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THE PETROLEUM, OR ROCK OIL OF CANADA.

For many years the Petroleum found floating on the surface of the Thames and Sydenham rivers, in the western part of the province, attracted some degree of attention, but it was not until the "rock oil" of Western Pennsylvania proved to be both abundant and of considerable commercial value that practical men directed their capital and industry to the so-called "oil springs" of Upper Canada. Now that public attention has been repeatedly called to the existence of these springs, and some of them have already acquired a certain degree of importance, as supplying material for a growing industry, it is time to enquire into the prospects which this new source of wealth offers to capital and enterprise, and how far we may suppose it susceptible of profitable extension.

In the first place, it is necessary to enquire into the source of supply and endeavour to ascertain its probable limits. This can best be done by examining into the origin of the petroleum or rock oil, and tracing the limits of those geological formations from which it is supposed to proceed.

There are two classes of bituminous substances which exist as natural deposits or exudations, and are often misnamed in popular descriptions. Some of these bodies are the probable result of the union of others with oxygen, derived from air or other sources.

They may be divided as follows:

1. Petroleums, or rock oils, or naphthas.
2. Bitumens or asphalts.

The members of the first class consist of two elements only, namely, carbon and hydrogen.

Those of the second class consist of carbon, hydrogen and oxygen.

Petroleum and others of its class result from the decomposition of organic substances of animal or vegetable origin, under a moderate temperature and pressure, in the absence of oxygen. Bitumens are probably the result of the oxydation of petroleums, and their hardness depends to a certain extent upon the amount of oxygen they contain.

All, or most true bitumens melt in boiling water; when they require a more elevated temperature to soften or liquify them, they receive the name of asphalts.

Bitumens and petroleums are found in all parts of the world, and in many countries have long been employed for economical purposes. In the United States, where rock oils have suddenly acquired great prominence, very extensive sources of supply exist.

On the Alleghany river, in the neighbourhood of Pittsburgh, a spring of petroleum was struck in boring for salt, which has been known to yield eighteen hundred barrels a day at one place only. In Kentucky, petroleum springs are not at all uncommon. In that part of Pennsylvania and New York which borders on Lake Erie, and in the north eastern part of Ohio, the rock from which the petroleum issues belongs to the Upper Devonian series. In other parts of Pennsylvania, in Ohio and Virginia, petroleum is found associated with the Carboniferous rocks, and probably proceeds from certain members of the series. It is in Western Pennsylvania that petroleum springs are at present most numerous and important. In the counties of Venango, Mercer and Warren, a new branch of industry is rapidly growing into great importance, and is in fact effecting a very beneficial influence upon the population and wealth of that part of Pennsylvania. The collateral branches of industry to which the preparation of the crude oil gives rise, are very valuable in themselves; and if the supply continues to keep pace with the appliances introduced to secure the raw material, it is not easy to estimate the value of the "oil region" of Pennsylvania, Ohio, Michigan, and south eastern New York.

The rock formation from which the petroleum of the north western part of Pennsylvania and the south-western counties of New York exudes, is probably that member of the Upper Devonian series which the New York geologists have denominated the PORTAGE and CHEMUNG GROUP. This group of rocks is of immense thickness in the United States, and is developed to a very great extent in Western Pennsylvania and in the State of Michigan. It is the VERGENT SERIES of Rogers, the able State Geologist of Pennsylvania, and is supposed to be not less than 4,900 feet thick. It is the next group but one underlying the Coal series; and between it and the lowest member of the Carboniferous rocks there is interposed the CATSKILL RED SANDSTONE, the PONENT RED SANDSTONE of Rogers, which has a supposed thickness of 5000 feet. Twenty years ago, James Hall, the distinguished U. S. Geologist, described the Petroleum Springs in Chautaque County, N. Y., bordering Lake Erie, as exuding from rocks belonging to the Portage Group. Carbonaceous matter frequently occurs in their strata, and much money and time has been expended in the United States in an expensive and wholly fruitless search for coal, by persons who have been misled by the thin laminæ of bituminous matter which is often met with in these Devonian rocks, and also in that member of the lower Silurian series in Canada which bears the name of the UTICA SLATES, and which is used at Collingwood for the distillation of "Shale Oil." The idea that the petroleum or rock oil of South Western New York, North Western Pennsylvania or Canada is necessarily associated with the coal bearing rocks, is altogether erroneous; and an attempt to search for coal from the supposed indications offered by "coal oil," or petroleum, would be wholly fruitless as regards coal itself, in many places where the oil is most abundant. Even if the Catskill Red Sandstone should be altogether wanting, there are conglomerates and carboniferous limestones lying above the Catskill Sandstone, before the coal measures begin, and these have a united thickness in the States of 5,600 feet, and are found in Michigan, together with the PORTAGE and CHEMUNG GROUP, underlying the coal field of that State.

The PORTAGE and CHEMUNG GROUP occupy nearly the whole of the south shore of Lake Erie, and extend far inland into the States of Pennsylvania, New York and Michigan. Many rock oil springs are found on or near the edges of the great Pennsylvanian coal field, where it overlaps the Portage and Chemung groups below it. There is no reason to doubt that they will ultimately be touched by the borer in many parts of the vast area of *western* country occupied by the Portage and Chemung group; but it must be borne in mind, that an inspection of a geological map is not a sure guide to the prospecter for coal oil. Rocks of the same geological age vary immensely in their mineral characteristics, and it is a remarkable case in point, that the same group of rocks which in the Western part of New York show such abundance of petroleum, in the eastern counties are altogether free from it.

It is necessary to be thus particular with respect to the geological position of the rock which forms the source of the petroleum; for as we have no trace of the Carboniferous Series remaining in Western Canada, we must search for the origin of the petroleum in that group of rocks which is known to yield it in abundance, and which is represented to a small extent in the most western counties of Upper Canada.

The Portage and Chemung groups extend from Michigan into Canada, entering the province near Kettle Point, Lake Huron, where the lowest members of this important group are exposed. They are there seen underlaid by limestone belonging to the Hamilton group, the series beneath them. The highly bituminous shales of the Portage and Chemung groups are also exposed on Bear Creek, in the township of Warwick, and in the township of Brooke. Petroleum springs, which doubtless come from this formation, are found in the townships of Enniskillen, and also in Mosa.

The reason why the Portage rocks of Michigan are not continuous with those of Pennsylvania, but are separated by a belt of the underlying Hamilton formation, has been very clearly shown by Sir Wm. Logan, in an article "On the Physical Structure of the Western District of Upper Canada," published in the *Canadian Journal* for August, 1854.

The area covered by the Portage rocks in Western Canada is very limited, when comparisons are made between their extensions in Pennsylvania and Michigan, where they occupy a region probably exceeding the whole of the settled parts of Upper Canada. Mr. Murray, of the Canadian Geological Survey, states that the Portage rocks in the western counties probably consist of two outlying patches, separated from one another by the Hamilton shales in the township of Euphemia. If this be the case, we shall have two rock oil or petroleum fields in Canada, in which that substance may be searched for by boring with considerable chance of success. These are the western field, including the townships of Plympton, Warwick, Brooke, Enniskillen, and perhaps Moore and Sarnia. The eastern field will be roughly shown by the townships of Camden, Zone and Mosa; but in so level a tract of country, it is very probable that those portions of the Portage and Chemung groups which have escaped denudation will be found over wider though perhaps more detached areas than is represented above.

Several important conclusions of a practical value may be derived from a knowledge of the extent of surface occupied by the rocks known to yield petroleum in Western Canada. The first is, that their thickness must be so small as to obviate the necessity of deep boring. If the borer passes through the Portage group without finding petroleum, and comes upon the underlying Hamilton shales, the operation should be pursued with extreme caution; for although petroleum is by no means uncommon in the bituminous shales of the Hamilton group, yet as these rocks have been bored in *search for coal* from one end of the State of New York to the other, at vast expense, without reaching rich petroleum springs, it cannot be regarded as a fruitful source of that material. Secondly, the supply of petroleum is likely to be soon exhausted in particular wells, until, by slow infiltration from higher to lower levels, the spring is replenished. Thirdly, the nature of the rock, which in some of its layers is compact, holding globules or drops of petroleum between the laminæ, will allow a copious spring to be struck in one locality, and yet within a few yards all attempts may be ineffectual. Fourthly, deep boring is to be avoided in the western counties. It will probably be very successful on the Michigan coast of Lake Huron, commencing a few miles above the mouth of the St. Clair, and extending fully 20 miles inland. It may also be successful on nearly the whole of the south shore of Lake Erie, but in Canada shallow borings will be likely to give favorable results only, within the limits indicated in the preceding paragraph.

With respect to the supply which may be looked for in our Canadian rocks, if the Hamilton Shales do not yield it, it may be stated with a considerable degree of confidence that the quantity will be very small compared with the abundant store in the United States. It will probably be also intermittent, and springs which promise favourably for a time will soon be exhausted, and require a greater or less period for their restoration. This will appear at once from the limited area occupied by those rocks from which the petroleum proceeds. They are merely outlying patches of the great Pennsylvanian and Michigan fields which underlie, with their associated formations, the coal measures of those States. At the best, the western patch in Plympton, Warwick, Brooke, &c., is but a tongue of the Michigan field; and possessing but a limited area, it has also a very small thickness, probably not exceeding one hundred feet. Hence, it is not likely that Canadian rocks can contain a large supply of this important material. But while we would strongly caution "prospecters" against deep boring, yet there is no reason why numerous shallow wells should not yield a considerable supply for some time to come—quite sufficient to make a limited outlay of capital, cautiously expended, give remunerative results; but it does not appear probable that the supply will be found sufficient to create a lasting and increasing industry. The deposits of asphaltum or bitumen in the township of Enniskillen are perhaps the existing records of petroleum springs which have been oozing for ages, and the material, by long exposure to the atmosphere, has absorbed oxygen and become converted into the viscid or semi-solid mass which now occupies several shallow depressions in that township, and also in Zone. Wherever these deposits are found, it appears reasonable to suppose that boring would reveal a petroleum spring, and in such localities a search for the fluid would be most successful and the supply most abundant.

THE SOLID MATERIALS CONVEYED TO THE SEA BY THE OTTAWA AND ST. LAWRENCE.

Few but those who have given attention to the solvent powers of water, can form an adequate conception of the enormous quantities of mineral substances annually conveyed to the sea by our great rivers. The amount of lime, flint, glaubers' salt, magnesia, soda, &c., dissolved out of the rocks over which the Ottawa and its tributaries flow, reaches the astonishing quantity of five million one hundred and fourteen thousand tons annually, most, or all of which, is carried to the sea. The quantity dissolved and carried away by the St. Lawrence, is not only vastly greater, on account of the magnitude of the river, but also because the St. Lawrence holds a much larger quantity of mineral substances in solution than the Ottawa. In every 10,000 lbs. weight of the Ottawa water, there are $9\frac{78}{100}$ ounces *avoirdupois* of solid matter. In 10,000 of the St. Lawrence water, there are $1\frac{6}{10}$ lbs. *avoirdupois* of mineral substances. These differences in the volume of water and amount of mineral substances held in solution, cause the St. Lawrence to carry towards the sea, not less than one hundred and forty-three million tons of minerals per annum. These estimates are based on the suppositions that the volume of water in the Ottawa is represented by 85,000 cubic feet flowing past a given point (Grenville) in one second of time,* and that the mineral substances it holds in solution are 6116 lbs. in 100,000,000 lbs. (0.6116 in 10,000.)† The volume of water in the St. Lawrence is represented by 900,000 cubic feet‡ in a second of time flowing past a certain point, containing 16,055 lbs of mineral substances in 100,000,000 of water. (1.6055 in 10,000 parts.)||

The following analyses by Mr. Hunt, show the relative quantities and kind of minerals in the respective waters of the two rivers, in 10,000 parts.

OTTAWA WATER.

Carbonate of Lime	0.2480
" Magnesia	.0696
Silica	.2060
Chloride of Potassium	.0160
Sulphate of Potash	.0122
" Soda	.0188
Carbonate of Soda	.0410
Alumina and oxide of Iron. (traces.)	
Manganese and Phosphorus "	
	0.6116

ST. LAWRENCE WATER.

Carbonate of Lime	0.8083
" Magnesia	.2537
Silica	.3700
Chloride of Potassium	.0220
" Sodium	.0225
Sulphate of Soda	.1229
Carbonate of Soda	.0061
Alumina, Phosphoric Acid. (traces).	
Oxides of Iron and Manganese "	
	1.6055

A cubic foot of water at the temperature of 60° Fah., weighs 998,217 oz., *avoirdupois*, or 62,3885 lbs.

* Thos. C. Clarke, C. E., Ottawa Survey.
† T. Sterry Hunt, F. G. S., Geological Reports, 1853.
‡ T. C. Clarke, C. E.
|| T. Sterry Hunt, F. G. S., Geo. Reports, 1853.

A series of simple calculations will show that in accordance with the foregoing data, 5.303,022 lbs of water pass Grenville, on the Ottawa, in one second of time. This immense mass of liquid carries with it 131.515 lbs of Carbonate of Lime or chalk; 36.9 lbs of Carbonate of Magnesia; 109.21lbs of Silica, or flint; 8.484 lbs of Chloride of Potassium; 6.47 lbs of Sulphate of Potassa; 9.969 lbs of Glaubers' Salts; and 21.742 lbs. of Carbonate of Soda; in all 324½ lbs nearly, of mineral substances every second of time, or more than five million tons in a year. By the same process we arrive at the curious and instructive result, that the St. Lawrence is the bearer of more than one hundred and forty-three million tons per annum to that great depository, the sea. Suppose this operation to continue for many thousands, and even hundreds of thousands of years, it can be easily understood how, by this slow but sure process, deep lake basins and river valleys are dissolved away and conveyed to the ocean, to form new rocks over its floor, and afford building materials for the countless millions of animals and vegetables which people its depths. A very considerable quantity of the materials thus carried away, would be deposited as soon as they reached salt water, in consequence of the large quantity of substances already in a state of solution in sea water; water possessing the curious property of relinquishing a certain proportion of minerals already in solution upon the addition of a fresh supply of a different substance. Thus, if water is saturated with common salt, that is to say contains as much common salt as it can hold in solution, and a portion of magnesia be added, the water will relinquish a definite quantity of salt, and take up a little magnesia; if now some potash be added, a small proportion of salt and a small quantity of the dissolved magnesia will be precipitated, and a corresponding quantity of potash dissolved; so also with regard to each new soluble mineral introduced, the water will always make room as it were for a certain proportion by relinquishing a little of each of the other minerals dissolved. Hence when the waters of the St. Lawrence mingle with the salt ocean, a part of their constituents will remain dissolved, and a part be precipitated, together with small quantities of the other compounds held in a state of solution by sea water. By this process, independently of animal or vegetable organisms, and the deposition of mechanically suspended matter, the floor of the ocean is gradually being covered with fine mud, which in process of time will become consolidated, entombing within it the remains of those marine animals and plants which derive the materials for the construction of their shells, shields, and the hard parts of their tissue from the dissolved constituents of sea water. In the foregoing remarks no reference has been made to the organic matter contained in the waters of the Ottawa and St. Lawrence. In those of the former river the amount is considerable, and gives a perceptible pale amber yellow colour to it; those of the latter are clear and transparent, containing but a small proportion of organic matter either in suspension or solution.

Mr. Hunt thus compares the waters of the Ottawa and the St. Lawrence.*

"The comparison of the water of these two rivers shows the following differences:—The water of the Ottawa, containing but little more than one-third as much solid matter as the St. Lawrence, is impregnated with a much larger portion of organic matter derived from the decomposition of vegetable remains, and a large amount of alkalies uncombined with chlorine or sulphuric acid. Of the alkalies determined as chlorids, the chlorid of potassium in the Ottawa water forms 32 per cent. and that of the St. Lawrence only 16 per cent., while in the former the silica equals 34 per cent., and in the latter 23 per cent. of the mineral matters. The Ottawa drains a region of crystalline rocks, and receives from these by far the greater part of its waters; hence the salts of potash liberated by the decomposition of these rocks are in large proportion. The extensive vegetable decomposition, evidenced by the organic matters dissolved in the water, will also have contributed a portion of potash. It will be recollected that the proportions of potash salts in the chlorids of sea-water and saline waters generally, does not equal more than two or three per cent. As to the St. Lawrence, although the basin of Lake Superior in which the river takes its origin is surrounded by ancient sandstones, and by crystalline rocks, it afterwards flows through lakes whose basins are composed of palæozoic strata which abound in limestones rich in gypsum and salt, and these rocks have given the waters of this river that predominance of soda, chlorine and sulphuric acid which distinguishes it from the Ottawa It is an interesting geographical feature of these two rivers that they each pass through a series of great lakes, in which the waters are enabled to deposit their suspended impurities, and thus are rendered remarkably clear and transparent.

The presence of large amounts of silica in river waters is a fact only recently established, by the analysis by H. Ste. Claire Deville of the rivers of France.† The silica of waters had generally been entirely or in great part overlooked, or had, as he suggests, from the mode of analysis adopted. been confounded with gypsum. The importance in an agricultural point of view of such an amount of dissolved silica, where river waters serve for the irrigation of the soil, is very great, and geologically it is not less significant, as it marks a decomposition of the silicious rocks by the action of water holding in solution carbonic acid, and the organic acids arising from the decay of vegetable matter. These acids combining with the bases of the native silicates, liberate the silica in a soluble form. In fact silica is never wanting in natural waters, whether neutral or alkaline, although proportionately much greater in those surface waters which are but slightly charged with mineral ingredients. The alumina, whose

* Geological Survey of Canada, 1853.

