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PETROLEUM GAS.

The London *Times* roughly estimates that the quantity of Petroleum or Rock Oil which will be exported to Europe in 1863 will amount to fifty or sixty million gallons. Numerous uses for the different light and heavy oils, which can be procured from petroleum by distillation, are already known, and application is now made of this curious product in a great number of forms. But it is as an illuminator that it will find most favor with the public, where the supply is constant and cheap; and it is very probable that, as an economical source of gas for illuminating and heating purposes, it will rapidly come into general use.

The results of a series of experiments which have recently been made at the gas works from which the small towns of Homer and Courtland, in the State of New York, are supplied, are most satisfactory and encouraging, both with regard to the luminous qualities and the remarkable cheapness of petroleum gas.

The following details are the results of careful measurement in all particulars, from which information as to the economy of the manufacture of petroleum gas could be derived.

The process employed at Homer and Courtland is similar, in most respects, to that which enables the proprietor of the Stevenson House, St. Catharines, C.W., to light his establishment with 180 burners, at a cost of 86 cents a night, under what is known as Thomson's patent.

The retorts at Homer are two in number, and of the following dimensions:—

Length	7½	feet.
Breadth	16	inches.
Height	12	"

Two vertical tubes are cast on each retort for the purpose of supplying water and petroleum. The retorts are laid horizontally in an arch, exactly the same as ordinary coal gas retorts, for which they can be substituted without much trouble or expense. Each retort is divided into three chambers called the petroleum, the water and the coke chambers respectively.

Petroleum and water are introduced in continuous streams through the tubes before described, so that when once a barrel of petroleum is placed at a sufficient height to allow a pipe provided with a stop-cock to feed the retort, the fluid may be admitted and the process of conversion into gas goes on without further trouble, until the barrel is exhausted.

Two series of experiments were recently made at Homer, with the following results:—

FIRST TRIAL.

Quantity of gas made by each retort, per hour, 450 cubic feet.

Total quantity of gas made, 3,380 cubic feet.

Petroleum consumed, 38 wine gallons.

Condensed petroleum, capable of being used over again, 4 gallons.

Quantity of petroleum per 1,000 feet of gas, $10\frac{1}{17}$ gallons.

Time required to make 3,380 feet, 3 hours 45 min.

Time of heating the retorts; the same as for coal gas.

Quantity of fuel; same as for coal gas.

SECOND TRIAL.

	C. F.
Quantity of gas made by the two retorts in the first hour	1,080
Quantity of gas made in second hour, less 10 minutes	820
Proportionate quantity in second hour	984
Total quantity in two hours	2,064
Mean quantity per hour	1,032
" " for each retort per hour	516

Quantity of fuel; same as for coal gas.

Time of heating retorts; same as for coal gas.

Quantity of petroleum consumed	25	wine gals.
" condensed petroleum, capable of being used again	1¾	"
Actual quantity of petroleum used	23¼	"
Quantity per 1,000 feet	$11\frac{9}{17}$	"

MEAN OF THE TWO EXPERIMENTS.

Total quantity of gas made, 5,280 cubic feet.

Total time occupied in making the gas, 5 hours 35 minutes, or very nearly 1,000 feet per hour, or 500 feet for each retort.

Petroleum consumed; 11 gallons per 1,000 feet.

In the first hour of the second experiment, the quantity made was 1,080 cubic feet; and the condenser shewed that too much water was admitted, (about one-eighth of the whole quantity of petroleum.) This unnecessary quantity of water evidently cooled the retort, and prevented the gas from being formed so rapidly as during the first trial.

A one-foot burner, with this gas, gives as brilliant a light as a four-feet burner supplied with common coal gas.* Hence, 1,000 feet of petroleum gas will go as far as 4,000 feet of ordinary coal gas for illuminating purposes.

Now, when we examine these results, and compare them with what has been done in the manufacture of coal gas, the following remarkable comparisons present themselves.

In making coal gas a charge of 150 lbs. of coal is generally introduced into the retort, and allowed to remain for five hours. It generates 600 feet of gas, if the coal is of moderately good quality. This is at the rate of 8,000 feet for 2,000 lbs., or one ton of coal. To produce 600 feet of gas, the destructive distillation has to be carried on for a period of five hours. In a retort of the same dimensions and heated in the same manner, no less than 2,500 cubic feet of petroleum gas are produced, under precisely similar conditions. But one cubic foot of petroleum gas is equal in illuminating power to 4 cubic feet of coal gas. Hence, in five hours the petroleum produces, when reduced to the equivalent of coal gas, the enormous quantity of 10,000 cubic feet of gas, against 600 by the coal process. The saving of fuel and labor is consequently enormous.

If we assume that the illuminating power of petroleum gas is only three times that of coal gas, the proportion of each kind produced in 5 hours is as follows:—

7,500 cubic feet of gas by the petroleum process.
600 " " by the coal process.

Hence, in this case, which is below the actual results, the GAIN IN TIME required for the manufacture of petroleum gas, as compared with coal gas, is as TWELVE to ONE. This fact alone reduces the number of retorts in petroleum gas works on a large scale, to at least, say, one-sixth of the number required for coal gas works. Actually one petroleum retort can produce the equivalent in gas of twelve coal gas retorts. When the annual expense of retorts is taken into consideration, this item alone establishes a great argument in favor of the petroleum process; for not only is the number of retorts required diminished to the extent named, but all connecting pipes, huge hydraulic mains, and the extensive system of coolers and purifyers, are dispensed with in equal proportion. The labor of handling the coal is done away with, and a large proportion of capital in the construction of works saved.

* A recent writer in the American *Gas Light Journal* states that petroleum gas gives a light 6 or 7 times as luminous as coal gas. This may be the case, but in order to avoid an error in excess, we place it at 4 times as great as ordinary coal gas: that is to say a one-foot burner with petroleum gas, is equal to a four-feet burner fed with common coal gas.

To proceed now to the question of cost. Assuming that two benches, each containing two retorts, are used for making petroleum and coal gas respectively. The cost of apparatus in the first instance is about the same. The time for heating and the fuel consumed is the same. The cost of 11 gallons of petroleum (or 1,000 feet of petroleum gas) at 6 cents a gallon (the price in Toronto) is 66 cents. The cost of 250 lbs. of coal (or 1,000 feet of coal gas, at $5 a ton, is 62½ cents. But 1,000 feet of petroleum gas is, at the lowest estimate, equal to 3,000 feet of coal gas. Hence, the cost of 3,000 feet of coal gas (equal to 1,000 feet of petroleum gas) or 750 lbs. of coal, at $5 a ton, is $1.87½. Then there is the coke to be deducted from the price of the coal used in making 3,000 feet of gas, which may fairly be set against the smaller amount of labour required in handling the petroleum, when compared with the handling of the coal.

Where petroleum is 10 cents a gallon, and coal $6 a ton, the proportionate cost of the raw materials used will be as follows:—

Cost of 1,000 feet of petroleum gas	$1 10
" 3,000 feet of coal gas	2 25

The foregoing comparisons refer to the original cost of the material from which the gases are made, but if we take the price actually charged by gas companies into consideration, the results are the more striking.

The cost of private works to supply 200 burners will be about $1,000; the labor of one man per diem; lime for purifying; three bushels of coke at 10 cents a bushel; so that the entire cost will be—

Interest on capital at 8 per cent. per ann.	$80 00
Labor at $1 per day	365 00
Lime for purifying, 200 bushels per ann. at 20 cents a bushel	40 00
Petroleum to produce gas for 200 one-foot burners, 5 hours a day throughout the year (365,000 feet of gas); 4,015 gallons, at 6 cents a gallon..........................	240 90
Fuel, say 4 bushels of coke a day, at 10 cents a bushel	146 00
Total cost...........	$871 90

The equivalent of 365,000 cubic feet of petroleum gas in coal gas is 1,095,000, reckoning one foot of petroleum gas equal to three feet only of coal gas.

Cost of 1,095,000 cubic feet of coal gas, at $2.50 per 1,000 feet (a low price in the United States and Canada)	$2,737 50
Difference per annum in favor of petroleum gas..................................	1,865 60

If the price of petroleum is 10 cents a gallon, instead of 6 cents, the difference in favor of the gas will be, per annum, $1,705.

Thus:

Interest on capital	$80 00
Labour	365 00
Lime	40 00
Petroleum......................................	401 50
Coke	146 00
	$1032 50
1,095,000 c.ft. coal gas, at $2 50 per 1000,	$2737 50
Diff. in favor of petroleum gas, per ann.	1705 00

In works, where twelve coal gas retorts are in operation day and night, each being charged with 150 lbs. of coal they can produce 36,000 cubic feet of gas in 24 hours. This quantity can be yielded by TWO petroleum retorts in twelve hours. Thus:

2 petroleum retorts yield 1000 cubic ft. per hour.

In 12 hours the yield will be 12,000 feet.

The equivalent of 12,000 feet of petroleum gas is equal to 36,000 feet of coal gas.

If reduced to the same unit of time, namely, 24 hours, two petroleum retorts, of the same dimensions as coal gas retorts, will yield 24,000 cubic feet of petroleum gas, the equivalent of 72,000 ft. of coal gas, or as much as 24 ordinary coal retorts charged with 150 lbs. of coal each, every five hours, can produce in 24 hours.

There are other facts which make the production of gas from petroleum more economical than from coal. The quantity of lime required for purifying is not so great by one-half. The amount of water needed for cooling and washing is very considerably less, and the tar produced is small in quantity when the yield of gas is taken into account. The gas is more free from those noxious sulphurous compounds which render badly purified coal gas so disagreeable and prejudicial.

The destruction of retorts in the manufacture of coal gas is immense. This arises in a great measure from the formation of graphite in the inside of the retorts, which accumulates in concentric layers, and sometimes forms a coating one or two inches thick. The retorts also suffer to a great extent by the entrance of air when introducing the charge of coal. This source of rapid destruction is avoided altogether in the petroleum retorts, which do not communicate with the atmosphere when in a heated state, and only require to be occasionally opened to remove the deposited carbon or graphite, which, by the way, can very conveniently be removed by partially filling the petroleum chamber with fire brick, whereby the heated surface to which the rich hydrocarbon vapours are exposed is greatly increased, and their conversion into permanent illuminating gases much facilitated. The deposition of carbon is materially diminished by reducing the pressure of the gas on the retort, and this by a simple adjustment of the water joints in the petroleum apparatus may be reduced to a minimum.

The use of water in the process by which the result described in the preceding pages is produced, is for the purpose of converting the volatile hydrocarbon vapours of petroleum into permanent gases. It is thrown into its spheroidal condition the moment it strikes the interior of the retort, and in this state its spheroids continually develope steam of very high temperature and great reducing power. The rich petroleum gas may be largely diluted by the formation of the so-called water gas, but this has been shown to be an expensive process, and it is far more economical to employ a one-foot burner with a highly luminous gas than a three or four-feet burner with a diluted gas. The use of water gas as a diluant for rich hydrocarbon gases, which will burn without smoke or smell, and give a brilliant light from a small burner, is of not only very questionable economy, but it is thought by some to be a dangerous expedient, on account of the admixture of poisonous carbonic oxide into the gas, which, if leakage should by any accident occur in dwelling houses, might be followed by those fatal results to human life which have occurred time and again in every country where coal gas is manufactured, and particularly where water gas is used either with hydrocarbons or in any other form. Water gas, in order to be economical, implies the conversion of the carbonic acid produced into carbonic oxide, the one being a feeble illuminator, the other not only an incombustible, but so prejudicial to illumination that one per cent. of carbonic acid in coal gas diminishes its illuminating power by 6 per cent. The use of water gas has been interdicted by several European governments, on account of the poisonous properties of the carbonic oxide it contains. In the petroleum process, only so much water is used as will ensure the conversion of the volatile hydrocarbon vapours into permanent gases by their reduction to a lower hydrocarbon condition; and an analysis of its constituents shows that it contains much less carbonic acid than common coal gas. Its great illuminating power is derived from a very large per centage of olefiant gas, together with carbonetted hydrogen.

Mr. G. Howitz, the manager of the Copenhagen gas works, obtained 1000 feet of water gas by the combustion of 140 lbs. of coke in the furnace, and about 20 lbs. of charcoal (15 lbs. pure carbon) in the retort. The water gas consisted of the following:

Hydrogen	64
Carbonic oxide	18
Carbonic acid	18
	100

M. Gillard and M. Isard, in France, make water gas by passing superheated steam over coke or charcoal; but by their process 1000 cubic feet of mixed gases require 15 lbs. of pure carbon in the retort, and 118 lbs. of coke in the furnace.

1000 cubic feet of water gas can be obtained theoretically from 27.4 lbs. of water, although in practice much more is used, as a considerable portion of the steam is passed over undecomposed.

The following are the results of Mr. White's process, compared with that of M. Gillard:

WHITE'S PROCESS FOR THE MANUFACTURE OF 1000 FT. OF WATER GAS.

Coke in the furnace	112 lbs.
Charcoal in retort (equal to 15lbs. carbon)	18
Lime for purifying	37

GILLARD'S WATER GAS (NARBOONE).

Coke in the furnace	118 lbs.
Charcoal in the retort	18
Lime for purifying	67

The amount of fuel expended is not only very considerable, but the lime required for the abstraction of the carbonic acid is immense. When coal gas contains 5 per cent. of sulphuretted hydrogen and carbonic acid, it requires only 15 lbs. of lime to purify 1000 feet. But by the foregoing table White requires 37 lbs., and Gillard 67 lbs. of this material to abstract the carbonic acid from the same quantity of the water gas.

The advantages possessed by petroleum gas as a cheap illuminator, have already been sufficiently established; but its claim to public patronage does not rest on this fact alone. It is a most economical and valuable source of heat. Coal-gas stoves have long been in limited use, but they have not met with general favor, because they do not supply a sufficient amount of heat, and they are besides too costly when the coal gas is maintained at $2 50 per thousand feet. Petroleum gas is admirably adapted as a source of heat. It contains a much larger proportion of carbonetted hydrogen than coal gas; but carbonetted hydrogen generates more heat during combustion than either the same measure of hydrogen or carbonic oxide, as the following table, deduced from Dulong's experiments, proves:—One cubic foot of carbonetted hydrogen, during its combustion, causes a rise of temperature from 60° to 80° in a room containing 2,500 cubic feet of air; whereas a cubic foot of carbonic oxide elevates the temperature of a room of 2,500 cubic feet from 60° to 66.6°, and one cubic foot of hydrogen raises the temperature of a room of the same cubical capacity as before stated, from 60° to 66.4°. Or in other words: a cubic foot of carbonetted hydrogen is capable of heating 5 lbs. 14 oz. water from 32° to 212°, a cubic foot of carbonic oxide 1 lb. 14 oz. through the same degrees of temperature, and a cubic foot of hydrogen 1 lb. 13 oz. of water from 32° to 212°. With a burner and apparatus of peculiar construction, and consuming six feet per hour, a petroleum gas flame from eighteen inches to two feet in length can be produced under the same pressure as is used for lighting purposes. The flame is almost destitute of luminous qualities, but the heat it emits is intense. It can be used for heating private dwellings, for cooking, and other domestic purposes. The cost of this gas fuel is, at the rate of one stove burning for 30 days, 10 hours a day, $1 30, when petroleum is 6c. a gallon; when it is 10c. the cost per month is $2. For two dollars a month, the house of a poor man may be supplied with light and fuel during ten hours of the day. With a burner of less dimensions—say 3 feet per hour—a cooking stove and a one-foot burner, supplying abundance of warmth and light for one room during 24 hours each day, may be fed at a cost of $2 a month. This, of course, is the price of the raw material alone. It is some consolation to reflect, that at a period when the price of fuel is rapidly rising in the United States and Canada, a means for affording the poor man cheap light and warmth has been developed by the discoveries of the rich stores of petroleum on the American continent.

After a perusal of this article, every candid reader will acknowledge that gas from petroleum, manufactured by the process described, is not only the most economical and agreeable mode of illumination which has yet been brought before the public, but as a cheap source of heat it may present its claim to the patronage and encouragement of the public, with the best prospects of general adoption.

THE NORTH WEST TERRITORY—THE FUR TRADE.

Whosoever chooses to wade through the voluminous documentary History of the early British colonies in America, will find that the Fur trade was the all absorbing interest for more than one hundred and fifty years in the valley of the St. Lawrence and the vast region tributary to Hudson's Bay, previous to the Second Conquest in 1759.(1)

(1) Quebec was taken by the British in 1629. Champlain and most of the Jesuits returned under free passes to France. In 1632, Charles I., by the treaty of St. Germain, resigned to Louis XIII. of France all his title to Canada and Nova Scotia, and Champlain returned to Quebec a Viceroy of Canada.

The Beaver, the present symbol of Canada, was early a source of considerable revenue to the colonies, and has far surpassed in importance all other furbearing animals, although now it is comparatively valueless, the tax on Beaver skins alone in early times being more than the present worth of the pelt, when the difference in the value of money is taken into consideration. In 1678 Sir E. Andros, Governor of New York, reports that "the rates or duties upon goods exported are 2s. for each hogshead of tobacco, and 1s. 3d. on a beaver skin, and other peltry proportionably."

Governor Dongan, under date 1687, in a Report on the Province of New York, writes, "It will be very necessary for us to encourage our young men to goe a beaver hunting as the French doe." "I send a map by Mr. Spragg, whereby your Lo[ps]. may see the several goverm[ts]., &c., how they lye where the beaver hunting is, @ where it will bee necessary to erect our Country Forts for the securing of the beaver trade, @ keeping the indians in community with us."(1) In the same report Governor Dongan notices "the custom or duty upon every beaver skin commonly called a whole beaver, ninepence." "And that all other fur and peltry be valued acordingly, that is, for two half beavers ninepence; for four lapps ninepence; three drillings one shilling and sixpence; ten ratoons ninepence; four foxes ninepence; four and twenty mees-cats ninepence; ten mallar ninepence; twenty-four pounds of moose and deer skin ninepence. And all other peltry to be valued equivalent to the whole beaver exported out of the province (bull and cow-hides excepted)." Father de Lamberville, a cunning, zealous, but not over scrupulous missionary, wrote to M. de Denonville, Governor of Canada, in 1684, that "the envoy of the Governor of New York, who is here, promises the Iroquois goods at a considerable reduction; 7 @ 8lbs of powder for a beaver; as much lead as a man can carry for a beaver, and so with the rest." It must not be supposed that this was the actual price paid for a beaver skin at that time. Father de Lamberville merely mentions these items to show that the English were bribing the Iroquois to adopt their side in the event of war with the French, or in future extension of trade. It was a system of presents which gave origin to the Indian expression. "*Underground or secret presents*," in order to avoid the appearance of bribery. The word "underground," has recently acquired a different application, familar to every ear. The fugitives from the slaveholder reach Canada by the "underground railway." The Confederates obtain information of the movements of the Federalists by the "underground telegraph," and the late rush across the Canadian frontier from the drafting in the United States was chiefly by the "underground line."

