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THE PETROLEUM, OR ROCK OIL OF CANADA.

No. III.

In the February and March numbers of this Journal attention was drawn to the new branch of industry growing into activity in the township of Enniskillen and elsewhere in the western part of Upper Canada. During the last month, the writer of this descriptive notice has had an opportunity of visiting the Springs and works in operation at Petrolia, and of accumulating a variety of information on the subject, which may be found useful to those who are desirous of engaging in the oil enterprise, or who are interested in its progress and development. Although the results of the enquiries which have been made do not tend to change in any material point the opinions already expressed in this Journal, as far as regards the oil wells of Enniskillen, yet it may be found that the facts which have been recently brought to light will extend the area over which Petroleum may be sought for with valuable results, and give a proper direction to further efforts in search of this useful product, where it may be supposed to exist in remunerative quantities.

History of the Springs—Geology of the Oil Region.

The existence of bituminous springs in Canada has been long made known to the public by the labors of the Geological Commission. In the year 1851, Mr. Murray included in his report for that year a brief notice of the *mineral caoutchouc* of the Western Peninsula, and pointed out the existence of the bituminous springs and beds of bitumen in the township of Enniskillen. The report for the year 1851-52, which contains this notice, being in the hands of private individuals or locked up in the appendices to sessional papers, it is not likely that its contents are widely known, we therefore introduce the following extract, which will suffice to show that the bituminous springs of Enniskillen were well known and briefly described in published documents ten years ago. It is necessary to remind the reader who may be familiar with the geology of Canada, that, during an exploration made in 1855 by Mr. Murray, the supposed black shales at Kettle Point, L. H., were ascertained by him and Mr. Hall to belong to the superior formation, known by the name of the Portage and Chemung group. An extract from Mr. Murray's report for 1855 will exhibit the area which these rocks are supposed to occupy.

"The black shales of the Hamilton group, in the Western Peninsula, are in general probably more bituminous than those of the Utica slate. Several places in their distribution are characterised by bituminous springs, and a visit was made in the early part of the season to a bed of nearly pure bitumen, of which the existence has been noticed in previous Reports, including that of last year, in which the range of the Hamilton group in the Western Peninsula is given. This bed of bitumen, which in some parts has the consistency of mineral caoutchouc, occurs on the sixteenth lot of the second concession of Enniskillen in the county of Kent, but its extent does not appear to be so great as we were at first led to understand. It does not seem to exceed half an acre, extending five chains in a north-east direction, with a breadth of rather less than half a chain. By different trial holes which have been sunk through the deposit, it would appear to have a thickness of two feet over about twenty feet square, towards the south-west end, from which it gradually thins towards the edge in all directions, varying in some parts along a low ridge which it forms, from a foot to four inches. The bitumen is underlaid by a very white clay, which I was informed had been bored through in one part for thirty feet. The upper portion of the clay was observed to be more or less penetrated with petroleum, and small black globules of the same were seen scattered through the mass for a depth of four or five feet. Bituminous oil was observed to rise to the surface of the water on the Black Creek, a branch of Bear Creek, in two places on the seventeenth lot of the third concession of Enniskillen, and I was informed that it had been observed at other parts further down the stream, but to what amount the material might be daily collected at any of the places, I am quite unable to say; a freshet prevailed in the river at the time of my visit, the current of which swept away the oil as fast as it rose."

The following extract from Mr. Murray's report for 1855 contains a short description of the geology of the Western District, which will be found very useful in an attempt to trace the origin and extent of the oil springs of the Western Peninsula.

"In my reports of 1848-49, and 1850-51, the black bituminous shales which were observed at Kettle Point, on Lake Huron, and at the flour mills, on the Sydenham River, are described under the head of the Hamilton formation. The shales in those instances are either altogether destitute of organic remains, or hold only forms of plants and obscure shells of species not then described, and being in each case immediately underlaid by beds of limestone, in which *spirifer mucronatus* and other characteristic fossils of the Hamilton group are abundant, it was inferred that the shales belonged to the group. Mr. Hall, however, on seeing the section at Kettle Point, expressed it as his opinion that the rocks were the lowest measures of the Portage and Chemung group, and this opinion was further confirmed by our subsequently finding a nearly complete section of the Hamilton group on the banks of some of the tributaries of the River Sable (south), shortly afterwards, on the twenty-fifth lot of the third range of Bosanquet. On the banks of a small tributary of the Sable, the following section was measured in ascending order:—

		FEET.
1.	A slope or talus over the stream	25
2.	Grey calcareous shales with *spirifer mucronatus* and numerous fossils	4
3.	Bed of compact encrinal limestone	2
4.	Soft shales, thinly laminated next the limestone, filled with fossils, among which *Cystiphyllum cylindricum* (Halls Rep. 4th Dist. N. Y.) is very abundant; the upper part decomposes into a clay, and fossils are found in the decomposed edges	20
5.	Decomposed shale or clay, not well exposed	80
6.	Grey encrinal limestone, weathering into small lenticular fragments, and holding bivalve shells, corals and encrinites	2
		133

"At Jones' mill, on the third lot, south boundary of Bosanquet, on the bank of a small tributary of the Sable, another section is exposed, which in ascending order, is as follows:—

		FEET.
1.	Brownish grey-weathering shales, holding *spirifer mucronatus* in great abundance, and a few other bivalves and corals	25
2.	Encrinal limestone	2
3.	Decomposing shale, with *Cystiphyllum*	3
		30

"At Austin's mill, on the fourth lot of the first range of Bosanquet, on another small creek, there is a corresponding section, where the encrinal limestone which forms the uppermost layers of the exposed strata, is about five feet thick. Below the encrinal limestone, the shales are characterized as at the other places by a profusion of *spirifer mucronatus;* and in the bed of the creek at a level probably about fifty or sixty feet lower than the upper limestone bed, there is a band of hard and compact arenaceous limestone, about seven inches thick, underlaid by black shales holding *Atripa, Leptœna,* and *Chonetes.*

"The overlying bituminous shales of the Portage and Chemung groupwere found at two localities not observed previously; one in the bed of a stream supposed to be the north branch of Bear Creek, near Kingston's Mills, on the seventh lot of the third range of Warwick; and the other at Branon's mills, on the twentieth lot of the seventh range of Brooke, in the bed of the east branch of Bear Creek. In each of these instances the shales are characterized by spherical concretionary calcareous nodules and masses, as at Kettle Point: but with the exception of some rather obscure scales of fish, which were found at the exposure in Warwick, no fossils were discovered at either place. The debris of the Hamilton shales with *spirifer mucronatus, Atrypa* and corals, were found abundantly among the drift; and large masses of the encrinal limestone lay at the bottom of the creeks, and in the surrounding country.

"In my Report of 1848–49, the clays of the town ship of Plympton, on the shore of Lake Huron, are described under the head of Drift, and the fossils in the limestone pebbles are represented as those peculiar to the Corniferous formation; a comparison of the Plympton fossils with the collection of the present year however tends to show that the clays and organic remains in the limestone are derived from the ruins of the decomposing shale of the Hamilton group, while the pebbles of quartz, granite, and altered rocks, are portions of the lake drift. It appears highly probable that a large portion of the clay country in the neighbourhood of Chatham, and at the mouth of the Thames, takes its argillaceous character from the same source, and that the limestone formerly mentioned, but not yet examined, which occurs in Harwich, belongs to one of the beds of encrinal limestone of the Hamilton formation.

"The result of the evidence thus obtained leads to the conclusion that the trough or belt of the Hamilton formation, running across the peninsula, is considably broader than previously represented, and that it contains near its centre, one and probably two outlying patches of the superior formation; because if it be admitted (which is most probably the case) that the asphaltic deposits and the petroleum springs of Bear Creek in Enniskillen on the one hand, and the petroleum springs of the Thames in Mosa on the other, take their origin from the bituminous shales of the Portage and Chemung group, the lower formation protrudes through, and probably divides the shales at Smith's mills, on the Sydenham River, in the township of Euphemia, as described in my Report of 1850–51, where the prevailing fossil is *spirifer mucronatus,* which at the time I wrote that Report, I supposed to be identical with a very similar species, peculiar to the Corniferous limestone.

"The absence of exposures of the older strata, in consequence of the great thickness of the drift deposits through the western region, renders it very difficult to give a perfectly accurate outline of the various boundaries of the formations; judging however from the facts above stated, together, with others previously mentioned in other Reports, it is probable that the eastern outcrop of the Hamilton formation commences on Lake Huron, near the town line, between Stephen and Hay, and then runs southerly, parallel to the Sable River, through McGillivray, Williams, Adelaide and Caradoc; thence bending easterly, it crosses the Thames near Munsey Town, and afterwards holds an easterly course towards Long Point, parallel with Lake Erie. The western outcrop may be supposed also, from data given in former Reports respecting the distribution of the Corniferous limestone, to run across from Lake St. Clair, somewhere near the mouth of the Thames, through East Tilbury and Raleigh, towards the Rondeau on Lake Erie.

An inspection of the geological map of Western Canada, by Sir W. E. Logan, accompanying a paper on the *Physical Structure of the Western District of Upper Canada,* published in the *Canadian Journal,* August, 1854, 1st Series, will show that the trough or depression mentioned by Mr. Murray, occupies that part of the peninsula which is intersected by the Thames, Black Creek and Bear Creek, the transverse axis of which probably passes through the townships of Chatham, Camden, Dawn and Zone, with a north westerly and south easterly extension towards Lakes Huron and Erie. It is in the rocks occupying that depression, consisting of the black bituminous Hamilton shales, overlaid in patches by the Portage and Chemung group, that the oil appears to have accumulated in fissures or crevices.

The whole of the western peninsula portion of the province has been subjected to a very considerable but gentle upheaval and subsequent denudation. The rocks may be fissured to a much greater extent than appears any where in those exposures which have been recognized and described. The general aspect of the rock, as far as observed, does not lead to the conclusion that these fissures are very extensive or numerous. Too little is known respecting the direction they preserve to warrant any genera rules being given for boring, in the hope of penetrating a fissure. When the country is properly mapped, the productive and non-productive wells accurately laid down, it is not improbable that the general direction of the fissures may be ascertained, and then boring will be prosecuted in conformity with these valuable guides, which are much more likely to produce favorable results than the blind attempts which are often made with no other foundation for success than a hope that oil may be struck. The following extract is from Sir William Logan's paper, before referred to, which should be studied in connection with the more recent examination of the country by Mr. Murray, the results of which are given in preceding paragraphs, and tend to show that the trough occupied by the rocks of the Hamilton and Portage groups covers a much wider area than was supposed when the first preliminary examination of the country was made many years ago.

"Taking these rocks in their general groupings it will be perceived by the map that the Lower Silurian series, by a change in the strike from west to north-west, sweeps round from Lake Ontario to Georgian Bay, and proceeds thence by the north side of the Manitoulin Islands, and the north shore of Lake Huron, to the northern peninsula of Michigan, gradually curving to Green Bay, in Lake Michigan. The Upper Silurian follows them. The Niagara Limestone at the base aids in forming the neck of land separating and holding up Lake Erie from Lake Ontario, and continues in a ridge along the Blue Mountains, and the promontory terminating at Cabot's Head and Cape Hurd, of which promontory the chain of the Manitoulin Islands is only an interrupted prolongation. The Gypsiferous rocks succeed conformably, running from Grand Island, by the Welland and Grand Rivers, to the River Sauguine, while the superimposed Corniferous Limestone, from Lake Erie on the one side and Lake Huron on the other, is projected forward into the Western District as far as the Township of Zone. The same formation, with a projected form in an opposite direction, comes up from Ohio by the upper end of Lake Erie, and is carried north-easterly as far as the eastward side of Chatham. Between Zone and Chatham, the Hamilton group, composed of black bituminous shales, constitutes a narrow band, which runs north-westward towards Lakes Huron and St. Clair, and south-eastward to Lake Erie, gradually widening in both directions in the surface it occupies, and finally merging into two rings, or irregular circular belts, one of which is rudely concentric with the coal measures of Michigan, and the other with those of the Appalachian field—of which last, however, the map shows but a small portion. Within these two rings, thus united by the band across the Western District, and between them and the Carboniferous centres, the Chemung and Portage groups occupy their place, in two broad and entirely separate zones, one of them showing itself north-west of Lake St. Clair, and the other south-east of Lake Erie.