† *Annales de Chimie et de Physique,* 1848. vol. xxiii., p. 32.

presence is not less constant, although in smaller quantity, equally belongs to the soluble constituents of the water. The quantity of silica annually carried to the sea in solution by the St. Lawrence and similiar rivers, is very great, and doubtless plays an important part in the silification of organic remains, and in the formation of silicious deposits, both directly and through the intervention of silicious infusorial animals.

BOOKS:—THE KIND TO READ, AND THE WAY TO READ THEM.

A LECTURE, BY THE REV. ADAM LILLIE, D.D.

The subject to which your attention is invited this evening—"Books: the kind to read, and the way to read them"—is one of great practical moment. *A book is a power.* One page of what it contains, nay a single sentence, may lodge a principle or give an impulse which shall continue to operate and bear fruit through life; may impress a character never to be effaced; may open a spring which will flow for ever. Books, then, are things which require to be carefully handled. There are multitudes living at this moment who have been made, to a large extent, what they are through the books they have read; and through the same instrumentality the characters of others are being formed and their destiny prepared. You live in the midst of this potent influence, which will operate for your advantage or your damage as your choice may determine. To assist you in turning it to the best account, will be our aim in the suggestions we have now to offer.

With respect to the kind of books to be read, we would say:

1. Let them be such as have a useful tendency.

The motives which induce reading vary with the characters and tastes of the readers. With one class the chief design is to while away time, which is felt to hang heavy on their hands; with a second it is the obtaining of relaxation and refreshment after exhausting exertion; with a third the securing of the pleasure which the exercise affords; with a fourth the gratification of an artificial appetite for excitement; while there are others, and we hope their number is not few, whose aim is self-improvement, by way of preparation for usefulness.

Of these ends, the first—the desire to kill time, as it is technically expressed—is unworthy of a being gifted with reason, because inconsistent with any correct view of our circumstances or duty. The portion of time allotted us here is so small in comparison with the multitude of things which must be done, if the ends of our being are to be answered in any fair measure, that he to whom most of it is given has not a moment which he can afford to waste. To themselves the parties owe it, had none others—God or man—claims upon them, to wake up and apply themselves to some serious occupation, through means of which they may, should they do nothing more, give themselves an opportunity of learning what life, true life, is—how much of dignity and glory it includes, as well as seriousness. What a character they give themselves! For any one else merely to insinuate that they were such arrant triflers would be a mortal offence.

But the time of which we find ourselves in possession is not our own, to be used as we please. Others have a claim upon it—He especially who bestows it on us. Him and them we defraud of their right by misusing it—a course of action for which an account will have to be rendered.

The reader for excitement, though apparently the antipodes of the time-killer, is actuated by a motive not one whit more rational or respectable than that which influences his drowsy neighbour. Substantially, their governing principle—if it be not a misnomer to speak of either as being governed by any principle—is one and the same, to wit, a morbid animal feeling, which manifests itself in the one case in an immoderate love of repose, while in the other it assumes the character of an equally immoderate propensity to constant and violent movement. Our emotional feelings have been given us to prompt to the varied action to which duty calls, and to sustain us in it. To consume them in mere gratification, is to act a part at once criminal and degrading; criminal, because it involves the mis-appropriation of a trust; degrading, because it proclaims the party so acting to care for none but himself, and shows the notions he has formed of self-gratification to be mean and unmanly.

Of the common practice of novel reading, the divorcing of feeling from its legitimate purpose—the business of life—is an all but inevitable result. Facts show it to be so, weeping over feigned distress being, among this class of readers, much more common than earnest, self-denying exertion for the removal of that which is real. It was not, we may venture to affirm, from this source Miss Nightingale caught the inspiration which has immortalized her name.

The other motives which we have described as actuating readers—the refreshment, to wit, of their minds when exhausted by exertion, the enjoyment of a rational pleasure, and the desire of improvement, are all legitimate and in harmony with one another; so that they may be pursued with a good conscience, and together.

In dignity, the last of these ends, the wish for improvement stands without question first, consequently it should be kept ever paramount. But the reading which improves may also afford pleasure and relaxation. This it will do, unless of such a nature as to overtax the powers, a thing of which there is danger in the case only of the student. With him, even it is the measure rather than the kind of reading which burdens, use converting subjects the most exact or abstruse, within certain limits, into an agreeable exercise—a source, in fact, of intense delight.

Let not improvement be lost sight of, should necessity—exhaustion of mind or body—compel you to make at any time relaxation or refreshment your first care. In reading, seek these through means which will at the same time instruct and inspire with honorable sentiment, and prompt to generous and becoming action. Say not you are without taste for this or that. Your duty is to have a taste for it if in its tendency it be beneficial; your business to form such a taste, which a reasonable measure of determination will enable you to do with ease. The power of habit is in this respect very great. Such a taste forms, moreover, in the moral sphere, a counterpart to the instincts which excite our admiration in the animal world—which at once direct their possessor to the discovery of what is serviceable, and give him protection against what would do him harm.

Of that which is polluting it will ensure the immediate and infallible rejection, whatever the disguise under which it may conceal itself, or the vehicle in which it may be attempted to be administered. Is it not strange that parties who feel it a duty to be careful as to the company they keep, should be found indifferent about the character of the books they read? Yet are there multitudes with whom it is so. They will yield their minds without suspicion to those with whom they would not trust their persons for a moment, those in whose company they would on no account be seen, those the imputation of acquaintance with whom they would resent as an insult and a slander. Beware! A book is the mind of its author in a state of action, his inner life concentrated and brought into a state of connection with your mind and heart. While you read the process of transference is going on, and through that the process of assimilation. How large the quantity of poison which is in circulation, and how sad the havoc it is making! Penitentiary offences are made of things which have in them much less of moral obliquity than is involved in the producing, or printing, or selling of a corrupting book. Yet, for profit, parties are to be found mean enough and unprincipled enough to perform these acts; while the community which consents to be largely taxed for the repression and punishment of the lesser criminals, has not for these greater one word even of reprobation. In relation to these matters a healthier tone is much wanted.

Books of the following classes are well adapted to secure the legitimate ends of reading—to instruct, and improve, and prepare for honourable action, while they interest, and please, and refresh; to interest, and please, and refresh while instructing, and improving, and fitting for usefulness, viz.: History, biography, travels, descriptions of customs and inventions, poetry and general literature, the physical sciences, natural history, and philosophy, intellectual, moral, and political.

To master the whole of these subjects would be the work of a life—a long and laborious life—if even that would accomplish it. But to secure a serviceable acquaintance with them—such an acquaintance as will afford valuable aid in the work of life, and at the same time give a grace to the character, and supply a source of ever fresh and worthy enjoyment—is by no means difficult, so difficult at any rate as is by many supposed. None of them can well be dispensed with, whether viewed in themselves or in relation to the completeness of our knowledge. History sets before us human society in movement and action, while biography familiarizes us with individual life. Travels show us man as modified by climate, circumstances, laws, institutions, and prevailing opinions. Notices of customs and inventions furnish an exhaustless source of suggestions which may be turned to good account. Poetry and general literature charm, and instruct, and elevate. The physical sciences and natural history enlarge our conceptions of the wisdom, and might, and goodness of God, and augment our power; while philosophy informs us as to the principles of God's government over us, and acquaints us with the provisions made in the human constitution for the accomplishment of its purposes.

Between the larger part of these topics there exists a relationship which facilitates their comprehension and acquisition. At the same time, the variety they include affords room for choice, so that he who feels that he cannot undertake all, may select what his tastes lead him to prefer. Being all honourable he can do this without violating propriety; while their usefulness ensures his being a gainer on whichsoever of them his choice may fix.

The books you read we would recommend to be,

2. The best of their respective class within your reach.

To entitle a book to the character of good in relation to the subject of which it treats, two things are indispensable, to wit, that the matter be such as shall do the subject justice, and that its mode of presentation be such as shall do justice to the matter. The best book is the one which combines these two requisites in the largest measure.

From the use of works of this class a threefold advantage accrues. They render the reader the most effective aid in the accomplishment of the object for which he has recourse to them, whether pleasure or improvement; they will be found, generally speaking, to contain least of what needs to be rejected; and they will exert the happiest influence on the taste or general habit of the mind—a consideration of very great importance.

Be willing to put yourselves to a little trouble, and, if need be, expense, to procure first-class works; as the reading of books of an inferior description is a waste of the time bestowed on them, and, what is worse—much worse—a means of deteriorating the reader's mind.

To supply here anything like a list of the sort of books we have in view is an impossibility, as it would much more than fill what of space remains to us. Nor is our doing so needed, were it practicable. But we may name, by way of specimen, such works as Robertson's, Prescott's, and Macaulay's histories; Livingstone's Travels; Hugh Miller's Treatises; Macnish's Philosophy of Sleep, Sir Walter Scott's Letters on Demonology and Witchcraft, Schoolcraft's Indian Tales and Legends, Jouffroy's Ethics; in the department of mind, Locke, Reid, Stewart, Sir William Hamilton; and in Poetry, the productions of our better authors—works which will interest quite as much as profit.

With works of Imagination as such we have no war to wage; still their use should be kept within reasonable bounds. Their engaging a very large share of our attention, or occupying any very large proportion of our time will interfere with more important and more profitable employments, and produce an unfitness for them. The world in which we live is real, hence the more of reality there is in our mode of looking at things the better shall we be qualified to deal with it.

Whatever their recommendations in other respects let nothing induce you to tamper with what would contaminate. The perverting, or even blunting of the moral sensibilities, is much too large a price to pay for being interested or amused. We connect amusement with interest because we have nothing to object to it. We may be morally benefitted by a laugh as well as exhilirated, but in mirth we must be on our guard as well as in our more serious moods.

In relation to the way in which books should be read, our advice is,

1. To peruse them with attention.

This they deserve, if worth reading at all, which they will be provided the principles we have been urging are acted upon. Attention is essential if we would possess ourselves of the contents of the books we read, or have awakened within us the emotions which it is their aim to excite, or be moved to the action to which they exhort. It is so also if we wish to retain what we gather from them, or be permanently affected by it. Just as objects on which we seem gazing may pass before the eye without making impression, so may ideas with which we may fancy ourselves engaged pass before the mind without imprinting themselves upon it. This they certainly will do, in the latter case not less than the former, unless singled out and looked at—viewed on every side and in every aspect, till we have completely acquainted ourselves with their nature, and afforded them opportunity of acting upon us.

As a matter of course the retention of an idea which we have failed to catch is an impossibility. This failure in catching—the result of inattention—is the grand reason why so little of what is read is retained. It is not the memory which is at fault, but the party reading.

The measure of attention which a book requires depends partly on its subject, partly on its mode of presenting the matter dealt with, partly on the familiarity or non-familiarity of the reader with the topics of which it treats, and partly on the state of his mind as to culture, the power of comprehension to which he has attained. Be the measure required what it may, his business is to bestow it, or dispense with the perusal of the work altogether. In the professed attempt to possess himself of its contents there is involved a pledge of the necessary attention.

From inattentive reading there arises a threefold mischief, namely, the loss of the time spent on the work, or a proportion of it at any rate, if not the whole; the formation of a habit of trifling, which will prove a source of abiding evil, detracting from the fruitfulness of future attempts; together with the deceiving of the reader, who will be apt to believe the amount of his knowledge to correspond with the number of the books he conceives himself to have read.

The power of attention is, to a large extent if not entirely, an acquired thing—the result of the habit of attending; and is hence within the reach of any one who will put himself to a reasonable measure of trouble. Once acquired it will largely repay the pains which its acquisition may have cost.

For the relief of the attention those who read much will find it a good plan to vary their books or their subject; or to discontinue their reading for a time when they find fatigue being produced. A few minutes spent in moving freely about their room will send them back to their work with their original freshness and power.

We counsel you;

2. To make a free, yet careful use of your judgment in relation to what you read.

You have a mind, as well as the author you may be perusing; hence you have a right to think as well as he. That right he admits, for he addresses himself to your reason. To act otherwise would be to forfeit all claim on your attention by insulting you.

But the exercise of your judgment is not less your duty than your right. To yourself you owe this—to prevent your receiving what should be rejected, or rejecting what should be received; by either of which courses you subject yourself to damage. You owe it to your author, whose end in addressing you cannot otherwise be attained, and against whom you otherwise bring by implication a charge of supplying you with nothing on which to form a judgment. You owe it, in addition, to truth, of which you can on no other condition either perceive the evidence or feel the power.

In exercising your judgment it is incumbent on you to act with carefulness as well as freedom. Neither condemn nor approve without valid reason. With independence mingle modesty, a quality becoming in all, but especially the professed learner; and as essential as becoming if we would be saved from mistake and its consequences, which are so often serious.

By such an exercise of attention and judgment as we have been recommending, you will, moreover, promote largely your mental advancement, in addition to the other benefits which you may anticipate from it.

We counsel you;

3. To read in the exercise of a spirit of candour.

Make truth your one object of pursuit, and accept it loyally wherever you meet with it. Be not offended with what may happen to contradict your notions, merely because of its doing so. Read anything of importance which may have been written in opposition to your views, as well as what has been produced in their favour. In this way you will have a chance of being set right, should you happen to be wrong; while, if you are right, you will be likely to be confirmed, to have your confidence in the correctness of your opinions and your feeling of their value increased. Objections to your belief may be the means of suggesting arguments in defence of it which might not otherwise occur to you. Your interest lies not in having the ideas you hold proven to be correct, but in the fact of their being so.

You will not understand us as recommending that you hold loosely the opinions you may have formed, or be occupying yourself constantly in their reinvestigation, as if faith were a crime or scepticism a virtue; but simply that you should avoid intrenching yourself behind the idea of your own infallibility.

4. Take reasonable pains to master the meaning of the author you may be perusing.

Till that is got nothing is done, inasmuch as it is only by what you understand you can be either instructed or moved.

To possess yourself of your author's meaning, apply, honestly and intelligently, to his language the rulés by which the signification of written speech is ordinarily determined. As far as practicable place yourself, at the same time, in the circumstances amid which he wrote. Through this means you will acquire a sympathy with him, which will greatly facilitate your comprehension of his ideas.

In the case of works of special importance or difficulty, you will find it worth your while to review carefully what you read. Each re-perusal will throw fresh light on what you may have imperfectly apprehended, perhaps reveal to you something you may have overlooked altogether, and deepen the impression which may have been made on your mind.

You will find it also of service to make occasionally an abstract of what you read. This will enable you to test your knowledge of it, will assist you in making it your own, and will train you to a habit of careful reading, and of correct and ready judgment.

We recommend you;

5. To make what you read the subject of frequent thought.

By so doing you will at once treasure it up in your memory, ready for use when it may be wanted, and increase your acquaintance with its relations or bearings—two matters of great importance. You will, moreover, likewise furnish for your mind healthful and improving employment.

Similar benefits will result from the habit of making what you read the subject of intelligent conversation, inasmuch as that will compel you to throw your thinking into a definite shape, and will bring out in relation both to it and its subject the opinion of the party with whom the conversation may be maintained.

We advise you ;

6. To communicate what you read to others as you obtain opportunity.

As in the case of conversation the effort to place the topic with which you may undertake to deal before the mind of the party you propose instructing, in such a way as may best secure its comprehension, or induce its acceptance, or make it productive of the effect natural to it, will exert a reflex influence on your own mind—the responsibility you have voluntarily assumed acting as a stimulus to your powers, and inducing exertion to inform yourselves on the points in regard to which you may be conscious of deficiency. This educating of himself through means of his labors for the education of others is recognized by the intelligent Teacher as constituting a very material part of his reward, as, in fact, constituting often its best part.

For such engagements Mechanics' Institutes and Debating Societies, when wisely conducted, afford valuable facilities. Indeed we would look on the culture and bringing out into public service of the mind of their members, as constituting at once one of their most imperative obligations, their most de lightful employments, and their best grounds of claim upon the community.

We add the further recommendation ;

7. That you apply, as often as occasion may offer, what you read to practice.

In this way you will be gratified and encouraged by the discovery of the usefulness of what you may have learnt ; and will have valuable hints suggested to you for your guidance in your further endeavours.

We cannot, of course, promise you that you will on the system we have been recommending, go through the same quantity of reading within a given time as you would do by a more cursory perusal of the works on which your attention may be bestowed ; but we can do what is very much better, namely, promise you a greatly increased measure of enjoyment and profit. In the case of the mind, as of the body, it is the assimilation of the food taken that nourishes, not its mere quantity. But to assimilation digestion is essential.

In the counsels we have been giving, we have presupposed, as you will have perceived, the habit of reading to be in existence on the part of those to whom we have been addressing ourselves. Should there be any portion of our audience, even a single individual, with whom it is otherwise, we would, ere we close, urge on him or them the formation and cultivation of this habit. If knowledge be power, the acquisition of it becomes a duty, because of the opportunity of using it with which the intercourse of life is constantly supplying us, and because of the demands for its exertion which the circumstances in which we are placed are constantly making upon us. On the same principle its acquirement must be recognized as constituting the object of an honourable and becoming ambition.

On the younger portion of our audience especially we would urge with all earnestness the cultivation of this habit. In addition to the other advantages you may anticipate from it, of which we have already spoken, it will help to protect you against influences deteriorating in their tendency and ruinous in their consequences, to which you stand exposed on every hand ; whose mischievous power is increased by the guise which they not unfrequently assume, and the appeal made by them to feelings incident to your years, which, though in themselves honourable, require to be held under regulation.