Father de Lamberville defeated Colonel Dongan's attempts to draw the Hurons and Ottawas to his side by "underground presents," although Dongan offered seven pounds of powder for a beaver, or as much lead as a man could carry.

The mission and the beaver were too frequently associated by the early French Missionaries. They made the fur trader and the proselytizer one. There is no doubt that wherever the fur trade extended there was but too much need of the humanizing influence of Christianity, but as long as the missionaries traded in furs, the gentle influences of religion were not felt. The condition of the colony in Denonville's time was deplorable. He himself writes, "I receive letters from the most distant quarters, from the head of River Mississippi, from the head of Lake Superior, from Lake des Lenemyngon (Lake St. Ann north of Lake Superior), where they propose wonders to me by establishing posts for the missions and for the beavers, which abound there. But in truth so long as the interior of the colony is not consolidated and secured, nothing certain can be expected from all those distant posts where hitherto people have lived in great disorder, and in a manner to convert our best Canadians into banditti."(1)

The failure on the part of the different French companies to establish successful monopolies arose in great part, from a spirit of personal aggrandizement which influenced men in power, and the excellent opportunities which the form of government then prevailing in the colony secured to them. In 1731 the administration of M. de Beauharnois was marked by continued erection of new forts and displays of military force, for the purpose of keeping the English traders within proper limits. Soon after the whole valley of the St. Lawrence came under British sway, the merchants of Montreal, among whom were many Scotchmen, seeing the advantage of united action, formed themselves into a company in 1784, and assumed the title of the North-west Company of Montreal. The stock of this company was at first divided into sixteen shares without any capital being deposited, each shareholder furnishing a proportion of such articles as were necessary to carry on the fur trade. It was soon found, however, that some of the traders in the Indian country were adverse to this union of interests, and a few of them joined together and established a rival company. As might have been

(1) Documentary History of New York.

(1) Denonville's Expedition, Paris, Doc. III.

expected, a collision between the two companies soon took place, murder was committed (1) and many of the injuries which rivalry and jealousy could engender, were inflicted by both sides, far beyond the reach of retributive justice. At length, in 1787, the discontented traders and the Northwest Company, came to an understanding, united their interests, and founded a commercial establishment on a sound basis, divided into twenty shares, a certain proportion being held by the merchants in Montreal, the remaining by the traders in the Indian country. The adventure for the year amounted to £40,000, but in eleven years from that date, or in 1799, it reached treble that sum, yielding large profits to the company. In 1798 the number of shares were increased to forty-six, and so rapid was the increase in power and wealth of the corporation, that the army of employees enlisted in its service rose to upwards four thousand.

The agents of the North-west Company came into frequent collision with the servants of the Hudson Bay Company, which not only led to a spirit of rivalry in trade baffling description, but also to numerous encounters in which much blood was shed and many lives lost. Wearied of this ruinous competition, and harrassed by the threatened difficulties to which the continuance of so much crime and bloodshed amongst their half wild subordinates were drawing upon them, the two companies agreed to unite, and in 1821 an end was put to contention and rivalry, by the amalgamation of the two bodies under the title cf the Hudson's Bay Company. From the date of union a new era in the fur trade began, which will be better described after a brief history has been given of one of the most successful and flourishing monopolies the world has ever seen.

The Hudson's Bay Company was incorporated in the year 1670, under a royal charter of Charles the Second, which granted them certain territories in North America, together with exclusive priviliges of trade and other rights and advantages. During the first twenty years of their existence the profits of the Company were so great (2) that, notwithstanding considerable losses sustained by the capture of their establishments by the French, amounting in value to 118,014*l.*, they were enabled to make a payment to the proprietors in 1684 of fifty per cent., and a farther payment in 1689 of twenty-five per cent.

In 1690 the stock was trebled without any call being made, besides affording a payment to the proprietors of twenty five per cent. on the increased or newly created stock; from 1692 to 1697 the Company incurred loss and damage to the amount of 97,500*l.* sterling from the French. In 1720 their circumstances were so far improved that they again trebled their capital stock, with only a call of ten per cent. from the proprietors, on which they paid dividends averaging nine per cent. for many years, showing profits on the originally subcribed capital stock actually paid up of between sixty and seventy per cent. per annum from the year 1690 to 1800, or during a period of 110 years.

Up to this time the Hudson's Bay Company enjoyed a monopoly of the fur trade, and reaped a rich harvest of wealth and influence.

In 1783 the North-West Company was formed, having its head-quarters at Montreal. The North-West Company soon rose to the position of a formidable rival to the Hudson's Bay Company, and the territory the two Companies traded in became the scene of animosities, feuds, and bloodshed, involving the destruction of property, the demoralization of the Indians, and the ruin of the fur trade. Owing to this opposition, the interest of the Hudson's Bay Company suffered to such an extent, that between 1800 and 1821, a period of twenty-two years, their dividends were, for the first eight years reduced to four per cent., during the next six years they could pay no dividend at all, and for the remaining eight years they could pay only four per cent.

In the year 1821 a union between the North-West and Hudson's Bay Companies took place, under the title of the last named. The proprietary were called upon to pay 100*l.* per cent upon their capital, which, with the stock in trade of both parties in the country, formed a capital stock of 400,000*l.*, on which four per cent. dividend was paid in the years 1821 to 1824, and from that time half yearly dividends of five per cent. to 1828, from 1828 to 1832 a dividend of five per cent., with a bonus of ten per cent was paid, and from 1832 to 1837 a dividend of five per cent., with an average bonus of six per cent. The distribution of profits to the shareholders for the years 1847 to 1856 both inclusive, was as follows;—

1847—1849, ten per cent per annum; 1850, twenty per cent. per annum, of which ten per cent. was added to stock; 1851, ten per cent.; 1852, fifteen per cent., of which five per cent. was added to stock; 1853, 18*l.* 4*s.* 6*d.*, of which 8*l.* 4*s.* 6*d.* was added to stock; 1854 to 1856, ten per cent. per annum dividend. (1) Of 268 proprietors in July

(1) Sir Alexander Mackenzie—A General History of the Fur Trade.

(2) See Letter from the Governor of the Hudson's Bay Company to the Lords of the Committee of Privy Council for Trade, February 7th, 1838.

(1) Letter from R. G. Smith, Esq., Secretary to the Hudson's Bay Company, to H. Merivale, Esq.—*Appendix to Report from the Select Committee on the Hudson's Bay Company.*

1856, 196 have purchased their stock at from 220 to 240 per cent. (1)

The affairs of the Hudson's Bay Company are managed by a Governor-in-Chief, sixteen chief-factors, twenty-nine chief-traders, five surgeons, eighty-seven clerks, sixty-seven postmasters, twelve hundred permanent servants, and five hundred voyageurs, besides temporary employés of different ranks, chiefly consisting of voyageurs and servants. The total number of persons in the employ of the Hudson's Bay Company is about 3,000.

The late Sir George Simpson was Governor of the Hudson's Bay Company for forty years. He exercised a general supervision over the Company's affairs, presided at their councils in the country, and had the principal direction of the whole interior management in North America. The Governor is assisted by a council for each of the two departments into which the territory is divided.

The seat of council for the northern department is at Norway House, on Lake Winnipeg; for the southern department at Michipicoten, Lake Superior, or Moose Factory, on James' Bay.

The council consists of the chief officers of the Company, the chief-factors being ex-officio members of council. Their deliberations are conducted in private. The sixteen chief-factors are in charge of different districts in the territory, and a certain number of them assemble every year at Norway House, for the northern department, generally about the middle of June, to meet the Governor and transact business. Seven chief-factors, with the Governor, form a quorum, but if a sufficient number of the higher rank of officers are not present, a quorum is established by the admission of chief-traders.

(1) The capital employed by the Hudson's Bay Company is as follows:—

June 1st, 1856.	£	s.	d.
Amount of assets	1,468,301	16	3
Amount of liabilities	203,233	16	11
Capital	1,265,065	19	4

Consisting of,	£	s.	d.
Stock, standing in the name of the proprietors.	500,000	0	0
Valuation of the Company's lands and buildings, exclusive of Vancouver's Island and Oregon	318,834	12	8
Amount expended up to 16th September 1856, in sending miners and labourers to Vancouver's Island, in the coal mines, and other objects of colonization, exclusive of the trading establishments of the Company, and which amount will be repayable by Government if possession of the island is resumed...	87,071	8	3
Amount invested in Fort Victoria and other establishments and posts in Vancouver's Island, estimated at	75,000	0	0
Amount paid to the Earl of Selkirk for Red River Settlement	84,[illegible]	18	5
Property and investments in the territory of Oregon, ceded to the United States by the treaty of 1846, and which are secured to the Company as possessory rights under that treaty—$1,000,000	200,000	0	0
Total	1,265,067	19	4

The Hudson's Bay Company's operations extend not only over that part of North America called Rupert's Land and the Indian territory, but also over part of Canada, Newfoundland, Oregon, Russian America, and the Sandwich Isles.

The operations of the Hudson's Bay Company extend over territories whose inhabitants owe allegiance to three different and independent governments, British, Russian, and the United States. These immense territories, exceeding 4,500,000 square miles in area, are divided, for the exclusive purposes of the fur trade, into four departments and thirty-three districts, in which are included one hundred and fifty-two posts, commanding the services of three thousand agents, traders, voyageurs, and servants, besides giving occasional or constant employment to about one hundred thousand savage Indian hunters. Armed vessels, both sailing and steam, are employed on the North-West coast to carry on the fur trade with the warlike natives of that distant region. More than twenty years ago the trade of the North-West coast gave employment to about one thousand men, occupying twenty-one permanent establishments, or engaged in navigating five armed sailing vessels, and one armed steamer, varying from one hundred to three hundred tons in burden. History does not furnish another example of an association of private individuals exerting so powerful an influence over so large an extent of the earth's surface, and administering their affairs with such consummate skill and unwavering devotion to the original objects of their incorporation.

The Hudson Bay Company, even when they relinquish the valley of the Saskatchewan and confine their operations to the region north of the 56th parallel of latitude, will still hold much of the Fur trade in their grasp. But they will do so as an independent company engaged in open competitive rivalry with all who choose to engage in that difficult and precarious traffic. The organization existing among the officers and servants of the company, their acquaintance with the habits, language, and hunting grounds of the Indians of the North American continent; and more especially the fact that they are not only personally acquainted with almost every Indian in North America, but have the means, if it suit the purposes of the trade, of communicating with them and of supplying their wants, will secure to this admirably organized association the command of the most lucrative branches of the fur trade, for many years to come. If the history of any fur-trading company in America were faithfully written, it would exhibit to the world a systematic course of action as surely destructive to the Indian race on this continent, within the limits of the law, as if it had been a predetermined object from the beginning of their operations to the close. The history, indeed, of almost any one abandoned fort or post, during the prosperous existence of a company, would be a type of the history of the entire trade and its prejudicial influences on the Indian races. An abandoned post implies in general the utter destruction of the fur-bearing animals or of the sources of food upon which the Indian hunters formerly subsisted. It is an acknowledgment that the country which once served the post has been converted into an inhospitable desert, wholly incapable in its wild and uncultivated state of supporting the small demands of the former inhabitants of the district it served.

On another page, under the heading of Canadian Industry and Trade, will be found a table showing the annual exportation of furs and skins from Canada exclusive of the Hudson's Bay Company's exports. Although the annual amount is considerable, yet it falls into insignificance when compared with the vast exportations and profits of the present monopolists of the great North West.

GULF OF ST. LAWRENCE—ANTICOSTI.

The steps which are now being taken towards the construction of an Intercolonial Railroad in British America, give unusual value to any information respecting the little-known tract of country through which the contemplated road will pass, as well as to the great Gulf of St. Lawrence, along or near which this intercolonial trunk-line will have its course. The following article refers principally to a little-known but most valuable Island in the Gulf, which may one day become the seat of a numerous maritime population, whose industry will have a great influence upon the future prosperity of Canada and the other British North American Provinces.

Anticosti was first discovered by Cartier, in 1534, and called by him in his second voyage "Assomption;" by the pilot, Jean Alphonse, in 1542, "Ascension Isle;" and by the Indians "Natiscotec," which the French transformed into "Anticosti." *

This fine Island is 122 miles long, 30 broad, and 270 miles in circumference, and contains nearly 2,000,000 acres of land. Its nearest point is about 450 miles below Quebec. The limestone rocks on the coast are covered with a thick and often impenetrable forest of dwarf spruce, with gnarled branches, so twisted and matted together that a man may walk for a considerable distance on their summits. * In the interior some fine timber exists, consisting of birch, a little pine, and spruce. † The streams which descend to the coast abound with trout and salmon in the summer season. Seals frequent the flat limestone rocks in vast numbers. Mackerel in immense shoals congregate around all parts of the coast. Bears are very numerous, foxes and martins abundant; otters and a few mice complete the known list of quadrupeds. Neither snakes, toads nor frogs are known to exist on this desolate Isle.

Unfortunately, there are no good natural harbours on Anticosti; and in consequence of very extensive reefs of flat limestone rock, extending some distance from the shore, the want of anchorage, and frequency of fogs, the Island is considered dangerous by mariners; but "not in so great a degree as to render reasonable the dread with which it seems to have been occasionally regarded, and which can only have arisen from the natural tendency to magnify dangers of which we have no precise knowledge." ‡

Provision posts have been established by the Canadian Government, for the relief of crews wrecked on the Island, || and three light-houses

* The Natiscotec River empties into the Gulf on the north side of the Island.

* Bayfield.

† On the authority of Pursh, the pond pine (*pinus serotina*) is found at Anticosti. This botanist visited the island in 1817. As this pine is a southern species, it having established itself on that northern island is a singular circumstance. On the same occasion Pursh brought back, in the shape of dried specimens as well as in the living state, many plants which seem peculiar to the island.—*Hon. W. Sheppard, on the Distribution of the Coniferæ in Canada.*

‡ Bayfield.

|| To those who have drawn conclusions unfavorable to the island, from the number of wrecks which have been reported to have taken place upon it, it is necessary to point out that the wrecks, which in returns appear so formidable in the aggregate, under the head of "Anticosti," have not occurred at one spot, but at many spots widely separated, extending over a distance of 320 miles, that being the circumference of the island, and consequently the extent of coast front, not taking into account the indentations caused by bays, creeks, &c. Take the same length of coast upon any part of the main shores of the river or gulf, and it will be found, upon proper inquiry, that six times as many wrecks have occurred within it each year, as have for the same period taken place upon Anticosti. Instead of the wrecks upon the latter having been compared with the number of wrecks spread over the same extent of coast on the former, they have been generally regarded as having occurred at one spot, and have been compared with those only which have happened at some one place on the main shore of the river or gulf, of a few miles, or of less than a mile in extent, lying in the course of fewer vessels, yet wrecking annually nearly as many. From an estimate, made by the writer of this communication, of disasters in the River and Gulf of St. Lawrence, during the ten years ending November, 1840, it appears that half as many wrecks occurred upon the Manicouagan shoals, as took place upon the island in that period, and that Cape Rosier, Matane and Green Island each wrecked upwards of a third of the number of vessels which were stranded during the same period upon the whole of the 320 miles of the much libelled coasts of Anticosti. The Manicouagan shoals,

are now maintained at the west, east, and south-west points. Along the lowlands of the south coast, a continuous peat plain extends for upwards of eighty miles, with an average breadth of two miles, giving a superficies of 160 miles, with a thickness of peat, as observed on the coast of from three to ten feet. This extensive peat plain—probably the largest in Canada—is about fifteen feet above the ocean. *

Cape Rosier, Cape Chat, and other spots upon the main shores of the river and gulf, are places not only much more to be dreaded by the mariner than Anticosti, on account of the number of wrecks which occur upon them, but in consequence of the great loss of life which sometimes accompanies those wrecks, while, from the shelving nature of the beach at Anticosti, there are few instances recorded of wrecks upon the latter having been attended with loss of life. While the circumstantially related and carefully preserved account of the fate of the crew of the *Granicus*, wrecked in 1828 near Fox Bay (who, in the course of a long winter, died from famine), has created in the minds of many, who adopt without reflection any popular fallacy placed before them, a belief that every poverty of soil, every drawback of climate, and every danger of coast must belong to Anticosti, those greater dangers and those more numerous disasters upon the main shores of the St. Lawrence, attended with greater loss of life, have been almost entirely lost sight of, or if thought of in connection with the former, have been set down as unimportant, when compared with the unfairly estimated disasters and the imaginary dangers of Anticosti.

The evil reputation which still hangs over the island, became attached to it many years ago, before its coasts were thoroughly surveyed, when it was laid down in the chart as being many miles shorter than it actually is, in consequence of which many vessels ran upon it in places where deep water was supposed to exist, and before light-houses were placed there, since the erection of which, and the late survey of its coasts, wrecks upon the island have become less frequent. Most of those which now occur there are caused by the neglect of using the lead in foggy weather, many of them through the incapacity or drunkenness of masters, who generally are shamefully underpaid, and some of them through design, for the purpose of cheating the underwriters. Of these latter cases the insurance offices are perfectly aware; but, instead of endeavoring to meet them by preventive measures, they increase the rates of insurance so as to cover such losses, by estimating for them in a certain proportion to the whole; thus making the entire trade pay for the dishonest acts of the rogue. This having the effect to increase the price of freight, by which the public are the sufferers, in having to pay a proportionably increased price for all articles imported, the Government should in future institute a strict inquiry into the loss of every ship in the river or gulf, by means of a naval police, and be empowered to inflict punishment where criminal design or even gross carelessness or drunkenness may be proved to have attended such loss. Those masters who desire to lose their ships, generally select Anticosti for the purpose, because they can always manage to run them ashore there without any danger to life, and without much risk of the circumstances attending the act being witnessed or understood by persons on shore; and the provision posts being now well supplied, there is no danger, as there was formerly, of their suffering from the want of food. Thus many of the wrecks which take place there are produced in consequence of the ease with which a vessel may be beached, with safety to life, on many parts of the island, and not through its dangers of coast. In regard to the latter, those masters who know the coasts of the island well, generally make free with them (unless there happen to be a fog), in perfect confidence and safety, by which they gain headway much faster than by keeping in the centre of the channel, or along the south shore of the main land.—*Resources and Capabilities of the Island of Anticosti, by A. R. Roche, Esq.*

* Mr. Richardson; Geological Survey of Canada.

