the trees.

To Remove Clinkers from Stoves.

Some kinds of coal are liable to form clinkers which adhere to the fire-brick lining of stoves, grates and furnaces, and become a source of great annoyance, as they cannot be removed by usual means without breaking the fire-brick. Persons who are thus annoyed will be glad to know that by putting a few oyster shells in the fire close to the clinkers, the latter will become so loose as to be readily removed without breaking the lining.

Monster Photographic Lens.

Perhaps the largest lens in the world has just been completed by Mr. Dallmeyer for the government establishment at South Kensington. It is a triple achromatic combination of sixty inches focal length, for the production of pictures three feet square. It consists of three combinations, the front and back being six and eight inches diameter respectively, whilst the diameter of the central or negative combination is four inches in diameter.—*London Review.*

Auriferous Rocks of Victoria.

The area of the quartz-bearing rocks at Victoria, in Australia, is estimated at 25,000 square miles. The total area of the extent of land at present mined upon in that colony is 561 square miles. Thus 89,920 square acres, have produced gold to the amount of £92,787,236, on an average of about £1,032 per acre, and there yet remains upwards of 15,000,000 acres almost every where intersected by quartz veins of greater or less thickness, which are as yet intact by the pick of the miner.

Light.

"Light, or rather the absence of it, can hardly be said to determine, in any important degree, the distribution and limitation of the lower forms of animal life. Light is not essential even in the case of some of the higher orders. A large class of creatures, both terrestrial and marine, possess no true organs of vision, although there is good reason for believing that they do possess some special sensory apparatus susceptible to the influence of light; whilst certain creatures, whose habitation is in subterranean caves or lakes, as in the Magdalena near Adelsburg, and the Great Mammoth caves in Kentucky, either possess no organs of vision or possess them in so rudimentary a state, as to prove clearly that the absence or imperfect development of the sense may be compensated for by the higher development of other senses. It is impossible at present to say to what depth light penetrates in the sea. The photographic art will, no doubt, one day solve the problem. But it is almost certain that a limit is attained, and that, moreover, long before the deep recesses gaged by the sounding machines are reached, where the light-giving portion of the ray cannot penetrate even in its most attenuated condition; and yet, as shall hearafter be shown, creatures have been found down in those profound and dark abysses whose coloring is as delicate and varied as if they had passed their existence under the bright influence of a summer sun."—*Wallech, British Association.*

Foreign Inventions.

Permanent Aniline Colors.—R. H. Gratrix, England, has applied for a patent for rendering printed and dyed aniline colors permanent. The cloth is first prepared with stannate of soda, then passed through a thickened solution of tannin, after which it is either printed or dyed with the aniline color (magenta, solferino, mauve, &c.), then subjected to the action of steam. Aniline colors have not yet been rendered permanent, so far as it relates to the action of sunlight upon them. They change rapidly under solar influence, but can be washed without fading.

Dressing Flax.—In the dressing of flax and other similar fibres, it has been customary to employ drums armed with teeth set at right angles to the surface of each revolving drum. A patent has been obtained by A. Smith, London, for setting the teeth on such drums pointing in a reverse direction to that in which the cylinder is driven. By thus setting the teeth of such drums at a reverse angle to those in common use, the fibres, it is stated, are not so much injured, therefore less tow is made and more good fibre secured. In combination with the drum, Mr. Smith uses an apron, hinged at the bottom end of the case. This apron is hollowed out on the inside and armed with brushes, so that the attendant can feed the flax in a superior manner to the action of the revolving machine.

To Clean Paint.—Smear a piece of flannel in common whiting, mixed to the consistency of common paste, in warm water. Rub the surface to be cleaned quite briskly, and wash off with pure cold water. Grease spots will, in this way, be almost instantly removed, as well as other filth, and the paint will retain its brilliancy and beauty unimpaired.

Silvering Glass.—J. Cimeg, patentee. A solution of ammonia, nitrate of silver and tartrate of soda is applied to the surface of the glass, when the metal is soon deposited in a bright film at the ordinary temperature of the atmosphere. This is considered to be, perhaps, the most simple method of depositing silver on glass yet discovered. Other modes require the application of high heat to produce the deposition of the metal from a nitrate solution.—*Scientific American.*

Fire Insurance in London.