Placed as you are in a country which supplies you with a sphere of action so wide and of an order so high, and holds out to you rewards so large and honorable, the responsibility resting on you to make the best of yourselves is very serious. Be it your aim, let it be a matter of principle with you, so to act as to prove your consciousness of the obligation under which you lie and appreciation of the privileges you enjoy ; above all, as to manifest your gratitude to their kind bestower, to secure His approval, and to realize His blessing now and for ever.

CONDITION AND PROGRESS OF FOREIGN COUNTRIES IN MANUFACTURING INDUSTRY.

No. 1.—Sweden.

The population of Sweden, during the years named was as follows :

	Men.	Women	Total.
1855......	1,764,118	1,875.214	3,639,332
1856......	1.781,641	1,890,788	3.672,429
1859......	1,786,010	1,898.023	3,687,033

Which would give about 470 inhabitants to the geographical square mile (German).

Belgium is stated to possess 8,442 inhabitants to the geographical square mile.

The Public Debt of Sweden has been incurred exclusively in the construction of railways ; it consists at the present moment of the very reasonable sum of 1,112,000*l*., bearing interest at the rate of 4½ per cent. per annum, and entailing an annual charge, with the Sinking Fund, of 65,000*l*. This debt, which is now quoted on the Hamburgh Exchange at about 97, will be totally extinguished in the year 1898.

The number of miles of Railway actually open to traffic amounts to 253 English miles. The grand total of completed and projected Railways is about 1,100 miles. The estimated cost of the Government lines amounts to 7,100,000*l*. Sterling.

The total value of imports from abroad in 1858 was 3,166,00*l*. Sterling, and of exports 3,722,000*l*. Sterling, a great diminution as compared with the years 1855 and 1856. In the latter year the imports were valued at nearly double the above amount and the exports exceeded 5,000,000*l*. Sterling.

The total quantities of metals shipped from Stockholm, during 1859 were 1,026,042 centners, an increase, as compared with 1858, of 217,179 centners. Of these, 342,737 centners went to England, against 172,196 in 1858. The stock on the 31st of December last was 675,245 centners, against 636,402 in 1858.

All the rails, and most of the locomotives, required for the railroads are imported from England, as also the whole of the mains and pipes for the water-works, which have recently been laid down in the city. The Swedish iron, although of excellent quality, cannot be produced at a price to make it available for ordinary purposes. One of the principal iron works in the country recently offered to supply the Government with a very limited quantity of rails, made of Swedish iron, at about 12*l.* 10*s.* the ton, and with ten locomotives, on the model of those now in use (which were made in England), at the price of 3,000*l.* per locomotive. It is calculated that, at the above price, the rails would cost from 15 to 20 per cent. more than British rails, and the locomotives 10 pere cent. more than those imported from England. Locomotives will eventually be made here almost, if not quite as cheaply as in England, as the Swedes are already able to manufacture all the marine engines they require, and even to execute large orders for Russia.

The quantity of sugar entered at Stockholm in 1859 was 15.000.000 lbs.; of coffee, 7,120,210 lbs.; and of tea, 25,185 lbs.

The trade of the port of Gothenburg continues to increase so rapidly that there can be little doubt it will eventually absorb the greatest portion of the foreign trade of Sweden. Already the Customs duties levied in that port have, in seven recent years, exceeded the receipts of the port of Stockholm, and the completion of the railway between the two places will give an additional advantage to Gothenburg.

The export of iron in 1859 shows a considerable increase over any previous year. The total quantity exported was 969,730 centners, of which 601,857 centners were shipped to England, and 191,220 centners to the United States.

Of deals, battens, and boards, 294.702 dozen were exported, against 205.057 dozen in 1858, and this is stated to have been the best year ever known. Of the above quantity for 1859, 138,660 dozen were shipped to England, and the equalization of the duty on foreign timber will, doubtless, give a still further impetus to this branch of Swedish exports to the United Kingdom.

The grain export amounted to 2,218,185 cubic feet of which 1,474,017 cubic feet went to England.

If, therefore, Sweden should continue hereafter to export grain in an ordinary year to the same extent, the value of her excess of exports over imports may be taken, without exaggeration, at 800,000*l.*; a most encouraging prospect, when it is considered that the total value of her exports of all kinds in 1858 was only 3.700.000*l.*, and that so recently as the year 1820 she imported annually upwards of 100,000 imperial quarters of grain from abroad.

Lucifer matches valued at 275,179 rix-dollars were exported from Gothenburg, the greater part of which were intended for the British market.

Statement showing the Quantities of Iron and Copper produced in Sweden, in 1858, and the Number of Persons employed.

	Number of Furnaces & Forges.	Quantities in British tons.	Number of Persons employed.
Pig iron	261	121,356	15,429 (Pig iron to Other kinds of iron and steel)
Castings	....	6.131	
Bar iron	386	104.148	
Other kinds of iron and steel	....	14.816	
Copper	....	1,660	1,773

Comparative Statement of the various Manufactories existing in Sweden, in the years 1857 and 1858 respectively.

	1857.		1858.	
	No. of Factories.	Value of product in Rixdollars	No. of Factories.	Value of Product in Rixdollars
Cotton and Linen	30	3,435.437	31	3,637.729
Cloth	105	10 621.887	105	7,359.267
Silk	9	916.302	7	557.353
Ribbon	10	77,306	10	64.084
Cotton spinning mills	20	10,479.372	20	7,709.819
Sail cloth	7	513,666	8	532 875
Stocking	18	447,210	17	409.267
Sugar refineries	13	13,640.547	10	10.660 582
Tobacco	95	4,711,077	100	3.841,649
Paper	80	1.946.349	87	2 187.250
Leather	561	3,700,419	591	3 413.594
Dyeries	432	1,250.299	448	1,095,023
Cotton printing	19	117,228	17	64,768
Glass	17	1,305.572	18	1,371.928
Porcelain	2	874.879	2	749.458
Earthenware and Stoves	54	329 312	53	336 424
Oil-pressing	40	1.223.560	44	1,256.354
Porter brewers	2	776.535	2	625,818
Tallow candle	12	735,751	14	256 398
Stearine candle	3	458,475	3	368,350
Soap-boilers	9	647,965	12	745.846
Rope	20	267.673	21	219,200
Clocks	126	69,141	130	64.659
Playing cards	10	87,022	9	40.664
Carpet	14	148,567	14	125.542
Chemical works	13	156.678	13	59.741
Coach makers	19	259,330	17	195.550
Chemical matches	10	236.907	19	365 240
Machinery works	37	3 311,308	47	2,901.160
Various minor works	598	1.875,174	594	1.494,954
Total	2,394	64,621,038	2,463	52,709,541
Motala Machinery Works	....	1,143,142	....	1,433,787

18 rixdollars = about £1 sterling.

One American dollar = to 4 rixdollars nearly ($3 94).

The number of Looms in operation in 1857 was 4,291, giving employment to 27,433 persons; in 1858 the number of looms was reduced to 3,758, employing 25,808 persons.

No. 2.—Denmark.

The commerce of Denmark consists, besides a considerable carrying trade, in the exchange of the raw produce of the country for manufactured goods and fruits of the south and trans-atlantic productions.

The foundation for the trade is the produce of agriculture, which, together with the breeding of cattle, forms the chief source of revenue to the country.

Although the progress of agriculture and commerce has of late been much impeded by the losses and temporary stoppage of trade caused by the late monetary crisis, and the political embarrassments which still exist, it has, notwithstanding, been considerable; this in a great measure has been produced by the large sums granted by the Diet for the promotion of professional knowledge, and by the foundation of institutions for acquiring agricultural and other sciences, and when the restraints which still impede industry are removed, there is little doubt that still further progress will be made.

There are at present several agricultural schools for peasants and stewards, besides a large institution the neighbourhood of Copenhagen, where the high branches of agriculture are taught, and where sound instruction with reference to all the sciences relative to agriculture can be acquired in eighteen months, for the moderate sum of about 5*l.*

The result of these institutions has been that old customs have been set aside, and a more rational mode of agriculture adopted throughout the country; still, however, there remains much room for improvement. The art of draining, marling, and manuring has made much progress. Irrigation seems to be but little understood, nor is it, perhaps, in general much required in this climate.

The improvements in the science of agriculture have not only caused a great increase in the produce, but also great amelioration in the quality of the grain.

RAILWAYS.

Of these there exist at present in Denmark Proper one from Copenhagen to Korör, distance 68 English miles paying an interest of 3 per cent. (Government guarantee 4 per cent.)

In Schleswig there is a railway extending from Flensburg to Tonning, with a branch line to Rensborg, connecting it with a line from Kiel to Altona, with short branches at different towns.

MANUFACTURES.

The manufactures of Denmark are unimportant. Although some progress has been made during the last two years, it is not probable that it can ever become a manufacturing country, as the most important raw produce necessary to manufacturers, viz., iron, tin, coal, &c., are wanting.

The Government has, however, of late done much for diffusing knowledge and technical skill amongst artizans. In this respect the Polytechnic School and Academy of Arts at Copenhagen have been instrumental.

One of the reasons of the hitherto low state of Danish industry may be attributed partly to the threefold protection it has been subject to, but especially to the extensive rights hitherto enjoyed by the Guilds or Close Corporations; this system of guilds has been done away with by the Law of 19th December, 1857, to come into operation on the 1st of January, 1862, from which period probations of masters and journeymen will be abandoned, and an almost unrestricted industry will take place.

The manufactures of the country may be put down as follows :—

1. The distillation of corn-brandy, in which a considerable increase has taken place of late years; the produce in 1857 amounted to 47,000,000 quarts. It is taxed at 4 skillings (about 1*d.*) per quart, and adds considerably to the revenues of the State. Besides the consumption in the country, great quantities are exported, especially to Sweden and Norway, and calling ships.

2. *The Cloth Manufacture.*—Although the protective duty on this article has been considerably diminished it still amounts to 50 rix-dollars per 100 lbs. Consequently only the finer sorts of cloth are as yet imported; that of a coarser kind is manufactured in the country. Of this description they are only four manufactories of any importance in the country, viz., at Brede, near Lyngby; Greis, near Silkiborg; Brunshaas, near Viborg; and at Neumnister in Holstein. The quality produced is generally coarse and heavy. The peasantry and the army and navy are principally supplied.

The manufacture of this article has somewhat increased.

The importation of fine cloth is valued at about 6,000,000 rix-dollars.

3. *Paper Manufactories.*—There are six of this kind The paper produced is in general of inferior quality. Some better kind of letter paper is manufactured, but in very small quantity. The best used is English or French.

The manufacture of this article has much increased. Formerly a very heavy protective duty existed both on paper and rags; this has been reduced, but it is still high. The import duty is now from 4 rix-dollars 48 skillings to 2 rix-dollars 16 skillings, and the import duty 1½ rix dollars per 100 lbs.

4. *Sugar Refineries.*—Of these they are six of importance. The quantity produced annually is about 30,000,000 lbs., and the average value about 700,000*l.* The manufacture has increased of late years. The import duty on sugar is 4 rix-dollars 66 skillings per 100 lbs.: of this amount, however, only about 1 rix dollar 32 skillings is protecting duty, the remainder being import duty on the raw produce.

5. *Iron Works.*—They are six of these of any importance, besides several smaller foundries for manufacturing stoves, pots, and pans, &c. The only manufactory of machinery is that of Messrs. Baumgarten at Copenhagen, who have built some steam-engines for the naval and postal service. The greater part of agricultural implements used are manufactured in the country. The principal iron works are at Copenhagen, Frederichsburg, Odense, Flensburg, Kiel, and Rensburg. This manufacture has also increased of late years, although the protecting duty has been reduced.

6. *Ship Building.*—There are 29 ship-building yards in Denmark. The principal ones are those of Assenrade, Svendborg, and the Island of Bornholm; but few are built at Copenhagen, as the cost of the material and other expenses are too high. The merchant fleet was, however, increased in that year by 141 vessels of 16,410 tons burthen. No private steamers were built; they are generally purchased in Great Britain, principally in Scotland. Ship-building in general has considerably improved.

7. *Oil Mills.*—There are twenty-one oil mills; the principal ones are at Copenhagen, Aarhuus, Horsens, Faaberg, Flensburg, Kiel, and Altona. The production annually of linseed and rape oil is about 3,000 English tons (Altona not included), and of linseed and rape cakes about 6,500 tons (Altona not included); value of oil about 1,700,000 rix-dollars, of cakes about 325,000 rix-dollars. This manufacture has also increased, but in 1858 there was a great decrease on account of the previous monetary crisis.

Brick and lime manufactures have considerably improved.

The manufacture of soda and alum from the new mineral cryolith lately discovered in Greenland has also some importance.

The Mechanics' Institute at Leeds.

It is intended that the accommodation of this building shall comprise a reading room and library; a lecture hall capable of seating 2,000 persons; class accommodation for 800 pupils; a gallery of art eighty feet by thirty feet; a school of art for 300 pupils; and a school of science and chemical laboratory for 100 pupils. The estimated cost of the building is fixed at £16,000, which sum will include the price of the land. The total amount already received in aid of the new building fund is £5,005.

THE OTTAWA SURVEY.*

The questions upon which information is sought, and to answer which the survey has been carried on during the past year, are as follows:

I. To determine the practicability of a navigation for vessels of the larger class, between Montreal and Lake Huron, by way of the River Ottawa and its tributary, the Matawan, Lake Nipissingue, and French River.

II. To ascertain what scale is best suited to the nature of the route.

III. To give a reliable estimate of the cost of the improvement.

In the first place, I have to report that the distance between Montreal and the mouth of French River, on Lake Huron, (according to the plans furnished me by the Department,) is, following the line of navigation adopted, 430.76 miles.

That, of this distance, 351.81 miles are already a good natural navigation, and require no improvement, and that it is perfectly practicable so to improve the remaining 78.95 miles, as to convert the whole chain of waters into a first class navigation for steam vessels, and to reduce the length of canalling to 29.31 miles, or, exclusive of the Lachine Canal, to 20.82 miles.

Secondly, the scale of navigation attainable, and which I would recommend as best suited to the capabilities of this route, is calculated for vessels of one thousand tons burden, and has locks 250 feet long by 45 wide, by 12 feet depth on the mitre sills.

Finally, a careful estimate, resulting from a close instrumental survey of all obstructed points, the details of which will be found hereafter, enables me to state that the cost of this improvement, exclusive of interest, legal expenses, and damages, none of which I have any means of ascertaining, will not exceed the sum of $12,026,354, distributed as follows:

OTTAWA AND FRENCH RIVER NAVIGATION.

	Distances.		Levels.		Cost.
	Rivers & Lakes.	Canals.	No. of Locks.	Feet Lockage.	
Lachine Canal	....	8.50	5	43.75	Not estimated
Lake St. Louis	13.31	....	......	....	do.
Saint Anne's	....	1.19	1	1.00	409672
Lake of Two Mountains	24.70				
Carillon to Grenville	7.73	5.00	7	58.50	1649909
Green Shoals	....	0.10	......	....	136105
Ottawa River	55.97				
Chaudière and des Chênes	.75	2.61	6	63.00	816733
Des Chenes Lake	26.69				
Chats	1.70	0.60	5	50.00	681932
Chats Lake	19.28				
Snows to Black Falls	18.32	1.05	11	104.00	1256840
River and Lake Coulonge	24.93	....	......	....	262414
Chapeau and L'Islet	4.85	0.14	2	18.00	243507
Deep River	33.58				
Joachims to Matawan	51.74	2.26	14	148.20	1757653
River Matawan	16.22	1.08	11	144.00	1162154
Summit level and cut	51.15	5 97	......	....	2160369
French River	47.52	0.82	7	77.00	886117
Add Engineering and Superintendence	....	....	......	....	574175
	401.44	29.32	64	665.70	1[illegible]057680

* Extract from the Report of T. C. Clarke, Esq., Engineer of the Ottawa Survey.

There are, exclusive of the Lachine Canal, 20.82 miles of Canals, costing $12,057,680, which is equal to $571,934 per mile of Canal. But the cost of the whole navigation from St. Anne's to Lake Huron, 408.76 miles, is but a trifle under $29,500 per mile.

COMPARISON OF ROUTES—CHICAGO TO MONTREAL, *via* ST. LAWRENCE AND OTTAWA.

Name.	Miles.					Number of Locks.	Lockage.	Current.	Total Rise and Fall.
	Open Navigation.			Canals.	Total.				
	Lake.	Inland.	Total.						
	Via St. Lawrence.								
Lachine	......	....	....	8.5	....	5	43.75		
St. Lawr'ce & Welland	......	....	....	60.5	....	49	490.00		
	1145	134	1279	69.0	1348.0	54	534.75	26.5	561.25
	Via Ottawa.								
Lachine	......	....	....	8.05	....	5	43.75		
Ottawa	......	....	....	20.52	....	64	665.70		
	575	401.74	976.74	29.02	1005.76	69	709.45	21.4	730.85

A Summary of the Tonnage on the Lakes, and River St. Lawrence, October, 1859.