An immense quantity of squared timber and logs ready cut for the saw mill, are scattered over the south coast, having drifted down the rivers of the main land, and particularly the St. Lawrence. Some of the squared timber may have been derived from wrecks. Mr. Richardson, of the Geological Survey of Canada, who explored Anticosti in 1856, calculated that if the whole of the logs scattered along the south shore of the Island were placed end to end, they would reach one hundred and forty miles, and give about one million cubic feet of timber. Mr. Richardson concludes his report on this Island with the following paragraphs:

"The strata of Anticosti being nearly horizontal, cannot fail to give to the surface of the country a shape in some degree conforming to them. The surface will be nearly a level plain, with only such modifications as are derived from the deeper wearing in a longitudinal direction of some of the softer beds, producing escarpments of no great elevation, with gentle slopes from their summits in a direction facing the sun, that will scarcely be perceptible to the eye. The easily disintegrating character of the rocks forming the subsoil, can scarcely fail to have permitted a great admixture of their ruins with whatever drift may have been brought to constitute a soil; and it is reasonable to suppose that the mineral character of these argillaceous limestones must have given to those ruins a fertile character. It is precisely on such rocks, in such a condition, and with such an attitude, that the best soils of the western peninsula of Canada West are placed, as well as of the Genesee country in the State of New York. I have seen nothing in the actual soil as it exists to induce me to suppose that in so far as soil is considered, Anticosti will be anything inferior to those regions; and considerations of climate only can induce the opinion that it would in any way be inferior to them in agricultural capabilities.

"The three months that I was on the island were altogether too short a time to enable me to form any opinion upon the climate of Anticosti. But taking into view the known fact that large bodies of water are more difficult to cool and more difficult to heat than large surfaces of land, I should be inclined to suppose that Anticosti would not be so cold in winter nor so hot in summer as districts that are more inland and more south, and that it would not compare unfavorably with any part of the country between it and Quebec. While autumn frosts would take effect later at Anticosti, the spring would probably be a little later at Quebec.

"But such is the condition of the island at present, that not a yard of the soil has been turned up by a permanent settler; and it is the case that about a million of acres of good land, at the very entrance from the ocean to the Province, are left to lie waste, while great expenses are incurred to carry settlers to the most distant parts of the west. Taken in connection with the fisheries, and the improvement of the navigation of the St. Lawrence, it appears to me that the establishment of an agricultural population in the island would not only be a profit to the settlers themselves, but a great advantage to the Province at large."

The scenery on Anticosti is tame, but there are parts of the coast where magnificent cliffs face the sea with towering fronts three or four hundred feet high. As no point of the interior is estimated to be more than 700 feet above the ocean, mountain scenery does not exist, but the headlands on the north coast are very picturesque; and being composed of limestone, * they often present most imposing outlines. Fox Bay, near the east point, is the scene of the dreadful sufferings and melancholy fate of the crew and passengers of the ship *Granicus*, wrecked on the coast in November 1828, before provision posts were established.

Anticosti, situated at the mouth of the River St. Lawrence, by its position commanding the Gulf, from its natural resources and the teeming life of the sea which surrounds it, capable of sustaining a large population, is of the utmost importance to Canada, and to Britain in relation to her North American dependencies. A well protected harbour and town at the west end, in Ellis Bay would be invaluable with regard to the fisheries of the Gulf. The north point is only 14½ miles from the western extremity of the Mingan Islands. A harbour of call and of refuge at Fox Bay, at the eastern extremity of the Island, would be of great advantage to the commerce of the Gulf, as well as to the fisheries. As a naval station, Ellis Bay would command both entrances to the river, and in fact control the entire Gulf. The corresponding station on the main land might be on the south, at Gaspé Bay, of which Admiral Bayfield says: "The admirable Bay of Gaspé possesses advantages which may hereafter render it one of the most important places, in a maritime point of view, in these seas. It contains an excellent outer roadstead, off Douglastown; a harbour at its head, capable of holding a numerous fleet in perfect safety; and a basin, where the largest ships might be hove down and refitted." If Gaspé Bay should be considered as too far out of the great line of communication by land between Nova Scotia, New Brunswick and Canada, the magnificent Bay de Chaleur offers every advantage which can be desired for a great inland terminus, open for the greater part of the year, and only 130 miles from Rivière du Loup, where the Grand Trunk Railway of Canada terminates. The Bay de Chaleur is 25 miles wide from Cape Despair to the celebrated Miscou Island, and 75 miles deep to the entrance of the magnificent River Ristigouche. Within this bay the climate is far superior to that of the adjacent gulf; fogs seldom enter it, and the navigation is by no means difficult.* The scenery on the Ristigouche is superb. On the north side of the valley, mountains rise to the height of 1,748 feet above the sea, at a distance of only two or three miles from the coast. On the southern or New Brunswick shore they reach nearly 1000 feet. The mouth of the Restigouche is destined to become of great importance, as it lies near to the coal fields of New Brunswick, and, when the Intercolonial Railroad is constructed, one point ought certainly to touch the head of the fine harbour of the Bay of Chaleur. If such a work could be accomplished, it would ensure steam communication between Canada and Britain for nine months in the year at least, as there are many safe harbours and roadsteads in different parts of the bay, where the largest ships of the line may lie in safety, and even ascend up to the River Restigouche, or nearly to Point Garde, with the assistance of buoys and a good pilot.†

Recent explorations establish the fact that there is a considerable quantity of good timber on Anticosti, fit for ship-building and exportation. Water power is abundant, and the timber could easily be manufactured on the spot. The manufacture of salt in the extensive lagoons on part of the south shore, might be very profitably carried on by following the methods pursued in the south of France or in the northern part of Russia, where advantage is taken of the cold of winter to concentrate brine for summer evaporation. The want of salt at Anticosti and in the Gulf generally, has frequently been the cause of the loss of an immense quantity of fish. Salines could not only be very easily constructed, but the high price and constant demand for this article would ensure the sale of as much as could be manufactured. It would be a vast annual saving to the Province if the Canadian Government were to encourage by every means in their power the manufacture of salt from sea-water on Anticosti, where all the conditions are favorable, and

*Lower and middle silurian—Caradoc formation.
The Anticosti group, consisting of beds of passage from the lower to the upper silurian, and supposed to be synchronous with the Oneida conglomerate, the Medina sandstone, and the Clinton group of the New York survey, and with the Caradoc formation of England.—*Billings; Geological Survey of Canada.*

* Bayfield. † Bayfield.

where the demand for this necessary substance in the prosecution of the fisheries is so great. A new and most important industry would soon be created, and one mean of settling Anticosti with great advantage to the commercial interests of the country secured at the outset. The Americans, the French, the Spanish, in fact every European nation has its artificial Salines ; Canada alone, with most favorable natural conditions for the manufacture of this article which costs us $700,000 annually, has not yet given attention to this most valuable source of national wealth. The present lessee of the island has a few herds of Ayrshire cattle, which remain out feeding longer than would be safe in the neighborhood of Quebec, and in the spring they look in better condition than at any place on the St. Lawrence below Quebec.*

The economic materials known to exist in abundance on the island are limited, in the present state of our knowledge, to building stones of limestone and sandstone, grindstones, clay for bricks, fresh-water shell marl, peat, drift timber, and sea-weed in great abundance. The fisheries on the coast are the same as those of the gulf generally, and already engage a large fleet of American, Nova Scotian, Jersey and Canadian vessels, and are quite sufficient to support a numerous population on the east and west extremities of the island, whose industry would furnish the fishermen with the supplies they most require, and which they are compelled to bring with them or seek in out-of-the-way ports when more are required.

The island of Anticosti originally formed a part of the country called Labrador. In 1825 it was re-annexed to Lower Canada by an act of the Imperial Parliament. The island was conceded in 1680 to the Sieur Jolliet; it is now in the hands of a considerable number of persons, some residing in England and some in Canada. It ought to be purchased by the Canadian Government, and a colonization road cut out between Ellis Bay and Fox Bay. These harbors should be improved, and the sites of two towns laid out. If encouragement were given to settlers there can be no doubt that Anticosti would rapidly become a very important adjunct to the British Provinces, rivalling Prince Edward Island in importance.† And in the present aspect of events it is desirable that it should receive attention at an early day, and the fisheries of the Gulf secured to British subjects, and both preserved and encouraged by every means that can be suggested.

* Mr. Roche.

† Prince Edward Island lies wholly within the Gulf of St. Lawrence. In 1857 it had a population of 71,496 souls, a revenue of £32,348, and exported articles to the value of £134,465, its imports during the same period amounting to £258,728. The island is 123 miles long, 32 broad at its widest part and four at the isthmus where two deep bays nearly meet.

CANADIAN INDUSTRY AND TRADE.

Statistical tables are proverbially dry and uninteresting to the majority of the reading public. Nevertheless they are frequently of great importance in shewing the direction of a people's industry, and its probable future development. It is often very troublesome to search for accurate statistical information in the parliamentary documents issued from year to year, and few have access to those which relate to the earlier years of our history. We append a few interesting tables, carefully compiled from parliamentary documents, which will be valuable to those who take an interest in our rapid commercial and industrial progress.

A correspondent has favored us with some remarks on the statistical tables published by the Legislature, which will appear in the December number of this journal.

TABLE I.

Exports of Wheat from 1838 *to* 1861.

Year.	Bushels of Wheat.	Year.	Bushels of Wheat.
1838	296,020	1850	4,547,224
1839	249,471	1851	4,275,896
1840	1,739,119	1852	5,496,718
1841	2,313,836	1853	6,597,193
1842	1,678,102	1854	3,781,534
1843	1,193,918	1855	6,413,428
1844	2,350,018	1856	9,391,531
1845	2,597,392	1857	6,482,199
1846	3,312,767	1858	5,610,559
1847	3,883,156	1859	4,032,627
1848	4,248,016	1860	8,431,253
1849	3,645,320	1861	13,369,727

TABLE II.

Value of all Agricultural Products exported from Canada from the years 1853 *to* 1861, *inclusive.*

Year.	$	Year.	$
1853	8,032,535	1858	7,904,400
1854	7,316,160	1859	7,339,798
1855	13,130,399	1860	14,259,225
1856	14,972,276	1861	18,244,631
1857	8,882,825		

TABLE III.

Comparative Statement of the Products of the Forest, during the years 1853 *to* 1861, *inclusive.*

Year.	$	Year.	$
1853	9,293,338	1858	9,284,514
1854	9,912,008	1859	9,663,962
1855	7,832,660	1860	11,012,253
1856	9,802,130	1861	9,572,645
1857	11,575,508		

TABLE IV.

Comparative Statement of Imports, exhibiting the value of Goods entered for consumption in Canada, during the years 1852 *to* 1861, *inclusive.*

Year.	Great Britain.	N. Amer. Colonies.	West Indies.	United States.	Other For. Countries.
	$	$	$	$	$
1852	9,671,132	480,954	5,115	8,477,693	651,598
1853	18,489,120	632,660	3,479	11,782,147	1,074,030
1854	22,963.331	675,115	2,673	15,533,098	1,355,110
1855	13,303,460	865,988	14,135	20,828,676	1,073,909
1856	18,212,934	1,032,595	17,613	22,704,509	1,616,736
1857	17,559,025	751,888	26,823	20,224,651	868,211
1858	12,287,053	423,826	....	15,635,565	732,083
1859	14,786,084	381,755	533	17,592,916	793,873
1860	15,859,980	393,864	15,802	17,273,029	905,260
1861	20,380,937	499,177	371	21,069,388	1,098,963

Total value of Imports of Goods entered for Consumption in Canada, during the years 1852 *to* 1861, *inclusive.*

Year.	Val. of Goods in dols.	Year.	Val. of Goods in dols.
1852	20,286,493	1857	39,430,598
1853	31,981,436	1858	29,078,527
1854	40,529,325	1859	33,555,161
1855	36,086,169	1860	34,447,935
1856	43,584,387	1861	43,054,836

TABLE V.

Table shewing both total value of Canadian Exports and Imports and the aggregate value of the Foreign Trade of the Province from 1852 *to* 1861, *inclusive.*

Year.	Exports.	Imports.	Total Value of Foreign Trade.
	$	$	$
1852	14,055,973	20,286,493	34,342,466
1853	22,012,230	31,981,436	53,993,666
1854	21,249,319	40,529,325	61,778,644
1855	28,188,461	36,086,169	64,274,630
1856	32,047,017	43,584,387	75,631,404
1857	27,006,624	39,430,598	66,437,222
1858	23,472,609	29,078,527	52,551,136
1859	24,766,981	33,555,161	58,322,142
1860	34,631,890	34,441,621	69,073,511
1861	36,614,195	43,046,823	79,661,018

TABLE VI.

Table shewing the annual exportation of Furs and Skins from Canada, exclusive of the Hudson's Bay Company's exports.

Year.	Value.	Year.	Value.
	$		$
1853	127,694	1858	163,213
1854	69,357	1859	229,147
1855	115,260	1860	227,115
1856	207,753	1861	230,596
1857	154,879		

CAUTION TO PETROLEUM REFINERS.

It is well known that one of the most objectionable impurities in coal gas is the bi-sulphide of carbon, which, upon combustion, yields sulphurous acid — a gas particularly detrimental to pictures, bindings of books, art decorations, and even to delicate constitutions. Numberless have been the expedients resorted to with a view to get rid of this noxious impurity, and latterly with some degree of success. Nevertheless the formation of sulphurous acid by the combustion of sulphur compounds in coal gas, has precluded its use in many public libraries, picture galleries, and in private dwellings.

It is much to be regretted that the rock oil furnished by some refining companies contains a notable quantity of sulphur, either in the form of sulphuretted hydro-carbons or sulphuric acid. These impurities generally arise from a neglect on the part of the refiner to remove the whole of the sulphuric acid he employs in his refining process. It is of the highest importance that the sulphuric acid should be abstracted as far as possible; and although we do not say that during the process of refining some sulphuretted hydro-carbons may be produced which, in the present state of our knowledge it would be impossible wholly to remove, yet from actual experiment we have detected the presence of sulphuric acid in some samples of rock oil, shewing that this acid was not wholly withdrawn by the after use of alkalies, washing or other expedients. It is essentially important, in order to produce a good sample of refined rock oil, that the whole of the sulphuric acid should be abstracted; otherwise, during combustion, sulphurous acid will be generated, and a noxious compound, very insidious and prejudicial in its effects will be generated, in greater or less quantities, by the use of rock oil. Refiners should satisfy themselves by chemical tests that every trace of sulphuric acid is removed from their samples of oil, before permitting it to go to market. Neglect in this important particular may soon engender a distaste for a beautiful and most economical mode of illumination, rendered prejudicial by inattention to simple precautions in refining, which a desire to produce a safe and saleable article ought to ensure. A piece of white blotting paper moistened with a solution of iodic acid and starch held over the flame of a rock oil lamp will become bluish purple, if sulphurous acid is generated during the process of combustion. This test, however, is not sufficient, as there may be other deoxidizing agents in the gases, resulting from combustion, which would set iodine free. The samples of rock oil may be tested with a solution of chloride of barium. If the sulphuric acid has not been wholly removed, a heavy white precipitate will indicate its presence. We would recommend refiners always to test their oil after the washing process is completed, to see if the last traces of sulphuric acid have been withdrawn. In some instances which have come under our notice, a very marked re-action took place when tested with chloride of barium or nitrate of baryta, as well as decided indications of sulphurous acid in the products of combustion when a slip of paper, moistened with a solution of iodic acid and starch, was held over the chimney of the lamp.

THE ART OF COLOR.

The Rules of the Art of Color are easily learned, and the principles upon which they depend can be tested by a few simple experiments worked out by the cheapest materials. With a penny-worth of mixed wafers, and a few slips of colored ribbon or tinted paper, the harmonies and discords of color may be exemplified, and the eye trained to distinguish accurately between them. The slips of paper should be cut into squares or circles of about two inches in diameter, and by fastening wafers on them experiments may be multiplied without end. White and black paper should also be used, as well as white and black wafers. When white paper is employed it will be an advantage sometimes to tint the paper round the wafer with its *complementary* color. Colors, or to speak more correctly, lights are said to be complementary when two of them, taken in certain proportions, produce white. This cannot be done by means of paints used by artists, for causes which it is unnecessary to explain here; but the fact is true, nevertheless. Now if rejecting Indigo, we take the primitive colors of the rainbow, we get a scale to which we shall have occasion to refer continually.

Primitive	*Complementary.*
Violet	Yellow.
Blue	Orange.
Green	Red.
Yellow	Violet.
Orange	Blue.
Red	Green.

Strictly speaking, there are only *three* colors (red, yellow and blue), which, being mixed, produce pure secondary colors. In experimentalizing on color, it will be advisable to sit with the back to the light, and to place the paper at least a yard from the eyes or farther, if the outline of the wafer or other object can be seen distinctly. It will be also necessary to look steadily for a few seconds, that the contrasted colors may produce their full effect upon the eye.

Confining our choice to two colors, we shall soon find that those which are prettiest apart do not always combine harmoniously, as Mauve and Magenta. Colors are something like those relations who agree best the farther they live asunder—of course, within the limits of reason. The cause of this agreement in colors we shall see presently. As soon as you bring two colors into contact they lose their strongest characteristics, and become modified. Thus, selecting three strips of ribbon of the three primitive colors, (red, yellow and blue), we shall find that, if we place them in juxtaposition with other colors, they become brighter or duller according to circumstances, each color having a tendency to monopolise its own peculiar hue by subtracting it from its neighbor.

Red—Yellow.

When these two beautiful colors are put side by side, we find that the *yellow* losses some of the red rays that enter into its composition, and appears bluish, inclining even to *green;* while the *red* is robbed of some of its yellow, and assumes a *purplish* tint.

Red—Blue.

In this case the *red* parts with some of its blue, and, becoming yellowish, inclines to *orange;* while the *blue*, parting with some of its red, appears yellower, and inclines to *green.*

Blue—Yellow.

Here the *blue* yields up some of its yellow, and appears more *violet;* while the *yellow* loses its blue, and thus taking up, as it were, more red, inclines to *orange.* If you put each of these in turn upon black or upon white, you will observe a similar modification, particularly on the edges.

It is not necessary to carry these exemplifications farther, as whatever colors we use the effects are analogous. Hence we derive a rule by which we may higher or lower the effect of every color without touching the color itself. Thus, by the juxtaposition of complementary colors—say, orange and blue—the intensity of each is increased; but in two kindred colors, such as blue and green, are brought together, the effect of each is lowered.—*Godey.*

THE NORTH-WEST TERRITORY.

Arrangements are now being made for the establishment of an English Land Emigration Company.

The object of the Company is to purchase two or more townships from the Government on the Kaministiquia river, including the new townships of Paipoonge and Nee-bing. A portion of these townships belongs to Joseph Peau du Chat and his tribe, consisting of some two or three hundred Ojibway Indians, whose reserve on the Kaministiquia commences about two miles from Fort William on the right bank of the river, and runs westerly parallel to the shores of the lake for six miles, thence northerly four miles, and thence to the right bank of the Kaministiquia. Here is situated the Mission of the Immaculate Conception near the foot of McKay's mountain, which has an altitude of 1,000 feet above the lake. The area of the reserve is about 25 square miles, and there would, probably, not be much difficulty in making arrangements with the Indians for the purchase of their lands. The flanks of McKay's mountain support a heavy growth of hardwood timber, as do also the flanks of many of the trap ranges between the Kaministiquia and Pigeon rivers. On White Fish river, some 18 miles from Fort William, Capt. Palliser found open larch woods, through which he and his companion, Dr. Hector, were capable of travelling on foot at the rate of 3½ miles per hour for 27 miles, between the White Fish river and the Kaministiquia. From this it may be inferred that land fit for cultivation is not confined to the valley of the Kaministiquia below the falls of Kakabeka, but that west of that river a very considerable area of good land exists, besides the trap ranges before mentioned. The English Company will not only endeavour to secure a tract of land near Fort William, but will make an effort to obtain possession of the large area of cultivable land about the Prairie Portage, in view of the completion of a line of communication between Lake Superior and Red River.