"To any one accustomed to consider the forms derived from the intersection of surfaces, who will carry in his mind that the various formations which have been given are nothing more than a set of thick, close fitting, conformable sheets, which are intersected by the general surface of the country, it will be at once apparent that the ascertained geographical distribution of the formations results from the fact that between the Michigan and Appalachian coal-fields there is *a flat anticlinal arch*, the axis of which runs, with a gentle curve, from the upper extremity of Lake Ontario by London, Zone, and Malden, to the Maumé River, at the upper end of Lake Erie, and that between Chatham and Zone there is in it a *slight transverse depression*."

Supposed Antiquity of the Wells.

The explorations which have been made at the new village of Petrolia, on the 13th lot of the 10th concession, and the 13th of the 11th concession of Enniskillen, lead to the supposition that the natural oil spring which now bears the name of Bligh's Well, or the Indian Well, was known to the Aborigines long before European settlers came to the country, and the oil or petroleum issuing from it was used by them for medicinal purposes. It is stated by Indians who hunted in that part of the country fully 50 years ago, that not only do they remember employing the oil as a great medicine in the vapour bath, so much used by the Aborigines, but from traditional accounts they believe it was so used by their ancestors from very remote periods. In a recent excavation at the Indian Well, which is situated in the flats or valley of Bear Creek, the workmen passed through six feet of alluvial clay, they then came to what had once been apparently a circular excavation five feet in diameter, uniformly round, and full of gravel, deer's horns, fragments of oak bark and wood, the whole glued or cemented together by petroleum. At the depth of thirty-five feet from the surface, the circular form of the supposed former excavation changed to that of an oblong, about four feet by two, with a slight bend at one end, the oil or petroleum then broke in upon the workmen and arrested further progress. The sides of the well, as it may be termed, were burned or calcined and traversed by cracks, as if it had once been subjected to great heat, such as might be supposed to arise from the long continued combustion of the oil and light carburretted hydrogen, which issues in abundance from this and other natural oil wells. It is also stated that fragments of Indian pottery were found in the Indian well, but this statement has not been traced to authority upon which perfect reliance can be placed.

The occurrence of fires in the highly bituminous rocks of the Western Peninsula is a well known fact, and one observation rests upon the excellent authority of Mr. Murray, who witnessed this phenomenon at Kettle Point, in 1848. The whole beach, where the bituminous shales occur, is described to have presented the appearance of having been overrun by fire, which the Indians assert had continued to burn for several consecutive years. On digging a foot deep or more into the shingle at Kettle Point, Mr. Murray observed a faint and almost colourless vapour arise immediately from the opening, which, gradually increasing in volume and density, became in the space of two or three minutes a distinct smoke, emitting an odor very similar to that produced by the combustion of a sulphurous coal, and evolving at the same time a considerable heat.* The shingle of the beach is of a bright red colour wherever the fire has extended, the bituminous matter having entirely disappeared.

Natural Oil Springs in the Western Peninsula,

Petroleum or Rock Oil has been observed to issue from the surface of the soil in the following localities, and it is consequently in the neighbourhood of these natural springs that the most extensive operations are in progress to obtain the coveted product.

1. Donnellson's Spring, 3rd con. Enniskillen.
2. Pike's Spring, " "
3. The Fountain Spring, 2nd " "
4. The Bligh or Indian Spring, 10th " "
5. Cooke's Spring, 11th " "
6. The Three Holes on lot 20, 13th " "
7. The Mosa Springs, on the 28th and 29th lot of the 1st concession of Mosa.
8. The Burne Springs, at Tilsonburg, near Ingersoll.

It is highly important to notice, as bearing upon the origin of these natural springs, that while the source of the first seven mentioned in the above list is apparently the bituminous shales of the Portage and Chemung group, the rock from which the Tilsonburg Spring in the township of Dereham arises, is unquestionably of the age of the Corniferous limestone. The importance of this fact will become more apparent when we consider the geological formation of the country between lakes Huron and Erie, and the large area of country occupied by the Corniferous Limestone.

At the Three Holes on 13th con. of Enniskillen, three natural depressions are visible, one of them, the largest, being about 100 feet long, 6 feet wide, and about 8 feet deep. Light carburretted hydrogen is continually bubbling through the water which occupies them in the spring of the year.

* Report of Progress in 1848-49.

The Tilsonburg Spring, coming from Corniferous limestone rock, is of special interest. When first observed, water and oil were seen issuing from the same orifice, and, on sinking about 13 feet through a black miry clay, the workmen came to a large horn about seven feet long and twelve inches in circumference. Making every allowance for exaggeration, it is not unlikely that this horn may be of considerable scientific interest; and if reliance is to be placed upon the brief description given above, it will be at once seen that it characterizes the horn of an extinct animal whose remains have been found elsewhere in the drift of Canada. After a further excavation of eight feet, or twenty-one feet in all, the men came to a deer's head and horns, almost in a state of petrifaction, with the tines partially worn away. These, like the horn before described, were thrown into the stream close at hand to be washed, but were soon forgotten. Steps have been taken to procure these interesting remains if still in existence and accessible, when they will be subjected to a proper examination, and the species of animal to which they probably belonged determined. When first commencing the excavation, the workmen at Tilsonburg observed two small holes at the surface, which increased in size as they penetrated deeper into the earth, and when 26 feet below the surface they had the form of an L, and were packed in the centre with fragments of vegetable matter cemented together with inspissated bitumen, water and oil issuing continually through the unobstructed part of the tubes. The well yielded, when the workmen first struck the oil, on the 11th May of the present year, about 60 gallons in the course of the day.

The Oil Wells in Enniskillen,

During the six months which have elapsed since public attention was first called to the oil springs of Enniskillen, about 86 wells have been sunk. Arrangements were in progress, chiefly by Americans, for sinking four or five times that number at the commencement of the present year, but the sudden stagnation of every kind of enterprise, produced by the American revolution, has led to the abandonment for the present of many contemplated sinkings and borings, so that the present condition of the oil industry in Enniskillen cannot be taken as any guide to the probable degree of importance which that industry would have attained, even at the present time, if the disastrous influence of civil war had not suddenly arrested the progress of numerous contemplated works. The number of wells known to be yielding oil to an extent varying from two to twelve barrels a day does not exceed eleven. From the most reliable sources, it appears to be certain that not more than 13 per cent. of the wells are yielding any return of oil to their proprietors, and out of this small per centage not more than four or five yield twelve barrels a day, of 42 gallons to the barrel.

All the prolific wells have been sunk in the valley of Bear or Black Creek, but attempts are now being made to obtain oil from wells sunk in the upland, which is about 50 feet above the surface of the valley of Bear Creek in the neighbourhood of Petrolia, on the 13th lot of the 10th and 11th concessions. The wells on the upland would have to be excavated in some places to the depth of at least 90 feet, before the rock is reached, that being the apparent average thickness of the drift near Petrolia, according to the following measurement.

Mean depth of Valley of Bear Creek below the Upland	50 ft.	0 in.
The Collner Well—		
Yellow clay	14	0
Blue clay	23	0
White clay	7	0
Gravel	0	6
Rock	0	0
Total	94 ft.	6 in.

The *London Free Press* states that,

"At 12 o'clock on Friday last, the new well of Mr. L. L. Collner, on the Bligh farm, lot 13, 10th concession, Enniskillen, when at the depth of 53 feet, suddenly broke in, with a tremendous rush of oil, filling the well to the depth of 45 feet with pure surface oil, now selling at Wyoming station for 15 and 20 cents per gallon."

The event must have occurred a few hours after the writer had visited the Collner Well. At eleven on Friday, 10th, 'signs of oil' were beginning to be perceived, and it was then expected that oil would be 'struck' in the course of the day.

The depth of the drift is not generally 90 feet on the upland. A boring was commenced on the 10th May in the 8th Concession, and a depth of 44 feet attained before nightfall. The auger having passed through clay with a trifling admixture of pebbles, but not sufficient to retard the operation. On the following day a depth of 66 feet 6 inches was reached, and the surface of the rock touched. Five feet six inches of the drift above the rock consisted of a "black gravel," most probably derived from the ruins of the subjacent bituminous shales. No signs of oil appeared when the borer touched the rock. It is in contemplation to penetrate the rock to a considerable depth, the result being anxiously looked for by many enterprising "oil-men."

Close to the Collner Well are two wells yielding large quantities of oil, which, together with the water, is pumped out by steam power. The oil and water are received into large square wooden tanks, provided with a partition, so that as the liquid rises in one compartment to the level of the partition, the lighter oil flows over and is received free from water in the second compartment. At the wells in question, the steam engine is placed between them and about 50 yards from each, the pumping gear being connected with the engine by means of shafting on timber supports.

A well may be sunk within a few yards of another yielding a continuous flow of oil without showing any sign of the presence of that fluid. From this fact it appears tolerably certain that the oil is contained in fissures and cavities in the subjacent rock, which may be sufficiently extensive in their ramifications as to produce an abundant supply for a long period of time, or they may on the other hand be rapidly exhausted. Instances have already occurred of wells giving a fair yield of oil for some weeks and then becoming dry. It is not improbable that where wells derive their supply from the same fissure or spring, that a greater drain upon one will exhaust its neighbour. This has occurred in the United States, and it has become no uncommon artifice for an enterprising 'oil man' to put up a steam engine of double or treble the power of those used by his neighbors, and, by sinking his well a few feet lower, draw from the wells around him the supply of oil which they formerly yielded. The presence of water in large quantities in the well operates as a serious drawback to their productiveness, but at the same time it affords a collateral proof that the oil is contained in fissures traversing the rocks at different levels. Experience shows that eight feet of water in one of the most prolific wells diminishes the yield to the extent of at least 30 per cent. This may probably be explained upon the supposition that the source of the oil is an irregular undulating fissure, occupying throughout its course different levels. An accumulation of water in a well raises by hydraulic pressure the water and oil in the fissure from which it derives its supply; the oil being the lighter body floats on the surface, and cannot pass to the well in quantity until the water has been drawn off and permits a passage through the undulating crack. For the same reason it is evident that the chance of striking a vein of oil is altogether uncertain; hence there is reason to suppose that profitable results may be obtained by boring in the upland, as well as in the bed of the river, although the latter appears at present to afford the best prospect of success, as it is not improbable that the course of the streams have been determined in some localities by depressions in the rock not wholly obliterated by the drift which covers the country, and in such depressions the oil has probably accumulated during the lapse of ages.