	No. of Vessels.	Tonnage.	Total Tonnage.
UNITED STATES.			
Lake Steamers	41	39,477	
River Steamers	16	2,324	
Tugs [side wheel] River	9	1,825	
Ferry Boats [side wheel]	2	122	
Lake Propellers	105	53,749	
River Propellers	7	550	
Lake Tugs [Propellers]	35	4,347	
River Tugs [Propellers]	31	1,722	
Ferry Boats [Propellers]	2	568	
			104,684
Barques	43	17,515	
Brigs	79	22,860	
Schooners	832	174,258	
Sloops	4	152	214,785
American Vessels	1,206	Tonnage...	319,469
CANADIAN.			
Lake Steamers	22	10,188	
River Steamers	25	7,859	
River Tugs [side wheel]	12	3,322	
Ferry Boats [side wheel]	3	2,[illegible]88	
Lake Propellers	14	4,285	
Lake Tugs [Propellers]	3	357	
River Tugs [Propellers]	3	117	
			28,416
Barques	18	5,946	
Brigs	15	3.630	
Schooners	210	32,498	
Sloops	4	244	42,318
Canadian Vessels	329	Tonnage...	70,734
Grand Total	1,535	....	390,203

Decline of the Shipment of Grain through the Lakes, in 1859.

Reliable sources give a return of only 14,800,000 bushels of grain as shipped Eastward from the Lake Regions over Lake Ontario, in 1859, against 21,800,000 in 1858, 18,044,000 in 1857, and 23,800,000 in 1856.

Facts in Industrial Zoology.

Since the Christian era, the only additions to the domesticated animals of Britain, have been four in number.

In 1524, the Turkey.
In 1650, the Musk Duck.
In 1725, the Gold Pheasant.
In 1740, the Silver Pheasant.

The number of species of animals in the world, is one hundred and forty thousand, and yet the attention of mankind is limited generally to but forty-three domesticated species.

In 1800, the first wool was imported from Sydney, amounting to 658 bales. In 1858, the quantity of wool imported into Britain from Australia, amounted to 51,104,560 lbs.

In 1834, the export of Alpaca wool from South Australia, was 5,700 lbs.; in 1842, it amounted to 1,458,000 lbs.; and in 1857, Mr. Titus Salt used in his manufactory for the purpose of mixing the wool with cotton in the warp, the enormous quantity of 3,000,000.

The Eland, a South African deer of large dimentions, is being introduced into the parks of English noblemen, and is already acclimatized.

There are forty-two specimens of deer in the world, and until recently only three were generally distributed in parks, or existed in the wild state in Britain. They are the Red Deer, the Fallow Deer, and the Roebuck. Efforts are now being made to introduce the Wapiti, the Barbary Deer, the American Virginian Deer, and the Moose or Elk of Canada.

Viscount Powerscourt has now in his park, near Dublin, one bull Nylgau, one cow ditto; two stag Wapiti, three hind ditto; one Barbary stag, one hind ditto; one Sambur deer, six hinds ditto; one Axis stag, two hinds ditto; one male Llama, one female ditto; one white hind: and about thirty-five red deer; all these are in good health, and the Nylgaus and deer breeding well.

The bison, or American buffalo, may now be seen cropping and thriving on Scottish grass in a magnificent park of the Earl of Breadalbane, in the North of Scotland.

The annual value of salmon alone to Scotland is no less than $4,000,000 per annum, and to Ireland, $1,500,000. With proper care of the young fish, there is no reason why this large sum should not in time be doubled.

The Board of Arts & Manufactures

FOR UPPER CANADA.

PROCEEDINGS OF THE BOARD.

Toronto, Jan. 22nd, 1861.

The adjourned Quarterly Meeting of the Board was held this day, at one o'clock, P.M.

The members present were:—Professor Buckland. University College, Toronto; Professor Hind, Trinity College University, Toronto; Dr. Beatty, President Cobourg Mechanics' Institute; John Shier. President, and John Bengough, Delegate, Whitby Mechanics' Institute; Thomas Sheldrick, President Dundas Mechanics' Institute; Dr. Craigie, Thomas Hilton and Alexander Stuart, Delegates, Hamilton Mechanics' Institute; Joseph D. Ridout, President, and J. E. Pell, W. H. Sheppard, John McBean, Benjamin Walton, Alexander Hamilton and William Edwards, Delegates, Toronto Mechanics' Institute.

Minutes of the former meeting were read and confirmed.

Letters were read by the Secretary expressive of satisfaction, on the part of the writers thereof, in respect to the design and general character of the Journal of the Board, as indicated by the first No. issued.

The Report of the Sub-Committee for the past year was read by the Secretary; it was then moved by Mr. Sheldrick, seconded by Mr. Ridout, and *Resolved,* "That the Report be adopted and ordered to be printed in the Journal of the Board for the ensuing month; and that 100 copies of the Report be also printed for the use of members."

Moved by Mr. Pell, seconded by Mr. Shier, and *Resolved,* That the Sub-Committee be instructed to offer the Journal of this Board to the various Literary, Scientific, and Agricultural Societies in the Province, on the same terms as to Mechanics' Institutes.

In accordance with notice given at a former meeting it was

Moved by Mr. Sheppard, seconded by Mr. McBean, and *Resolved,* That article XI. of the By-laws be amended by substituting the word "twelve" for "fifteen," in the first line of said article, as the number necessary to constitute a quorum of the Board.

Moved by Mr. Bengough, seconded by Mr. Hamilton, and *Resolved,* That in the opinion of this Board it is desirable that Mechanics' Institutes, in their several localities, should be placed in the same relation to county Agricultural Societies, as this Board holds to the Provincial Agricultural Association's Exhibitions in Upper Canada.

Moved by Mr. Bengough, seconded by Professor Buckland, and *Resolved,* That the thanks of this Board are due, and hereby tendered, to the Sub-Committee for the past year, for their praiseworthy exertions in supplying—through the Journal just issued—a want that has long been felt in Upper Canada, of a medium for distributing useful information in arts and manufactures, and also devoted to the interests of the Mechanics' Institutes of the Province; the Board also especially appreciates the services of Professor Hind, who has accepted the responsible position of editing said Journal.

The election of Office-bearers and Sub-Committee for the ensuing year then took place, which resulted in the election of the following gentlemen:—

President—John Beatty, Jun., M.D.

Vice-President—John E. Pell.

Secretary & Treasurer—William Edwards.

Sub-Committee—Messrs Dr. Craigie, Prof. Hind, Joseph D. Ridout, W. Hay, W. H. Sheppard, Prof. Hincks, Thomas Sheldrick, John McBean and Alexander Hamilton.

Moved by Mr Sheldrick, seconded by Mr. Hamilton, and *Resolved*, That the Sub-Committee be instructed to obtain one or more wood-cuts for each issue of the Journal, whenever none are supplied gratuitously for that purpose—the expense to be incurred not to exceed the sum of ten dollars per issue.

The Board then adjourned.

REPORT OF SUB-COMMITTEE.

In compliance with the By-Laws of the Board of Arts and Manufactures for Upper Canada, the subcommittee elected at the last Annual Meeting beg to present the following Report of their proceedings.

During the year 12 Mechanic's Institutes, and one Board of Trade have connected themselves with this Board, either through their respective Presidents as *ex-officio* members, or by having accredited Delegates to take part in the proceedings, viz:—Ayr, Aurora, Cobourg, Dundas, Hamilton, London, L'Orignal, Stratford, St. Thomas, Toronto, Woodstock, and Whitby Mechanics' Institute, and the Board of Trade of the City of London. The Smith's Falls Mechanics' Institute contributed from its funds the sum of ten dollars, which amount your committee have appropriated to its library in books at reduced prices.

FINANCES.

The Treasurer's Audited detailed Statement, herewith submitted, shows total receipts $4,101.75; expenditure $1,605.91; leaving a balance in hand of $2,495 84: the whole of this balance, however, cannot be considered available, as an order has been given for books for the library that will amount to somewhere about $250, besides the sum of $225 offered as prizes for essays.

LIBRARY AND MODEL ROOMS.

The Library of Reference and Model Rooms have continued open to the public, free, during the year, and have been visited by a large number of persons seeking information connected with the Industrial Arts, and with Patented Inventions and Discoveries.

Your Committee have appropriated from the limited funds at their disposal, the sum of $500 for the purchase of books of Reference of a practical character. A portion of these works are already on the shelves of the Library; the remainder have been ordered from England, through the Society of Arts, thereby saving the usual discount to associated Institutes of 27½ per cent. on purchases made through that society. These books may be expected in the course of a few weeks.

The Library now contains upwards of 400 folio and octavo volumes of specifications, plates, indexes, &c., &c., of British and Canadian patented inventions, 135 volumes of Cyclopædias, Dictionaries, and works on the various Arts and Manufactures, 100 volumes of Statutes, Journals and Appendixes of the Legislature of Canada, and a large number of pamphlets containing parliamentary and other reports.

Eighteen of the leading British and American Mechanical and Scientific Journals are regularly received at the rooms.

It is proposed to arrange the works in the Library under the following heads, and to publish a catalogue as soon as practicable.

CLASSIFIED INDEX TO CATALOGUE.

1.—Alphabets, Writing, &c.
2.—Antiquities.
3.—Architecture, Engineering and Building.
4.—Biography of Artists, Engineers, Inventors, Manufacturers, &c.
5.—Decoration and Ornament.
6.—Dictionaries, Directories and Cyclopædias.
7.—Drawing, and Designing not embraced in class 3.
8.—Fine Arts.
9.—Geography, Topography, and Statistics.
10.—Horticulture and Agriculture.
11.—Manufactures, Trades, and Industrial Arts in general.
12.—Miscellaneous, and works treating on subjects in more than one department of the library.
13.—Natural History,—General.
14.—Naval Architecture.
15.—Patents of Inventions and Designs.
16.—Periodicals.
17.—Science—General.

Your Committee beg to acknowledge a donation from the Council of the Canadian Institute, of its Journal, for the five years ending December 31st, 1860, being a complete set of the new series of that valuable publication. The Patent department of the Bureau of Agriculture and Statistics has also furnished the Library with 2 copies of the first volume of Specifications and plates of Canadian Patents, embracing a period of 25 years, from 1824 to 1849. The second volume of this work is expected to be issued in April next.

The Model Rooms contain as yet, only the models of Canadian Patented Inventions, numbering about 500; your Committee would, however, suggest to the Board, that so soon as permanent accommodation is secured, an effort should be made to organize a museum of the manufactures of Canada, which should exhibit the products of the Province in all their various stages and processes of manufacture.

EXAMINATIONS.

During the past year your Committee have carried out the idea, long entertained by the Board, of organizing a system of periodical examinations of Members of Mechanics' Institutes, for the purpose of encouraging and rewarding efforts made by the Industrial classes for self-improvement.

These examinations are open to all Members of Mechanics' Institutes and Library Associations in Upper Canada, who are over sixteen years of age, and are not Students of any college, graduates or undergraduates of any University, or certified school teachers, or who are not following any of the learned professions.

Programmes have been sent to the several Institutes in Upper Canada, and they have been earnestly invited to co-operate with the Board in carrying out the scheme. Your committee hardly expect that these examinations will be taken much advantage of during the present session, although they cannot but encourage the belief that next year, when the plans and objects of the Board shall be better understood, a large number of candidates will present themselves for examination.

The subjects appointed for the Final examinations in May next, are as follows:—

I.—Arithmetic.
II.—Book-keeping.
III.—Algebra.
IV.—Geometry.
V.—Mensuration.
VI.—Trigonometry.
VII.—Conic Sections.
VIII.—Principles of Mechanics.
IX.—Practical Mechanics
X.—Magnetism. Electricity and Heat.
XI.—Astronomy.
XII.—Chemistry.
XIII.—Animal Physiology.
XIV.—Botany.
XV.—Geology & Mineralogy.
XVI.—Agriculture & Horticulture.
XVII.—Geography.
XVIII.—Political & Social Economy.
XIX.—History.
XX.—English Grammar & Composition.
XXI.—English Literature
XXII.—French.
XXIII.—German.
XXIV.—Music.
XXV.—Drawing & Modelling.
XXVI.—Penmanship.

The following Table will show the estimation in which these examinations are held in England, under the management of the Society of Arts.

In 1859, the No. of candidates examined by 79 Local Boards, at the previous examinations, was 641

No. passed previous examinations	544
" examined at final examinations	480
" passed at final examinations	368
" of papers worked at final examinations	766
" of first class certificates awarded	78
" of second class certificates awarded	154
" of third class certificates awarded	308
" of prizes awarded	28
" of unsuccessful candidates	112

Of the 368 who passed the final examinations, 95 were Mechanics, 151 Mercantile and Professional Clerks, and Book-keepers, and the remainder Engravers, Warehousemen, Teachers, Gardeners, Porters, Labourers, &c.

Age	No of Candidates.	Age.	No. of Candidates.	Age.	No. of Candidates.
16	52	26	11	36	2
17	68	27	8	37	2
18	77	28	6	38	1
19	64	29	4	39	3
20	54	30	9	44	1
21	44	31	6	43	1
22	36	32	5	44	1
23	23	33	6	47	2
24	16	34	1		
25	21	35	1		

As an evidence of the advantages likely to be secured to the holders of the certificates awarded by the Board, we give an extract from "an exposition of the Society of Arts examinations," published under the auspices of the Glasgow Athenæum in 1858. "If any thing were wanting to enforce the benefits accruing from the Society's examinations it might be derived from the approbation signified by the great number of Master Manufacturers, Railway Directors, and Bankers throughout England, and of the leading commercial firms in London and in the Provinces, which have declared their readiness to accept the certificates of the Society as a guarantee of proficiency."

The writer, also, after passing a high eulogium on British Governesses, as a class, remarks "Still, the respectability of the profession might be better appreciated, and their remuneration might be increased, if they were known to have passed a high examination of the Society of Arts."

These extracts and figures afford sufficient encouragement to the Board to persevere, although success may not for some consderable time crown their efforts.

JOURNAL.

When your Committee came into office, this Board was in communication with the Board of Agriculture with a view to entering into an arrangement to publish a Journal conjointly with that Board; after mature consideration, your Committee concluded that such a system as was contemplated would prove unsatisfactory in its working, and therefore decided to publish a Monthly Journal, of 32 pages each issue, entirely on its own responsibility. Tenders were at once obtained for the publication of such a Journal, and the contract was given to Messrs. Maclear & Co., of this city. Your Committee were also so fortunate as to secure the services of Professor Hind as editor of the Journal, and 2,000 copies of the first number have been issued.

The terms of subscription have been placed at the low sum of $1 00 per annum, or to clubs of ten or upwards 75 cents per annum; while to members of Mechanics' Institutes, when subscribing through their secretaries or other officer, it is supplied for 50 cents per annum.

As this Journal is intended to advocate the interests, and to be devoted entirely to the promotion, of the Arts and Manufactures of the Province, and at the same time to be made available as a medium of communication between the several Mechanics' Institutes of Upper Canada, your Committee look forward with confidence to a very liberal support being afforded to it by these institutions, as well as by all engaged in, or interested in the promotion of, the manufacturing industry of the country.

AMENDMENTS TO ACT OF INCORPORATION.

One of the first matters attended to on your Committee's acceptance of office was, in conjunction with the Board of Arts and Manufactures for Lower Canada and the Board of Agriculture for Upper Canada, to prepare certain amendments to the act constituting these several Boards. These amendments were submitted to a committee of the House of Assembly during the last meeting of the Legislature, but were not introduced to the House by Bill until so near the close of the session that it was found impracticable to carry it through. The principal objection your Committee had to this bill was, that it was prepared as a bill of amendments to the Old Act, instead of a New Bill; thus leaving it impossible to be understood unless read in conjunction with the act as found in the Consolidated Statutes.

Your Committee would recommend that an effort be made to have the present Act repealed, and a new one passed embracing the several amendments provided in the Bill of Amendments above referred to, during the approaching session of Parliament.

PATENT LAWS.

Your Committee think it highly desirable that amendments should be made to the Patent Laws of this Province, on the basis of a bill introduced by the Hon. Mr. Lemeiux in the session of 1859, giving to British subjects non-resident in Canada, and Foreign subjects, the right to obtain Patents in this Province on paying an amount equal to the fees and charges that may be payable, at the time of such application, by a Canadian inventor to secure a Pateut in the country of the applicant.

Restricting grants of patents to British subjects, actual residents of Canada, your Committee believe is impolitic, and leads to constant evasions of the laws of the Province, and consequent frequent litigations.

PROVINCIAL EXHIBITIONS.

In the early part of the year your Committee was invited by the Board of Arts and Manufactures for Lower Canada, to unite with them in holding a Provincial Exhibition in Montreal, on the occasion of the late visit of His Royal Highness the Prince of Wales. Your Committee felt compelled to decline the invitation thus given on the ground of the previous engagements of the executive officers of this Board, to assist in the management of the Provincial Association's Exhibition for Upper Canada, which was expected te take place in the City of Hamilton during the Prince's visit to that city. Had it not been for these prior engagements, and the claims of Upper Canada to their services, your committee would have been most happy to have assisted and co-operated with the sister Board of Lower Canada.

Your Committee have to acknowledge the receipt, from the Lower Canada Board, of a number of copies of the Catalogue of Articles shown, and Prizes Awarded, at the Exhibition just alluded to in the City of Montreal.

ESSAY ON MANUFACTURES.

Convinced of the importance of possessing a thorough knowledge of the manufacturing capabilities of the Province, and of the several branches of manufactures which it would be most profitable for us to engage in, your Committee have offered a First Prize of $150, and a Second Prize of $75, for the 1st and 2nd best essays on "The Manufactures which are most suited to the circumstances and capabilities of Upper Canada;" the essays to be enclosed to the Secretary of the Board not later than the first day of July next.

Full particulars of what is required to be treated of in these essays, is contained in the pages of the January number of the Journal.

BOARD ROOMS.

Your Committee have made arrangements for leasing a suite of rooms for the purposes of the Board, in the new hall of the Toronto Mechanics' Institute, which are expected to be ready about the first of April next.