In the last and present number of this Journal, we have adverted to the immense importance of the fisheries of the Gulf of St. Lawrence and of the Island of Anticosti. In our next issue we shall describe some of the vast resources of the Great North-West, in continuation of the brief history of the Fur trade which appears in this number.

ARTIFICIAL PRODUCTION OF OYSTERS.

M. Coste, of the French Institute, states in a report to the Emperor " On the Organization of the Fisheries," that the production of oysters on the plan recommended by him, has taken such a prodigious development, that, in the Ile de Rè alone, more than 3,000 men, who have come from the interior, have already established 1,500 parks, which produce annually about 387,000,000 oysters of the value of 6,000,000 francs.

Efforts have been made by the Canadian Government, through Capt. Fortin, to establish artificial oyster beds in the Lower St. Lawrence and different parts of the Gulf. The success of the French augurs well for the effective prosecution of this important adjunct to the Fisheries of the Gulf of St. Lawrence.

Board of Arts and Manufactures

FOR UPPER CANADA.

MEETING OF SUB-COMMITTEE.

The sub-committee met at the Board Rooms on Thursday, Nov. 6th, the President, Dr. Beatty, in the chair. After reading of correspondence, and transaction of some other routine business, the following resolutions were adopted :—

Resolved.—" That the programme of examinations of Members of Mechanics' Institutes, as published in the *Journal* for January, 1861, be adopted as the programme for 1863; and that such examinations be held during the last week in May, of which full particulars will be furnished any Institute upon sending up names of candidates for examination."

Resolved.—" That the sum of *ten dollars* be awarded to each Institute establishing, and keeping in operation for not less than three months, a class or classes of not less than *ten* members, for the study of any of the subjects named in the programme, and submitting at least two members of such class or classes as candidates for examination in May next."

Resolved.—" That in addition to the certificates given to candidates at the final examinations, Silver Medals will be awarded to the most succesful candidates, in the proportion of one to every five who shall pass such examinations."

Resolved.—" That the annual subscription to the Journal of this Board, for the ensuing year, be at the uniform rate of *fifty cents ;* and that Secretaries of all Mechanics' Institutes, Literary and Agricultural Societies, be requested to act as agents in receiving and remitting subscriptions, to whom, for every $5 remitted, a free copy of the *Journal* will be sent."

Resolved.—" That the Secretaries of the several Mechanics' Institutes in Upper Canada be requested to furnish brief abstracts of the annual Reports and proceedings of their respective Institutions, for publication in the *Journal.*"

Resolved.—" That the thanks of the Committee be tendered W. Wagner, Esq., Canadian agent in Germany, for the donation of a stove transmitted by him from Berlin in Prussia, as a specimen for the Model Rooms of the Board."

W. EDWARDS, *Secretary.*

LIST OF BRITISH PUBLICATIONS FOR SEPTEMBER 1862.

Anderson (Col. W.) Mode of Manufacturing Gunpowder at the Ishapore Mills, Bengal, s. r. 8vo	0	14	0	*Weale.*
Antrobus (J.) Orator's Guide; or, the Practice and Power of Eloquence, cr. 8vo	0	3	6	*Longman.*
Baird (H. J.) Tables of Foreign Exchanges, and Weights and Measures, 4to	0	15	0	*Simpkin.*
Charley, (William.) Flax and its Products in Ireland, cr. 8vo	0	5	0	*Bell and Daldy.*
Dove (H. W.) Law of Storms Considered, 2nd edit., revised and enlarged, 8vo	0	10	6	*Longman.*

Gregory (O.) Mathematics for Practical Men, by H. Low, 4th edit., revised by J. Young, 8vo	1	1	0	*Lockwood.*
Grove (W. R.) Correlation of Physical Forces, 4th edit. 8vo	0	7	6	*Longman.*
Horton (R.) Complete Timber, &c., Measurer, for Growers, Mer., Surveyors, &c., p. 8vo	0	6	0	*Weale.*
International Exhib., 1862, Official Illust. Cat., Part 13, Classes 33-35, roy. 8vo	0	1	0	*Exhibition.*
Jackson (And.) Robert O'Hara Burke and Australian Explorer, Expedition of 1860, post 8vo	0	6	0	*Smith and Elder.*
Lukis (Capt. J. H.) Common-Sense of the Water Cure; a Description of the Treatment, &c., cr. 8vo	0	5	0	*Hardwicke.*
Marsh (Geo. H.) Origin and History of the English Language, 8vo	0	16	0	*Low.*
Miles (Wm.) Plain Treatise on Horse-Shoeing, with illust., 4th edit., sq. cr. 8vo	0	2	0	*Longman.*
Pope (Manly) History of the Kings of Ancient Britain, cr. 8vo	0	3	6	*Simpkin.*
Reason Why (The), General Science, 36th thousand, cr. 8vo	0	2	6	*Houlston.*
Trees and their Uses, fcap. 8vo	0	1	6	*Wertheim.*

AMERICAN PUBLICATIONS FOR OCTOBER.

Bates (Edw. P.) English Analysis; containing forms for the Complete Analysis of English Composition, 12mo.	$0 75	*Crosby & Nichols.*
Champlin (J. T.) First Principles of Ethics, 12mo	0 80	"
Francis (John) History of the Bank of England, including Statistics of the Bank to the close of the year 1861, or Statistics of British Finance, Currency, &c.	0 80	*Putnam & Tousey*
Hopkins (M.) Lectures on Moral Science, delivered before the Lowell Institute	1 00	*Gould & Lincoln.*
Hooker (Prof. W. H.) First book in Chemistry, for the use of Schools and Families	0 50	*Harper Brothers.*
McGregor (P.) A system of Logic, comprising a discussion on the various means of acquiring and retaining knowledge, 12mo	1 00	"
Parrish (Ed.) Treatise on the Art of Skeletonising leaves and seed vessels, and adapting them to embellish the home of taste	0 75	*Lippincott & Co.*
Rowbotham (T. L.) The Art of Sketching from Nature, 27 vols.	0 75	*J. E. Tilton & Co.*
Sorignet (L'Abbe A.) Sacred Cosmogony; or, Primitive Revelation demonstrated by the Harmony of facts of the Mosaic History, with the Principles of General Science	0 75	*P. Fox, St. Louis*

Patent Laws and Inventions.

Bureau of Agriculture and Statistics, and Patent Office, Quebec, 29th October, 1862.

James Chase, of Brooklin, county of Ontario, Melodeon Maker, for a "Tile Ditcher."—(Dated 7th July, 1862.)

Alexr. Fraser Cockburn, of the city of Montreal, Brass-founder and Finisher, for "A compression Swivel action water cock."—(Dated 18th July, 1862.)

Marshall Kimpton, of the township of Stanstead, county of Stanstead, Gentleman, for "A new and improved water drawer."—(Dated 19th July, 1862.)

George Gauld, of the township of Onondaga, county of Brant, Cooper, for the "Archimedean Churn."—(Dated 21st July, 1862.)

Frederick Rumohr, of the village of Markham, in the township of Markham, county of York, Carpenter, for "An improved two horse Cultivator."—(Dated 21st July, 1862.)

Benjamin Thrasher Morrill, of the township of Stanstead, county of Stanstead, Farmer, for "A Metallic Milk Cooler."—(Dated 23rd July, 1862.)

Abiel O'Dell, of the town of Bowmanville, in the county of Durham, Machinist, for "A new and improved Clothes Wringer called "O'Dell's self adjusting and self fastening Clothes Wringer."—(Dated 31st July, 1862.)

Charles Hubbard Gould, of Montreal city, Miller, for "A new and useful improvement in Frictional Gearing."—(Dated 1st August, 1862.)

William Duncan Stephenson, of the city of Montreal, Gentleman, for "An improved spring bed."—(Dated 1st August, 1862.)

Archbd. McKillop, of the township of Inverness, county of Megantic, Farmer, for "A self-acting security Gate."—(Dated 5th August, 1862.)

Thomas Sholto Douglas, of the city of Montreal, Practical Chemist, for the discovery of "Benzine Copal Varnish."—(Dated 21st August, 1862.)

David Wm. Ruttan, Yeoman, and Richard York, Cordwainer, both of the village of North Port, in the county of Prince Edward, for "A spring power Boot Crimper."—(Dated 22nd August, 1862.)

Henry Fryatt, of the village of Aurora, in the county of York, Carpenter, for "An improved scrubbing Machine."—(Dated 22nd August, 1862.)

Thomas Doyle, of the village of Sweaburgh, in the township of Oxford, county of Oxford, Millwright, for "A Chair and Sofa Combined."—(Dated 22nd August, 1862.)

Abiel O'Dell, of the town of Bowmanville, in the county of Durham, Machinist, for "A Saw Set and Clamp, called "O'Dell's portable Combined Saw Set and Saw Clamp."—(Dated 22nd August, 1862.)

Joseph James Baguley, of the village of Allandale Mills, county of Peterborough, Teacher of Music, for "A Musical Modulator, styled, Baguley's Singing School Mechanical Modulator."—(Dated 25th August, 1862.)

John Soules, of Mount Pleasant, township of Brantford, county Brant, Cabinet Maker, for "A new and improved Grain and Grass Drill, designated "Soule's upright rotary Grain and Grass Drill."—(Dated 25th August, 1862.)

Francis Cant, of the town of Galt, county of Waterloo, Machinist, for "An improved Cam for working the under-needle or Catch-pin of Sewing Machines."—(Dated 25th August, 1862.)

Thomas Head, of the township of Beverley, in the county of Wentworth, Farmer, for "A Machine adapted to every kind of Churn for more efficient and speedy way of making Butter."—(Dated 25th August 1862.)

Michael North, of the town of Brantford, in the county of Brant, Builder, for "An Invention called

"Michael North's Cheap and Economical Mangle."—(Dated 25th August, 1862.)

John Marritt, of the township of King, in the county of York, Farmer, for "A Clothes Washer."—(Dated 25th August, 1862.)

William Farrell, of Carleton Place, in the county of Lanark, Carpenter, for "An apparatus for working a Common Churn."—(Dated 25th August, 1862.)

George Ross, of the city of Kingston, in the county of Frontenac, Carpenter, for "A portable frost-proof Fence."—(Dated 25th August. 1862.)

John Addison, of the city of Hamilton, in the county of Wentworth, Builder and Machinist, for "A Spring Mattress."—(Dated 25th August, 1862.)

Joseph Parizeau and Stanislas Parizeau, both of the parish of St. Martin, in the county of Laval, Carriage Makers, for "A new and Improved Churn."—(Dated 2nd September, 1862.)

H. C. Drew, of the township of Whitby, in the county of Ontario, Mechanic, for "A new and improved Water Conductor and Elevator."—(Dated 2nd September, 1862.)

Edred Drew, Cabinet Maker, and David Johns, Blacksmith, both of the township of Usborne, in the county of Huron, for "A Churning Machine to be called the Economist Churn."—(Dated 2nd September, 1862.)

Thomas Forfar, of the city of London, in the county of Middlesex, Carpenter, for "An improved Straw Cutter."—(Dated 2nd September, 1862.)

James Campbell and George Grobb, both of the town of St. Catharines, county of Lincoln, Millers, for a portable Mill Stone Cooler."—(Dated 2nd September, 1862.)

James Fletcher, of the town of Woodstock, county of Oxford, Teacher, for "An improved Circular rotatory Harrow."—(Dated 2nd September, 1862.)

Epiphane Duchesne, of the parish of L'Acadie, in the county of St. Johns, Joiner, for "A Double Action Rake."—(Dated 11th September, 1862.)

Gelston Sanford, of the city of Quebec, Machinist, for "New and useful improvements in Machinery for separating fibres from the stalks and leaves of fibre yielding plants."—(Dated 12th September, 1862.)

Eben B. Shears, of the town of Clifton, in the county of Welland, Gas Engineer, for "A process or mode by which gas made from crude earth or rock oils of Canada, known as Petroleum, may be made to burn without emitting smoke."—(Dated 15th September, 1862.)

Edward Holmes, of the city of Hamilton, Manufacturer, for "A new and improved Stave Dressing Machine."—(Dated 15th September, 1862.)

Edward Holmes, of the city of Hamilton, Manufacturer, for "new useful improvements in Machine for Jointing Staves."—(Dated 15th September, 1862.)

Edward Holmes, of the city of Hamilton, Manufacturer, for "A new and improved hoop driving and Stave Crozing Machine."—(Dated 15th September, 1862.)

Robert Anderson, of the township of Peel, county of Wellington, Plough Maker, for "A new mould board for a Plough."—(Dated 17th September, 1862.)

Peter Wesley Freeman, of the township of Loughborough, county of Frontenac, Farmer, for "A lever and Roller Gate."—(Dated 17th September, 1862.)

Richd. N. Walton, of the city of London, in the county of Middlesex, Carpenter and Builder, for "An article designated "Walton's Economical Clothes Dryer."—(Dated 17th September, 1862.)

George Campbell, of the city of Toronto, in the county of York, Blacksmith, for "A Fire Escape."—(Dated 20th September, 1862.)

Edward Lawson, of the city of Toronto, in the county of York, Merchant, for "A Double Dash rotatory Churn."—(Dated 20th September, 1862.)

Jedediah Hubbell Dorwin, of the city of Montreal, Gentleman, for "An improved Portable Mercurial Barometer."—(Dated 24th September, 1862.)

Aimee Nicolas, Napoleon Aubin, of Belœil, in the county of Vercheres, for "A new and improved Hydrometer."—(Dated 10th October, 1862.)

Notices of Books.

Ventilation and Warming of Buildings; to which is added a complete Description and Illustration of the Ventilation of Railway Carriages, for both winter and summer. By the HON. HENRY RUTTAN, late Vice-President of the Board of Agriculture for Upper Canada, &c.; 1 vol., 8vo, pp. 105. Illustrated by fifty-four plates, exemplifying the Exhaustion Principle. New York: G. P. Putman. Toronto: W. C. Chewett & Co.

Having, in common with many others, been long accustomed to consider "Ventilation" as the unfruitful, though, at the same time, harmless hobby of the author of the volume before us, it was with no ordinary feelings of curiosity that we entered upon the perusal of his work. It must be confessed that the practical results of his theories, manifested in well ventilated Railway carriages and comfortably heated dwellings, have, of late years, caused some of his doctrines to receive partial recognition, and prepared many to regard with an unprejudiced eye whatever inventions and discoveries he might announce. Notwithstanding our being, to a certain extent, prepared for something more than the mere utopian projects of a visionary enthusiast, we were entirely taken by surprise in finding the book to be a plain, scientific, and thoroughly practical treatise on the theory of Ventilation, and its application to every description of human habitation.

The object of the author in publishing this work is, as he states in his preface, "to put the rising generation, and especially the young builders upon the right track, so that before long, the million—the poor as well as the rich—may avail themselves of the inestimable advantages of pure air within their dwellings, instead of the foul atmosphere in which they have been obliged to live." He then proceeds to remark that his system of ventilation is founded upon the very reverse of the generally received principles, that "that part of the air which lies nearest the ceiling, being the warmest, must necessarily be the *foulest*," and that, since warm air *naturally* rises, the proper place to let this air out is the top of the room. By his method, on the contrary, a properly ventilated apartment has, especially in winter, *the purest air at the top*, and is so constructed that the warmed air, if not prevented *naturally falls downward.*

The book consists of two main portions; one relating to the principles of ventilation and other kindred subjects, the other to the author's mode of applying these principles to buildings of every description, railway carriages, &c. His system of "ventilation and warming," as far at least, as regards dwelling-houses, we will endeavour to state as briefly as we can.

To ventilate a building in this climate, it is necessary not only to change the air in it, but also during the greater portion of the year, to supply it with a certain degree of heat. This, of course, cannot be done by opening windows, or other apertures on opposite sides of the house, as the current of air thus produced would be intolerable, even if the process were perfect in other respects; it follows then, that a vertical movement of the air, either upward or downward, is the only alternative. Now the coolest air, as every one knows, always lies when at rest at the bottom of the room, spreading itself horizontally; the warmest occupies the top in a similar manner, the intermediate spaces being filled with strata, each occupying a position higher or lower according to its temperature. If therefore, in ventilating a room, the warm air is let out at or near the top, and its place supplied by cool air, this cool air will naturally spread itself over the floor, and then the temperature of the room will be *reduced* instead of increased by the process; and this, says our author, "has been the policy in nearly all former modes of ventilation; cold air is introduced, which, taking the heat from the occupants of the room, and from the fire, immediately escapes through an aperture provided for the purpose at or near the ceiling. Thus, proceeding on the erroneous notion that cold air only could be pure they have actually been freezing the people, when they wanted to warm them." His own principle, on the other hand, is based on the very natural supposition that we wish our houses to be comfortably heated as well as ventilated; and this he contends can only be done by taking the air out at the bottom,—thus exhausting the cooler air,—and then supplying its place with warm air brought in from the top. The fresh air being, in this case, the warmest, spreads itself in horizontal strata over the ceiling, and keeps its relative position to the whole body, until it reaches the bottom, and passes out at the aperture there provided for it. Every particle of every stratum of air is thus removed from the apartment, and perfect ventilation is secured. If, instead of this, warm air were admitted at the *bottom* of the room, egress being afforded by an aperture near the ceiling, it would go directly through the body of foul or cold air already in the room, and pass out at the top, displacing a very small portion of the original air, and neither ventilating nor warming the apartment.

For a description of the apparatus by means of which the fresh air is warmed and put in circulation, we must refer our readers to the book itself, in which the whole is clearly explained and illustrated; any account of it, to be intelligible, would require a much larger space than we can afford.

The second and larger portion of the volume is entitled, "Explanation of the Plates," and contains all the details of the author's system, illustrated with numerous elaborate diagrams, and explained in such a way as to be clearly understood by any ordinary mechanic. The latter part of it is devoted to the ventilation and warming of Railway carriages, but our limited space forbids our entering upon any description of the various ingenious appliances made use of for the purpose. Suffice it to say that they have proved completely successful in practice, as all who have travelled in "Ruttan's Ventilated Cars" can abundantly testify.

We can only add that the author has our best wishes for the success of his philanthropic efforts for the promotion of the comfort and well being of his fellow-creatures. We trust indeed, that all who read his book will rise up from its perusal as favourably impressed with the value of his system, when properly applied, as we are ourselves.