The artifices employed to prevent an inconvenient quantity of water from mingling with the oil in the well is both simple and ingenious. It is applicable, however, in those cases only where the oil is found to enter the well through a fissure. A hole is drilled about two feet below the vein, the bottom of the pump is plugged, and feed holes are bored in the side of the tube, two feet from the extremity. Below and above the feed holes, two leather bags containing linseed or peas are fastened to the tube, the extremity of which is then inserted into the drill at the bottom of the well, and the feed holes turned opposite to the vein. The bags with peas or linseed are adjusted round the tube, above and below the vein, and packed or puddled as tightly as possible. Water slowly permeates the leathern bag, swells the peas or linseed, and so fills the drill that neither water or mud from above or from below can enter the feed holes of the pump in sufficient quantity to interfere with the operation of pumping out the oil. A second pump is introduced for the purpose of drawing off the water above the vein, if it accumulates in quantity sufficient to arrest the flow of the oil in the manner explained in preceding paragraphs.

Properties of the Oil—Its Cost.

No one who has once been in the neighborhood of a barrel of the Enniskillen oil will be disposed to renew his acquaintance with its odour without some special inducement. In cold weather the smell is not oppressive, nor in fact particularly disagreeable, but when the sun shines for a few hours upon an assemblage of barrels full of this odoriferous fluid, the stench must be intolerable to unaccustomed nostrils not rendered insensible by the spirit of enterprise or the desire of gain. Three hundred barrels of Enniskillen oil were exposed on an open platform at the Wyoming Station in the second week of May, and if no protection is afforded during the hot summer months, the odour will probably be any thing but agreeable.

A barrel of the oil containing 42 gallons, weighs 365 lbs.; the weight of the barrel varies from 60 to 85 lbs., according to the extent to which the wood has absorbed oil. The weight of a gallon of crude oil is about 7½ lbs.; but as the character of oil from different wells varies, its specific gravity cannot be exactly stated. A gallon of water weighs 10 lbs.; if therefore the weight of the same measure of oil be assumed as above, its specific gravity will be about 73, water being 100. The purified oil is now extensively used as a medicinal agent, even by educated and experienced practitioners. Among the oil men at Enniskillen it is considered a grand specific. The occupations connected with the collecting and handling of this substance are stated to be singularly healthy, and many are willing to bear testimony that they have enjoyed better health during their labours at the oil wells than at any previous period of their lives. The process of refining the oil for economical purposes is yet in its infancy. Distillation at low temperatures appears to be absolutely necessary in order to secure the largest proportion of available illuminating fluid. Oil of vitriol, soda, and bi-chromate of potassa, for the purposes of getting rid of carbonaceous impurities and of volatile hydrocarbons, which cause the disagreeable odour, are largely employed in refineries; but there is no doubt that distillation at a fixed low temperature would permit expensive chemical operations to be dispensed with to a large extent.

The following statement of the original cost, cost of transporting and refining the crude oil, to one of our most successful Canadian establishments, is stated to be as follows:

Cost of oil at Wyoming Station, per gallon,	0.14 cts.
Cost of transport to Hamilton	0.04 "
Wear of casks....................................	0.03 "
Refining..	0.07 "
Interest on capital, contingencies, &c, &c.	0.05 "
	0.33 cts.
Selling price	0.70 "
Profit, per gallon	0.37 "

On another page of this number of the Journal, a new process for refining coal and rock oils, recently patented in England, will be found. It is probable that the high price of the chemicals in Canada would for the present preclude its adoption on a large scale in our refineries.

Extensive refining works are being put up at Petrolia, by the Boston Oil Company, who own some of the most productive wells in that locality. When these come into operation, a considerable additional impetus will be given to the search for the raw material. Besides the refinery already in very successful operation in Hamilton, it is intended to introduce this branch of industry into Toronto, and as there can be little doubt respecting a rapid increase in the supply of the raw material, now that the Corniferous Limestone is known to yield it, the importance of the manufacture of a cheap and excellent illuminator will be felt and appreciated by the public.

Accessibility of the Springs—Wyoming.

The Wyoming Station on the Sarnia branch of the Great Western Railway is about forty-three miles from London and sixteen from Sarnia. On the right or Enniskillen side of the line the country is still nearly in a state of nature, no clearing being visible in the immediate neighbourhood. On the west side there is a considerable tract converted into excellent farms, but the new Village of Wyoming, standing on the edge of the clearings, is still in a rough and primitive condition. The mud road which, passing from the Township of Plympton, penetrates through Enniskillen, is in a shocking state, and may be described as similar to all mud roads traversing a low and wet country much cut up by traffic. The Village of Wyoming contains two 'hotels,' a few stores, and several buildings in process of erection, among which is a foundry built on or near the site of a grist mill, which was unfortunately destroyed by fire some short time since.

A plank road, passing through the centre of Enniskillen, is about to be constructed, and a bill to incorporate the Petrolem Springs Road Company has already become law. The directors of the Great Western Railway have provided a number of cars for the exclusive transportation of the oil; the lasting odour imparted by this fluid to anything with which it may be brought in contact, has already made 'oil cars' a necessary addition to the rolling stock of the Company.

Quantity of Oil produced in Enniskillen.

The most exaggerated statements have been made respecting the yield of the wells in Enniskillen, and the quantity already exported from Wyoming—the only outlet. By the courtesy of Thos. Bell, Esq., the traffic Superintendent of the Great Western Railway, we are enabled to state that not more than one hundred and seventy thousand (170,000) gallons of Enniskillen oil have been transmitted over the Great Western Railway, from the commencement of the pumping operations to the 30th April, 1861. Of that quantity, Messrs. Williams & Co. alone received, at their Hamilton Works, 125,000 gallons. Assuming that there were 1000 barrels of 42 gallons each at the Wyoming Station, at Petrolia, and Black Creek, waiting transhipment, the total yield of the Enniskillen wells will amount to 212,000 gallons, up to the 30th April, 1861. The value of this, at 14 cents per gallon, amounts to about $30,000.

Such is the position of this new branch of industry in its infancy. It has received a very severe check from the unhappy disturbances in the United States, but there is good reason for the expectation that it will soon become a very important addition to the natural and applied resources of this country.

ON THE CHEMICAL HISTORY OF A CANDLE.

BY M. FARADAY, D.C.L., F.R.S.

From the Chemical News, Jan. 26th 1861.

LECTURE IV.—PRODUCTS: WATER FROM THE COMBUSTION—NATURE OF WATER—A COMPOUND—HYDROGEN.

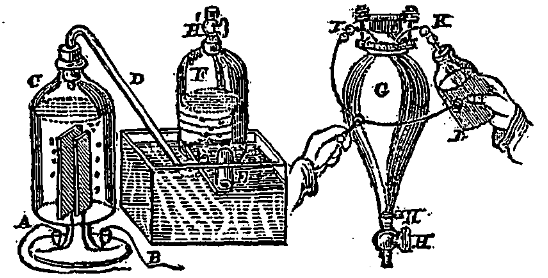
I see you are not tired of the candle yet, or I am sure you would not be interested in the subject in the way you are. When our candle was burning we found it produced water exactly like the water we have around us; and by further examination of this water we found in it that curious body, hydrogen—that light substance of which there is some in this jar. We afterwards saw the burning powers of that hydrogen, and that it produced water. And I think I introduced to your notice an apparatus which I very briefly said was an arrangement of chemical force, or power, or energy, so adjusted as to convey its power to us in these wires; and I said I should use that force to pull the water to pieces, to see what else there was in the water besides hydrogen; because, you remember, when we passed the water through the iron tube, we by no means got the weight of water back which we put in the form of steam, though we had a very large quantity of gas evolved. We have now to see what is the other substance present. That you may understand the character and use of this instrument let us make an experiment or two. Let us put together, first of all, some substances, knowing what they are, and then see what that instrument does to them. There is some copper (observe the various changes which it can undergo), and here is some nitric acid, and you will find that this being a strong chemical agent will act very much when I add it to the copper. It is now sending forth a beautiful red vapour: but as we do not want that vapour, Mr. Anderson will hold it near the chimney for a short time, that we may have the use and beauty of the experiment without the annoyance. The copper which I have put into the flask will dissolve: it will change the acid and the water into a blue fluid containing copper and other things, and I purpose then showing you how this voltaic battery deals with it; and in the meantime we will arrange another kind of experiment for you to see what power it has. This is asubstance which is to us like water—that is to say, it contains bodies which we do not know as yet. Now this solution of a salt I will put upon paper and spread about, and apply the power of the battery to it, and observe what will happen. Three or four important things will happen which we shall take advantage of. I place this wetted paper upon a sheet of tinfoil, which is convenient for keeping all clean, and also for the advantageous application of the power; and this solution, you see, is not at all affected by being put upon the paper or tintfoil, nor by anything else I have brought in contact with it yet, and which, therefore, is free to us to use as regards that instrument. But first let us see that our instrument is in order. Here are our wires. Let us see whether it is in the state in which it was last time. We can soon tell. As yet when I bring them together, we have no power, because the conveyers—what we call the electrodes—the passages or ways for the electricity—are stopped; but now Mr. Anderson by that [referring to a sudden flash at the ends of the wires] has given me a telegram to say that it is ready. Before I begin our experimen t will get Mr. Anderson to break contact again at the battery behind me, and we will put a platinum wire across to connect the poles, and then if I find I can ignite a pretty good length of this wire we shall be safe in our experiment. Now you will see the power. [The connection was established, and the intermediate wire became red hot.] There is the power running beautifully through the wire, which I have made thin on purpose to show you that we have those powerful forces; and now, having that power we will proceed with it to the examination of water.

I have here two pieces of platinum, and if I lay them down upon this piece of paper [the moistened paper on the tinfoil] you will see no action; and if I take them up there is no change that you can see, but the arrangement remains just as it was before. But now see what happens: if I take these two poles and put either one or the other of them down separately on the platinum plates, they do nothing for me, both are perfectly without action; but if I let them both be in contact at the same moment, see what happens [a brown spot appeared on each pole of the battery]. Look here at the effect that takes place, and see how I have pulled something apart from the white—something brown; and I have no doubt, if I were to arrange this, and were to put one of the poles to the tinfoil on the other side of the paper, why, I get such a beautiful action upon the paper, that I am going to see whether I cannot write with it—a telegram if you please [the Lecturer here traced the word "juvenile" on the paper with one of the terminal wires]. See there how beautifully we can get our results.

You see we have here drawn something, which we have not known about before, out of this solution. Let us now take that flask from Mr. Anderson's hands, and see what we can draw out of that. This, you know, is a liquid which we have just made up from copper and nitric acid, whilst our other experiments were in hand, and though I am making this experiment very hastily, and may bungle a little, yet I prefer to let you see what I do rather than prepare it beforehand.

Now see what happens. These two platinum-plates are the two ends (or I will make them so immediately) of this apparatus; and I am about to put them in contact with that solution, just as we did a moment ago on the paper. It does not matter to us whether the solution be on the paper or whether it be in the jar, so long as we bring the ends of the apparatus to it. If I put the two platinums in by themselves they come out as clean and as white as they go in [inserting them into the fluid without connecting them with the battery]; but when we take the power and lay that on [the platinums were connected with the battery and again dipped into the solution], this, you see, [exhibiting one of the platinums], is at once turned into copper, as it were; it has become like a plate of copper; and that [exhibiting the other piece of platinum] has come out quite clean. If I take this coppered piece and change sides, the copper will leave the right hand side and come over to the left side; what was before the coppered plate comes out clean, and the plate which was clean comes out coated with copper; and you thus see that what copper we put into this solution we can also take out of it by means of this instrument.