At the annual meeting of the shareholders of the Royal Insurance Company, Liverpool, it was stated that a meeting of all the officers engaged in fire insurance in London had recently been held, consequent on the late great fire, at which it was agreed to advance the rate of premium on commercial insurance to a considerable extent. Subsequent reflection, however, had shown that a modification of the proposed rise would be sufficient; and Mr. DOVE, the manager of the Royal Company, was of opinion that these modified rates would be found sufficient to meet all contingencies. He proceeded to say, that within the last seventeen years 580 new insurance offices, of all kinds, had been projected. Of these, 233 had ceased to exist in the same period, 11 had amalgamated with other companies, 134 had transferred their business, and 42 were winding up their affairs in chancery. Of the whole number, 95 fire offices had discontinued business. Within the last seventeen years 48 fire offices had been established. Of these, only 12 survive, 36 having discontinued business; and, in all, there are only 52 fire offices now doing business.

Cattle in Buenos Ayres.

In the three *Partidos* of the province of Buenos Ayres alone, there were, according to the returns of 1858, 3,875,742 horses, 8,672,675 oxen and 1,385,280 sheep. In the year 1838 the number of horned cattle did not exceed four millions; but since the pampas south of the Salado has been cleared of Indians, and the country in general become more settled, the above enormous increase has taken place. The same with the sheep, the wool of which was formerly so coarse that it was only fit for carpets: whereas, since the improvement of the breed by a cross with fine-woolled sheep, it is largely exported for finer manufactures. The exportation for 1858 consisted of 969,604 dry and 318,304 salted ox-hides, 68,874 dry and 120,757 salted horse-hides, wool to the amount of 37,423 fardos, tallow, 240,362 cwt., besides horns, oil, bones and hair. The number of ships in which these were exported was 404.

Steamships for the Montreal Ocean Steamship Company.

Messrs. R. Steele & Son, of Greenock, have turned out a screw of 1,400 tons, named the St. George, 253 feet long, 33 feet 6 inches broad, and 22 feet deep. The St. George, which will be fitted with engines of 175 horse-power, has been built by Messrs. J. &. A. Allan, of the Montreal Ocean Steamship Company, and is intended to ply between Glasgow and Montreal. A similar screw, built for the same owners by Messrs. Barclay, Curle & Co., of Whiteinch, is as nearly as possible of the same tonnage and dimensions, and has received the name of the St. Andrew; she is to be fitted with engines by the same firm, of 150 horse-power, and will also run between Glasgow and Montreal.

The extent of the Oil Region in America.

The oil region comprises parts of Lower and Upper Canada, Ohio, Pennsylvania, Kentucky, Virginia, Tennessee, Arkansas, Texas, New Mexico, and California. It reached from the 65th to the 128th degree of long. W. of Greenwich, and there are outlying tracts besides.

Rocks of Silurian, Devonian and Carboniferous age yield this material, which is rapidly becoming one of the most important natural productions of the continent, and is likely to exercise a very extensive influence upon the comforts and civilization of mankind.

Phosphorescence.

The experiments of M. De Reichenbach tend to prove that phosphorescence is a usual consequence of all molecular phenomena, and not the result of combustion or oxidation. Mr. Phipson proved this last point some time ago, when he showed that dead fishes shine in the dark, even under water, and in the absence of oxygen.

According to M. De Reichenbach there is phosphorescence during fermentation or putrefaction, crystallisation, evaporation, condensation of vapours, the production of sound (vibrations therefore), and the fusion of ice; a considerable glow is remarked when a galvanic pile in activity, a block of ice in fusion, or a solution of sulphate of soda in the act of crystallising is observed in the dark.

The human body itself is not devoid of phosphorescence: in a healthy state it emits a yellow glow; when in ill-health the glow becomes red. The author considers that this observation may possibly be of use in diagnosis.

To perceive these phenomena the eye ought to have been previously rendered sensitive by remaining some hours in perfect darkness, and even then all eyes are not equally impressionable. But, if several persons unite in performing the experiment together, there will always be a certain number who are able to see the phenomena.

These facts of the production of light remind the author of observations published some time ago, by M. Wullner, according to which every molecular movement is accompanied by a disengagement of electricity.—*Poggendorff's Annalen*, vol, cxii., p. 459.