Proceedings of Societies.

TORONTO MECHANICS' INSTITUTE.

In the last number of the *Journal*, we noticed that the Directors of this Institution had determined upon establishing a number of Evening Classes for the ensuing Winter. On the 28th of October, Mr. Richard Lewis, Teacher of the English Class, delivered an introductory lecture, which was largely attended, at the conclusion of which the several classes were organized.* A great deal of enthusiasm appeared to animate the youthful members of the Institute; upwards of one hundred enrolled their names as pupils in the several classes during the first week of their organization.

We trust this notice of the successful inauguration of classes, and the publication of Mr. Lewis's very excellent introductory Lecture, may be the means of inducing many other Institutes to establish similar means of evening instruction for their members.

Mr. Lewis's Lecture.

The objects for which we are called together this evening are significant and important. They are significant as marking the character of the age and the country we live in. We meet to inaugurate the establishment of classes in connection with a Mechanics' Institute. Our aspect and our preten-

* A list of the classes and terms of admission were given in the October number.

sions are humble. We are not surrounded with the lofty and venerable associations of recognized and established seats of learning. The students whose aspirations for improvement it is the design of this institution to aid, are not entering on a professional career, with means and abundant leisure to master the most important subjects of human knowledge, with freedom from the cares and toil falling to the lot of those who have to labour for subsistence, and with all the powerful motives which the hopes of future professional success create to sustain them in their mental pursuits. The students who will form the classes to be organized here, are supposed to be the children of toil—their days are spent in arduous labour at the bench of the workshop, in the merchant's office or the store. Before they sit down to the studies of the evening classes, their energies, physical and mental, have been heavily taxed in the struggle for existence. The mere animal impulses of a man under such circumstances, would demand, not new toils and efforts, but relaxation and amusement; and the habits of society afford abundant temptations and means of gratifying such impulses. Hence it is that this meeting is significant and important. It is significant as marking the character of the age. The culture of the mind is a growing necessity, as imperative in its claims as the wants of the body. In its very lowest aspect—regarded as necessary for worldly success—it marks the advanced character of our civilization, that an educated mind has incalculable advantages over an uneducated one. But we may assuredly believe that higher and nobler motives animate many, if not all, who, under the heavy difficulties to which I have referred, seek for mental culture. The desire to master any subject of human knowledge is a noble and pure desire—the discontent with defects of education is a just and praiseworthy discontent—and he who can resist the temptations of pleasure—the instincts of animal nature to satisfy the higher yearnings of the mind manifests some of the qualities of genuine greatness. It is a step in the right direction—in that path which, receding for ever from all that degrades humanity, advances for ever to excellence and peace. It is in this that its highest significance lies; and because it is common—because it animates more or less all classes—because it is being regarded as a mark of true manliness to desire improvement—and altogether ummanly, as well as unchristian, to be satisfied with ignorance and to indulge in low and degrading pursuits—it is the most hopeful as it is the most noble feature of the age. The establishment of free institutions and just laws—the increase of prosperity founded upon industry may form high elements of civilization and means of progress; but there is no guarantee of solid and pure advancement equal to that of a people feeling their mental deficiencies—conscious of the evils of ignorance and vice, and yearning for a higher state of intelligence. This is the characteristic of the present age. With all its sins and shortcomings, all its passions and errors, it is an age of advancement and high aspirations; and no where is the advancement seen clearer than amongst the people. The institutions for popular education and the high value placed upon them, the growing demand for them—notwithstanding the resistance made to them by those who have stronger sympathies for the national purse than the national character—who measure national greatness by its dollars rather than by its virtues and its intelligence; the increasing demand for books, for Mechanics' Institutes and for schools of Art and Public Libraries, all testify to the cheering fact that it is the people who are changing in their tastes and habits, and that society is advancing to higher conditions of civilization, more lasting and beneficial because they are fixed upon purer and more spiritual foundations.

I admit that in these intellectual manifestations of the age there is much of error, bad taste, and judgment; much selfishness, disrespect of established authorities, and dreary doubts of the truth of a solemn faith and of the sanctity of venerable institutions. Science is valued for its commercial not its intellectual and moral influences. Its truths are investigated as mines of hidden wealth are laboriously explored, for the temporal riches they may yield. Books are written and read too often to gratify the passion for excitement, and sacred doctrines are examined for the sake of disproving their truth. Yet amid all these outward signs of evil, a spirit of good reigns and will finally prevail. The popular taste is no longer downwards. They who begin to delight in reading and inquiring after truth, although the reading may be nothing better than fiction, and the inquiries may lead to doubt and self conceit and error, are in a more hopeful state than they whose highest pleasures are sensual and vicious. Brutal exhibitions, once common among all classes, now only find countenance on the very outskirts of society; and if occasionally the representatives of a higher class, degrade their rank and abuse their privileges, by sanctioning vice and lawlessness—a noble fraternity of all classes, high and low, aristocratic and plebeian are working together in generous harmony and earnest zeal to advance the work of human progress. The pursuits of science, however narrow and selfish may be the motive, enlarge and exalt the mind. He who ponders the laws of Nature, who seeks to make great discoveries, who explores the elements for new and hidden powers of production, whatever be his motive, cannot fail to rise purified and elevated by his labours. Daring speculations on the destinies of our race may engage the minds of acute thinkers, and doubt may shake the empire of ancient faith, but truth is in the field, and God is above all, and the universal exercise of thought and the growing dominion of mind over brute force, is the assurance to us all that a nobler age is dawning upon our race, and that out of the present conflict and perplexity, right and truth shall be finally evolved.

Now it is these signs of the times that attach importance and interest to meetings like this. It is not in the political arena alone that the power and the hopes of nations lie. A nobler field is opening to them, free from the factious agitation, the unhealthy excitement and the false expectations of politics, and offering them richer and more lasting rewards. Political power is not the ruling power in a country. It is of little value to individual progress. Its best quality is that it leaves men alone—gives them freedom, not to exercise political privileges, but to do whatever is best for their interests. The greatest things done for the prosperity and elevation of the people have been always done by themselves, and the best forms of government, the highest political privileges, are those which never interfere with their personal right and liberty to advance themselves. The true ruling powers of a country are its wealth and intelligence. The intelligence forms and guides public opinion, and the wealth is the source of its material power. In fact, in great commercial communities, where the prosperity and material comfort of the people depend so much upon money, no one will doubt but that politics, government, privileges of voters, are all more or less under the power of wealth. But the avenues to wealth are open to all who possess the gift of getting it. We may complain against an aristocracy of wealth governing a country and usurping the place of the ancient aristocracy of birth; but it is a just usurpation. There is nothing so democratical as trade and commerce. Its ways are countless, and are open to the whole world; and its successes are dependent upon laws, simple and clear and practicable to all. And in one respect it is an aristocracy, a best power; for wealth rightly earned is the justest, as well as the most influential power that ought to be exercised in temporal affairs. As a general rule, it is the fruit and reward of industry and skill; and because industry and skill lie more or less within the reach of all—because all can labour and all can cultivate to the necessary degree the faculties common to all men, and yet the chief ones needed for the acquisition of wealth—the power which wealth exercises is a just power. And the other power that combines with wealth is intelligence. And this again is a democratical power. For intelligence is the result of a cultivated mind, and requires only for its achievement the same industry and common ability that men need for success in acquiring wealth. Thus the two great instruments for good—wealth and intelligence—without which prosperity could not exist, progress could not be made, and neither christianity nor civilization would be advanced—are essentially popular, and no law nor predjudice, no conspiracy of privileged faction, no humbleness of birth can shut us out from reaching the one or the other. Hence no age was ever so full of hope and encouragement to the people as the present. No other age could in any such regard be called the people's age, because in the past all power lay with the few; the wealth was monopolized by the temporal ruler, and the intelligence by the spiritual; and both conspired to use them to oppress and to darken, and not to advance mankind.

It is these considerations that make a man's education of such vast importance. The educated man, with other things equal, is always the superior of the uneducated man. His resources are more ample, and he can direct his energies, his skill and his natural gifts, with more judgment and better success. A cultivated mind can influence other minds, and more easily win the confidence and respect of men. If its possessor is assailed by worldly conflicts, he can bear and resist with a calmer front and a manlier self-reliance, and rise to new efforts with surer chances of final triumph. This, however, is a general statement. Because civilization is so high, and intelligence so general, business and professional duties are compelled to advance in the same direction; and whether a man has to sell goods in a store or to make them, he whose mind is cultivated will immeasurably outstrip an uneducated competitor. For it is the proper result of study—however unnecessary it may appear to be—to sharpen the intellect, and endow it with a keener and larger power of vision. The clerk in a store, or its head, who has mastered the higher principles of arithmetic or some branch of the mathematics, may never need such knowledge in his business, but he wields a power of which he may be unconscious, to calculate, to reason, and to decide, which he never could have exercised without such training. In this light it is hard to place a limit on popular education. We are in the habit of saying that one should be educated according to his necessities. And thus we have a sliding scale to measure out certain portions of education to certain classes. To the child of poverty we award the scantiest intellectual culture, and pronounce it a piece of extravagance to enrich the minds of the poor with truths of God's universe which are only designed for, and needed by the rich. "An education suited to their condition in life," is the favourite phrase, and yet a phrase that means more than they conceive who insolently use it. For if by their moral wants and condition, education were measured out, who shall say what culture were too high and too costly for immortal creatures perishing of ignorance! If by their needs we are to judge, why educate professional men as we do in subjects which they never require in after professional life? Does the lawyer solve a point of law by an algebraic formula, or the physician probe a wound or prescribe a potion on geometrical principles? Yet who will doubt but that the admirable discipline of the mathematics, gives to both the acuteness and strength of judgment and clearness of thought, so necessary to their respective duties? And thus in every condition of life—if we decide the question by the mere outward needs of a human being—how vain and useless the toil, and time, and costliness of modern education; but, if we measure it by the claims and qualities of an immortal creature—by his capacities for good or evil—by the comparative worth of the highest cultivated minds—we have no excuse for denying to every one the highest culture that his nature is capable of, save the base and selfish one of its costliness.

"What needs one!
"Oh reason not the need; our basest beggars
Are in the poorest things superfluous:
Allow not nature more than nature needs,
Man's life is cheap as beasts."

—*King Lear.*

Moreover a new impulse has been given to invention and discovery in arts and manufactures; and the homage of civilized nations, the gratitude of the people, the honours of princes and potentates are awarded to them, who, by their skill and industry, add to human wealth and the prosperity of nations. Exhibitions of art and industry have not only awakened new interest in the production of the Mechanic's workshop: they have shown that the humblest artizan, by a scientific culture of his art, can produce works of marvellous ingenuity, and the rarest beauty combined with the highest usefulness, that exalt his labours far above the estimate which once only regarded them as the fitting pursuits of slaves. And while, by the skilful exercise of his craft, he can secure for himself public distinction and fame, he has the satisfaction of knowing that he who adds one invention to the productive powers of man is a benefactor of his race, and wins for himself a nobler renown than he who conquers empires. But here again we know that education enlarges and invigorates the faculties of man, and gives them new powers in the fields of discovery and invention. While science teaches the enlightened mechanic new principles of construction and combination; art not only gives him a deeper insight into the true principles of beauty, and exalts and refines his own taste, which itself is a reward worth years of study; but it is of direct profit to him in a pecuniary point of view, since it enables him to complete the work of his hands in the best, and most elegant, and beauteous forms—whether that work be the humble one of making a boot to protect and ornament a lady's foot—of assisting in clothing her form in the cunning fabrics of the loom, or that of erecting a temple for the advancement of learning or the worship of the Deity. It is thus, in fact, that the people truly exalt themselves, and make themselves a Power. For this power is built upon their skill and intelligence directed to create national wealth. It makes rank dependent for its enjoyments on their industry and ingenuity, which also are the true sources of national wealth and prosperity. Thus they achieve a dominion more sure and lasting than any that political privileges can give them.

Now these considerations press themselves on all who desire success. The success is sure to him who fits himself to win it, whether that success be to attain excellence in any art or trade, or that general intelligence by which one man can more or less guide and rise above others of his class. And here I desire to make the matter clear as to the meaning of this term—becoming so prevalent—success in life. I desire to make a distinction between *success* and success in life. Nothing is more common than to hear that success in life is of a man's own making, and that every one who wills, may, by the mere force of will, achieve success. The opinion, first brought out by some successful man, has been accepted; and it is taken for granted, that, whoever fails in life, that is to say, fails in becoming eminent in any profession or business, fails because he did not direct the circumstances around him as he could have done—as he should have done—and as all successful men have done. And success in life is thus pronounced to be greatness. Now, this doctrine is unjust to all who in this light fail. It falls to the lot of few to rise to the eminence of what the world pleases to call a successful man, and the success of some successful men is not always of that kind, that independence of spirit or high integrity would sanction. It is not always by industry and prudence that men rise to wealth, and it is not always that industry and prudence ensure wealth. It is not always by the mere exercise of rectitude and talent that men rise in the state, and it is not always that statesmen are distinguished for rectitude or talent. The popular idol or the successful candidate for office is not always he who has the highest claims to confidence; but sometimes he who can dispense with the qualities essential to true greatness first reaches the top of the pinnacle, which is vulgarly pronounced to be the summit of greatness. Successful men are in fact no authorities on the subject. Successful men are always apt to overvalue their own efforts, and to undervalue the circumstances that helped them to success. But failure in life in the popular sense is still so common, that we may well doubt if such success is either very desirable—very much to be respected, or at all within the great purpose of life —whether in fact it is worth the anxiety or the homage it receives. No doubt many fail because they do not act with unvarying steadiness in pursuing what they determine for themselves. They fail because their energy and resolution fail. But are these qualities—the necessary energy and resolution—the possession of all men? Are they not the result of organization, of example, of early training; and are not organization, example and training the result of so many circumstances beyond individual control, that they may be rightly classed as the mysterious dispensations of providence? It is true that human success, human happiness, good and evil, are the result of fixed and perhaps clearly understood laws. But the knowledge of these laws does not always give us the power to obey them. This is the great mystery of life; call it human frailty or what you will—that we know the right but fail in doing it. Evil still reigns, and failure in accomplishing a purpose still continues to mark the conduct of men. If some succeed—although credit may be allowed them for their energy and resolution—the causes which endowed them with the gifts of success are not of their own making. Generations may have laboured for the creation of one eminent man, as a thousand circumstances combine to help one man to success in life.

For success in life, in the low and popular sense, I see no reason to believe that mental culture is a sure guarantee. It has its successes, noble and lasting, but they are not of that kind which falls in with the popular view of greatness. Men who devote themselves earnestly to self-culture, to the study of some branch of human knowledge, to the pursuit of Truth, do not always attain eminence, fame or wealth. Their success is the inward satisfaction of having achieved a purpose—a satisfaction in the power of most—and the high sense of having done well—done to the best of their power—although that doing may never win the world's applause, or rank them among its successful men. In the view of higher natures, and of that Judge who beheld higher merit in the widow's mite than the ostentatious offerings of rich men, before whom human greatness, eminence, honour, fame, are less than dust, there may be a purer and loftier success in the life of some poor, obscure child of poverty and toil, over whose brows the laurel of genius or eminence never shone,—who may pass through life despised, and but faithfully fulfilling its humbler duties—than in their lives whom nations delight to crown with immortal renown. Then there arises the difficulty, so common, of the earnest mind struggling under the disadvantages of a defective early education, a difficulty often full of the gloomiest discouragement. When we measure those defects and see before us the vast expanse of human knowledge, the all of which we know so little, we dread to meet the difficulties. The student who in this condition begins to enter on the career of self-improvement is overwhelmed with the sense of his own ignorance, and the first struggles are the most perilous to his future advancement. But his encouragement is to know that the first struggles are the hardest, that every successive effort and conquest not only adds to his acquisitions but also to his intellectual strength, and that as he advances the difficulties melt before resolute energy and perseverance, and the pleasure of mental triumph grows in its intensity and reality. Besides all this he is to reflect that in a practical point of view he does not want to make himself master of every thing at once, that one subject thoroughly secured may often satisfy all the necessary ends in view, whilst the discipline through which he is passing, and the new tastes he is acquiring—as well as the sense of power—prepare him for new efforts and reveal to him capacities of mind in himself of which he had no conception when he began. Those difficulties are not insurmountable, and they are the very elements of future triumphs. The harder the difficulty, the higher the moral culture, the grander the result. It is a world of difficulties we live in, but behind and above all there is ever a just, and a considerate and a tender Arbitrator. He who destined the mind for improvement gave it faculties and energies mightier than any difficulties. The strength is in us all, and if we fail it is not because we cannot, but because we will not succeed. The desire that burns, more or less, in every one's mind, to raise himself to the heights of a cultivated intelligence, is an intimation of our duty and our destiny, and he who shrinks because the task is hard—who prefers ignorance because the paths to knowledge are sometimes rocky—seeing not the glorious light beyond—fails only because he has not the manliness to advance.

Besides, there is always a tendency to over-estimate the difficulties of mental culture. Because education has been so long the privilege of the few, the multitude have grown into the belief that a good education, like refinement of manners and all the polish of high life, could only be accomplished by those who have had some peculiar faculty of birth or genius for it. A man expert in mathematics or the knowledge of language or any art—because wielding a power not exercised by the many, was supposed to be born with some extraordinary gift of genius. But the truth is, that many a mechanic has to devote more thought, to practice more patience, and to give more time and labour to attain skill in his trade, than a man gives to master a foreign language, a science, or a fine art. Why then, is it that we have so many skilful artizans, and so few skilful linguists or men of science, or artists? The reason is plain. The supply depends on the demand. We need more artizans than linguists or artists, and because the business is more extensive the teachers are more numerous, and the means of acquiring the necessary skill more available and abundant. I maintain, then, that the artizan who by his industry and skill produces an article of complicated make of finished beauty, and fitted to meet all the ends in view, has manifested capacity, patience and originality of mind equal to any mental qualities exhibited by the professors of language, of science, or of art. When I behold a work of mechanical skill, so wonderfully adapted to all its uses, so admirable even in artistic beauty, whilst it is impossible for me not to do homage to the intellectual power, and patience, and thought which all the while directed the trained hand to such issues, I am compelled to reflect how much more might be done were the same intellectual powers enlarged and invigorated by an education in the principles and theories upon which all mechanical skill is founded, and how much he loses, how much we all lose, because the man is trained only as a machine, while the rich and noble stores of power in his mind, lie buried in darkness and uselessness. The great end is to make the man less a machine and more a man. It is because he is regarded only as a machine that he too often only acts as one, and believing himself incapable of higher advancement sinks into animal drudgery and animal life. His god-like faculties lie utterly neglected—or if their life cannot altogether be crushed out, because it is immortal, he rushes into the excesses of vice or lawlessness or crime.