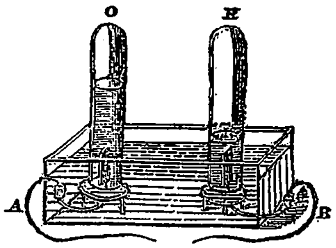
Putting that solution aside, let us now see what effect this instrument will have upon water. Here are two little platinum-plates which I intend to make the ends of the battery, and this, (C) is a little vessel so shaped as to enable me to take it to pieces, and show you its construction. In these two cups (A and



B), I pour mercury, which touches the ends of the wires connected with the platinum-plates. In the vessel (C), I pour some water containing a little acid (but which is put only for the purpose of facilitating the action, it undergoes no change in the process), and connected with the top of the vessel is a bent glass tube (D), which may remind you of the pipe which was connected with the gun barrel in our furnace experiment, and which now passes under the jar (F). I have now adjusted this apparatus, and we will proceed to effect the water in some way or other. In the other case, I sent the water through a tube which was made red hot; I am now going to pass the electricity through the inside of this vessel. Perhaps I may boil the water; if I do boil the water I shall get steam; and you know that steam condenses when it gets cold, and you will therefore see by that, whether I do boil the water or not. Perhaps, however, I shall not boil the water, but produce some other effect. You shall have the experiment and see. There is one wire which I will put to this side (A), and here is the other wire which I will put to the other side (B), and you will soon see whether any disturbance takes place. Here it is seeming to boil up famously; but does it boil? Let us see whether that which goes out is steam or not. I think you will soon see the jar (F), will be filled with vapour, if that which rises from the water is steam. But can it be steam? Why, certainly not; because there it remains, unchanged. There it is standing over the water, and it therefore cannot be steam, but must be a permanent gas of some sort. What is it? Is it hydrogen? Is it steam? Is it anything else? Well, we will examine it. If it is hydrogen it will burn. [The Lecturer then ignited the gas collected, which burnt with an explosion.] It is certainly something combustible, but not combustible in the way that hydrogen is. Hydrogen would not have given you that noise, but the colour of that light when the thing did burn was like that of hydrogen; it will, however, burn without contact with the air. That is why I have chosen this other form of apparatus, for the purpose of pointing out to you what are the particular circumstances of this experiment. In place of an open vessel, I have taken one that is closed; (our battery is so beautifully strong, that we are even boiling the mercury, and getting all things right,—not wrong, but vigorously right); and I am going to show you that that gas, whatever it may be, can burn without air; and in that respect differs from a candle, which cannot burn without the air. And our manner of doing that is as follows:—I have here a glass vessel (G) which is fitted with two platinum wires (J K), through which I can apply electricity; and we can put the vessel on the air-pump and exhaust the air, and when we have taken the air out we can bring it here and fasten it on to this jar (F), and let that gas into the vessel which was formed by the action of the voltaic battery upon the water, and which we have produced by changing the water into it,—for I may go as far as this, and say we have merely, by that experiment, changed the water into that gas. We have not only altered its condition, but we have changed it really and truly into that gaseous substance; and all the water is there which was decomposed by the experiment. As I screw this vessel (G H), on here (R), and make the tubes well connected, and when I open the stop-cocks (H H H), if you watch the level of the water (in F), you will see that that gas will rise. Now, I will close the stop-cocks, as I have drawn up as much as that vessel can hold, and being safely conveyed into that chamber, I will pass into it an electric spark from this Leyden jar (L), and the vessel, which is not quite clear and bright, will become dim. There will be no sound, for the vessel is strong enough to confine the explosion. [A spark was then placed through the jar, when the explosion mixture was ignited.] Did you see that brilliant light? If I again screw the vessel on to the jar, and open these stop-cocks, you will see that the gas will rise a second time. [The stop-cocks were then opened.] Those gases [referring to the gases first collected in the jar, and which has just been ignited by the electric spark] have disappeared, and as you see: their place is vacant, and fresh gas has gone in. Water has been formed of them; and if we repeat our operation [repeating the last experiment], I shall have another vacancy, as you will see by the water rising. I always have an empty vessel after the explosion, because the vapour or gas into which that water has been resolved by the battery, explodes under the influence of the spark, and changes into water; and by-and-by you will see in this upper vessel some drops of water trickling down the sides and collecting at the bottom.

We are dealing with water entirely, without reference to the atmosphere. The water of the candle had the atmosphere helping to produce it; but in this way it can be produced independently of the air. Water, therefore, ought to contain that other substance which the candle takes from the air, and which, combining with the hydrogen, produces water.

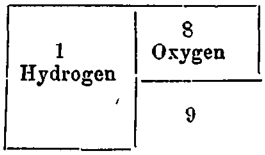
Now, you saw that one end of this battery took hold of the copper, extracting it from the vessel which contained the blue solution. It was effected by this wire; and surely we may say if the battery has such power with a metallic solution which we made and unmade, may we not think that it is possible that it can split asunder the component parts of the water, and put them into this place and that place? Suppose I take the poles—the metallic ends of this battery—and see what will happen with the water in this apparatus (Fig. 2) where we have separated the two ends far apart.



I place one here (at A), and the other there (at B), and I have little shelves with holes which I can put upon each pole, and so arrange them that whatever escapes from the two ends of the battery will appear as separate gases; for you saw that the water did not become vaporous, but gaseous. The wires are now in perfect and proper connection with the vessel containing the water, and you see the bubbles rising; let us collect these bubbles and see what they are. Here is a glass cylinder (O), I fill it with water and put it over one end (A) of the pile, and I will take another (H) and put it over the other end (B) of the pile. And so now we have a double apparatus, with both places delivering gas. Both these jars will fill with gas. There they go, that to the right (H) filling very rapidly; the one to the left (O) filling not so rapidly; and though I have allowed some bubbles to escape, yet still the action is going on pretty regularly, and were it not that one is rather smaller than the other, you would see that I should have twice as much in this (H), as I have in that (O). Both these gases are colourless; they stand over the water without condensing; they are alike in all things—I mean in all *apparent* things; and we have here an opportunity of examining these bodies and ascertaining what they are. Their bulk is large, and we can easily apply experiments to them. I will take this jar (H) first, and will ask you to be prepared to recognize hydrogen.

Think of all its qualities—the light gas which stood well in inverted vessels, burning with a pale flame at the mouth of the jar, and see whether this gas does not satisfy all these conditions. If it be hydrogen it will remain here while I hold this jar inverted. [A light was then applied and the hydrogen burned.] What is there now in the other jar? You know that the two together make an explosive mixture. But what can this be which we find as the other constituent in water, and which must therefore be that substance which made the hydrogen burn? We know that the water we put into the vessel consisted of the two things together. We find one of these is hydrogen: what must that other be which was in the water before the experiment, and which we now have by itself? I am about to put this lighted splinter of wood into the gas. The gas itself will not burn, but it will make the splinter of wood burn. [The Lecturer ignited the end of the wood and introduced it into the jar of gas.] See how it invigorates the combustion of the wood, and how it makes it burn far better than the air would make it burn, and now you see by itself that every other substance which is contained in the water, and which, when the water was formed by the burning of the candle, must have been taken from the atmosphere. What shall we call it, A, B, or C? Let us call it O—call it "Oxygen;" it is a very good distinct-sounding name. This, then is the oxygen which we present in the water, forming so large a part of it.

We shall now begin to understand more clearly our experiments and researches; because when we have examined these things once or twice we shall soon see why a candle burns in the air. When we have in this way analysed the water—that is to say, separated, or electrolysed its parts out of it, we get two volumes of hydrogen, and one of the body that burns it. And these two are represented to us on this diagram, with their weights also stated, and we shall



Oxygen............	88·9
Hydrogen..........	11·1
Water..............	100·0

find that the oxygen is a very heavy body by comparison with the hydrogen. It is the other element in water.

I had better, perhaps, tell you now how we get this oxygen abundantly, having shown you how we can separate it from the water. Oxygen, as you will immediately imagine, exists in the atmosphere, for how should the candle burn to produce water without it? Such a thing would be absolutely impossible, and chemically impossible without oxygen. Can we get it from the air? Well, there are some very complicated and difficult processes by which we can get it from the air; and we have better processes. There is a substance called the black oxide of manganese; it is a very black-looking mineral, but very useful, and when made red hot it gives out oxygen. Here is an iron bottle which has had some of this substance put into it, and there is a tube fixed to it, and a fire ready made, and Mr. Anderson will put that retort into the fire, for it is made of iron, and can stand the heat. Here is a salt called chlorate of potassa, which is now made in large quantities for bleaching, and chemical and medical uses, and for gunpowder and other purposes. I will take some and mix it with some of the oxide of manganese (oxide of copper, or oxide of iron would do as well), and if I put these together in a retort far less than a red heat is sufficient to evolve this oxygen from the mixture. I am not preparing to make much because we only want sufficient for our experiments but, as you will see immediately, if I use too small a charge the first portion of the gas will be mixed with the air already in the retort, and I should be obliged to sacrifice the first portion of the gas because it would be so much diluted with air; the first portion must, therefore, be thrown away. You will find in this case that a common spirit lamp is quite sufficient for me to get the oxygen, and so we shall have two processes going on for its preparation. See how freely the gas is coming over from that small portion of the mixture. We will examine it and see what are its properties. Now, in this way we are producing, as you will observe, a gas just like the one we had in the experiment with the battery, transparent, undissolved by water, and presenting the ordinary visible properties of the atmosphere. (As this first jar contains the air, together with the first portions of the oxygen set free during the preparation, we will carry it out of the way, and be prepared to make our experiments in a regular, dignified manner.) And inasmuch as that power of making wood, wax, or other things burn, was so marked in the oxygen we obtained by means of the voltaic battery from water, we may expect to find the same property here. We will try it. You see there is the combustion of a lighted taper in air, and here is its combustion in this gas [lowering the taper into the jar]. See how brightly and how beautifully it burns;—you can also see more than this,—you will perceive it is a heavy gas, whilst the hydrogen would go up like a balloon, or even faster than a balloon, when not encumbered with the weight of the envelope. You may easily see that although we obtained from water twice as much in volume of the hydrogen as of oxygen, it does not follow that we have twice as much in weight; because the one is heavy and the other a very light gas. We have means of weighing gases or air; but without stopping to explain that, let me just tell you what their respective weights are. The weight of a pint of hydrogen is three-quarters of a grain; the weight of the same quantity of oxygen is nearly twelve grains. This is a very great difference. The weight of a cubic foot of hydrogen is one-twelfth of an ounce; and the weight of a cubic foot of oxygen is one ounce and a third. And so on we might come to masses of matter which may be weighed in the balance, and which we can take account as to hundred-weights and as to tons, as you will see almost immediately.

Now as regards this very property of oxygen supporting combustion, which we may compare to air, I will take a piece of candle to show it you in a rough way, and the result will be rough. There is our candle burning in the air: how will it burn in oxygen? I have here a jar of this gas, and I am about to put it over the candle for you to compare the action of this gas and that of the air. Why, look at it; it looks something like the light you saw at the poles of the voltaic battery. Think how vigorous that action must be! And yet during all that action nothing more is produced that what is produced by the burning of the candle in air. We have the same production of water; and the same phenomena exactly, when we use this gas instead of air, as we have when the candle is burnt in air.