All which is respectfully submitted.

WM. EDWARDS, *Secretary.* JOHN BEATTY, JR., *President.*

Members of Mechanics' Institutes, and of other public bodies, subscribing for this Journal throug their respective Societies, will have their copies addressed to them direct from the Office of the Board.

The free Library of Reference, and Model Rooms, are open to the public daily, from 10 a.m. till noon, and from 1 to 4 o'clock, p.m., at the Board Room, No. 79 King Street West, Toronto.

The regular meetings of the Sub-Committee of the Board are held on the last Thursday of each month.

EDITORIAL NOTICES.

DR. LILLIE'S LECTURE.

On another page will be found an admirable lecture, by the Rev. Dr. Lillie, on "BOOKS; THE KIND TO READ, AND THE WAY TO READ THEM." Manuscript copies of this lecture have been sent by the Board to several Mechanics' Institutes, where it has been read at one of the ordinary meetings of those Institutions. The publication of Dr. Lillie's Lecture will ensure it a more extended circulation, and thus bring it within the reach of many who would not otherwise have had an opportunity of hearing or reading it.

INTERNATIONAL EXHIBITION OF 1862.

All preliminaries for this exhibition are satisfactorily completed. Her Majesty's commissioners for the exhibition for 1851 accept the same trust in relation to the approaching exhibition as they filled with so much honour and success ten years ago.

The commissioners are Earl Granville, the Marquis of Chandos, Mr. Thomas Baring, Mr. C. Wentworth Dilke, and Mr. Thomas Fairbairn.

The guarantee list includes 662 persons, and the sum guaranteed now amounts to £366,800.

The commissioners for the exhibition of 1851 have granted a site for the building on their estate at South Kensington.

DUNDAS MECHANICS' INSTITUTE.

ABSTRACT OF ANNUAL REPORT.

To the President and Members of the Dundas Mechanics' Institute and Library Association.

The Auditors beg leave to present the following Report for the year, to Dec. 31st. 1860:

They find that the number of paying members are about 50; average number of readers, 20: the number of volumes added to the library for 1860, 90; the number of monthly magazines and quarterly reviews 64; the above at a cost of $68 45.

Dr.	
As shown by the Treasurer's Report and Librarian's Books, the total disbursments for the year were	$159 25
Cr.	
By credit to Institute in Treasurer's hands.	$165 07
By cash collected by Librarian	66 18
By orders on Treasurer	69 30
	$300 55
	159 25
Balance in favour after paying debts	$141 30

The auditors further consider that the sum of $45 is now due and available from members, which, when collected and placed in the Treasurer's hands, there will be then in our favour $186 30.

The Institute is now in good working order, and the members may congratulate themselves that their Institute is not in debt, but own property, in books and apparatus, to the amount of $1400, unincumbered, and is insured to the amount of $1000.

All of which is respectfully submitted.

THOMAS SHELDRICK, } *Auditors.*
GEORE BICKELL, }

The following gentlemen were elected office-bearers for the ensuing year:—

Thomas Sheldrick, President; William Roberts. Vice-President; A. D. Calder, Secretary; J. M. Babington, Treasurer; Geo. Bickell, Librarian; Duncan McMillan, Assistant Librarian.

DIRECTORS:—David Anderson, R. McKechnie, Senr., James Somerville, William McDonald, Senr., William McDonald, Junr., John McGachie, R. McKechnie, Junr., John Anderson.

Messrs. George Bickell and Roberts were chosen delegates to the Board of Arts.

SOCIETY FOR THE ACCLIMATISATION OF ANIMALS.

This is the name of a society recently established in England, for various objects which are enumerated in the subjoined paragraphs. The secretary is Mr. F. T. Buckland, M.A., Assistant Surgeon, Second Life Guards. The society has already received a munificent donation of £500 stg., from Miss Burdett Coutts, together with a promise of an annual subscription of £10 for five years.*

The purposes of the Society are—

1. The introduction, acclimatisation, and domestication of all innoxious animals, birds, fishes, insects and vegetables, whether useful or ornamental.
2. The perfection, propagation, and *hybridisation* of races newly introduced or already domesticated.
3. The spread of indigenous animals, &c., from parts of the United Kingdom where they are already known, to other localities where they are not known.
4. The procuration, whether by purchase, gift, or exchange, of animals, &c., from British and foreign countries.
5. The transmission of animals, &c., from England to her colonies and foreign parts, in exchange for others sent thence to the society.
6. The holding of periodical meetings, and the publication of reports and transactions for the purpose of spreading knowledge of acclimatisation, and inquiry into the causes of success or failure.

The society will begin with small and carefully conducted experiments.

It is proposed that those members who happen to have facilities on their estates for experiments, and who are willing to aid the objects of the society, should undertake the charge of such subjects for experiments as may be offered to them by the society, periodically reporting progress to the council.

It will be the endeavour of the society to attempt to acclimatise and cultivate those animals, birds, &c., which will be useful and suitable to the park, the moorland, the plain, the woodland, the farm, the poultry-yard, as well as those which will increase

* See an admirable paper. "On the Acclimatisation of Animals," by F. T. Buckland. M. A. Assistant Surgeon, Second Life Guards, in the Journal of the Society of Arts, Nov. 30th, 1860.

the resources of our sea-shores, rivers, ponds, and gardens.

It is hoped that this endeavour to increase the internal resources of the country will meet with the support of the public.

Persons desirous of becoming members may do so on subscribing £2 2s. per annum. A donation of £10 will make the donor a life member of the society.*

The animals to which the society intend first to direct their attention, are:

1. A small sheep, one from Brittany.

2. The prairie grouse, prairie hen, or pinnated grouse, and the tree grouse of America.

3. The "Lucid Perca," or the Sander, which it is desired to transform into a useful pond fish.

As this society becomes more widely known, it will receive great support from the British Colonies, and it certainly appears both feasible and desirable that branch societies should be established in British America, and elsewhere with a view to collect and transmit to England such animals as are worthy of attention and trial.

MANUFACTURING INDUSTRY IN FOREIGN COUNTRIES.

This number of the Journal contains the first of a series of articles on the manufacturing industry of foreign countries. The information is derived chiefly from the "Reports by Her Majesty's Secretaries of Embassy and Legation on the Manufactures, Commerce, &c., of the countries in which they reside." In order to render the description as complete as it compatible with the space which can be devoted to this subject, various facts relating to the population, climate, and natural productions, will be introduced when such information is likely to be of advantage to Canadian readers.

PATENTS OF CANADA FROM 1824 TO 1849.

A handsome royal octavo volume, bearing the above title, has just been issued from the Bureau of Agriculture and Statistics. In the introduction it is stated, that the business of the patent office in Canada has so greatly increased during the last few years, that the government has deemed it advisable to follow the example of other countries, and to publish from time to time the specifications and drawings of all patents issued in the province.

The present volume contains the specifications of patents issued in both provinces, before and after the union, from the year 1824, to January, 1844; and of the specifications and drawings from January, 1844 to May 1849. The drawings of those inventions the patent right of which expired in January, 1858, have not been given, as they are now the property of the public.

It is sufficient to say of this volume, that it is one of the best printed public documents which has yet appeared in Canada; the type is large, the paper good, and the general arrangement admirable. The model after which this very superior work has been got up, is that of the Patent Office Reports of the United Kingdom, than which nothing better can be desired. The contents of the volume are of interest and importance, first, as records; secondly, as a work of reference; but it is not probable that Canadian patents dating so far back as from 1824 to 1849, will possess much practical value at the present day, considering the marvellous strides which have taken place during ten or fifteen years in all branches of mechanical industry, and in the introduction of new processes which have originated from the progress of science and art. The next volume will possess greater interest, bringing us more within our own times. If liberally and judicially distributed, there can be no doubt that the "PATENTS OF CANADA" will exercise a very valuable and encouraging influence throughout the country, as soon as they come within the reach of the manufacturers and mechanics of the Province.

PRIZES FOR THE MANUFACTURE OF PAPER.

Among the list of prizes offered for public competition (open to all Nations) by the Industrial Society of Mulhouse, France, and which are awarded at its general meeting in May, 1861, are the following on the

MANUFACTURE OF PAPER.

1. For importing into France a filamentous substance in the state of half-stuff, which may be applied to the manufacture of paper—*Gold medal and a premium of £160.*

2. For the best treatise on decolorizing and bleaching rags—*Gold medal worth £20.*

3. For introducing into commerce 500 kils. [about 1,000 lbs.] at least of paper, having all the qualities required for photographic purposes—*Silver medal.*

The papers are to be sent in before the 16th February, 1861.

Correspondence.

"VICTORIA OIL."

The permission to make use of the following reply to a letter of enquiry, addressed to the secretary of the Canada Oil Company, Hamilton, is embraced with pleasure, and the prompt and courteous attention it shows, cordially acknowledged.

* Temporary offices, 346, Strand.

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

Hamilton, Jan. 7th, 1861.

Dear Sir:—Your letter of the 1st was duly received. We will endeavour to answer the majority of the questions you propose; others of them we will only touch upon, as their full answers would involve the imparting to the public of information which has cost our company several thousands of dollars to obtain, and the giving of publicity to which might result in serious injury to ourselves. The crude material from which we manufacture our "Victoria Oil" is obtained in the Township of Enniskillen, County of Lambton, from wells sunk to depths, averaging, say forty feet through a white clay to the rock, the fissures in which form a natural outlet for the oil into these wells. As to the source of supply we have no available or satisfactory information. About 100,000 gallons have been taken from two of our wells, during the last eighteen months by means of a common hand pump. With the oil comes a large quantity of water, say one half, sometimes much more. We are now trying a steam pump with a view of testing the full capacity of our springs.

With regard to the mode of purifying, we would simply remark, that it is done by means of distillations, and the application of acids and other substances. We do our manufacturing entirely at this place. The first and largest portion which comes over on distillation, is treated for burning oil and has a specific gravity of 40 Beaumè. The balance of the distillate is much more dense, containing a larger per centage of parafine, and is used for lubricating and other purposes. The refuse being about five per cent, is a coke, remaining in the still, rich in carbon, burns freely in a grate, making a good fuel. The loss in manufacturing consists in carburetted and sulphuretted hydrogen, and other gases formed and liberated during the process, and varying from one to five per cent., according to the rapidity with which the vapours are driven off. Numerous other parties are digging and boring for oil in the Western Counties with anticipations of great success. They have obtained several thousands of gallons of oil. What will be the result from the application of steam, time will determine. If you think any of the above information is of service, you are at liberty to use it as you see fit.

Respectfully yours,
W. P. Fisher, *Sec. C. O. Co.*

AMMONIA FROM BONES.

Our Correspondent P. R. L. asks whether there is a market for the ammonia which could be collected in the manufacture of animal charcoal; the price; the state in which it is sold; the purposes for which it is used; and the best means of preparing and collecting it for the market. In reply we state that, in Britain, ammonia is not manufactured largely from bones, but it is produced to a great extent from the ammoniacal liquor of the gas works. In France, where bone black or animal charcoal is employed to a very considerable extent in refining syrups, ammonia as a by-product is an important branch of manufacture. The condensed vapours from the retort in which the bones are calcined contain much carbonate of ammonia, water, and oil. The greater portion of the oil can be separated by decantation; the carbonate of ammonia can be fixed and collected by converting it into sal ammoniac by the addition of muriatic acid to saturation, and then evaporating the solution in a leaden boiler until a skin or pellicle appears; it may then be run off into tubs to crystallize and the crystals drained. As crude sal ammoniac it will find a sale, and it is in this state that it may be brought into the market; but the carbonate of ammonia, made by distilling the sal ammoniac with lime, is the most profitable compound. Sal ammoniac is largely used in tinning cast iron, copper and brass, and for pharmaceutical preparations. Sulphate of ammonia, made chiefly from the gas liquor, is worth $60 a ton in England, and is used as a fertilizer.

Selected Articles.

METALLURGY OF IRON.

By T. Sterry Hunt, Esq., Chemist and Mineralogist to the Geological Survey.*

The new metallurgical processes of Adrien Chenot attracted in a particular manner the attention of the Jury at the Palace of Industry, and were the object of a special study by the 1st class, who awarded to the inventor the *Gold Medal of Honour.* M. Chenot there exhibited a series of specimens serving to illustrate the processes which bear his name, and which have been the result of extraordinary labors on his part, continued through the last twenty-five years. As the industry of iron smelting promises for the future to be one of great importance to Canada, it may be well to advert briefly to the history and theory of the metallurgy of iron, in order to explain the processes now in use, and to prepare the way for an exact understanding of those of Chenot.

The most ancient and simplest mode of obtaining iron from its ores is that practised in the Corsican and Catalan forges, where pure ores are treated with charcoal in small furnaces, and by variations in the mode of conducting the process, are made to yield at once malleable iron, or a kind of steel. But this method requires very pure ores, and a large expenditure of fuel and labor; while from the small size of the furnaces it yields but a limited quantity of iron. It is scarcely used except in the Pyrennees, Corsica, some parts of Germany, and northern part of the State of New York.

The high or blast furnace, which converts the ore directly into cast metal, furnishes by far the greater part of the iron of commerce. This furnace may be described as consisting essentially of a crucible in which the materials are melted, surmounted by a vertical tube or chimney some thirty feet in height, in which the reduction of the ore is effected. Into this furnace a mixture of ore and fuel is introduced from the top, and the fire, once kindled, is kept up by a blast of hot or cold air, supplied by a proper apparatus, and admitted near the bottom of the furnace. The ores submitted to

* Geological Survey of Canada; Report for 1855.

this process are essentially combinations of iron with oxygen, often containing besides water and carbonic acid, and always mingled with more or less earthy matter, consisting of silica, alumina, &c. The water and carbonic acid being readily volatile, are often expelled by a previous process of roasting. When these oxyds of iron are heated to redness in contact with charcoal, this material combines with the oxygen of the ore, and the iron is set free or reduced to the metallic state, after which, by the further action of the combustible, it is fused, and collects in a liquid mass in the crucible below. The earthy ingredients of the ore, with the ashes of the fuel, are also melted by the intense heat, and form a glassy substance or *slag*, which floats upon the surface of the molten metal, and from time to time both of these are drawn off from the crucible. It is very important to give to these earthy substances that degree of fluidity which shall permit their ready separation from the reduced and melted iron, and to attain this end the different ores are generally mixed with certain ingredients termed fluxes, which serve to augment the fusibility of the slags. Limestone, sand and clay may each of them be used for this object with different ores. It will be kept in mind that the fuel employed in the process of smelting serves for two distinct objects: first, as a combustible to heat the materials; and, secondly, as a reducing agent to remove the oxygen from the ore.

The contents of a blast furnace in action consist then of a great column of mingled ore and fuel, continually moving downward towards the crucible, and constantly replenished from the top, while a current of air and gases is constantly traversing the mass in a contrary direction. The investigations by Leplay and Ebelman of the theory of this operation have prepared the way for the processes of Chenot, and we shall therefore state in a few words the results of their researches. They have shewn, in the first place, that the direct agent in the reduction of the ore is a portion of the carbon of the fuel in a gaseous state; and secondly, that this reduction is effected at a temperature far below that required for the fusion of the metal. The oxygen of the air, entering by the blast, is at first converted by combination with the ignited coal into carbonic acid, in which an atom of carbon is combined with two atoms of oxygen; but as this gas rising in the furnace encounters other portions of ignited coal, it takes up another equivalent of carbon, and forms carbonic oxyd gas, in which the two atoms of oxygen are combined with two of carbon. This gas is the reducing agent; for when in its upward progress it meets with the ignited oxyd of iron, the second atom of carbon in the gas takes from the iron two atoms of oxygen to form a new portion of carbonic acid, which passes on, while metallic iron remains.

The interior of the blast furnace may be divided into four distinct regions: the first and uppermost is that in which the mixture of ore and fuel is roasted; the water and volatile matters are there driven off, and the whole is gradually heated to redness. In the second region, immediately below the last, the already ignited ore is reduced to the metallic state by the ascending current of carbonic oxyd gas; the metal thus produced is, however, in the condition of malleable iron, nearly pure, and very difficultly fusible; but in the third region it combines with a portion of carbon, and is converted into the fusible compound known as cast iron. In addition to this, small portions of magnesium, aluminium and silicium, whose combinations are always present in the contents of the furnace, become reduced, and alloying with the iron affect very much its quality for better or worse. Cast iron generally contains besides these small portions of sulphur, phosphorus, and other impurities less important.

In the fourth and lowest region of the furnace, which is near to the blast, the heat becomes more intense, the carburetted metal melts, together with the earthy matters, and both collect at the bottom of the crucible upon what is called the earth, from which the two are drawn off from time to time. The cast iron thus obtained is very fusible, but brittle, and is far from possessing those precious qualities which belong to maleable iron or steel.

To convert the cast metal into malleable iron, it is exposed to a process called *puddling*, and consists essentially in fusing it in a furnace of a peculiar kind, where the metal is exposed to the action of the air. The carbon, manganese, silicium, and other foreign matters, are thus burned away, and the once liquid metal is converted into a pasty, granular mass, which is then consolidated under hammers or rollers, and drawn out into bars of soft malleable iron.

To convert into steel the soft iron thus obtained, it is heated for a long time in close vessels with powdered charcoal, a small quantity of which is absorbed by the iron, and penetrating through the mass changes it into steel. This process is known by the name of *cementation*. The change is, however, irregular and imperfect: it is therefore necessary to break up these bars of cemented or blistered steel, as it is called, and after assorting them according to their quality, either to weld them together, or to melt down each sort by itself in large crucibles. The metal is then made into ingots, and forms cast steel, which is afterwards wrought under the hammer and drawn out into bars.