Let no excuse then stand in the way of him who being awakened to a sense of his mental defects, desires to know more. For he has no excuse, for every difficulty he can name, history gives noble examples of self-taught men, who have encountered and overcome difficulties greater; whether that difficulty be overtaxed energies in laboring for life, infirmity of health, poverty, advanced age, the biographies of men eminent for triumph over circumstances, give us examples to shew that they contended with like foes to progress, and that they conquered not because they were more highly gifted, but because they were patient, persevering, hopeful, and made the best of the abilities they possessed—which we all can do with like if not with equal results. There is no branch of human knowledge, no science, nor art, nor language, which has not been mastered by men, working at the plough, delving in the mine, toiling at the bench, selling goods over the counter, making calculations at the desk, sailing over stormy seas, wandering over strange lands, sitting in the soldier's camp, pining in dungeons, living in storms and conflicts, hungering, thirsting, sorrowing, suffering, yet never giving in, never resting until they conquered.

Some have begun the work of self culture from mere necessity, or for worldly advancement; others have taken it up from a noble love of knowledge; others to do good by the power which education always gives; but the results have satisfied all. None who have entered into the work and pursued it with manly energy and industry have ever failed in accomplishing the end of self culture, and always with the effort has grown up a richer and nobler reward than that of knowledge itself, the habit of self-reliance, the moral discipline which educates a man to nobler issues than all schools and universities in the world could do. This is the compensation which self-educated men, or those who are compelled to struggle for education under difficulties and with wearied energies have over the more favored class of men. They gather strength as they advance. Difficulties bring out new energies and reveal to them new powers in their own souls. They learn to command their passions, to look at moral conflict with heroic coolness, to resist temptations with heroic fortitude. I do not say that the mere pursuit of knowledge does all this alone. There must be moral culture as as well as intellectual. There must be the culture of Truth and Faith, there must be a reverence for God and his laws, an utter casting away of all base and degrading—soul-polluting influences. But thus the work of pursuit of knowledge under difficulties has the great advantage of helping all other moral and religious influences. The mere direction of the mind to intellectual pursuits is a direction *from* animal and sensual pursuits, and were nothing else to follow but the acquisition of some new mental power, there would be a gain in favour of virtue. But the conflict with difficulties is a conflict with indolence, with discontent, with the attractions of degrading pleasures, with all that helps to brutalize immortal natures, and to perpetuate the reign of sorrow and suffering amongst our race. There is a moral disease always infecting large communities which causes the multitude to look for help to every one and every thing but themselves. They can only act in masses, they can only depend on forms and systems and established authorities. It is this moral weakness that makes a people believe that every evil comes from bad government, that every reform must come from political revolutions or amended legislation. They can only save virtue by act of Parliament, and error can only be crushed by penal laws. And the moral disease infects individual character, which is its worst feature; it is leading multitudes into the dark and dreary paths of Doubt; it is uprooting all high and holy faith; it is begetting an infidelity worse than any the world has yet seen—an infidelity that beholds nothing great or heroic or holy in life, and that unable to rest in humble faith on supreme wisdom and goodness, seeks only to live in the Present with no hope for the Future. There is no peril that threatens us more than that of this moral weakness, this want of purpose in life, and its remedy lies on that mental and moral discipline so much the effect of self-culture.

No doubt there are branches of study which have a special value for their exalting and enlarging tendencies. After the claims of a trade, or an art, or a profession have been satisfied, there opens up the field of general knowledge, the pursuit of art, or of science, or of language, all of which beside the mental discipline—beside the gratification of taste or even of human pride in supplying us with a new power, still have a tendency to take us beyond the narrow boundaries of self, and to lead us towards the Great and the Infinite. And this result is inevitable, lying in the very nature of all knowledge, whatever end we have in view. When we study geology for example, it not only reveals to us a wonderful history of the past, but in carrying our imaginations over countless centuries, over the vast expanse of unmeasured time into the dim and far life of a primeval world, we are thus permitted to stand as it were in the awful presence of eternity and gaze upon the work of the Creator from the beginning and through its progress; and this association with Infinitude and Omnipotence cannot fail to re-act upon a man's moral nature and fill him with some of the qualities which he contemplates. Thus too, the mere mathematician whose highest effort may be to master an abstract problem in geometry or to solve a complicated equation, though he never step beyond the region of pure mathematics, is sustaining an intellectual influence beneficial to moral culture; but when he directs his knowledge to higher efforts, when he treads in the paths of the planets, pursues them through their mighty orbits, bids them stand still that he may measure their height and depth, and meditate on all their marvellous phenomena, his faculties grow in proportion to the greatness of his contemplations, and his studies give an elevation to his thoughts and impress a kindred grandeur on his soul.

So again, in the study of language, whether it be the mother tongue or a foreign language, when the student examines its forms of expression, and the structure and relations of sentence as symbols of thought, he is engaged in an exercise of a high intellectual character. And when he advances into the regions of its literature, when he investigates the thoughts of lofty intellects or seeks to comprehend the teachings of genius, although his purpose may only be to understand words and to use them correctly, he is acquiring a knowledge of the laws of thought and habits of logical analysis. But further than this, a just study of language cannot fail to excite a taste for the higher order of literature. We blame the people because the books in favour amongst them are low in character. We commend works of talent and genius to them. But the truth is, that they read what they understand. Popular books are suited to the popular intellect; and although it is fashionable to praise Shakspeare or Milton, or any great poet or prose writer, their popularity lies in a very narrow compass. And the reason is clear. Men of very imperfect education may understand an election speech, or a work of fiction which paints highwaymen as heroes, or fills its pages with sensual recitals of passion and insane exhibitions of love, because the language and the facts are in keeping with their tastes and intelligence; but there must be a higher education to appreciate the teachings of genius or philosophy. The mind needs discipline in the analysis, and a thorough familiarity with the force and nature of words and expressions, as well as the power to see the relations which complicated processes of reason and thought have with each other, before their true force and beauty can be discovered and their value experienced. And this is the discipline which we get even in the study of our native language, a discipline no doubt superior when it is extended to the study of other languages. And its rewards are, that it opens up rich treasures of enjoyment and sources of consolation and power in trials, in darkness, in temptations, of which they are destitute who pass through life without it. The influence of all great minds is to lift up other minds to the pure regions of thought and imagination in which they dwell, and whilst the constant study of the works of genius increases the taste for them, we gain in power, and loftiness, and expansion of thought by this association with the great minds of our race. This is the privilege of all; and it is as much the duty of all, as it is the noblest office of genius to instruct and exalt all. When the inspired poets of every age pour forth the splendid creations and hopes that flash across their minds, we may be assured that the power they wield is a divine one, and given for high and divine purposes. For genius discerns truth and mercy where common minds behold only darkness or despair. It sees everlasting beauty under the veil of dust and forms of humbleness and even of human degradation. It utters in language and thoughts, like those of inspiration, the hopes of humanity; and while it indicates, with prophet like power, the destinies of man, it asserts the dignity and obligations of life by shewing that in the noblest affections of the soul, in the passions and virtues of humanity, nor birth, nor blood, nor race, nor clime, make any distinction.

In the commencement of this address I referred to the difficulties of those who seek self-improvement after being engaged in daily toil. Perhaps, however, the chief difficulty lies in throwing off the tyranny of old habits and in falling in with the drill, and discipline, and order of studious habits. Let the student, however, remember that the new habit grows in its power and attractiveness, that in the study of any subject of human knowledge—although there is necessarily some toil and drudgery—it differs altogether so much from the toil and drudgery of the daily life, it incessantly affords such noble excitement to the mind, its conquests which occur at every step of progress, are so pure and satisfactory, and the hopes of success and distinction so constant and bright, that it becomes less and less, as we advance, a toil. The simple fact that intellectual men grow in their attachment to study and frequently over-tax their brain, is a proof that study has fascinations and charms that take away the roughness of the labour. We suffer often more from inactivity than work; and the work that gives a new direction to our thoughts, that carries them away from the petty cares and anxieties of life, or draws them from the direction of intemperate pleasures is most invigorating and healthy. The rule of enjoyment and of advancement is simply to undertake only what we can do, and to do it thoroughly—continuously and to the end. No doubt some self-denial must be practised, no doubt the student will feel himself called upon to exercise energy, resolution, and manly endeavour. But the exercise of these qualities have not only their moral advantages; they are noble sources of enjoyment and true greatness. In referring to the efforts of men who submit to this discipline, John Foster has truly and beautifully said: "They have nobly struggled with their threatened destiny, and have overcome it. When they think with regret how confined after all is their portion of knowledge as compared with the possessions of those who have had from their infancy all facilities and the amplest time for its acquirement; let them be consoled by reflecting that the value of mental progress is not to be measured solely by the *quantity* of knowledge possessed, but partly, and still more by the corrective, invigorating effect produced on the mental powers by the resolute exertion made in attaining it. And, therefore, since, under their great disadvantages, it has required a much greater degree of this resolute exertion in them to force their way victoriously out of ignorance, than it has required in those who have had everything in their favour to make a long, full career over the field of knowledge, they may be assured they possess one greater benefit *in proportion* to the measure of their acquirements. This persistence of a determined will to do what has been so difficult to be done, has infused a peculiar energy into the exercise of their powers; a valuable compensation in part for their more limited share of the advantage, that one part of knowledge becomes more valuable in itself by the accession of many others. Let them persevere in this worthy self-discipline appropriate to the introductory period of an endless mental life. Let them go on to complete the proof how much a mind incited to a high purpose, may triumph over a depression of its external condition; but solemnly taking care that all their improvements may tend to such a result that at length the rigour of their lot and the confinement of mortality itself—bursting at once from around them—may give them to those intellectual revelations—that everlasting sunlight of the soul in which the truly wise will expand all their faculties in a happier economy."

Selected Articles.

ENGINEERING EXAMPLES—THE BRUNELS.

In the last number of the *London Quarterly*, there is an interesting essay on two of the greatest engineers of the present century, namely the two Brunels, father and son. The elder Brunel has perhaps been most widely known as the engineer of the great tunnel under the river Thames in London; the son as the author of the broad guage on railways; the engineer of several stupendous bridges, and the designer of the steamer *Great Eastern*. Sir Marc Isambard Brunel, the father, was born 1769, at Hacqueville in France, and when eight years of age he was sent to college to be educated for the priesthood. He early exhibited such a predilection for mechanics, that he neglected theological studies, and greatly pained the heart of his father, who sometimes shut him up in close confinement, and whipped and coaxed him by turns to make him cease making wooden clocks, water wheels and windmills; but all in vain. Brunel was born an inventor, and it formed part of his existence to construct machines. When he arrived at seventeen years of age, his father, who had very strong affection for him, obtained a situation for him as an officer on board a French war vessel. Being a good mathematician and draftsman, he soon became a good navigator, and he constructed his own nautical instruments. The French revolution broke out about this time, and he being a fervent royalist had to fly for his life, and so he came to New York in 1793. Here he resided for six years, and made a moderate livelihood as surveyor, architect and civil engineer. It is stated that he designed several buildings in this city, also some of the fortifications in the harbor. He went to London in 1799, and was soon engaged by the British Admiralty in constructing self-acting machinery, which he had invented for making ships' blocks. In this way he was very successful, and his reputation as a mechanical genius established. Having received a considerable sum for his invention of ship-block machinery, he then designed machinery for making shoes, and engaged in this business; but, although an able inventor, he was a very indifferent merchant, and was soon involved in debt, and put into prison, from which he was kindly relieved by the British Government paying $25,000 to satisfy the claims of his creditors. In 1822 he invented a carbonic acid gas engine, as a substitute for the steam engine, intending to use liquid carbonic acid, which is very sensitive to the influence of heat. But, like many persons of the present day, he did not understand the subject fully, and failure was the result. About this time, it was publicly proposed to make a tunnel under the river Thames in London, but no good method for accomplishing the object was proposed. The attention of Brnnel being directed to the subject, it is stated that, while he was in the navy yard one day, he lifted a piece of timber which had been penetrated by the *teredo navalis;* and while examining the little molusc, he found that its head was armed with a pair of strong shell valves, and that it worked into the wood by having its nose attached as a centre bit to the timber, while its shell moved like an augur. In this manner it was enabled to bore under water, into the planking of the stoutest ship. Reflecting upon this natural method of boring under water by this little shell fish, Brunel was led, step by step, to invent peculiar mechanism, embracing a slowly-rotating shield, for forming tunnels under ground, and he secured a patent for his invention, submitting his plans to a number of scientific persons, as adapted for tunneling under the Thames, and the result was the formation of a company, with a capital of $1,000,000, to carry out his plan. Brunel, being appointed engineer, constructed a great tunneling machine, upon the basis of the *teredo navalis.* It weighed 200 tons. was divided into several parts, and was operated by a powerful steam engine. The work of tunneling was of a very difficult character. The river broke in several times, and operations ceased occasionally for a long period. Arragements were made to commence the undertaking in 1825; it was not complete and opened until March, 1843, a period of eighteen years. Some idea of Brunel's arduous labors may be learned from one fact. While the excavtions were going on by night (it went on by night as well as day), he was awakened, by his own orders, every two hours, and informed of its progress. His house was close to the tunnel, and when a bell in his bedroom was rung from below, he arose, struck a light, and examined a portion of the excavated soil which was sent up to him in a tube for inspection. A record was then made in his journal, he gave such instructions as were necessary, and went to bed again. For several months after the tunnel had been finished, such was the force of habit, that he awakened regularly every two hours during night. The Thames tunnel was successful as a feat of engineering, and the genius and endurance of Brunel shone out conspicuously in all that was achieved, but it cost $2,320,000, which was more than double the original estimates, and it was next to useless after it was finished. It proved disastrous as an investment to all who were concerned in it. Brunel died at the advanced age of 81 years, in December, 1849.

Isambard Kingdom Brunel, the son of Marc, became quite distinguished as an engineer when a youth, he acting as assistant engineer of the tunnel to his father. When it was completed, he devoted himself to railway engineering, and being somewhat ambitious perhaps for distinction, he projected the wide guage of seven feet, for the Great Western Railway in England. He produced many arguments to show that it was preferable to the common narrow guage of four feet eight and a half inches, which had been adopted by George Stephenson and others. Brunel's plan was violently attacked by leading engineers, but he was successful in carrying out his wishes. This was the parent of wide-guage railroads, and it is the most magnificent railway in the world. Some of the structures on it are splendid exhibitions of daring engineering skill. One viaduct over the river Trent is 880 feet in length; it is supported by eight elliptical arches of seventy feet span, having a spring of eighteen feet in the centre. Gigantic square columns rise in pairs from a broad square basement, each pair being united at the top by bold architraves, forming the pier from which the arches spring. The structure imparts the idea of massiveness combined with elegance. A bridge on the same line, at Maidenhead, consists of ten brick arches, two of which are 128 feet span, each with a spring of only twenty-four and a half feet. They are the flattest arches ever made in brick. Brunel was apparently fond of executing daring projects, and doing things differently from other engineers, but he sometimes committed great mistakes. He became engineer of the Croyden and South Devon Company, for constructing an atmospheric railway, which he advocated against the opinions of several scientific engineers. He invested $100,000 in the project and lost it all, as it was a complete failure. Compressed air with stationary engines was not found equal to steam locomotives; and in view of this fact, one of its shareholders, in 1848, described himself and his fellows, "as the most unfortunate proprietors of the most unfortunate railway in the kingdom,"

The younger Brunel was the engineer of several railways, and all the structures which he designed are distinguished for boldness and grandeur. We can form but a very inadequate idea of the great bridges and viaducts, and other similar structures on English railways, from those on most American railways. Take for example one or two similar bridges, designed by Brunel, and constructed under his superintendence. It is called Saltash Viaduct, and passes over the river Tamar, on the Cornwall Railway. It consists of nineteen arches, seventeen of which are from seventy to ninety-three feet span, and the two main central spans are no less than 445 feet each. These two central arches span the river with a double leap of 910 feet, and ships sail freely under them. This is called bow-string girder bridge. The central spans are formed of wrought iron tubes, each of which weighs over a thousand tons. This viaduct is a combination of the tubular and suspension methods; it is cyclopean in character, is 300 feet larger that the Britannia bridge, and it is one of the greatest triumphs of engineering skill in the world. The steamer *Great Eastern* has also tended to extend the fame of the younger Brunel, and it was his last great engineering achievement. While being constructed, and especially while it was being launched under so many mishaps, his health was impaired by incessant labor and anxiety. After this vessel had been launched. and made ready for her first trip, he went on board of her, but she did not sail for a week afterwards. During this brief interval, the great engineer who had projected her, was seized with paralysis, and just as she was gliding down the river to the sea, his spirit left this earthly tabernacle, and entered upon its voyage to "the spirit land." The younger Brunel did not possess the mechanical ingenuity of his father, but he was one of the boldest engineers that ever lived, and his ideas were of the grandest kind. "He was the Napolean of engineers," thinking more of glory than of profit, and of victory than of dividends. He was ambitious to construct the greatest railway, and the greatest steamship in the world, and he succeeded. But although many of his projects were financially unprofitable, he was not a selfish speculator in schemes at the expense of others; he was always ready to invest his own fortune in all the projects which he proposed. The lives and labors of the two Brunels, both in those objects which were successful, and in those which were failures, afford lessons in engineering to future generations.—*Scientific American.*

A COURSE OF SIX LECTURES,

On some of the Chemical Arts, with Reference to their progress between the Two Great Exhibitions of 1851 *and* 1862, *by Dr.* LYON PLAYFAIR, *C. B., F.R.S., Professor of Chemistry in the University of Edinburgh.*

CALICO PRINTING—SHOWING THE IMPORTANT CHEMICAL MANUFACTURES DEPENDENT ON THIS ART, AND SOME OF ITS PRELIMINARY PROCESSES.

LECTURE III.

In my last lecture I brought before you various colours produced by coal-tar which had recently been employed in the art of calico printing. I also at the same time mentioned to you that the discovery of these colors from coal-tar was likely very materially to alter the whole art of calico printing, which, in its present aspect, involves some beautiful applications of science. You will readily understand that, after we have gone over the preliminary processes connected with this art.