But now we have got a knowledge of this new substance, we can look at it a little more distinctly, in order to satisfy ourselves that we have got a good general understanding of this part of the product of a candle. It is wonderful, you see, how great the supporting powers of this substance are as regards combustion. For instance, here is a lamp which, simple though it be, is the original, I may say, of a great variety of lamps which are constructed for divers purposes,—for lighthouses, microscopic illuminations, and other uses; and if it was proposed to make it burn very brightly, you would say, "If a candle burnt better in oxygen, will not a lamp do the same?" Why, it will do so. Mr. Anderson will give me a tube coming from our oxygen-reservoir, and I am about to apply it to this flame, which I will previously make burn badly on purpose. There comes the oxygen: what a combustion that makes! But if I shut it off, what becomes of the lamp? [The flow of oxygen was stopped, and the lamp relapsed to its former dimness.] It is wonderful how, by means of oxygen, we get combustion accelerated, But it does not affect merely the combustion of hydrogen, or carbon, or the candle; but it exalts all combustions of the common kind. We will take one which relates to iron for instance, as you have already seen iron burn a little in the atmosphere. Here is a jar of oxygen, and this is a piece of iron wire; but if it were a bar as thick as my wrist, it would burn the same. I first attach a little piece of wood to the iron, I then set the wood on fire, and let them both down together in the jar. The wood is now alight, and there it burns as wood would burn in oxygen; but it will soon communicate its combustion to the iron. The iron is now burning brilliantly, and will continue so for a long time. As long as we supply oxygen, so long can we carry on the combustion of the iron until the latter is consumed.

We will now put that on one side, and take some other substance; but we must limit our experiments for we have not time to spare for all the illustrations you would have a right to, if we had more time. We will take a piece of sulphur: you know how sulphur burns in the air; well, we will put it into the oxygen, and you will see that whatever can burn in air can burn with a far greater intensity in oxygen, leading you to think that perhaps the atmosphere itself owes all its power of combustion to this gas. The sulphur is now burning very quietly in the oxygen; but you cannot for a moment mistake the very high and increased action which takes place when it is so burnt, instead of being burnt merely in common air.

I am now about to show you the combustion of another substance—phosphorous. I can do it better for you here than you can do it at home. This is a very combustible substance, and if it be so combustible in air, what might you expect it would be in oxygen? I am about to show it to you not in its fullest intensity, for if I did so we should almost blow the apparatus up; I may even now crack the jar, though I do not want to break things carelessly. You see how it burns in the air. But what a glorious light it gives out when I introduce it into oxygen, [Introducing the lighted phosphorous into the jar of oxygen.] There you see the solid particles going off which cause that combustion to be so brilliantly luminous.

Thus far we have tested this power of oxygen and the high combustion it produces, by means of other substances. We must now, for a little while longer look at it as respects the hydrogen. You know when we allowed the oxygen and hydrogen derived from the water to mix and burn together we had a little explosion. You remember also that when I burnt the oxygen and the hydrogen in a jet together, we got a very little light but great heat; I am now about to set fire to oxygen and hydrogen mixed in the proportion in which they occur in water. Here is a vessel containing one volume of oxygen and two volumes of hydrogen. This mixture is exactly of the same nature as the gas we just now obtained from the voltaic battery; it would be far too much to burn at once; I have therefore arranged to blow soap bubbles with it and burn those bubbles, that we may see by a general experiment or two how this oxygen supports the combustion of the hydrogen. First of all we will see whether we can blow a bubble. Well, there goes the gas [causing it to issue through a tobacco-pipe into some soap-suds.] Here I have a bubble. I am receiving them on my hands and you will perhaps think I am acting oddly in this experiment, but it is to show you that we must not always trust noise and sounds, but rather toreal facts. Exploding a bubble on the palm of his hand.] I am afraid to fire a bubble from the end of the pipe because the explosion would pass up into the jar and blow it to pieces. This oxygen then will unite with the hydrogen, as you see by the phenomena and hear by the sound, with the utmost readiness of action, and all its powers are then taken up in its neutralisation of the qualities of the hydrogen.

So now I think you will perceive the whole history of water with reference to oxygen and the air, from what we have before said. Why does a piece of potassium decompose water? Because it finds oxygen in the water. What is set free when I put it in the water, as I am about to do again? It sets free hydrogen, and the hydrogen burns; but the potassium itself combines with oxygen; and this piece of potassium, in taking the water apart,—the water you may say, derived from the combustion of the candle, —takes away the oxygen which the candle took from the air, and so sets the hydrogen free; and even if I take a piece of ice, and put a piece of potassium upon it, the beautiful affinities by which the oxygen and the hydrogen are related are such, that the ice will absolutely set fire to the potassium. I show this to you to-day in order to enlarge your ideas of these things, and that you may see how greatly results are modified by circumstances. There is the potassium on the ice, producing a sort of volcanic action.

It will be my place when next we meet, having pointed out these anomalous actions, to show you that none of these extra and strange effects are met with by us—that none of these strange and injurious actions take place when we are burning, not merely a candle, but gas in our streets, or fuel in our fireplaces, so long as we confine ourselves within the laws that Nature has made for our guidance.

TEA, COFFEE, AND COCOA.

Tea and coffee have hardly any other properties in common than the possession of an alkaolid called caffeine or theine, which is identical in the two. Chocolate contains a peculiar alkaloid, theobromine; but the only other substance used extensively for a dietetic infusion, the Paraguay tea, contains theine.

TEA (*Thea Sinensis*).

Tea consists of the leaves of several varieties of a small shrub found in China and India. The leaves are gathered in the fourth year of the growth of the plant, which is generally dug up and renewed in its tenth or twelfth year. The leaves are cropped with care by gatherers, who wear gloves, wash frequently, and avoid eating things likely to affect the breath. The differences between teas result partly from the varieties of soil and growth; but also from the mode of curing and drying the leaves. Black Tea consists of leaves slightly fermented, washed, and twisted. Genuine green tea is made of exactly the same leaves, washed and twisted, without fermentation; but commercial "green" teas are often black teas coloured with Prussian blue. Probably five hundred millions of men, or half the human race, now use tea. In the United Kingdom, above 32 thousand tons, or 73 millions of pounds, are annually used; or about $2\frac{3}{4}$ lbs. for every person in the Kingdom. The chief action of tea depends, firstly, on its volatile oil (less in old than in new teas), which is narcotic and intoxicating; and, secondly, on a peculiar crystalline principle, called Theine. Theine excites the brain to increased activity; but soothes the vascular system by preventing rapid change or waste in the fleshy parts of the body, and so economises food. Four grains of Theine, contained in half an ounce of tea, act in this way; but if one ounce of tea, containing 8 grains of Theine, be taken in a day by one person, then tremblings, irritability of temper, and wandering of thoughts, ensue. When the system becomes thus saturated with Theine, it is useful to resort to cocoa as a beverage, for a few days, when the irritable symptoms subside and the use of tea may be renewed.

The tea-leaves, which become changed in the process of drying and preparation, resemble coffee in many points. They are rich in casein or cheese, but contain in the same weight nearly twice as much Theine as coffee. The aromatic oil, which by itself is intoxicating, is present in greater quantity than in coffee. One hundred parts of good tea contain:

Water	5·00			
Theine	3·00			
Casein or Cheese	15·00			
Aromatic Oil	0.75		Water	5 0
Gum	18·00	or	Flesh-formers	18·0
Sugar	3·00		Heat-givers	72.0
Fat	4·00		Mineral Matter	5·0
Tannic Acid	26·25			
Fibre	20·00			
Mineral Matter	5·00			

In an ordinary infusion of tea, the flesh-formers remain with the leaves; but may be taken up by Soda in the water. Hence the practice of the poor of adding Soda to the water in making tea extracts much of its nutritive ingredients. The ingredients in 1 lb. of good tea are:

1. Water in 1 lb. of tea—350 gr.
2. Theine in 1 lb. of tea—210 gr.
3. Casein in 1 lb. of tea—2 oz. 175 gr.
4. Aromatic oil in 1 lb. of tea—52 gr.
5. Gum in 1 lb. of tea—2 oz. 385 gr.
6. Sugar in 1 lb. of tea—211 gr.
7. Fat in 1 lb. of tea—280 gr.
8. Tannic acid in 1 lb. of tea—4 oz. 87 gr.
9. Woody fibre in 1 lb. of tea—3 oz. 87 gr.
10. Mineral matter—350 gr.

PARAGUAY TEA, OR MATÉ (*Ilex Paraguayensis*). Nat. Ord. Aquifolaceæ.

The Maté occupies the same important position in the domestic economy of South America as the Chinese Tea (*Thea Sinensis*) does in this country. The leaves of the Maté Plant, a species of Holly (*Ilex Paraguayensis*), are from four to five inches in length, and are prepared by drying and roasting, not in the manner of the Chinese Teas, in which each leaf is gathered separately, but large branches are cut off the plants and placed on hurdles over a wood fire until sufficiently roasted; the branches are then placed on a hard floor and beaten with sticks; the dried leaves are thus knocked off and reduced to a powder, which is collected, made into packages, and is ready for use. There are three sorts known in the South American markets: the Caa-Cuys, which is the head of the leaf; the Caa-Miri, the leaf torn from its midrib and veins, without roasting; and the Caa-Guaza or Yerva de Palos of the Spaniards, the whole leaf, with the petioles and small branches roasted. The method of preparing it for drinking is by putting a small quantity, about a teaspoonful, into a gourd or cup, with a little sugar; the drinking tube is then inserted, and boiling water poured on the Maté; when sufficiently cool to drink without scalding the mouth, the infusion is sucked up through the tube. It has an agreeable slightly-aromatic odour, is rather bitter to the taste, and very refreshing and restorative to the human frame after enduring great fatigue. It contains the same active principle as tea and coffee, called Theine; but does not possess the volatile and empyreumatic oils of those substances. It is calculated that about 40,000,000 lbs. of this substance are consumed annually in South America.

The leaves of many plants have been used as substitutes for tea, but they do not seem to contain the same alkaloid. These substances are as follows:

Swiss Tea, prepared from Alpine plants. Fabam Tea of the Mauritius (*Angræcum fragrans*). Lime flowers and leaves (*Tilia Europœa*). Appallachian Tea (*Prinos glaber*). New Jersey Tea (*Ceanothus Americanus*). Labrador Tea (*Ledum palustre.*)

COFFEE (*Coffee Arabica*).

The Coffee plant belongs to the natural order *Chinchonaceæ*, which contain the plants yielding Quinine. It is an evergreen shrub, with oval, shining, wavy, sharp-pointed leaves, white fragrant flowers with projecting anthers, and oblong pulpy berries which are at first green, then of a bright red, and afterwards purple. Each berry contains two seeds, which are covered over with a tough membrane called "parchment." The seeds alone are used in the preparation of Coffee. The Coffee plant is indigenous in Southern Abyssinia, where it grows wild over the rocky surface of the country. In the fifteenth century it was introduced into Arabia; in the sixteenth century, into Constantinople; and in 1652, the first coffee shop was established in London. It is now cultivated in Ceylon, the East and West Indies, and in South America.

The Coffee plant attains a height of from ten to fifteen, or twenty feet. It is planted in nurseries, and at the end of three years bears fruits and seeds, and continues to do so for twenty years. The seeds vary in size according to the countries in which they are produced. The best seeds are obtained from Yemen, the southernmost province of Arabia; these yield the richest Mocha Coffee.