Such is an outline of the long and expensive processes by which malleable iron and steel are obtained from the ores of iron. The reduction of the iron to the metallic state constitutes but a small part of the operation, and consumes comparatively but little fuel; but as we have already seen that reduced iron is first carburetted as it descends in the furnace, then melted by an intense heat into the form of cast iron, which is again fused in the puddling furnace before being converted into malleable iron, the transformation of which into cast steel requires a long continued heat for the cementation, and still another fusion.

In Derbyshire, in England, there are consumed for the fabrication of one ton of cast iron, two tons and twelve quintals of ore, and two tons of mineral coal; while in Staffordshire, two tons eight quintals of coal, and two tons seven quintals of ore are required for the production of one ton of cast metal. In the furnaces of the Department of the Dordogne, in France, where wood charcoal is employed, two tons and seven quintals of ore, and one ton and three quintals of charcoal are employed for a ton of iron. For the production of a ton of wrought iron in England, about one ton and one-third of cast iron, and from two to two and a-half tons of mineral coal are consumed; while the same amount of the cast iron of the Dordogne requires to convert it into a ton of wrought iron, one ton and a-half of charcoal. Thus in England the fabrication of a ton of wrought iron, from poor ores yielding from thirty-eight to forty per cent. of metal, requires a consumption of about five tons of mineral coal, and in Dordogne little over three tons of wood charcoal, which costs there about fifty-eight shillings currency the ton. The average price of charcoal in France, however, according to Dufrénoy, is about seventy-four shillings, while in Sweden it costs only about fourteen shillings, and in the Ural mountains eleven shillings the ton. In France much of the pig iron manufactured with charcoal is refined by the aid of mineral coal.

The questions of the price and the facility of obtaining fuel are of the first importance in the manufacture of iron. The ores of this metal are very generally diffused in the earth's surface, and occur abundantly in a great many places where fuel is dear. The iron which is manufactured either wholly or in part with wood charcoal, is of a quality much superior to that obtained with mineral coal, and commands a higher price. One principal reason of this difference is that the impurities present in the coal contaminate the iron, but it is also true that the ores treated with mineral coal are for the greater part of inferior quality. Interstratified with the beds of coal in many parts of Great Britain, Europe and North America there are found beds of what is called *clay iron stone*, or argillaceous carbonate of iron, yielding from twenty to thirty-five per cent. of the metal. This association of coal with the ore offers great facilities for the fabrication of iron, which is made in large quantities, and at very low prices from these argillaceous ores.

These poor ores will not admit of being carried far for the purpose of smelting, and it is not less evident that the large quantity of coal required for their treatment could not be brought from any great distance to the ores. As a general rule the richest and purest ores of iron belong to regions in which mineral coal is wanting, while the carboniferous districts yield only poorer and inferior ores. On this continent, which contains vast areas of coal-bearing rocks, the great deposits of magnetic and hematitic iron ores are chiefly contained in the mountainous district north of the St. Lawrence, and the adjacent region of northern New York, to which may be added a similar tract of country in Missouri. In the old world it is in Sweden, the Ural mountains, Elba, and Algiers that the most remarkable deposits of similar ores are met with; and it is not, perhaps, too much to say, that if favourable conditions of fuel and labor were to be met with in these regions, these purer and more productive ores would be wrought to the exclusion of all others. But obliged to have recourse to wood charcoal the forests in the vicinity of large iron furnaces are rapidly destroyed, and fuel at length becomes scarce. In a country like ours where there is a ready market for fire-wood near to the deposits of ore the price of fuel will one day become such as to preclude the possibility of their economic working by the ordinary processes. As the industrial arts progress the consumption of fuel is constantly increasing, and its economical employ becomes an important consideration.

From these preliminaries it is evident that a great problem with regard to the manufacture of iron, is to find a process which shall enable us to work with a small amount of fuel those rich ores which occur in districts remote from mineral coal. Such was the problem proposed by Adrien Chenot, and which, in the opinion of the International Jury, he has in a great measure resolved.

To return to the blast furnace. We have seen that the second and moderately heated region is that in which the reduction of the ore is effected, and that the intense heat of the lower regions of the furnace only affects the carburation and fusion of the metal. M. Chenot conceived the idea of a furnace which should consist only of the roasting and reducing regions: his apparatus is but the upper portion of an ordinary blast furnace; the carburetting and fusing regions being dispensed with. In this the ore is reduced at a low red heat, and the metal obtained in the form of a grey, soft, porous mass, constituting a veritable metallic sponge, and resembling spongy platinum. The furnace of Chenot is a vertical prismatic structure, forty feet high, open at the top for the reception of the ore, and having below a moveable grate by which the charge can be removed—the bottom is susceptible of being closed air tight. The lower part of the furnace is of iron plate, and is kept cool, but about midway the heat is supplied for the reduction of the ore;—and here comes in an important principle, which will require a particular explanation. It is required to heat to moderate redness the entire surface of the rectangular vertical furnace throughout a length of several feet; a result by no means easy to be effected by the use of a solid combustible, but readily attained by a gaseous fuel such as is employed by M. Chenot.

We have already explained the theory of the production of carbonic oxyd. The possibility of employing this gas as a combustible was first suggested by Karsten, and in 1841 M. Ebelman, of the School of Mines at Paris, made a series of experiments on the subject, by the direction of the Minister of Public Works. The process employed by this chemist consisted essentially in forcing a current of air through a mass of coal of such thickness that the whole of the oxygen was converted into carbonic oxyd; this escaping at an elevated temperature was brought into contact with the outer air, and furnished by its combustion a heat sufficient for all the ordinary operations of metallurgy. A consideration of great importance connected with this process is, that it permits the use of poor, earthy coals, and other waste combustibles, which could hardly be employed directly, while by this method the whole of their carbonaceous matter is converted into inflammable gas. Wood and turf may be made use of in the same way, and the gas thus obtained will be mingled with a portion of hydrogen, and probably with some hydrocarburet: a similar mixture may be obtained with charcoal or anthracite, if a jet of steam be introduced into the generating furnace—a modification of the process, which has, however, the effect of reducing the temperature of the evolved gases.

This mode of employing combustibles becomes of great importance in the process of Chenot, who generates the gas in small furnaces placed around the great prismatic tube, and conducts it into a narrow space between this and an outer wall; through this, by openings, a regular supply of air is introduced for the combustion of the gas, by which the ore contained in the tube is raised to a red heat. The next step is to provide the reducing material which shall remove the oxygen from the ignited ore, and for this purpose, we have already seen, that even in the ordinary smelting process carbonic oxyd is always the agent: but instead of the impure gas obtained from his furnaces, and diluted with the nitrogen of the air, M. Chenot prefers to prepare a pure gas, which he obtains as follows. A small quantity of pure carbonic acid, evolved from the decomposition of carbonate of lime, is passed over ignited charcoal, and thus converted into double its volume of carbonic oxyd gas; this is then brought into contact with ignited oxyd of iron, which is reduced to the metallic state, while the gas is changed into carbonic acid, ready to be coverted into carbonic oxyd by charcoal as before. In this way the volume goes on doubling each time the two-fold operation is repeated. By introducing the carbonic oxyd thus obtained into the furnace charged with ignited iron ore, and withdrawing a portion of the gas at a higher level, for the purpose of passing it again over ignited charcoal in a smaller tube apart, the process may be carried on indefinitely; the carbonic acid serving as it were to carry the reducing combustible from the one tube to the ore in the other.

A modification of this process consists in mingling the ore with an equal volume of small fragments of charcoal, and admitting a limited supply of air into the body of the apparatus, by openings at mid-height, the heat being, as before, applied from without. In this case the action is analagous to that which takes place in the ordinary blast furnace: carbonic oxyd and carbonic acid are alternately formed by the reactions between the oxygen of the air, the ore and the charcoal; but the supply of air being limited, and the temperature low, neither carburation nor fusion of the metal can take place, and five-sixths of the charcoal employed remain unchanged, and serve for another operation. This simpler way has the disadvantage that one-half of the furnace is occupied with charcoal, so that the product of metal is less than when the reducing gas is prepared in a separate generator. In either case the product is the same, and the iron remains as a soft, porous substance, retaining the form and size of the original masses of ore This metallic sponge is readily oxydized by moisture, and if prepared at a very low temperature, takes fire from a lighted taper, and burns like tinder, yielding red oxyd of iron. In order to avoid the inconvenience of this excessive tendency to oxydation, the metal is exposed in the process of manufacture to a heat somewhat greater than would be required for the reduction: this renders the sponge more dense, and less liable to oxydation in the air.

The part of the furnace below the action of the fire is so prolonged, that the reduced metal in its slow descent has time to become very nearly cold before reaching the bottom. It is then removed at intervals, by an ingenious arrangement, which enables the operator to cut off, as it were, the lower portion of the mass, without allowing the air to enter into the apparatus. In the case where the ore has been mixed with charcoal. the larger masses of metal are now separated from it by a screen, and the smaller by a revolving magnetic machine.

This spongy metallic iron may be applied to various uses. If we grind it to powder, and then submit it to strong pressure, coherent masses are obtained, which, at a welding heat, contract slightly, without losing their form, and yield malleable iron. By this process of moulding — which may be termed a casting without fusion—the metal may be obtained in forms retaining all the sharpness of the mould, and possessing the tenacity, malleability and infusibility of wrought iron The masses thus compressed have in fact only to be forged to give wrought iron of the finest quality; and it is found that during the hammering any earthy matters mechanically intermixed are eliminated like the scoriæ of the iron from the puddling furnace.

But without overlooking the great advantage of this method of making malleable iron, and moulding it into the shapes required, it is especially as applied to the manufacture of steel that the metallurgical methods of Chenot deserve attention. In the ordinary process, as we have already seen, the bars of malleable iron are carburetted by a prolonged heating in the midst of charcoal powder; but the operation is long and expensive, and the metal obtained by this mode of cementation is not homogeneous. M Chenot avails himself of the porosity of the metallic sponge to bring the carbon in a liquid state into contact with the minutest particles of the iron. For this purpose he plunges the sponge into a bath of oil, tar or melted resin, the composition of the bath varying according to the quality of the steel which it is desired to obtain. The sponge thus saturated is drained, and heated in a close vessel. The oily or resinous matter is expelled partly as a gas, but for the greater part distils over as a liquid, which may again be employed for cementation. A small portion of the carbon from the decomposition of the oil rests, however, with the iron, and at the temperature of low redness, employed near the end of distillation, appears to have already combined chemically with the metal. This treatment with the bath and distillation may be renewed if the carbonization is not sufficient after one operation.

The cemented sponge is now ground to powder, and and moulded by hydraulic pressure into small ingots, which may be heated and directly wrought under the hammer, like the compressed iron sponge;—the metal thus prepared may be compared to refined blistered steel. If, however, the cemented and compressed sponge is fused in crucibles, as in the ordinary process for making cast steel, the whole of the earthy impurities which may be present rise to the surface as a liquid slag, which is easily removed, while the fused metal is cast into ingots. In this way, by cementation and a single fusion, the iron sponge is converted into a cast steel, which is, from the mode of its preparation. more uniform in quality than that obtained by the ordinary process, and which was found by the Jury to be of remarkable excellence.

Such is a brief outline of the methods invented by Adrien Chenot for the reduction of iron ores, and the fabrication of wrought iron and steel, constituting, in opinion of one eminently fitted to judge the case, (M. Leplay, of the Imperial School of Mines, and Commissary General of the Exhibition), the most important metallurgical discovery of the age.

The peculiar condition of the iron sponge has enabled the inventor to make many curious alloys, some of which promise to be of great importance; by impregnating it with a solution of boracic acid, a peculiar steel is obtained, in which boron replaces carbon, and by a similar application of different metallic solutions, various alloys are produced, whose formation would otherwise be impossible.

The processes of M. Chenot are now being applied to the fabrication of steel, at Clichy, near Paris, where I had an opportunity of studying in detail the manufacture. The iron ore is imported from Spain, and notwithstanding the cost of its transport, and the high prices of labor and fuel in the vicinity of the metropolis, it appears from the data furnished by M. Chenot to the Jury, that steel is manufactured by him at Clichy, at a cost which is not more than one-fourth that of the steel manufactured in the same vicinity from the iron imported from Sweden. According to M. Chenot, at the works lately established on his system by Villalonga & Co., near Bilboa in Spain, they are enabled to fabricate the metallic sponge at a cost of 200 francs the ton, and the best quality of cast steel at 500 francs, or $100 the ton of 1000 kilogrammes, (2 200 pounds avoirdupois.) The conversion of the ore to the condition of sponge is, I was assured by M. Chenot, effected with little more than its own weight of charcoal.

The differences in the nature of the steel made from various ores have long been well known, but until the recent experiments of Chenot, the subject was but very imperfectly understood. According to him, the nature of the ore has much more to do with the quality of the metal than the mode of treatment, and he compares the different steels to the wines of different localities, which owe their varied qualities far more to the nature of the grapes, than to any variations in the mode of their fermentation. The process of cementation employed by Chenot furnishes, according to him, an exact measure of the capability of the iron to produce steel The sponges of the iron from Sweden and the Ural Mountains, after taking up six per cent. of carbon, yield a metal which is still malleable, while that of Elba with four per cent., becomes brittle and approaches to cast iron in its properties. While the ores of Sweden and the Urals are famous for the excellent quality of their steel, the ore of Elba is known to yield a very superior iron, but to be unfit for the fabrication of steel; and Chenot concludes, from a great many observations, that the steel producing capacity of any iron is measured by the quantity of carbon which it can absorb before losing its malleability and degenerating into cast iron.

Desirous to avail myself of these researches of M. Chenot, I placed in his hands, in September, 1855, specimens of the different iron ores from Canada, which had been sent to the Exhibition at Paris, and engaged him to submit them to the process of reduction, and to test their capabilities for the production of steel. M. Chenot has also obtained remarkable alloys of chromium and titanium with iron, his processes enabling him to effect the direct reduction of chromic and titaniferous iron ores; specimens of these two ores from Canada were therefore furnished him, but the sudden and lamented death of Chenot, by an accident, in the month of November following, deprives us for a time of the advantages of his experiments. His sons however are instructed in his processes, and have promised to undertake at an early day the examination of our Canadian ores. I am disposed to attach great importance to these investigations, from the hope that among our numerous deposits of iron ire, belonging in great part to the same geological formation as the iron ores of Scandanavia, there may be found some capable of yielding a steel equal to that of the Swedish iron. With the new and economical processes of Chenot a valuable steel ore will be sought for, even in a distant country, and may be advantageously transported in a crude state, to the localities where fuel and labour are most available.

One great condition for the successful application of these processes is, that the ores should be comparatively pure and free from earthy mixtures. We have already alluded to the impurity of the ores which are smelted in the coal districts of England, and even the ore brought by Chenot from Spain, and employed by him in his works at the gates of Paris, contains about ten per cent. of fixed, and as much volatile matter, it being a decomposed spathic iron. Many of the magnetic and hematite ores of Canada are almost chemically pure: such are those of Marmora, Madoc, Hull, Crosby, Sherbrooke, MacNab and Lake Nipissing, which even if they should not prove adapted to the manufacture of superior steel, offer for the fabrication of metallic iron, by the processes of Chenot, very great advantages over the poorer ores, which in many parts of this continent are wrought by the ordinary processes.

The small amount of fuel required by the new methods, and the fact that for the generation of the gas which is employed as combustible, turf and other cheap fuels are equally available, are considerations which should fix the attention of those interested in developing the resources of the country. With the advantages offered by these new modes of fabrication, our vast deposits of iron ore, unrivalled in richness and extent, may become sources of national wealth, while by the ordinary method of working they can scarcely, at the present prices of iron and of labour, compete with the produce of such poorer ores, wrought in the vicinity of deposits of mineral coal.

NEW INDUSTRIAL PROCESSES.

ON ELECTRO-BLOCK PRINTING,

ESPECIALLY AS APPLIED TO ENLARGING OR REDUCING ANY PRINTING SURFACE OR ORIGINAL DRAWING.

BY H. G. COLLINS.

Abreviated from the Journal of the Society of Arts.

ENLARGING OR REDUCING PROCESS.

I take my subject, which may be a printing surface of any description, either a wood cut, a steel or copper-plate engraving, a stereotype or electrotype block, or a lithographic stone, and in fact any surface capable of giving off an impression; and then on a sheet of vulcanised india-rubber, covered with a composition possessing equal elasticity, and of a non porous character, I take the impression in transfer ink; if from stone, at the lithographic press; if from steel or copper-plate at the copper-plate press, and if from surface-block or type, at the type press. I then punch small holes at equal distances (generally half an inch) round the rubber, into all of which I insert hooks of the same size. I connect them, by means of four bars passed through the body of these hooks, and thus the sheet is ready for the expanding machine. This consists of two parts, the table and the screw. The table is composed of slate, perfectly even, and mathematically true; round it is a sort of raised shelf for the four bars before mentioned to rest upon, and divided into inches, half-inches, quarter inches, and eighths. I place the sheet of rubber, with the hooks and bars round it, square upon the frame, then take the screw, and after duly fixing it, I extend the rubber equally in all directions till it assumes the required size. I test the accuracy of the extension, from time to time during the operation, by measuring the distances between different marks printed on the sheet for that purpose when in an unextended state, and I adjust the tension until I find that the distances have all been increased in the same ratio. The impression on the rubber being thus enlarged, I transfer it to a prepared surface of stone or metal, which is then printed in the usual mode of litho or zincography. When the amount of extension required is greater than can be well obtained at one operation, which is generally limited to four times the area, it is only necessary to repeat the process.