"Calico printing" is a generic term. Although the term "calico" is used in it, it embraces all the arts of making dresses with colored patterns, whether they are manufactured from silk, from woollen, from linen, from cotton, or from any mixture of those materials. It is, therefore, merely a generic term, describing the ordinary dresses which receive designs by means of impression and not by mere dyeing. The name "calico printing" was originally derived from Calicut, in Hindoostan, where the art of impressing cotton with colors was carried out to a great extent, although the same art had been employed long before in Egypt as regards linen. The skill of the printer consists in placing as many colors as possible upon the tissue, and deriving them from one dyeing material; for all his supplementary processes are merely confessions of his inability to produce all the colours which he desires from one material. Pliny gives us a description of the manner in which the ancient Egyptians practised the art, and his account is so excellent that I could not possibly give you a better explanation of the art of the present time. I therefore quote it in full. "Robes and white veils," says Pliny, "are painted in Egypt in a wonderful way. They are first imbued, not with dyes, but with dye-absorbing drugs, by which they seem to be unaltered, yet when they are immersed for a little while in a boiling caldron they are found to become painted. Yet, as there is only one color in the caldron, it is marvellous to see many colors imparted to the robes in consequence of the influence of the excipient drug. Nor can the dye be washed out. A caldron which would merely confuse the color of cloths previously dyed is thus made to impart several pigments from a single dye stuff, painting as it boils." You will find as I proceed in the description of the art that this latter term of Pliny's, "painting as it boils," is a true description of the art as now practised. Since the time of the ancient Egyptians the practice of calico printing has made enormous strides, and yet it would be impossible in the present day for any one to write a more concise or accurate description of the art even as now practised, than Pliny has done of the condition of the art of the old Egyptians. Although the principles upon which the art was carried out were known in former times, yet its resources have vastly improved. I may mention as an instance that it is recorded that Alexander the Great wore a pectoral of printed linen — probably not better, and certainly not nearly so gaudy, as those Turkey red handkerchiefs which we are accustomed to send to Brazil and Mexico to adorn the lowest classes of the population.

The British calico printing trade is now of great magnitude. It consumes one-seventh of all the cotton which is imported into this country. Perhaps this may not give you an idea of its largeness, and therefore I will put it in another way. There are printed annually, in this country, thirty-one millions of pieces of calico, which is equal to 450,000 miles. This is also a method of indicating the largeness of the subject which it is difficult to understand: supposing you were to measure the calico annually printed in Great Britain by a gigantic standard measure — take the diameter of the earth as your "yard measure," with which you are to measure the calicos printed in Great Britain in one year—you would require to stretch it along the diameter of the earth fifty-six times; or, if you were to wrap the whole world round with a bandage of the calico printed annually in this country, you would envelope it in nineteen folds. You will hence see that it is an art of great magnitude, and it is one which, therefore, justly draws our attention, not only on account of its importance as regards itself, but also (and this, as you will observe by the programme, is mainly the subject of my lecture to-day) on account of the arts which it brings into its train, and the important manufactures which it creates and helps to sustain. To-day's lecture is therefore directed to these arts, and to the preliminary processes in the printing of calico.

The preliminary processes are numerous. I will merely enumerate them in their names just now. There are six of them.

There is, first, the bleaching of the calico; second, the application of the mordants, or what Pliny has called the "excipient drugs," which drag the color out of the bath and fix it upon particular parts of the fabric; third the resists or discharges, which keep the calico white at particular parts, or produce a white pattern; fourth, the ageing which will explain itself when we come to it; fifth, the dunging or the fixing of the mordants; and, sixth, the dyeing.

I commence with the bleaching. The bleaching of the calico is an exceedingly important part of the process. On the right hand side of that small table you will see the calico as it is delivered to the printer from the weaver. It is of a grey color, and not at all adapted for the purpose of the printer. It contains the flour and the grease which the weaver uses in his operation. It also contains a natural resin, which prevents the calico from taking on the color, and it is necessary that all this should be removed, and that the calico should be converted from that dirty grey into a white before the calico printer can use it. Well, up to the last two years of the last century—to 1798—the bleaching of calico was an extremely formidable operation. It required for its completion from the month of March to the month of September. After the grey calico was boiled in alkaline lyes to take out the grease of the weaver and the rosin of the natural calico, it was spread out in vast fields, and was exposed to the action of the sun and moisture, being occasionally watered, first with water, and then with buttermilk; and in this way a true combustion took place. Under the influence of the sun and the moisture the oxygen united with the coloring matter and burnt it; and the coloring matter was thus burnt out of the cloth, and the cloth became white. In this combustion, however, part of the cloth itself was burnt, and the texture was often injured; but the greatest evil was this — that every calico-printing works, in order to bleach its calico for use, required vast estates in connection with the works, upon which to spread out the calico to the action of the sun and air; or in absence of these, the printers sent the calico to Holland to be bleached. The bleaching, therefore, became an extremely expensive part of the operation. Towards the end of last century it was discovered that bleaching might take place in a much more easy way; but the circumstances that led to this discovery are so interesting, that I would not hesitate, if we had not so much before us, to give you a description of the manner in which this discovery resulted. I will do so in a few words. France, during the revolution, was shut out from a supply of soda, which was used to dissolve out the resin of the calico, from Spain, where it was manufactured under the name of barilla, being derived from the ashes of sea-weed. Our cruisers were vigilant, and we shut out this supply of soda from France. The consequence was that the soap-boilers of Marseilles were nearly ruined, and the manufacturers of calico also suffered extremely. Accordingly, the government offered a high reward to any person who would discover how to make soda from sea-salt. Sea-salt, as you are aware, contains the metal sodium, but united with chlorine and not carbonic acid. It was sagaciously thought that soda might be made out of it; and it was ascertained that, some time before, Leblanc, a private manufacturer, had actually practised a method for converting this common salt into soda. The process is a complex one. I cannot describe it to you further than by stating that the first step is to treat the common salt with sulphuric acid, which drives off the hydrochloric or muriatic acid, and leaves sulphate of soda behind. This is then treated with carbonate of lime, and is converted into carbonate of soda. For a long time the muriatic acid from the common salt went out through tall chimneys into the atmosphere, and devastated the country by destroying vegetation: It is this of which Lord Derby complained in the House of Lords the other night, and which led him to move for a committee to inquire in what manner manufacturers can be restrained from sending these injurious gases into the atmosphere. Lancashire alone converts 135,000 tons of common salt into carbonate of soda every year. This hydrochloric acid was for a long time lost, but it was soon found to consist of chlorine and hydrogen; and this chlorine possesses strongly bleaching powers. I have here some of this chlorine dissolved in water. If I add to it a coloring matter such as this indigo you will see that the color quickly disappears. The color of the indigo is removed from it.

When it was found out that chlorine had such a power for destroying color, persons began to think that it might be employed as a bleaching agent, instead of exposing the calico for such a number of months to the action of the sun and air. Now, the mode by which this bleaches the color is by the decomposition of water. Water, as you are aware, consists of hydrogen and oxygen, and the chlorine has a great love for the hydrogen and desires to unite with it; and so it takes away the hydrogen from the water, and forms hydrochloric acid with it; and the oxygen liberated from the water goes and burns away the coloring matter. You know that ordinary combustion in a fire-place is the oxygen uniting with the material of the fire. So here, the oxygen of the water, being set at liberty by the hydrogen uniting with the chlorine burns the coloring matter and destroys it, just as the oxygen burnt the coloring matter when the calicoes were exposed to the air in the old process of bleaching.

After a time it was found that if this chloriné, which is a gas, was passed over lime it was absorbed by the lime, and formed what we are now so familiar with as bleaching powder, and that this bleaching powder bleached just as well as chlorine did, and without having the irritating smell and the irritating action on the lungs which are common to chlorine. As soon as the property of bleaching-powder was discovered, an extraordinary impulse was given to the process of bleaching. After the resinous and fatty matters have been removed from the grey cloth, it is treated with a weak and clear solution of chloride of lime. In this action the chlorine, desiring to unite with the calcium of the lime, accomplishes this by liberating the oxygen which destroys the coloring matter. From beginning to end of the operation of bleaching only five days are necessary instead of the months which were formerly required. Five days are occupied in converting this grey cloth into white cloth, to make it ready for the calico printer who is generally his own bleacher. The cloth is first singed by being passed over a red hot cylinder, as you see represented here in the second diagram. This is done tolerably slowly, in order to take away the fibres and clean them from the surface. The texture, however, does not get injured.

After being passed over the red hot cylinder it appears in this state—a little browner. It is now boiled in lime. The lime loosens the resins, and forms a compound of resin and lime on the cloth. This is boiled with dilute sulphuric acid in order to dissolve out the lime and liberate the resin. It is now boiled in a solution of carbonate of soda—the substance is made from common salt, and it renders the grey calico much whiter than it was before. After that it is passed through a solution of chloride of lime. There are one or two boilings which I need not enter into, but the mode in which the boiling is effected is interesting. There is a diagram representing the "bowk," as it is called, or the vessel in which the boiling of the soda and the lime takes place. You see the calico is coming in by machinery, and a boy is represented spreading it along the floor of the caldron. In this there is placed, after the boy of course has departed, a quantity of water and a quantity of carbonate of soda; and there is an elegant fountain arrangement which cannot be represented there on account of the boy being present, by which the hot fluid is thrown up to the top through these tubes. It is prevented by the arch at the top from getting out, and is thrown in a fountain-shape over the cloth below, so that it it is continually percolating through it, and coming down over it; and in that way the resinous matter is completely removed from the cloth. The latter is now passed through a solution of bleaching powder—chloride of lime, consisting of lime and chlorine. The chlorine has a great desire to unite with the calcium, the metal of the lime, and form chloride of calcium, and the oxygen being set at liberty burns away the coloring matter of the calico and bleaches it. There would appear to be no decomposition of the water, as in the case of bleaching with chlorine in the form of a gas. All these operations—boiling in lime, boiling in soda, steeping in the bleaching liquor, and all the operations of washing and drying, occupy only five days from the beginning, and it is carried on in works of small extent. No estates are necessary in connection with the works. The verdure of miles of country is no longer defaced with outstretched calico bleaching in the sun.

Before parting from this subject, let us pause here to consider how this method of bleaching has raised up several important manufactures.

The soda-ash trade is of enormous extent, and is now carried on by extensive manufacturers to supply materials for bleaching and washing soda. Sulphuric acid is necessary in its production, as I told you; so that the price of sulphur regulates the price of calico. The price of sulphur also regulates the price of other materials, such as soda, and of glass, in making which soda is much used. About twenty years ago, as many of us recollect, the King of Naples was persuaded by a Marseilles firm that it would augment the small revenues of his country very much if he gave that firm a monopoly in all the Sicilian sulphur. They immediately raised the price of sulphur from £5 to £14 per ton. Our calico trade, soap trade, glass-works, and various other interests were soon affected by this proceeding, and the consequence was that our Government were obliged to take some of the Sicilian sulphur and convert it into gunpowder, with which our fleet went to Naples, threatening to bombard that place unless the monopoly was abolished. The Neapolitan Government did not like the return of their sulphur in this form, and so they permitted the export on the old terms, and our manufactures again flourished. But what was the consequence of this short monopoly. Naples has lost enormously by it. Like all foolish experiments of this kind on trade, it had a most disastrous effect upon those who made it, and it has had a most beneficial effect upon our sister country Ireland. The skill of our chemists was brought into play to see whether they could not discover sources of sulphur in our own country. We found an abundant supply of sulphur in iron pyrites, which exists in such large quantities in Wales and Ireland, and also in Spain and Portugal. The consumption of Sicilian sulphur is thus much reduced.

There are one or two other things in connection with these arts which I must allude to very shortly as my time is going on.

In the manufacture of this bleaching powder, where chlorine is made, hydrochloric or muriatic acid is boiled with peroxide of manganese, and this produces chlorine. All the manganese was, until recently, wasted after the operation. The chloride of manganese was a waste product, and there were no means discovered for getting back this expensive salt—for producing again the peroxide of manaanese after it had been boiled with hydrochloric acid. A beautiful plan has been recently invented, but which will be appreciated chiefly by the chemists present. The protoxide of manganese produced by precipitation from the chloride will not absorb oxygen from the air to form peroxide of manganese, but carbonate of manganese, MnNOC-O_2, when roasted in air, allows its carbonic acid allows its carbonic acid to be displaced by the oxygen of the air, and peroxide of manganese, MnO_2, is thus produced. I here take a little of this carbonate of manganese, which is a white or nearly white substance; if I gently roast it, stirring it at the same time, you see that it becomes the ordinary brown oxide of manganese, the carbonic acid having been displaced by the oxygen. In this way all this manganese, or, at least, the greater part of it, is recovered.

There is another interesting process for producing bleaching powder, which has been made within the last few years, and which my chemical friends here will fully appreciate if they are not acquainted with it already, but which I fear I shall scarcely make intelligible to a general audience. It was devised by Mr. Shanks, of St. Helen's. First common chrome ore is roasted with lime, and is thus converted in the usual way into chromate of lime—this yellow salt which I have here. The chromic acid in this compound contains oxygen. The chromate of lime is boiled with hydrochloric acid, the hydrogen of which is taken away by the oxygen of the chromic acid. Chloride of chromium is formed, and part of the chlorine is liberated which combines with the lime to form bleaching powder. The chloride of chromium remains in solution. This chloride of chromium is again treated with lime, and precipitates oxide of chromium with which we started, and chloride of calcium remains in solution. Now, this oxide of chromium is merely mixed with more lime and roasted again in the air. It abstracts oxygen from the air, and forms again chromate of lime, another of the substances with which we started; so that by this beautiful process the oxygen is continually taken from the air, forced to unite with the hydrogen of the hydrochloric acid, and the chlorine, entering the lime, forms bleaching powder. The process is, therefore, elegant, but is not yet extensively employed.

(To be continued.)

THE INDESTRUCTIBILITY OF FORCE.

(From Macmillan's Magazine.)

That all living things are doomed by death is a truth so urgently forced upon man that the very savage can hardly escape from moralizing about it; but he falls back upon the belief that, though her children perish, Nature herself is unchangeable; though storms and wintry change may ruffle her countenance, the features are as imperishable as the solid framework of the globe itself. The nineteenth-century man is deprived of this soothing notion. Irrefragable evidence has been laid before him by the geologist that nothing is as it was, nothing as it will be. "Alps and Andes are children of yesterday;" rivers do not flow on for ever: between the granite rock and the cloud it is but a question of time; with the stability of both the forces of nature are ever at war. Yet the fact that underlies this universal destruction is, Indestructibility. The atoms with which these everchanging forms are built up are absolutely changeless. *They*, at least, bid utter defiance to time. They never wear, never grow old, never lose one iota of their original endowments. "A particle of oxygen," says Faraday, "is ever a particle of oxygen. If it enter into composition and disappear as oxygen—if it pass through a thousand combinations, animal, vegetable, mineral—if it lie hid for a thousand years and then be evolved, it is oxygen still, with all its first qualities, neither more nor less.

What are its first qualities—the qualities of matter generally? If we consider attentively, we find that they all resolve themselves into certain powers—forces. "We know matter only by its forces," says Faraday: *weight*, for instance, or gravitating force, the universal attraction of every atom by all other atoms; *cohesion*, or the attraction of certain like particles for each other; *chemical affinity*, or the far more energetic attraction of certain *un*like atoms for each other; *heat-force*, the antagonist of cohesion, which, according as it prevails or is prevailed over, determines the form of matter, whether solid, fluid, or gaseous; *visibility*, or the power which the atoms of matter possess over *light*. Reflection, refraction, interference, absorption, polarization—all these are only names for the different kinds of power which matter exercises upon light—power, so to speak, which compels it to become the messenger of the secrets of the constitution of bodies to the human eye and brain. The undulations of light which "break upon the retina as waves upon the sea shore," betray by their condition the varying influences to which they have been subjected by the way. Last, not least, *electricity*, subtlest, most Protean of all the forces of nature. With opposing, or dual attributes, it invests every atom of earth, air, and ocean, and of all they contain, but gives no outward sign of its existence, except when the equilibrium of these opposing tendencies is disturbed.

These, then, are the inseperable qualities of matter; we cannot conceive of its existence apart from them; and if matter cannot (humanly speaking) be annihilated, so neither can these forces be. Such is the meaning of that which has been called the "grandest generalization of modern science," the principle of the CONSERVATION OF FORCE. One half of this great principle, namely, that relating to matter, was early recognised, though, "perhaps, its distinct reception in philosophy may be set down to the overthrow of the doctrine of Phlogiston and the reformation of chemistry, at the time of Lavoisier." But the other half, the Indestructibility of Force, was not securely grasped till within the last twenty years. There was indeed, an implied acknowledgment of the principle in the third law of motion, that action and reaction are equal and contrary. But as to applying the same to all the forces of nature—heat, light, chemical affinity, electricity, magnetism, as well as gravitation—or even clearly recognising these *as* forces, it was not possible, until the recent rapid development of the physical sciences, especially of chemistry and electricity, had brought to light the fact that these forces can change into one another—electricity into chemical action, into heat, into light; heat into motion, motion into heat, &c.; that, when a certain amount of force of any kind disappears, or seems utterly spent and annihilated, it is manifesting itself as *some other force*. Not until this mutual convertibility of forces was distinctly apprehended, could the doctrine of the "conservation," or indestructibility of force, be more than a mere assertion, a guest, with appearances mostly against it.

To settle the claims of priority in scientific discovery is not only a difficult, but happily an unimportant task; for, as it has been well said by Professor Tyndall, "great scientific principles, though usually announced by individuals, are often merely the distinct expression of thoughts and convictions which had long been entertained by all advanced investigators." In literature it would be little short of a miracle for two original men to hit the same mark, seeing that each has a widely separate aim and stand-point. In science, on the contrary, many are pressing towards one goal. In the present instance, however, it seems universally agreed that to M. Meyer, of Heilbronn, is due the honour of having been the first to give "distinct expression" to the principle of Conservation of Force; to a perception of which his physiological researches conducted him. But what we may call the first general survey of the field, the first attempt to trace out the connexions of all the forces of nature with each other (the true key to their modes of "conservation"), was made by Mr. Grove in his lectures on the Correlation of Physical Forces delivered at the London Institution in 1843. Guided partly by him, partly by subsequent writers, we propose to grope our way through a somewhat tangled path. It is not through indolence that we quote freely from others, but in the desire, wherever possible, to set this great and sometimes startling subject before the reader in words of authority.

When a spent ball drops to the ground, so strongly does it impress us with the notion that this word "spent" conveys the literal truth, and that the force which was expended to set it in motion is exhausted, that we can hardly shake off the idea in spite of better knowledge. Yet the very first law of motion teaches us that force cannot thus exhaust itself, and that a body once set in motion would go on for ever if there were nothing to stop or hinder it. But the air resists, the earth attracts, and both together soon overpower the force originally impressed on the ball. Overpower, yes; but do they destroy it? Certainly not. Part is taken up by the air, part by the ground on which it falls, and part we should find, had we sufficiently delicate means to test it, under a wholly new manifestation in the ball itself; namely, as *heat*. When the motion of the mass ceases, a motion of its constituent molecules begins, a movement of mutual repulsion or expansion which we call heat. In such a case as this, however, the original amount of force employed is so small that, in its altered and subdivided state, we cannot follow it, nor experimentally prove its entire "conservation," any more than we can test the indestructibility of matter by collecting and re-weighing the particles of a burnt-out candle. Yet no one doubts that in an altered condition they continue to exist. But, if we intensify the force and limit its direction, as in percussion or friction, then we obtain an accumulation which cannot elude us. And how does it manifest itself? Unmistakably as *heat*. A piece of iron may be made red-hot by mere hammering. And it is not enough to say vaguely, that striking or rubbing produces heat. We must regard it "as a continuation of the force, whether of the human arm or from whatever source, which was previously associated with the moving body, and which, when this impinges on another body, ceasing to exist as gross palpable motion, continues to exist as heat." On this view we may readily understand why hard bodies, such as flint, steel, glass, metals, give the greatest amount of heat from friction or percussion. The greater the resistance to motion, the greater the development of heat; the less the resistance, as in fluids, the less the resulting heat, for their particles, being very mobile, take up instead of opposing the motion impressed on the mass. Friction is simply impeded motion; and to lessen friction, as by smoothing or oiling a surface, lessens the development of heat, because it lessens the amount of force required to overcome the resistance. Thus, too, the heat resulting from friction in the axle of a wheel is diminished by surrounding it by rollers; these take up the primary motion of the axle, and, the more unimpeded the motion, the less heat."