The separation of the seeds from the pulp and parchment of the fruit is a complicated process. The berries are first fermented, the pulp cleared away and the seed dried in the parchment; the latter is afterwards bruised and separated from the seed, which is immediately placed in bags to render permanent the greenish colour that the unroasted Coffee bean possesses. In its unroasted condition the bean consists of a horny mass, which, after it is submitted to roasting, yields very different products from those which existed before that process. Exposure to heat develops the peculiar volatile oils, and the astringent acid, on which the flavour of coffee depends. The oil acts as a stimulant upon the nervous and vascular system, producing an agreeable excitement of the mind, and a gentle perspiration on the skin. It also tends to impede the waste of the tissues of the body, and when taken in too large quantities produces sleeplessness and palpitation of the heart. The acid called Caffeo-tannic, found in roasted coffee, acts as a light astringent; but in this respect coffee does not act so powerfully as tea. It contains a similar active principle to that of tea, called *Caffeine*. The quantity of coffee consumed in the United Kingdom in 1858 was upwards of 35,000,000 lbs. The yearly consumption of coffee in the world is calculated to be about 600,000,000 of pounds.

The chemical properties of the Coffee-berry are altered by roasting, and it loses about 20 per cent. of weight, but increases in bulk one-third or one-half. Its peculiar aroma, and some of its other properties, are due to a small quantity of an essential oil, only one five-thousandth part of its weight, which would be worth about £100 an ounce in a separate state. Coffee is less rich in Theine than tea, but contains more sugar, and a good deal of cheese (Casein). One hundred parts consist of:

Water	12·000	or	Water	12·00
Caffeine, or Theine	1·750		Flesh-formers	14·75
Casein, or Cheese	13.000		Heat-givers	66·25
Aromatic Oil	0·002		Mineral Matter	7·00
Sugar	6·500			
Gum	9·000			
Fat	12.000			
Potash with a peculiar acid	4·000			
Woody Fibre	35.048			
Mineral Matter	6·700			

In the usual way of making coffee, the flesh-formers are thrown away; the addition of a little soda to the water partly prevents this waste. The various ingredients in 1 lb. of coffee are:

1. Water in 1 lb. of coffee—1 oz. 407 grs.
2. Caffeine or Theine in 1 lb. of coffee—122 grs.
3. Casein or Cheese in 1 lb. of coffee—2 oz. 35 grs.
4. Aromatic Oil in 1 lb. of coffee—1½ gr.
5. Gum in 1 lb. of coffee—1 oz. 192 grs.
6. Sugar in 1 lb. of coffee—1 oz. 17 grs.
7. Fat in 1 lb. of coffee—1 oz. 402 grs.

8. Potash, with a peculiar acid, in 1 lb. of coffee—280 grs.
9. Woody fibre in 1 lb. of coffee—5 oz. 262 grs.
10. Mineral matter in 1 lb. of coffee—1 oz. 31 grs.

COFFEE SUBSTITUTES.

A large number of substances have been employed from time to time as substitutes for coffee, and prepared in the same way. They have none of them established themselves in public reputation, and are seldom sold. This is probably owing to the fact that they do not contain the principal Theine, or any compound analogous to it.

The following substances are used as Coffee Substitutes:

Iris Seeds, and Coffee.
Broom Seed, and Coffee.
Fenugrec Seed, and "Rosetta Coffee."
Spanish Acorns, and Coffee.
Chick Peas, and Coffee.
Swedish Coffee.
Rice, and Coffee.
Carrot Root, and Coffee.
Parsnip Root, and Coffee.
Acorns, and "Hayet's" Coffee.
Beans, and Coffee.
Lupin Seed, and Coffee.
Chicory Root, and Coffee.
Dandelion Root, and Coffee.
Beet Root, and Coffee.

COCOA (*Theobroma Cacao*). Nat. Ord. Byttneriaceæ.

Cocoa is the seed of the Chocolate Plant, a small tree with dark-green leaves, growing in Mexico, Carraccas, Demerara, and other places. It produces an elongated fruit in shape between a Cucumber and a Melon, which grows directly from the stem or main branches. The seeds or beans that afford the Cocoa are imbedded in the fruit in rows in a spongy substance, and are about fifty or sixty in number. When the fruit is ripe the seeds are taken out, cleaned, and dried, and sometimes a little fermented. The best cocoa is made from these seeds, which are shelled from the outer husks and then roasted. In the inferior kinds the shell is ground up with the seeds. *Cocoa-Nibs* are seeds merely roasted and crushed after being shelled. *Cocoa Paste* is the seed ground down, and when this paste is mixed with sugar, and flavoured with aromatics, as Vanilla, it is called Chocolate. The peculiar flavour of Chocolate is due more especially to Vanilla. The latter substance is the fruit of the *Vanilla aromatica and V. planifolia*, an orchidaceous plant, a native of Mexico, and contains a volatile oil which gives the flavour to Chocolate. Soluble, Rock, Flake, and other Cocoas are the whole seeds ground and mixed with Sugar, Gum, Starch, etc. Cocoa is a rich and nutritious food, containing in 100 parts, 51 of Butter, 22 of starch and Gum, 20 of Gluten or flesh-forming matter, and about 2 parts of a principle called *Theobromine*, to which no doubt its peculiar character is due: Theobromine contains more Nitrogen than Theine, the active principle of Tea and Coffee. The quantity of Cocoa consumed in the United Kingdom in 1858 was 3, 071,115 lbs.

Cocoa, though drunk like Tea and Coffee as a beverage, differs from them remarkably in composition. The distinguising feature of its composition consists in the large quantities of fat and albumen which it contains; so that Cocoa not only acts as an alterative through its Theobromine, but as a heat giving and flesh forming food. 100 parts of Cocoa contain:—

Water	5·0	or	Water	5·0
Albumen	20·0		Flesh-formers	22·0
Theobromine	2·0		Heat-givers	69·0
Butter	50·0		Mineral Matter	4.0
Woody Fibre	4·0			
Gum	6·0			
Starch	7·0			
Red Colouring Matter	2·0			
Mineral Matter	4·0			

The ingredients in a pound of Cocoa paste are:—

1. 1 lb. of Cocoa nibs.
2. 1 lb. of Cocoa paste.
3. Water—350 gr.
4. Albumen and Gluten—3 oz. 85 gr.
5. Theobromine—140 gr.
6. Butter—8 oz.
7. Gum—426 gr.
8. Starch—1 oz. 53 gr.
9. Woody fibre—280 gr.
10. Colouring matter—140 gr.
11. Mineral matter—280 gr.

—*Guide to the Food Collection, S. Kensington Museum.*

ASHES OR MINERAL MATTERS IN VEGETABLE AND ANIMAL FOOD.

MINERAL MATTER IN FOOD.

The mineral salts contained in plants and animals are indestructible by heat, hence they are called "ashes."

The body of a man weighing 154lbs. contains about 8 lbs. of mineral matter, consisting of Phosphoric Acid, Silica (or Flint), Chlorine combined with Sodium (common salt), Fluorine combined with Calcium (Fluor Spar), Sulphur, Soda, Potash, Lime, Magnesia, and Oxide of Iron. These substances are extracted from food, and distributed by means of the blood to the various parts of the body, where they are taken up, or absorbed, into the system; different portions of the body showing a strong affinity for different mineral substances: thus, Phosphorus is found in the brain, and also in the form of Phosphoric acid in combination with Lime, in the bones; Fluorine in the bones and teeth; Silica or Flint in the teeth, hair, and nails; Sulphur in the hair; Phosphate of Magnesia and Phosphate of Potash in the flesh; and Phosphate of Soda in the blood and the cartilages. In some cases, as in Phosphate of Lime, which forms the ground-work of bones, the use of mineral matter in the body is sufficiently obvious; but, in other cases, its use is less understood, though it is supposed to exert important action on the transformation of the tissues, and the support of respiration. Mineral matter is quite indispensable to health, and disease results from a deficient supply of it. All animals, man included, require salt for the digestive processes and for the proper secretion of bile; in fact, each substance has its peculiar uses, of many of which we are yet to a great extent ignorant.

MINERALS IN FOOD.

In the body of a man, weighing 154 lbs., there are about 8 lbs. of mineral matter. Different parts of the body show peculiar affection for particular ingredients to the exclusion of others.

1. *Phosphate of Lime*, or Bone Earth, consists of three proportions of Lime and one of Phosphoric Acid. There is no animal tissue in the body in which it is

not present. In bone it forms from 48 to 59 parts in 100; the bones most exposed to mechanical influences containing the largest quantity. It is always found with flesh-forming substances, whether derived from the vegetable or animal kingdoms; generally in the proportion of 0.5 to 2 per cent. Casein contains 6 per cent.

2. *Carbonate of Lime*, or Chalk, always occurs in the bones, though in much less quantity than bone earth, the proportions being 1 to 4 parts in a newly born child, 1 to 6 parts in an adult, and 1 to 8 parts in the old. It is also found in animal concretions.

3. *Phosphate of Magnesia.*—This substance is present, in only small quantities, in the bones and in animal fluids.

4. *Fluoride of Calcium*, or Fluor Spar, exists in small quanties in animal tissues, but more abundantly in the bones and teeth.

5. *Silica*, or Flint, exists in small quantities in the enamel of the teeth and hair.

6. *Chloride of Sodium*, or Common Salt, forms the greatest part of the soluble mineral ingredients in all animal tissues. In blood, 6 parts in 1,000 consist of salt. It no doubt exerts an influence on the change of tissues, on the action of the gastric juice, and on other functions.

7. *Carbonate of Soda* is found in small quantities in blood, and is useful in dissolving Fibrin, Casein, and other flesh formers; it may also aid in respiration.

8. *Phosphates of Soda and Potash.* Salts of Soda and Potash certainly exist both in blood and the tissues, and they may be present as phosphates, but our knowledge on this subject is deficient.

9. *Iron* is found in blood, gastric juice, hair, black colouring matter of the eye, etc.

10. *Sulphates of Soda and Potash* exist occasionally in animal fluids, but do not appear to be essential.

11. *Carbonate of Magnesia* occurs very sparingly in the body, and is not deemed essential.

12. *Oxide of Manganese* is found in bile, gallstones, etc., but would appear to be only accidentally present.

13. *Copper and Lead* are rarely found in the blood but generally in the bile, of man. They are no doubt deleterious, and introduced accidentally.

14. *Sulphocyanide of Sodium*, though not existing in food, is found generally in the saliva of man.

All these substances, as will be seen in the analysis of the human body, are required for forming the blood and the tissues of the human being. As by the use of the body they are constantly being carried away, it is necessary that they should be supplied by means of our daily food. Some plants contain more of one kind of these ingredients than others, thus Liebig has divided plants into four groups, according to the nature of their inorganic constituents.-

1. *Lime-Plants*, in which lime abounds, embracing beans, peas, and other *Leguminosæ*.

2. *Alkali-Plants*, which take up potash and soda, as potatoes, beet, &c.

3. *Silex-Plants*, embracing plants which require silica in their tissues, as the palms and grasses.

4. *Phosphorus-Plants*, which contain in their tissues phosphoric acid in the form of phosphates of the earths or alkalies, and embracing the most important food plants, as wheat, barley, oats, rye, &c.

The salts of soda appear to prevail in the blood, but those of potash in the tissues.

The absence of potash in food appears to be the cause of scurvy at sea; and fresh vegetables, or lime juice, which contain potash, are known to be an effectual preventive and cure of this terrible disease.

It should be recollected, that in the boiling of food many of the mineral substances are dissolved out of it, and where the liquid that they are boiled in is not consumed, such mineral matters are thrown away. This is the case with boiled meat and vegetables, and a constant use of such food may lead to injurious effects. The best corrective to such a diet is the use of uncooked fruit and vegetables. In this way the eating of ripe fruits, as apples, pears, gooseberries, &c., and salads, has a beneficial effect on the system.

ON THE PURIFICATION OF BITUMENS AND COAL OILS.