For reducing—the operation is simply reversed. I extend the rubber first to the original size of the work to be reduced, then take the impression; after which I release the sheet from the tension, which then necessarily assumes its original dimensions; it is then put upon stone or metal, as before described, in the same manner as the enlarged subject, and printed in the usual way.

It is as well to mention that the indian-rubber, in order to extend equally, must be made of an uniform substance in every part, for the old axiom must here prove true, that the same thing, under the same circumstances, must always produce the same result; and it will be obvious that the slightest variation in this particular would materially detract from the perfection of the process; for if any portion should be thinner than the general character of the sheet, that portion must of necessity possess greater yielding power than the remainder, and thus produce an inequality, and a consequent error in its mathematical proportions, and although this slight difference might not signify for ordinary work, such as landscapes, or general illustrations, it would totally preclude the adoption of my invention for maps and plans, or any matter where accurate scales would be indispensable. This perfection in the rubber has not been obtained without great cost of anxiety, time, and money, as in my first steps I was not sufficiently acquainted with the wonderful mysteries of its nature, and consequently was unable to furnish the manufacturers with all the conditions required, the knowledge of which has only been obtained from pure experiment and closely calculated results; and I am happy to say that at length all these difficulties have through the kindness and assistance of the various india-rubber Houses, especially Messrs. Silver, of Silvertown, been entirely surmounted.

With respect to the composition with which I coat the face of the sheet, I may mention, that without it the rubber would not give off the impression to the stone; in fact, the ink would be entirely absorbed; it is simply a transfer surface, involving the one necessary condition of equal tension with the rubber, or it would crack when extended, and destroy the picture. It is composed generally of flour, treacle, starch, white lead, and gelatine, and, when reduced to the consistency of cream, is applied with a brush, and allowed to become quite dry before being used.

ELECTRO-BLOCK PRINTING PROCESS.

This invention has for its object improvements in the production of blocks or surfaces to be used in printing. For these purposes, the drawing is obtained on a block or surface to be used in printing from a drawing, on a lithographic stone or other surface, whether the same has been produced thereon by hand, transferred or otherwise, by subjecting the drawing on the lithographic stone or other surface to a series of processes similar to that in which a lithographic stone is inked when about to be printed from in the ordinary way, but the ink or composition used is to be mixed with suitable dryers, so that each succeeding coating of the composition may quickly dry or set before the next coating is applied. By these means the lines and parts constituting the drawing on the stone or other surface, which would be inked and printed from it used in the ordinary manner, become more and more built up or raised; and when such raising has been sufficiently accomplished, a cast in wax or other suitable material is taken, from which an electrotype is obtained, as is well understood.

I do not, however, confine myself to this method; much depends on the character and quality of the work. In many cases, after obtaining the transfer on stone or zinc, instead of building up the picture by successive rollings, I eat away the surrounding part by acid, taking care that the transfer is made in ink, that will resist the action of acid and the galvanic battery, or that it be rolled up with a varnish possessing the same qualities. For fine work this second method is much more satisfactory.

From these two patents have sprung several valuable adjuncts The first, and perhaps most important, is the production of electrotype blocks from the artist's original drawing, without the aid of the engraver. I simply require the artist to make his sketch on transfer paper in transfer ink, or, if he prefer it, in transfer ink upon grained metal plate, and this, when delivered into my hands, I roll up with the acid-resisting composition, and then submit it to the process before described for making surface blocks from the lithographic stone.

I have also succeeded in making transfers on to stone from most old prints and typography, which may be enlarged or reduced to any size, and made generally into electrotype blocks.

Photography and many other valuable processes in connection with the illustrative art are now engaging my attention, and I have no doubt that in a short time I shall be able to produce an electrotype block from a photograph in the course of a few hours.

I fully contemplate, from a series of experiments upon which I have been engaged the last few weeks, shortly being able to take a photograph of any passing scene, and to make the same into a block, ready for press within six or eight hours; thus affording to the public the opportunity of being supplied with what may be termed really a daily illustrated newspaper; and it would not be any presumption to say that, as in times gone by, Sir Robert Peel was handed a newspaper before he left the "House" containing the whole of his speech, which had taken him four hours to deliver, so we shall by this new aid be able to furnish an illustrated newspaper containing a faithful delineation of any grand or imposing ceremony that may have taken place during the day.

Crary's Improved Brick-making Machine.

The *Scientific American*, for January 5th, contains a drawing and description of this important machine for manufacturing bricks from comparatively dry clay. In the description it is stated that, "in Crary's machine, while the pressure is one of the most powerful capable of being produced by mechanism, it is brought to bear on only a portion of the brick at a time, and the clay is crowded into the mould with a peculiar kneading motion, which fills the edges and corners of the mould in the most perfect manner conceivable; thus producing a brick which, in smoothness, hardness and strength, is greatly superior to those made by the ordinary wet moulding processes."

"This machine is the invention of a man who has been engaged for many years in the manufacture of brick on an extensive scale. Having a large contract for furnishing brick to be used in the construction of Fort Jefferson—the largest fortification in the United States, situated on the island of Tortugas, off the coast of Florida—he had one of these machines constructed, and has subjected it to a thorough test. He says that it will, when running quite slow enough, turn out 40,000 bricks per day, requiring about a ten-horse power engine to drive it; that in New York it takes seventy hands to set and burn 40,000 bricks per day; but that, with his machine, twenty hands will do the work. The brick, too, made by his machine, are smoother, better finished, and more solid than those made in the ordinary way; they have been thoroughly tested in regard to strength and power of resisting pressure, by the engineers who have charge of Fort Jefferson, and found to be far superior in these respects to ordinary brick. But perhaps the most important feature in this machine is the facility which it gives of carrying on the manufacture of bricks in all weather. As the moulded forms require no drying, but may be placed at once in the kiln as they come from the machine, it is only necessary to provide a supply of clay under cheap sheds to keep the works in constant operation."

Iron deposited on Copper by Electrolysis.

At the Ordinary Meeting, October 2, 1860, of the Manchester Literary and Philosophical Society, the President brought under the notice of the meeting a sheet of copper, upon which, whilst under magnetic influence, *iron* had been deposited electrolytically. The experiment was made by Mr. F. H. Hobler, of London, as follows:—The plate of copper forming the bottom of a shallow vessel filled with a saturated solution of sulphate of iron, was placed on the poles of a powerful horse-shoe magnet, fixed vertically with its poles uppermost. An iron wire, dipping into the solution, was placed in connection with the positive electrode of a Daniell's cell, of one pint capacity, the copper plate being connected with the negative electrode. The deposited iron exhibited the lines of magnetic force in the same manner as in the case of iron filings scattered on a sheet of paper placed over a magnet.

The President also exhibited a slip of paper which he had received from Professor Thomson. On the paper was printed by photography the line indicating the various changes of atmospheric electricity, which took place at the Observatory of Kew during twelve successive hours. Much interest was excited by witnessing one of the first-fruits of Professor Thomson's beautiful instrument. The paper indicated a series of very rapid oscillations, about one per minute, of the intensity of atmospheric electrical force.

Bleaching of Sugar by Sulphurous Acid.

This has been often attempted, but without success; for when sulphurous acid is employed to bleach sugar solutions, the sulphurous acid thereby formed destroys a great amount of sugar, transforming it into non-crystalizable or liquid sugar. The same takes place when chorine is used even in minute quantities, and upon solid brown sugar or molasses. However, M. Moiuier appears to have succeeded perfectly by conducting sulphurous acid vapours into a chamber containing brown sugar in the solid state. The bleaching progresses rapidly, and three-fourths of the colouring matter disappears without injuring the quality of the sugar, which only smells strongly of the acid, and may be immediately submitted to refining.

NOTICES OF BOOKS.

Autobiography of the Rev. Dr. Alexander Carlyle, Minister of Inveresk, containing Memorials of the Men and Events of his Time; Octavo, pp. 471. Boston: Ticknor & Fields Toronto: Rollo & Adam, 1861.

Carlyle has so long been a name illustrious in history and in literature, that it is necessary to have some distinctive mark in order to recognise individuals whom it honours. The subject of this autobiography was born in 1722, and died in 1805, having during a long and busy life, exceeding four score years, mixed much with the prominent men of his times. The volume is full of very interesting, witty, and striking anecdotes, and brings the reader as it were in familiar contact with historical names, such as Simpson and Stewart, the mathematicians, Robert Dick, Prince Charles, Wilkes, Smollett, Thompson, Hume, Adam Smith, Adam Ferguson, John Blair, Garrick, Home, Archibald Duke of Argyle, Admiral Byng, Benjamin Franklin, Lord Clive, Ambassador Keith, and a host of others. It affords an excellent description of the state of society in different towns in England, towards the middle of the last century. As might be expected there is a tinge of national prejudice throughout, and in some cases the author is rather severe on the clergy of the Church of England, and patronising to John Bull, but on the whole it is a genial and pleasant work, and one which must be read with delight and probably with advantage by all.

Personal History of Lord Bacon, from unpublished papers, by William Hepworth Dixon, *of the Inner Temple;* Octavo, pp. 524. Boston: Ticknor & Fields. Toronto: Rollo & Adam, 1861.

There are not many men of any age or country whose reputation increases with the lapse of years. Bacon was among that illustrious few of whom the more we know, the more we desire to learn, however much in his case we may regret the weaknesses of his later life At the age of nineteen this extraordinary man wrote a work, entitled "Of the state of Europe," which displayed remarkable industry and penetration His *Organon* and *Novum Organum* were works of maturer years and remain as monuments of the genius and energy of one who laboured for posterity. "*The Personal History of Lord Bacon*," reveals many of the secrets of the public and private life of him who has been designated the "Father of Experimental Philosophy." This book is written in a nervous and attractive style; the author is perhaps just touched with Hero-worship, but there is that in Francis Bacon which wins our warmest admiration, while we grieve over his shortcomings. Bacon took an active interest in the affairs of America during his time, and, as our author tells us, "a conspicuous part in the sacrifices, through which the foundations of Virginia and the Carolinas were first laid." Bacon in fact was one of the founders of the United States, yet no city is known by his name. To those who take an interest in biographical literature this volume will be a prize.

The American Journal of Science and Arts, Vol. XXXI. Second Series, January, 1861. New Haven.

This Journal was commenced in 1818, and has continued without interruption until the present time—a period of forty-two years. The first series was originally edited by Prof. B. Silliman, from 1818 to 1838; then by Prof. Silliman and his son, until 1845, when J. D. Dana, the well known mineralogist, joined the Sillimans, and a new series was commenced, which continues under the same management, in connection with Professors Gray and Agassiz and Dr. Wolcott Gibbs, an array of scientific names of the first class on this continent. A scientific journal, so long, favourably and widely known, both in America and Europe, requires no formal notice. It is sufficient to say that the first number of the XXXI. Vol., just issued, exhibits the same characteristics as those which have earned for its predecessors the reputation they enjoy.

The American Journal of Science and Arts ought of necessity to be found in all public libraries; and there are no private individuals who make Science a study or a recreation who would not be amply repaid by receiving this excellent record of progress in science, both at home and abroad. It is published on the first of every second month Price, $5 per year. The postage is prepaid by the Publisher after the payment of the year is received. B. Dawson, of Montreal, Maclear & Co. and Rollo & Adam, of Toronto, will receive orders.

The Chemistry of Common Life, by James F. Johnston, M.A., F.R.S., F.G.S. 10th edition. 2 vols. octavo. New York: D. Appleton & Co.

The author of this work has endeavoured to exhibit, in a manner as free from the abstruse technicalities of science as the subject will admit of, the Chemical and Physiological Wonders of Common Life. In this difficult undertaking he has succeeded to admiration, and furnished the public with a series of most instructive and interesting chapters on the following subjects:

I. The Air we breathe; II. The Water we drink; III The Soil we cultivate; IV. The Plant we rear; V. The Bread we eat; VI. The Beef we cook; VII-IX. The Beverages we infuse—The Teas—The Coffees—The Cocoas; X-XI. The Sweets we extract—The Grape and Cane Sugars—The Manna and Milk Sugars; XII-XVI. The Liquors we ferment—The Beers—The Wines—The Brandies

Volume II. contains: XV-XXII. The Narcotics we indulge in—Tobacco—The Hop and its substitutes, the Poppy and the Lettuce — Indian Hemp — The Betel Nut and the Pepperworts—Cocoa—The Thorn Apples—The Siberian Fungus, and the Minor Narcotics—General considerations: XXIII. The Poisons we select; XXIV. The Odours we enjoy — Volatile Oils and Fragrant Essences — The Volatile Ethers and Animal Odours; XXVI-XXVIII. The Smells we dislike—Natural Smells—Smells produced by chemical art — The prevention and removal of Smells; XXIX. What we breathe and breathe for; XXX. What, how and why we digest; XXXI. The Body we cherish; XXXII-XXXIII. The circulation of matter.

The Manufacture of Photogenic or Hydro-Carbon Oils, from Coal and other Bituminous Substances capable of supplying Burning Fluids, by Thomas Antisell, M. D. New York: D. Appleton & Co.

The author of this treatise is engaged in the United States Patent Office, where he has the charge of examining a large class of patented applications involving chemical processes. It may be presumed, therefore, that the sources of information at his command enable him to offer to the public a reliable account of the origin and present condition of this important manufacturing process. The work before us is a very good exposition of what is now doing in the United States in the distillation of coal, bitumen, &c., as far as it goes; but the inexperienced manufacturer will find its information meagre on those points where he is most likely to be at a loss, namely, in the purification and utilization of the products of the distillation. The author does not profess to enter minutely into these details; but in a work bearing the above title, we naturally expect to find the whole process described as a scientific art in a commercial point of view. The practical contents of the treatise are chiefly limited to the mode of distilling coal, bitumen, &c. Its value would have been materially enhanced if two or three additional chapters had been added on the by-products, and on the best and cheapest mode of purifying the crude materials from those offensive hydrocarbons which are so objectionable to coal oils generally. The results of the destructive distillation of coal, wood, peat and bitumens, is yet in its infancy. The future developement of this remarkable art, with reference to the by-products, may be inferred from the extensive class of bodies of great commercial value which are directly or indirectly produced from the materials named above. These will be noticed in a separate article, in a future number of this journal.

MISCELLANEOUS.

ON THE PRINCIPLES OF THE SOLAR CAMERA.

BY A. CLAUDET.

The solar camera, invented by Woodward, is one of the most important improvements introduced in the art of photography since its discovery. By its means a small negative may produce pictures magnified to any extent; a portrait taken on a collodion plate not larger than a visiting-card can be increased, in the greatest perfection, to the size of nature; views as small as those for the stereoscope can be also considerably enlarged. This is an immense advantage, which is easily understood when we consider how much quicker and in better proportion of perspective small pictures are taken by the camera obscura, while the manipulation is so greatly simplified. There is nothing new in the enlargement of photographic pictures. This has been done long ago simply by attending to the law of conjugate foci; and every photographer has been enabled, with his common camera, to increase or reduce the size of any image. For the enlargement, it was only necessary to place the original very near the camera, and to increase in proportion the focal distance. But the more the focal distance was increased, the more the intensity of light was reduced; and a still greater loss of light arose fr m the necessity of diminishing the aperture of the lens, in order to avoid the spherical aberration. Such conditions rendered the operation so long that it became almost an impossibility to produce any satisfactory results when the picture was to be considerably enlarged. For these reasons, it naturally occurred, that if the negative, having its shadows perfectly transparent and its light quite black, was turned against the strong light of the sun, its positive image at the focus of the camera would be so intense that the time of exposure would be considerably reduced. So that, in order to employ the light of the sun, and follow easily its position without having to move constantly the whole camera, it was thought advisable to employ a moveable reflecting mirror, sending the parallel rays of the sun on a vertical plano-convex lens condensing those rays on the negative, placed before the object glass, and behind the condenser, somewhere in its luminous cone. Many contrivances for this object were resorted to, but without considering anything else than throwing the strongest light possible on the negative to be copied. The constructors of these solar cameras never thought it very important to consider whether the focus of the condensing lens was better to fall before or behind the front of the object-glass, provided the negative was placed in the luminous cone of the condenser. This want of attention has been the cause which has made the solar camera a very imperfect instrument for copying negatives. The beautiful principle of Woodward's apparatus consists in his having decided the question of the position of the focus of the condenser, and having placed it exactly on the front lens of the camera obscura. As this principle had not yet been explained when the invention was exhibited before the Photographic Societies of London and Paris, and not even by the inventor himself in the specification of his patent, Mr. Claudet has undertaken, in the interest of the photographic art, to bring the subject before the British Association, and to demonstrate that the solar camera of Woodward has solved the most difficult Problem of the optics of photography, and is capable of producing wonderful results. This problem consists in forming the image of the negative to be copied only by the centre of the object-glass reduced to the smallest aperture possible, without losing the least proportion of the light illuminating the negative. The solar camera does not require any diaphragm to reduce the aperture of the lens, because every one of the points of the negative are visible only when they are defined on the image of the sun, and they are so (in that position exclusively) for the centre of the lens is the only point which sees the sun, while the various points of the negative which forms the marginal zone of the lens are defined against the comparatively obscure parts of the sky surrounding the sun, are, as it were, invisible to that zone; so that the image is produced only by the central rays, and not in the least degree by any other points of the lens, which are subject to spherical aberration. It is, in fact, a lens reduced to an aperture as small as is the image of the sun upon its surface, without the necessity of any diaphragm, and admitting the whole light of the sun after it has been condensed upon the various separate points of the negative. It is evident that from the centre of the lens the whole negative has for back-ground the sun itself, and from the other points of the lens it has for background only the sky surrounding the sun, which fortunately has no effect in the formation of the image. Such is the essential principle of Woodward's solar camera, which did not exist in that instrument when the focus of the condenser was not on the object glass. This principle is truly marvelous, but it must be observed that the solar camera, precisely on account of the excellence of this principle, requires the greatest precision in its construction. For its delicate performances it must be as perfect as an astronomical instrument, which, in fact, it is. The reflecting mirror should be plane, and with parallel surfaces, in order to reflect on the condenser an image of the sun without deformation; and in order to keep the image always on the very centre of the object-glass, the only condition for the exclusion of the oblique rays, the mirror should be capable by its connexion with a heliostat of following the movements of the sun. The condenser itself should be achromatic, in order to refract the image of the sun without dispersion, and to define more correctly the lines of the negative; and a no less important condition for loosing nothing of the photogenic rays would be, to have it formed with a glass perfectly homogeneous and colourless. With such improvements, the solar camera will become capable of producing results of the greatest beauty; and, without any question, its introduction into the photographer's studio will mark a period of considerable improvement in the art.