We shall be more ready to receive this idea of the actual transformation of motion into heat, if we pass in review a few of those facts which most plainly indicate the true nature of heat as a dynamic force, and then glance at the other half of the truth, how heat may be changed back into palpable motion, or the motion of masses. How do we test heat? Always by motion—molecular motion or expansion, that is. The mercury *rises* in the thermometer; in other words, it expands in the only direction in which there is room for it to do so. Heat weakens the cohesion of solids, till at length they cease to be solid and become liquid. Liquids under heat's influence expand into gases. Gases increase in volume so rapidly and violently that they break all bounds. But the reader will say, this may be true of most substances; yet some absolutely contract on the application of great heat. Your cook tells you that meat and vegetables diminish in bulk or "waste" in the process of cooking. But, if we examine carefully what happens, we find that, so far from being an exception, these are an extreme case of the rule. For, meat and vegetables being of a mixed nature, part solid, part fluid, the fluids expand into and escape as vapour, leaving the solid particles between which they were contained in a collapsed state. There are other apparent exceptions far more difficult to explain. Water, for instance, and some other substances expand as they approach the freezing or solidifying point. It is possible, says Mr. Grove, that, as this only occurs with bodies that assume a crystalline form, they may in solidifying undergo some structural alteration, some peculiar arrangement of their particles which causes them to occupy more room. At all events, the fact is equally difficult to explain in accordance with every other theory of heat that has been advanced.

The sensation of heat in our own bodies is not irreconcilable with this view of heat as an expanding or "molecular-repulsive" force, though at first sight it might appear so. "The liquids of the body are expanded, that is, rendered less viscid by heat, and from their more ready flow we obtain the sensation of agreeable warmth. By a greater degree of heat their expansion becomes too great, and causes pain; and, if pushed to extremity, as with a burn, the liquids of the body are dissipated in vapour, and an injury or destruction of the organic structure takes place." There is a far more refractory-looking case in "latent heat." How can we imagine an expansive force "latent?" It must either cause expansion or cease to be heat. We accept the alternative. But, first, let us come to a clear understanding of what is meant by that perplexing expression, latent heat. It is heat which does not manifest itself *as* heat, or temperature, nor in fact give any sign of its existence, until some change in the physical state of the matter in which it exists—a change either from solid to fluid, or fluid to solid, or fluid to gaseous—calls into activity this latent heat and enables us to detect its presence. For instance, to take a case of heat that was manifest becoming latent: "a given weight of water at a temperature of 172°, mixed with an equal weight at 32°, will acquire a mean temperature of 102°. But water at 172°, mixed with *ice* at 32°, will be reduced to 32°." What, then, has become of the heat over and above the 32° that was in the water? We are told it is "latent." But that is only hiding its disappearance under a fine name, whatever theory of heat be adopted. Looking to facts, we see that there is as much *work done* by the heat in this second case as there was in the first. For, the ice being a solid, a greater amount of cohesive force has to be overcome in making it liquid than in merely raising the temperature of what was already in that state. The water, therefore, yields up to the ice heat (*i. e.* force) enough to tear asunder the particles of the ice, and maintain it in a fluid condition. Hence its own contraction or fall to 32°. And this heat partially changes its nature while thus engaged in "interior work," as Dr. Tyndall calls it. For it is no longer able to communicate itself to the thermometer, or whatever test you may apply. Now this power of communicating itself is one of the most striking characteristics of heat. We raise the temperature of a body merely by "bringing it near some other heated or expanded substance." We must, then, look upon "latent heat" as, to some extent, a transmutation of force.

The change of heat into motiom is so much more obvious and familiar a thing (as in the steam-engine, for instance) than that of motion into heat, that we are prepared to receive it with less surprise or incredulity. But we must keep steadily in mind the "peculiarity of the modern view of the subject, that heat cannot do mechanical work and continue heat." It does more than produce; it *becomes* palpable motion, passing from the movement of particles to the movement of masses. Therefore the disappearance of heat is in exact proportion to the work done. And as this side of the subject touches on the utilitarian, it has been investigated with special industry. Mr. Joule of Manchester has ascertained the precise amount of work a given quantity of heat can do—"the mechanical equivalent of heat." He finds that "one unit of heat, or that quantity which is necessary for raising the temperature of a pound of water one degree centigrade, is equivalent to the mechanical work by which the same mass of water is raised 1,389 feet." (Helmholz.)

We have seen how mechanical force can pass into heat. It can, in like manner, produce electricity and magnetism. In friction, for instance, if the two substances rubbed together are strictly homogeneous, heat alone is the result; but, if they be heterogeneous, electricity accompanies it. Hammering, twisting, bending—the force employed in all these operations reappears in part as magnetism, in iron and steel, to so decided an extent as to add one more to the many complications which, in an iron-built ship, disturb the action of the compass. The direction of the magnetic force thus produced is dependent on the position of the ship's head and keel while building—a fact well established by that able and energetic investigator of magnetic phenomena, the late Dr. Scoresby.

If we take *Electricity* as our starting point, the transformations of force are even more varied and startling. As heat the most intense, light the most brilliant, chemical action the most searching and powerful, can this subtle and all-pervading force manifest itself. By attraction and repulsion it can do drudgery as a mechanical motive power; and in the electro-magnet we see it far surpassing in energy every other source of magnetism.

Chemical Affinity can be converted into heat and light, as in combustion; into motion, as with the explosive effects of gunpowder; and into electricity in the voltaic pile, which is in fact an apparatus for generating electrical out of chemical action. Far more difficult to detect are the relations of *Light* with the other forces of nature. We cannot say that light and heat are one, though the very same sunbeam contain them; for heat is often obscure, and light unaccompanied by the faintest trace of heat. But light when absorbed, when it disappears as light that is, manifests itself as heat. "The rays of heat differ from the rays of light," says Dr. Tyndall, "simply as one colour differs from another. As the waves which produce red are longer than those which produce yellow, so the waves which produce heat are longer than the red." That which we call light, then, "embraces an interval of rays of which the eye is formed to take cognisance," and heat might be described as light, of too low a pitch to be visible." But the red rays, intermediate between these two, combine the powers of both, and excite the sensation of light when falling on the retina, and of heat when falling on the nerves of sensation. Thus is each sense formed to catch its octave or two of the vast scale of visible and invisible vibrations which constitute the grand harmonies of nature. Light and chemical affinity are as closely, yet not indissolubly, blended in the sunbeam as light and heat. Those rays which most vividly excite the sensation of light are feeblest in actinic or chemical power; whilst the most active chemical rays are feebly luminous. Yet it may be safely said that light can exert chemical action, and through it initiate or pass into all the other modes of force.

A great principle not only leads on to the discovery of new truth, but casts so strong a light on all the error, vagueness, and insufficiency within its sphere, that it is no longer possible to rest satisfied with them, or to pause till clear and harmonious interpretations of fact have taken their place. In this manner has the principle of Conservation of Force led some of our highest scientific minds to a growing dissatisfaction with the hitherto received views of the Force of Gravitation. "There are signs that even Newton's axiom is not exempt from the restless law of progress," said Professor Owen in his address to the British Association the other year. It must not be for a moment thought that Newton's great law of gravitation is impugned. No! but a protest is entered against accepting that law, which gives account of one exercise of the force, as a full and satisfactory description of gravitation in its totality. For, says Faraday, our definition of gravity as an attractive force between the particles of matter, varying inversely as the square of the distance, implies that the mere fact of bringing near two bodies or particles *creates* an enormous force, and that their removal from one another *annihilates* the same. But, if force be truly as indestructible as matter, then this gravitating power must have some disguise as yet unpenetrated, some other mode of action, when by distance its gravitating power is suspended or diminished. "*Consequences must occur* equal in importance to the power suspended or hidden." Which consequences, involving the relations of gravity with the other forces, of nature, have yet to be discovered. Ten years ago, Faraday endeavoured (but with only a negative result) to establish by experiment a connexion between gravity and electricity. Mossotti, in a very remarkable paper on the Forces which Regulate the Internal Constitution of Bodies, referred to by all who have written on the subject of Conservation of Force, boldly shows *how* gravitation "may follow as a consequence from the principles which regulate the electric forces." He looks forward to the time when the mathematician shall achieve as great a triumph over that which is hidden from us by minuteness and subtlety, as he has attained over that which seemed utterly beyond the grasp of man from vastness and remoteness. By the discovery of the laws of molecular action, he will be led to "establish molecular mechanism on a single principle, just as the discovery of the law of universal attraction led him to erect on a single "basis the mechanism of the heavens."

How, indeed, after reviewing the close relationship —the mutual interchangeableness—of the physical forces, is it possible to avoid the conclusion that (in Faraday's memorable words), they have all "one common origin, or rather, are different manifestations of one fundamental power?" And further, it would be hard to reconcile such views of the continuity and varied manifestation of force with the notion of vacuum—of direct action at a distance through a vacuum, that is—though such has hitherto been the usual idea of gravitation. It was not Newton's. He had a far profounder, and, so to speak, more modern idea of it than his successors, as his own emphatic words testify: "That gravity should be innate, inherent, and essential to matter," wrote he, "so that one body may act upon another at a distance, through a vacuum without mediation of anything else by and through which thier action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it." Empty space! it is a delusion. Between us and the sun, between us and the remotest star whose beams strike upon human eyes, there is no void. Though our senses are not so finely attuned as to catch so subtle a reality, we know that through that space comes to us force, light, actinism, heat, gravitation; and, the more earnestly man searches into the modes of action of these, the more impossible it becomes to conceive of their existence apart from matter, any more than that of matter apart from force. It is no novelty to us that matter should be invisible and intangible: not merely is the air we breathe so, but the most dense and solid rock may by the action of intense heat (as in the voltaic arc) pass into that condition. Why then may not matter of a far subtler and more ethereal kind than that of which our atmosphere is composed pervade the regions of space, conveying to us the sweet and mighty influences of sun and stars? Unhappily—yet not, perhaps, unhappily, for it compels boldness to go hand in hand with humility—the profounder the knowledge gained by the man of science of the workings of force and of the composition of matter, the more heavily the conviction presses on him that the true secret of both is beyond his grasp. An unthinking man will grant you readily enough that mind is an inscrutable mystery; but of matter he believes he has a very clear and adequate idea, little dreaming that of that idea one half only is perception, the other half conclusions from perception, which may be true or false. But the physical philosopher, long pondering, experimenting, measuring, testing these objects of our perceptions, comes more and more to distrust the received conclusions; nay, in many cases, to form entirely opposite ones, led especially by the subtle relations of the forces of nature with one another, and the mysterious and indissoluble connexion, perhaps identity (for so have Boscovich and Faraday been tempted to surmise) between matter and force. Whether man can do more than speculate concerning the nature of these—more than say what they are not, what they may be, but never what they are—whether the most piercing and aspiring intellect must in this direction only beat its wings against the bars, it is not for us to decide. At least it is a gain worth all the toil to recognise vividly that there *is* a deep mystery not only in that which lives and grows, but in the very stocks and stones. No longer mistaking our own shallow conceptions for complete and absolute truth, our minds may become as a clear unclouded mirror, where in dim and shadowy grandeur some suggestions of this far-off absolute truth will perhaps be reflected.

But to return to the definite and practical aims of science. Hitherto we have glanced at the indestructibility of force in the inorganic world. But the tie between organic and inorganic is so close, the organic being nourished and built up out of the inorganic, that we must look to find the same indestructible forces at work in the one as in the other, though under new conditions, and under the control of that higher agency which we call Vital Force. We take in force in the air we breathe, in the food we swallow. In decomposition these forces are set free, and find new scope for their activities. Hence it is that "decomposition is the handmaid of growth." That slow combustion, for instance, which is the source of animal warmth—the combining of the oxygen of the air with the inflammable constituents of food—witnesses to the continued activity of chemical force within us as without. Yet it must always be borne in mind that in the living organism chemical affinity is controlled and and often opposed (else how should organic differ from inorganic products?) by that wonderful power of which, knowing absolutely nothing, we speak vaguely as the vital force. As in the world around us heat may pass into motion, so does the mechanical work of the body bear a strict relation to the amount of fuel consumed in respiration. The experiments of Mateucci demonstrate that electricity also is a powerful agent in the internal economy of a living creature.

With yet stricter truth may the vegetable kingdom be said to be built up out of the inorganic; for here the process is a direct one, whereas in the animal it is for the most part *in*direct. Here too, then, the forces of the inorganic world work unceasingly. "To suppose," says Dr. Carpenter, "that all the forces that are concerned in the growth and nutrition of countless generations of oaks were slumbering in the one acorn from which they all sprung, is to suppose a pure absurdity. The forces which carry on vegetable life are derived from without; are, in fact, the forces of nature, heat, light, chemical affinity; and that which does exist in the germ and which is peculiar to organization—the vital force, in fact—is simply *directive* power." Words which, while they impress us by their boldness, seeming as it were to bridge over an abyss of ignorance, awaken again that painful sense of man's limitations; for in the expression "the vital force is directive power," we stretch out our hands towards a truth that for ever eludes us, and find ourselves grasping an empty garment of words. Though it be good to recognise this, it is not good to be daunted or discouraged. If God has set a limit to the conquering power of man's intellect, He has left it for man himself to discover where that limit lies; left it to be discovered by the gifted and laborious, aided by "the long results of time," not to be predicted by the timid and indolent. It is not piety, but self-satisfied ignorance and cowardice, which makes a man shrink from pressing on into the dim unknown, and decry, as presumptuous and irreverent, those whose heaven-otsen impulse it is to do s.

These remarks might seem uncalled for at the present day, when science confessedly occupies so honourable a position. But there still lingers in the minds of the religious a tendency to view with distrust and suspicion its bolder flights. Why should this be? How can harm come of the faithful and earnest study of God's works, seeing that He has implanted both the faculty and aspiration to gain understanding of them? Perhaps there is even a touch of what has, with just severity, been called "that worst kind of infidelity, the fear lest the truth be bad," in this shrinking from a face-to-face encounter with some of the facts of nature, and the inevitable deductions from them. Conflicting opinions upon the wisest there may be, conflicting truths there cannot. If, therefore, science bring to light facts which seem to militate against that which we hold as high and sacred truth, we may rest calmly assured that a fuller knowledge of such facts, a deeper insight into their true bearings, will dispel the appearance of antagonism. But then we must go boldly on to reach this higher stage, not turn back and basely seek the dark shelter of ignorance. Or rather, the man of science goes boldly on for us. How ungenerous to reproach him for his boldness!

It cannot be denied that there is also in our highest literature a tone, not of open hostility, but of covert contempt for science. It is looked down upon as tending to materialism; and its devotees as men whose eyes, long scrutinizingly fixed upon the outward aspects of things, grow dim to all beyond; and who, in Wordsworth's memorably unjust words, "would peep and botanize upon their mother's grave." Does, then, a too curious searching into nature's works strip them of their beauty, their mystery? Does it tend to debase the heart and dull the imagination? Impossible. The beauty, the mystery, are not of such flimsy, shallow kind, as to vanish beneath an earnest questioning gaze. What it was worth God's while to make, it is surely worth man's while to understand. As to the charge of materialism, of course the business of physical science is with the material world. But if it have one decided tendency at the present day, it is to exalt and spiritualize our idea of matter, and, far from destroying, to enchance the sense of mystery. Why should literature treat science as men treat one another—each expecting in his neighbour all his own virtues added to all theirs, with the faults of both left out? Why, because it does not comprise all man seeks for of truth and knowledge, should he slight what it does? Rather should we honour the humblest labourer in the fields of science, and prize the fruits of his labour. What man is so rich in intellectual possessions that he can afford to despise the smallest fragment of truth? Nature has not denied legs to those creatures whom she has endowed with wings; neither can the soaring imagination wisely leave unvisited the solid ground of fact, whereon science is so notably extending her possessions. Like the birds, she must come down to feed if she would be strong on the wing.

Miscellaneous.

Albert Coal, or Albertite.

A beautifully lustrous, and intensely black substance is exhibited, under the name of Albert Coal, in the New Brunswick Court. It occurs at Hilsborough, Albert County, N. B. Albertite presents the general appearance of an excellent cannel-coal, and breaks with an extremely brilliant, conchoidal, vitreous fracture. Its jet black powder when heated in an open vessel, partially melts, and then gives off continuously a large volume of combustible vapour, leaving a light and bulky coke. This vapour burns with an intensely smoky flame. But there is one point to be noted here of considerable interest: the coke which Albert coal leaves is nearly pure carbon, there being in fact, speaking practically, no ash in Albertite, as the following result proves:—

1·55 grammes left ·001 of ash.

This is equal to no more than ·0645 per cent., which we believe that no cannel-coal or anthracite hitherto analysed contains so little as 1·0 per cent. of ash. Among its volatile constituents, Albertite contains scarcely determinable traces of nitrogen and sulphur.

Accompanying the Albert coal, there may also be found in the New Brunswick Court some very pure and pale-looking specimens of oil produced by its destructive distillation. As might be expected from the almost entire freedom of the mineral from nitrogen and sulphur, these oils are almost without offensive odour, and are, moreover, admieably adapted for burning in paraffin lamps. They are not capable of forming an explosive or inflammable vapour, and the light they give is brilliantly white.

A sample of oil submitted to fractional distillation did not commence to boil until the thermometer had risen to 170° C., while only half the oil had come over at 270° C., one-seventh or even more, remaining in the retort when it had been raised to the boiling point of mercury. This residue did not show any traces of crystals when cold.

It is to be regretted that the discovery of an abundant supply of native mineral oil has caused the manufacture of Albertite oil to be discontinued.

Specific Gravity of Oils.

Oils of different specific gravities are obtained from petroleum according to the temperature to which it is subjected during distillation. That which passes over at a temperature of 302° Fah., according to the experiments of Professor B. Silliman, junior, has a specific gravity of ·733 (three lower than sulphuric ether); that which has been obtained at 320° has a specific gravity of ·752; that at 338° Fah., ·766; at 392°, ·800; at 518° ·854, Pure alcohol has a specific gravity of ·815. As several eupion oils obtained from petroleum are lighter than alcohol, we can thus form a very correct idea of their volatile character.