A patent has lately been taken out in England by James Stuart, of London, for the treatment of petroleum and crude oils of all descriptions obtained from coal, shale, bitumen or wells, such as those which have become so numerous in various parts of this country. The following is a condensed description of the invention, taken from the London *Journal of Gas Lighting.* We do not vouch for the *chemistry* of the description. A solution of *chromic acid* in water is a novelty. The practical use of the description is not affected by the mode of describing the effects produced.

"For every 100 gallons of crude oil to be treated, 12½ lbs. of bichromate of potash is taken and dissolved in 12½ gallons of water, and to this solution is added 1¼ gallons of oil of vitriol (the sulphuric acid of commerce). The solution of chromic acid which is thus obtained is added to and mixed with the oil, the oil being kept intimately mixed by churning or agitating it for about an hour. By this treatment, a quantity of pitchy matters and other impurities are separated from the oil, and the oil is deprived of the greater part of its unpleasant smell. The chromic acid is at once converted into oxyd of chromium, with which the excess of sulphuric acid unites, and forms sulphate of chromium. The mixture is now left at rest until separation takes place, which is usually the case in from one to two hours. The oil then being the upper portion is drawn off into another vessel, agitated with a solution of soda for about an hour. This is done to wash out or neutralize any acids remaining in the oil. The solution of soda, which it is preferred to use, is made by dissolving 12½ lbs. of soda ash of commerce in 12½ gallons of water, and adding that quantity to every 100 gallons of oil to be washed. After one hour's agitation, the whole is left at rest until the oil has separated from the soda solution, after which the oil is placed in an iron still, and distilled. The distillation is continued until the whole bulk of oil distilled over reaches .840 sp. gr. at 60° of temperature. The distillate is then to be placed in a proper vessel, and treated as before by churning or agitating with a solution of chromic acid in water. For every 100 gallons of oil to be treated, 12½ lbs. of bichromate of potash is dissolved in 12½ gallons of water, and to the solution is added 1¼ gallons of oil of vitriol. The compound is mixed with the oil by agitation for about an hour, and then the whole is left at rest until the oil is separated from the solution of sulphate of chromium and impurities. Afterward, the oil is drawn off into another vessel, and washed by mixing or agitating it, for half an hour or thereabouts, with one-fourth its bulk of water or one-fourth its bulk of lime-water. When the water or lime- water has completely separated, and the oil has become bright, it will be fit for use as an illuminating oil. The heavy oil remaining in the still is distilled to dryness, and may then be treated by any of the known methods for obtaining paraffine or lubricating oil. The chromic acid used in the process above described may be obtained otherwise than from the bichromate of potash; it is, however, usually most convenient to employ this salt. It is preferred to apply chromic acid in the first place. to the crude oils, because the solution of chromic acid, by removing the pitch, tar and other impurities from the oil, enables it to be distilled at a heat much lower than would otherwise be necessary, and so prevents decomposition taking place in the still. It is found that, after treating some crude oils with a solution of chromic acid, and distilling until the distillate or whole bulk of oil distilled over reaches 840° sp. gr., that the oil so obtained is of too dark a color to be used as an illuminating oil. In this case, the oil is treated by churning or agitating it with two per cent (by bulk) of oil of vitriol for about an hour, then allowing the whole to rest until the acid, tar or sludge is separated from the oil. The oil is then drawn off into another vessel, and agitated with two per cent of powdered quicklime or dried chalk for another hour, or until all the smell of sulphurous acid has left the oil. There is then added 25 per cent (by bulk) of water, and the whole is agitated for a quarter of an hour; after which time, the mixture is left at rest until the oil has become bright, when it is drawn off for use; but if the oil is not of a good color, it is re-distilled. If there is difficulty in getting the oil perfectly bright, there is added to every 100 gallons of oil, 26 lbs. of common salt dissolved in 8 gallons of water, and the whole is agitated well together for a quarter of an hour; then, when left at rest, the oil will become perfectly bright. In no case however, is the oil of vitriol used for treating the oil, if it can be avoided, as it unites with and decomposes a great part of the lighter oils, and this it is wished to avoid as much as possible. The chromium used in the process may be recovered either as sulphate or oxyd, as desired."

The Board of Arts and Manufactures for Upper Canada.

THE ACT RELATING TO BOARDS OF ARTS AND MANUFACTURES.

The Act relating to the Board of Arts and Manufactures in Upper and Lower Canada has not yet become law. Another year must pass before the desired amendments receive the sanction of Parliament. The unusual shortness of the session and the great press of business were no doubt largely instrumental in preventing the adoption of the amendments desired by the Board, and which they consider necessary to enable them to fulfil the duties imposed by the act of incorporation.

THE INTERNATIONAL EXHIBITION OF 1862.

Our readers will regret to learn that it is not the intention of the Government to appropriate any sum of money, during the present year, towards assisting in the representation of Canada at the International Exhibition of 1862. This determination does not in any way remove or lessen the expectation that a grant will be made early in the ensuing session, for the purposes set forth in the memorials of the Boards for Upper and Lower Canada. It is, however, much to be regretted that no encouragement has been afforded to our Manufacturers and Artizans to prepare the results of their progress during the past ten years for exhibition at London. No doubt great individual exertion will be made and a valuable representation of Canadian industry accumulated; but if the Government had thought proper to lend their material assistance, a very unexpected and encouraging exhibition of the progress of Canadian industry and arts would have been transmitted to London, and Canada would have had no reason to anticipate falling in the rear of her sister Colonies, or of those countries in Europe among whom she occupied an enviable position in 1850 and 1855.

Now that no prospect remains of receiving assistance from Government during the present year, Manufactures and Mechanics will be left to their own energies and resources. These we are sure will never fail; and it may happen that the exhibition of our progress in the industrial arts, resting altogether upon individual effort, will be more satisfactory and encouraging than if supported and cherished by the aid of a pecuniary grant.

PROVINCIAL AGRICULTURAL ASSOCIATION'S EXHIBITION.

The following is the Prize List of the Arts and Manufactures Department of the Agricultural Association's Exhibition, to be held in the City of London, during the last week of September next. The whole of the Rules and Regulations will be published in the next issue.

PRIZE LIST.

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

Diplomas will be awarded in this Department, in addition to first Money Prizes, for Articles or Collections evidencing in their production a high degree of merit. (*See* Rules and Regulations.)

CLASSIFICATION OF PRIZE LIST.

Class.	
40	Architecture, and Miscellaneous Useful and Decorative Arts.
41	Cabinet Ware and other Wood Manufactures.
42	Carriages and Sleighs, and parts thereof.
43	Chemical Manufactures and Preparations.
44	Fine Arts.
45	Furs and Wearing Apparel.
46	Groceries and Provisions.
47	Indian Work.
48	Ladies' Work.
49	Machinery and Models thereof, Castings and Tools.
50	Metal Work, Plain & Ornamental, including Stoves.
51	Miscellaneous.
52	Musical Instruments.
53	Natural History.
54	Paper, Printing, Bookbinding, &c.
55	Pottery, Building and Paving Materials.
56	Saddle, Engine Hose, and Trunk Maker's work, Leather, &c.
57	Shoe and Boot Maker's work, Leather, &c.
58	Woollen, Flax, and Cotton Goods.
59	Foreign Manufactures.

Class 40—Architecture, and Miscellaneous Useful and Decorative Arts,

Sect.		1st Prize.	2nd Prize.
1	Architectural Drawing	6 00	4 00
2	Architectural Drawing, in perspective	6 00	4 00
3	Composition Drawing of Natural Foliage (Canadian) applicable to architectural details.	7 00	5 00
4	Modelling in Plaster of Natural Foliage (Canadian) applicable to architectural details..	7 00	5 00
5	Mathematical, Philosophical and Surveyor's instruments, collection of	10 00	6 00
6	Stained Glass, collection of specimens	6 00	4 00
7	Ventilation of Buildings, Model showing the best system for warming and distributing the air	10 00	6 00
	Miscellaneous.		
8	Banner Painting	6 00	4 00
9	Carving and Gilding	6 00	4 00
10	Carving in Wood	6 00	4 00
11	Carving in Stone	6 00	4 00
12	Drawing of Machinery, in perspective	5 00	3 00
13	Decorative House Painting	5 00	3 00
14	Dentistry, collection of specimens	5 00	3 00
15	Engraving on Wood, with proof	5 00	3 00
16	Engraving on Copper, with proof	5 00	3 00
17	Engraving on Steel, with proof	5 00	3 00
18	Electrotyping, specimens of	5 00	3 00
19	Goldsmith's Work	5 00	3 00
20	Geometrical Drawing of Engine or Millwright work, colored	5 00	3 00
21	Heraldic Painting	5 00	3 00
22	Lithographic Drawing	5 00	3 00
23	Lithographic Drawing, colored	6 00	4 00
24	Lithographic Drawing, on Canadian stone	5 00	3 00
25	Modelling in Plaster	6 00	4 00
26	Monumental Tomb or Head Stone (price and design considered)	6 00	4 00
27	Painting, Imitation of Woods and Marbles	5 00	3 00
28	Picture Frame, ornamented gilt	5 00	3 00
29	Picture Frame, plain gilt	4 00	2 00
30	Seal Engraving, with wax impressions	6 00	4 00
31	Silversmith's Work	5 00	3 00
32	Extra entries		

Class 41—Cabinet Ware, and other Wood Manufactures.

Sect.		1st Prize.	2nd Prize.
1	Bed Room Furniture, set of	8 00	6 00
2	Centre Table	6 00	4 00
3	Drawing Room Sofa	7 00	5 00
4	Drawing Room Chairs, set of	7 00	5 00
5	Dining Room Furniture, set of	8 00	6 00
6	Ottoman	3 00	2 00
7	Side Board	6 00	4 00
8	School Desk and Chairs (price considered)	3 00	2 00
9	Wardrobe	4 00	3 00
	Miscellaneous.		
10	Corn Brooms, six	2 00	1 00
11	Cooper's Work	3 00	2 00
12	Curled Hair, 10 lbs	3 00	2 00
13	Door, 4 or 6 panelled	3 00	2 00
14	Flour Barrels, three	3 00	2 00
15	Handles for Tools, for carpenters, blacksmiths, gunsmiths, watchmakers, &c., &c., collection of	8 00	5 00
16	Joiner's Work, specimen of	4 00	3 00
17	Machine wrought Moulding, 100 feet	3 00	2 00

Class 41—Continued.

Miscellaneous.

Sect.		1st Prize.	2nd Prize.
18	Machine wrought Flooring, 100 feet	3 00	2 00
19	Shingles, Two Bundles of Split	3 00	2 00
20	Turning in wood, collection of specimens	5 00	3 00
21	Veneers from Canadian Woods	5 00	3 00
22	Wash-tubs and Wooden Pails, three of each	3 00	2 00
23	Window Sash hung in Frame, 12 lights	4 00	3 00
24	Wash-boards, six, zinc covered	2 00	1 00
25	Willow Ware, six specimens	3 00	2 00
26	Extra entries		

Class 42—Carriages and Sleighs, and Parts thereof.

Sect.		1st Prize.	2nd Prize.
1	Axle, wrought iron	3 00	2 00
2	Bent Shafts, half dozen	3 00	2 00
3	Buggy, double seated	6 00	4 00
4	Buggy, single seated	5 00	3 00
5	Carriage, two horse, pleasure	10 00	6 00
6	Carriage, one horse, pleasure	7 00	5 00
7	Child's Carriage, (price considered)	3 00	2 00
8	Dog Cart, single horse	5 00	3 00
9	Hubs, two pairs of carriages	3 00	2 00
10	Rims or Felloes, two pairs of carriages	3 00	2 00
11	Spokes, one dozen machine made carriage	3 00	2 00
12	Sleigh, two horse, pleasure	7 00	5 00
13	Sleigh, one horse, pleasure	6 00	4 00
14	Springs, one set of steel carriage	3 00	2 00
15	Wheels, one pair of carriage (unpainted)	4 00	3 00
16	Extras		

Class 43—Chemical Manufactures and Preparations.