The Smelting of Lake Superior Copper.

The following are the practical operations in the smelting of American copper:—

"For the purpose of obtaining pure malleable copper from the masses, stamp and barrel-work sent down from the mines of Lake Superior, it is only necessary to separate the earthy matter which still adheres to the metal, and then to deprive the copper of the oxygen it has absorbed while in the liquid state. The furnaces are reverbratories of an ordinary construction.

"Sometimes the whole process is conducted in a single furnace. In this case the ore is charged into the furnace, mixed with a flux adapted to the nature of the earthy matter under treatment. The heat is kept up till the whole is fused, when the copper, owing to its greater specific gravity, sinks, while the liquid earthy matter or slag floats upon its surface. This slag is now drawn off the face of the copper by means of rabbles, and the metallic bath is exposed. During the fusion the copper has of course absorbed oxygen, which, if allowed to remain would render the metal to a great extent fragile. The surface is, therefore, covered with charcoal, and rods of green wood are plunged into the metallic bath, in order to reduce the oxide. The refining being completed, the metal is ladled out, and poured into moulds.

"At other times, two furnaces are used, and in that case the metal is first obtained in the form of pigs, which are afterwards refined. The slags taken from these furnaces are very rich in copper, containing numerous shots and flakes of copper diffused through them. They are therefore worked over again with an additional quantity of flux, in order to obtain as much as possible of this retained metal. Still the slag is found to contain too much copper to be thrown away. In order to obtain this, the slags are passed through a small cupola furnace. The resulting slag may be considered clean, but there has been an unavoidable waste of copper, which has volatilised at the high heat of the cupola and passed out of the chimney.

"The establishments at which the Lake Superior copper is worked, are at Detroit, Cleveland, Pittsburg and Boston."

Distillation of Coal.

One ton of Newcastle coals, of the average weight of 2,240 lbs., yields—

1 chaldron of coke	1494	lbs.
12 gallons of tar	135	"
10 gallons of ammoniacal liquor	100	"
9,000–10,000 cubic feet of gas	291	"
Loss	220	"
	2240	lbs.

Tables of the Expansion of Liquids and Solids.

EXPANSION OF CERTAIN LIQUIDS, Heated from 32° to 212° F.

Name of Liquid.	Expansion in Decimals.	Expansion in Vulgar Fractions.
Mercury	0·018018	$\frac{1}{55.5}$
Do. in glass	0·015432	$\frac{1}{65}$
Water from its maximum density	0·043320	$\frac{1}{23}$
Muriatic Acid, sp. grav. 1·137	0·0600	$\frac{1}{17}$
Nitric Acid, sp. grav. 1·400	0·1100	$\frac{1}{9}$
Sulphuric Acid, sp. grav. 1·850	0·0600	$\frac{1}{17}$
Alcohol (to its boiling point)	0·1100	$\frac{1}{9}$
Water	0.0460	$\frac{1}{22}$
Water saturated with Common Salt	0·0500	$\frac{1}{20}$
Sulphuric Ether (to its boiling point)	0·0700	$\frac{1}{14}$
Fixed Oils	0·0800	$\frac{1}{12.5}$
Oil of Turpentine	0·0700	$\frac{1}{14}$

LINEAR EXPANSION OF SOLIDS.*

(A bar ·1000 in length at 32° becomes at 212°).

Name of Solid.	Expansion in Decimals.	Expansion in Vulgar Fractions.
Glass Tube	1·00084000	$\frac{1}{1190}$
Plate Glass	1·00089080	$\frac{1}{1123}$
Crown Glass	1·00087572	$\frac{1}{1142}$
Glass Rod	1·00080787	$\frac{1}{1238}$
Platinum	1·00088420	$\frac{1}{1131}$
Palladium	1·00100000	$\frac{1}{1000}$
Antimony	1·00108300	$\frac{1}{923}$
Cast Iron	1·00111111	$\frac{1}{900}$
Steel	1·00118990	$\frac{1}{840}$
Blistered Steel	1·00112500	$\frac{1}{888}$
Steel, not tempered	1·00107875	$\frac{1}{927}$
Do. tempered yellow	1·00137000	$\frac{1}{730}$
Do. hardened	1·00122500	$\frac{1}{816}$
Do. annealed	1·00122000	$\frac{1}{820}$
Iron	1·00120000	$\frac{1}{833}$
Soft Iron, forged	1·00122045	$\frac{1}{819}$
Iron Wire	1·00123000	$\frac{1}{813}$
Bismuth	1·00139000	$\frac{1}{720}$
Gold, annealed	1·00146000	$\frac{1}{684}$
Do. Paris Standard, unannealed	1·00155155	$\frac{1}{645}$
Do. do. annealed	1·00151361	$\frac{1}{660}$
Copper	1·00180000	$\frac{1}{555}$
Brass	1·00184000	$\frac{1}{543}$
Brass Wire	1·00191000	$\frac{1}{523}$
Silver	1·00190000	$\frac{1}{528}$
Do. Paris Standard	1·00190868	$\frac{1}{524}$
Speculum Metal	1·001933 '0	$\frac{1}{517}$
Malacca Tin	1·00193765	$\frac{1}{516}$
Tin from Falmouth	1·00217298	$\frac{1}{462}$
Grain Tin	1·00248000	$\frac{1}{403}$
Pewter	1·00228300	$\frac{1}{438}$
Soft Solder, Lead 2 + Tin 1	1·00250800	$\frac{1}{400}$
Zinc 8 + Tin 1	1·00269200	$\frac{1}{374}$
Brass 16 + Tin 1	1·00190800	$\frac{1}{524}$
Copper 8 + Tin 1	1·00181700	$\frac{1}{550}$
Lead	1·00284360	$\frac{1}{351}$
Zinc	1·00294200	$\frac{1}{340}$

* The numbers in this Table are the mean of those given by the best authorities.

Australia.

The problem as to the possibility of crossing the continent of Australia, from South to North, has been virtually solved, and no question now remains that a land transit may be opened up, available, not only for the general purposes of commerce, but also for telegraphic communication. Mr. Stuart, who started from Adelaide about last March on an exploring expedition, with two companions and a number of horses, has returned, after having crossed the country to a distance of about 1,600 miles from Adelaide and to within 300 miles of the Victoria river. Here he was turned back by a body of hostile natives; but, as he had already reached 100 miles further north than the point to which Gregory's expedition in 1856 descended from the Victoria, the continent may be considered, by the joint results of these surveys, to have been fairly opened up from one end to the other. Instead of an arid desert, it is described to be a practicable country throughout. The full details of the observations made were for the present, however, kept secret, the Parliament of South Australia having voted £2,500 to enable Mr. Stuart to start again with a larger and more strongly organised party, and a desire being entertained to prevent the triumph of final success being snatched from him by rival explorers in the other colonies, who might hastily avail themselves of all his information. Still, enough had been allowed to transpire to give a general idea of the route traversed. Mr. Stuart and his companions suffered terribly from want, not only of water, but of food, and also from an attack of scurvy. The part of the route in which water was totally absent, however, was only 60 miles. In many parts there was fine grass, besides splendid gum and other trees, including at least four kinds of palm. A very large salt lake was also discovered in the interior, supposed, from the blueness of its water, to be of great depth. The event had created great excitement and rejoicing at Adelaide, and the general impression was that a number of new provinces would ultimately be formed in the territory thus explored, and that meanwhile the tract might be made available almost immediately to facilitate communication with India, and especially the export trade in horses. The new expedition, which was to to start immediately, would consist of Mr. Stuart and one of his former companions, ten other well-armed men, and a suitable number of horses.

The Disc Wheel Propeller.

An experiment of a novel mode of propulsion in steam navigation has recently been made in a trip from Blackwall to Erith. The paddle-wheel and screw have hitherto been the means employed for utilising steam power in navigation, but Mr. James Jones Aston, of the Middle Temple, has, it appears, taken out a patent for propelling steam-ships by a very different contrivance. *A priori*, the arrangement invented by Mr. Aston, is the very last that would suggest itself to an observer, and the inventor himself candidly admits that both practical men and men of science ridiculed his idea when first propounded. The steam-tug *Saucy Jack*—by no means a favorable boat for the success of the experiment—was propelled down the river at a rate of six knots an hour by the agency of a disc wheel, and with a far less expenditure of coal than if either paddles or screw had been used. The earliest objection to the locomotive was that it would not "bite" the rail, but the experiment soon proved the objection to be worthless. It is still more difficult to conceive what hold a thin metal or wooden plate, not striking the water horizontally or obliquely, but cutting into it edgewise, like a knife, can have of the water. The diameter of the disc used in the experiment was 14 feet, with about two feet in the water. The thickness of the plate was only three-eights of an inch. and it is asserted that the thiner the plate the greater the power. The engines of the tug were 30-inch, with a stroke of 42. The greatest number of revolutions made was 47. In the trip down the river the pressure in the boilers was 6lbs., and coming up 4lbs., the speed attained being about six knots. With the paddles the tug used to make about eight knots, but the expenditure of fuel was about 40 per cent. in favor of the disc. The conditions under which the trial was made was unfavorable to the experiment. She was not so readily started or so speedily stopped as the ordinary steamboats, but, perhaps, these disadvantages may disappear under more favourable circumstances. The disc may be constructed of metal or wood, or of both in combination, and several discs may be used on the same shaft, at convenient distances apart. There were five plates on each side in this experiment. The advantages of the disc, as enumerated by the inventor, are the following;—

1. It is less likely to be disabled in storm or battle, and is therefore a safer propeller.
2. There are no paddles or blades to agitate the water, and the boat is free from vibration.
3. All the action of the propeller is in the direction in which the boat travels, and the motive power being more perfectly utilised, a much greater rate of speed may be attained than has hitherto been deemed practicable.
4. Its action is perpetual, and not intermittent.
5. There is no backwater, or loss of power on that account.
6. It is much less affected by wind and tide.
7. It is the only propeller well suited for canals and shallow rivers.
8. It may be used for small boats and other craft.
9. It may be worked with lower power, and at great saving of fuel.
10. It is of more simple construction, less costly, less liable to injury, and causes less water and tear of the boat.

There were present to witness the experiment:—Capt. Lovell, of the Peninsular and Oriental Company; Mr. Wright, Assistant-engineer-in-chief to the Admiralty; Mr. Adams, Mr. Macrory, and Mr. Aston himself, the inventor and patentee.

Selection of Solders.

Solders must be selected in reference to their appropriate metals. Tin plates are soldered with an alloy consisting of from one to two parts tin, with one of lead. Pewter is soldered with a more fusible alloy containing a certain proportion of bismuth, added to the lead and tin. Iron, copper and brass are soldered with spelter—an alloy of zinc and copper in nearly equal parts. Silver is soldered, sometimes with pure tin, but generally with silver-solder—an alloy of five parts of silver, six of brass, and two of zinc. Zinc and lead are soldered with an alloy of from one to two parts of lead with one of tin. Platinum, with fine gold. Gold, with an alloy of silver and gold, or of copper and gold; &c.

In all soldering processes, the following conditions must be observed:—The surfaces to be united must be entirely free from oxyd, bright, smooth and level. The contact of air must be excluded during the soldering, because it is apt to oxydize one or other of the surfaces, and thus to prevent the formation of an alloy at the points of union. This exclusion of air is effected in various ways The locksmith encases in loam the objects of iron or brass that he wishes to subject to a soldering heat; the silversmith and brazier mix their respective solders with moistened borax powder; the coppersmith and tinman apply sal ammoniac, resin, or both, to the cleaned metallic surface, before using the soldering-iron to fuse them together with the tin alloy.

Remarkable Phenomena on the Surface of the Sun.

On the first of September last, at 11h. 18m. a.m., a distinguished astronomer, Mr. Carrington, had directed his telescope to the sun, and was engaged in observing his spots, when suddenly two intensely luminous bodies burst into view on its surface. They moved side by side through a space of about 35,000 miles, first increasing in brightness, then fading away; in five minutes they had vanished. They did not alter the shape of a group of large black spots which lay directly in their paths. Momentary as this remarkable phenomena was, it was fortunately witnessed and confirmed, as to one of the bright lights, by another observer, Mr Hodgson, at Highgate, who, by a happy co-incidence, had also his telescope directed to the great luminary at the same instant. It may be, therefore, that these two gentleman have actually witnessed the process of feeding the sun, by the fall of metoric matter. But however this may be, it is a remarkable circumstance that the observations at Kew show that on the very day, and at the very hour and minute of this unexpected and curious phenomenon, a moderate but marked magnetic disturbance took place; and a storm or great disturbance of the magnetic elements occurred four hours after midnight, extending to the southern hemisphere. Thus is exhibited a seeming connection between magnectic phenomena and certain actions taking place on the sun's disk—a connection which the observations of Schwabe, compared with the magnetical records of our colonial observatories, had already rendered nearly certain.—*British Association.*

Value of Manufactured Earthy Minerals in the United Kingdom.

Bricks, tiles, &c.	£2,911,980
Building and other stones	4,622,924
Superior kinds of clay, china stone	285,846
Sands	10,250
Coprolites	65,500
Rotten Stone	750
Ochre, Umber, &c.	5,450
Barytes	15,500
Gypsum	17,750
Fuller's Earth	13,500
Fluor Spar	4,625
Total value of the Earthy Minerals	£7,954,075

A cubic yard of bricks is estimated to contain 384 bricks, and on the average about 373 bricks go to the ton.

Value of Minerals in the United Kingdom.

The total value of metals, metalliferous minerals and coal produced in 1858, was £81,266,932 stg. If to this immense sum the value of the manufactured earthy minerals be added, the total product of the mine will be represented by nearly £40,000,000 stg.

TO INVENTORS AND PATENTEES IN CANADA.

Inventors and Patentees are requested to transmit to the Secretary of the Board short descriptive accounts of their respective inventions, with illustrative wood cuts, for insertion in this Journal. It is essential that the description should be concise and exact. Attention is invited to the continually increasing value which a descriptive public record of all Canadian inventions can scarcely fail to secure: but it must also be borne in mind, that the Editor will exercise his judgment in curtailing descriptions, if too long or not strictly appropriate; and such notices only will be inserted as are likely to be of value to the public.

TO CORRESPONDENTS.

Correspondents sending communications for insertion are particularly requested to write on one side only of half sheets or slips of paper. All communications relating to Industry and Manufactures will receive careful attention and reply, and it is confidently hoped that this department will become one of the most valuable in the Journal.

TO MANUFACTURERS & MECHANICS IN CANADA.

Statistics, hints, facts, and even theories are respectfully solicited. Manufacturers and Mechanics can afford useful coöperation, by transmitting descriptive accounts of LOCAL INDUSTRY, and suggestions as to the introduction of new branches, or the improvement and extension of old, in the localities where they reside,

TO PUBLISHERS AND AUTHORS.

Short reviews and notices of books suitable to Mechanics' Institutes will always have a place in the Journal, and the attention of publishers and authors is called to the excellent advertising medium it presents for works suitable to Public Libraries. A copy of a work it is desired should be noticed can be sent to the Secretary of the Board.

PATENTS OF INVENTIONS,

As issued by the BUREAU OF AGRICULTURE AND STATISTICS, to 4th January, 1861.

His Excellency the Administrator of the Government has been pleased to grant Letters Patent of Invention for a period of FOURTEEN YEARS, from the dates thereof, to the following persons, viz:

David Buckler, of Garafraxa, County of Wellington, School Teacher, for "A Chair or Lounge, termed the "Lazy Man's Friend."—(Dated 25th September, 1860.)

Francis Marshal Ackerman, of the Village of Morven, County Addington, Mechanic, for "An article termed the "Ackerman Washing Machine,"—(Dated 12th October, 1860.)

Eugene Cooper, of the Township of Oneida, County Haldimand, Farmer, for "A Stumping Machine,"—(Dated 22nd October, 1860.

David Tees, of the City of Montreal, Undertaker, for an "Air-tight Coffin or Burial case, denominated by him "Tees's Air-tight Coffin or Burial Casket."—(Dated 25th October, 1860.)

David Klein, of the City of Quebec, Mechanic and and Merchant for "A Floating Bridge."—(Dated 13th December, 1860.)