Sect.		1st Prize.	2nd Prize.
1	Blacking for shoes	2 00	1 00
2	Essential Oils, assortment of	6 00	4 00
3	Glue, 14 lbs	3 00	2 00
4	Isinglass, 1 lb	3 00	2 00
5	Medicinal Herbs, Roots and Plants, native growth	7 00	5 00
6	Oils extracted from plants	3 00	2 00
7	Oils, Linseed and Rape	3 00	2 00
8	Oil, Coal, Shale or Rock	4 00	3 00
9	Varnishes, assortment of	4 00	3 00
10	Extra entries		

Class 44—Fine Arts.

Professional List — Oil.

Sect.		1st Prize.	2nd Prize.
1	Animals, grouped or single	10 00	6 00
2	Historical Painting, Canadian subject	10 00	6 00
3	Landscape, Canadian subject	10 00	6 00
4	Marine Painting, Canadian subject	10 00	6 00
5	Original Composition, any other subject	10 00	6 00
6	Portrait	8 00	5 00

In Water Colours.

Sect.		1st Prize.	2nd Prize.
7	Animals, grouped or single	7 00	5 00
8	Flowers, grouped or single	7 00	3 00
9	Landscape, Canadian subject	7 00	5 00
10	Marine View, Canadian subject	7 00	5 00
11	Miniature Portrait	6 00	4 00
12	Original Composition, any other subject	7 00	5 00

Pencil, Crayon, &c.

Sect.		1st Prize.	2nd Prize.
13	Crayon, colored	5 00	3 00
14	Crayon, plain	5 00	3 00
15	Pencil drawing	5 00	3 00
16	Pen and Ink Sketch	5 00	3 00
17	Portrait in pencil	5 00	3 00
18	Portrait in crayon	5 00	3 00

Amateur List—Oil.

Sect.		1st Prize.	2nd Prize.
19	Animals, grouped or single	7 00	5 00
20	Historical Painting, Canadian subject	7 00	5 00
21	Landscape, Canadian subject	7 00	5 00
22	Marine Painting, Canadian subject	7 00	5 00
23	Original Composition, any other subject	7 00	5 00
24	Portrait	6 00	4 00

Class 44—Continued.

In Water Colours.

Sect.		1st Prize.	2nd Prize.
25	Animals, grouped or single	6 00	4 00
26	Flowers, grouped or single	4 00	3 00
27	Landscape, Canadian subject	6 00	4 00
28	Marine View, Canadian subject	6 00	4 00
29	Miniature Portrait	4 00	3 00
30	Original Composition, any other subject	6 00	4 00
	Pencil, Crayon, &c.		
31	Crayon, colored	4 00	3 00
32	Crayon, plain	4 00	3 00
33	Pencil Drawing	4 00	3 00
34	Pen and Ink Sketch	4 00	3 00
35	Portrait in pencil	4 00	3 00
36	Portrait in crayon	4 00	3 00
	Photography.		
37	Ambrotypes, collection of	5 00	3 00
38	Photograph Portraits, collection of, colored	7 00	5 00
39	Photograph Portraits, collection of, plain	6 00	4 00
40	Photograph Landscapes and Views, collection of	7 00	5 00
41	Photograph Portraits in oil	6 00	4 00
42	Extras		

Class 45—Furs and Wearing Apparel.

Sect.		1st Prize.	2nd Prize.
1	Business Coat	4 00	3 00
2	Fur Cap	3 00	2 00
3	Fur Gloves, Mits or Gauntlets	3 00	2 00
4	Fur Sleigh Robe	4 00	3 00
5	Gloves and Mits, buckskin	2 00	1 00
6	Gloves and Mits, of any other leather	2 00	1 00
7	Gloves and Mits, lined with wool	2 00	1 00
8	Overcoat	4 00	3 00
9	Pantaloons	3 00	2 00
10	Silk Hat	3 00	2 00
11	Suit of Clothes of Canadian Cloth	5 00	3 00
12	Extra entries		

Class 46—Groceries and Provisions.

Sect.		1st. Prize.	2nd Prize.
1	Barley, Pot and Pearl	3 00	2 00
2	Biscuits, an assortment	4 00	3 00
3	Bottled Fruits, an assortment	3 00	2 00
4	Bottled Pickles, an assortment	3 00	2 00
5	Buckwheat Flour	3 00	2 00
6	Candles, an assortment	3 00	2 00
7	Cayenne Pepper, from Capsicums grown in the Province	2 00	1 00
8	Chickory, 20 lbs of	3 00	2 00
9	Confectionary, an assortment	4 00	3 00
10	Indian Corn Meal	3 00	2 00
11	Mustard, one jar	3 00	2 00
12	Oatmeal	3 00	2 00
13	Preserves, six kinds	3 00	2 00
14	Preserved Meats, one can	3 00	2 00
15	Sauces for table use, an assortment	3 00	2 00
16	Soap, 28 lbs of	3 00	2 90
17	Soaps, collection of assorted fancy	4 00	3 00
18	Starch, 12 lbs of Corn	2 00	1 00
19	Starch, 12 lbs of Flour	2 00	1 00
20	Starch, 12 lbs of Potatoe	2 00	1 00
21	Sugar, 20 lbs of Beet Root	3 00	2 00
22	Sugar, 20 lbs of Corn Stalk	3 00	2 00
23	Sugar, 20 lbs of Maple	3 00	2 00
24	Sugar, one loaf of refined	3 00	2 00
25	Tobacco, 14 lbs of Canadian manufactured	3 00	3 00
26	Varnishes, an assortment	4 00	3 00
27	Wheat Flour	4 00	3 00
28	Extra entries		

Class 47—Indian Work.

Sect.		1st Prize.	2nd Prize.
1	Bark Canoe	4 00	2 00
2	Buckskin Mittens, one pair	2 00	1 00
3	Clothes Basket	2 00	1 00

Class 47—Continued.

Sect.		1st Prize.	2nd Prize.
3	Deer Skin, dressed	2 00	1 00
5	Fruit Basket	2 00	1 00
6	Hand Basket	2 00	1 00
7	Indian Cradle	3 00	2 00
8	Moccasins, one pair of plain	2 00	1 00
9	Moccasins, worked with Porcupine quills, one pair of	3 00	2 00
10	Moccasins, worked with beads, one pair of	3 00	2 00
11	Paddles, two pairs of	3 00	2 00
12	Pipe of Peace	2 00	1 00
13	Rice, 14 lbs of	3 00	2 00
14	Snow Shoes, common size, one pair	3 00	2 00
15	Snow Shoes, eight inches long, one pair	3 00	2 00
16	Sugar, 14 lbs of	3 00	2 00
17	Tobacco Pouch, worked with Porcupine quills	2 00	1 00
18	Extra entries		

Class 48—Ladies Work.

Sect.		1st Prize.	2nd Prize.
1	Bonnet of Canadian straw	4 00	3 00
2	Braiding	4 00	3 00
3	Crochet Work	4 00	3 00
4	Embroidery in Muslin	4 00	3 00
5	Embroidery in Silk	4 00	3 00
6	Embroidery in Worsted	4 00	3 00
7	Gloves, three pairs	3 00	2 00
8	Guipure work	4 00	3 00
9	Hat of Canadian straw	4 00	3 00
10	Knitting	4 00	3 00
11	Lace Work	4 00	3 00
12	Mittens, three pairs of woollen	3 00	2 00
13	Needle work, ornamental	4 00	3 00
14	Netting, fancy	4 00	3 00
15	Quilts in crochet	4 00	3 00
16	Quilts in knitting	4 00	3 00
17	Quilts in silk	4 00	3 00
18	Quilts in piece work	4 00	3 00
19	Shirt, gentleman's	3 00	2 00
20	Socks, three pairs of woollen	3 00	2 00
21	Stockings, three pairs of woollen	3 00	2 00
22	Tatting	4 00	3 00
23	Wax fruit	5 00	3 00
24	Wax flowers	5 00	3 00
25	Worsted work	4 00	3 00
26	Worsted work (raised)	4 00	3 00
27	Extra entries		

Class 49—Machinery and Models thereof, Castings and Tools.

Sect.		1st Prize.	2nd Prize.
1	Castings for General Machinery	6 00	4 00
2	Cast Wheel, spur or bevel, not less than 50 lbs weight	4 00	3 00
3	Castings for Railways, Rail Road Cars and Locomotives, assortment of	10 00	6 00
4	Engine, Steam, of one to four horse power, in operation on the ground	15 00	10 00
5	Engine, Hot Air, one to four horse power, in operation on the ground	15 00	10 00
6	Fire Engine	12 00	8 00
7	Model, in metal of Engine, Millwright's work, or Machinery	7 00	5 00
8	Pump, in metal	4 00	3 00
9	Refrigerator (price considered)	4 00	3 00
10	Scales, platform	4 00	3 00
11	Scales, counter	3 00	2 00
12	Smoke Consuming furnace, in operation on the ground	10 00	6 00
13	Turning Lathe	5 00	3 00
14	Valves and Gearing for working steam expansively, either in model or otherwise, principle of working to be the point of competition	12 00	8 00
	Tools.		
15	Augurs, assortment of	3 00	2 00
16	Augurs, earth	2 00	1 00
17	Axes, six narrow	3 00	2 00
18	Brace Bits, set of	3 00	2 00
19	Bench Planes, set of	3 00	2 00
20	Blacksmith's Bellows	3 00	2 00
21	Cooper's Tools, set of	3 00	2 00
22	Edge Tools, assortment of	12 00	8 00
23	Moulding Planes and Plows, collection of	3 00	2 00
24	Weaver's Reeds, assortment of	2 00	1 00
25	Extra entries		

Class 50—Metal Work, Plain and Ornamental, including Stoves.

Sect.		1st Prize.	2nd Prize.
1	Coal Oil Lamps, an assortment	5 00	3 00
2	Coppersmith's work, an assortment	5 00	3 00
3	Fire Arms, an assortment	5 00	3 00
4	Files, collection of cast steel	3 00	2 00
5	Finishing in Iron, vice work	3 00	2 00
6	Fire Proof Office Safe	6 00	4 00
7	Gas Fittings, an assortment	6 00	4 00
8	Horse Shoes, set of	2 00	1 00
9	Iron Fencing and Gate, ornamental	6 00	4 00
10	Iron Work from the Hammer, ornamental	5 00	3 00
11	Iron Work, ornamental cast	5 00	3 00
12	Locksmith's Work, an assortment	5 00	3 00
13	Malleable Iron from the ore	5 00	3 00
14	Malleable Iron from scrap iron	5 00	3 00
15	Nails, 20 lbs of pressed	5 00	3 00
16	Nails, 20 lbs of cut	5 00	3 00
17	Ornamental Fencings for Burial Plots in Cemeteries	6 00	4 00
18	Plumber's Work, an assortment	5 00	3 00
19	Screws and Bolts, an assortment	5 00	3 00
20	Sheet Brass Work, an assortment	5 00	3 00
21	Tinsmith's Work, an assortment	5 00	3 00
22	Tinsmith's Lacquered Work, an assortment of	5 00	8 00
23	Wire Work, an assortment	6 00	4 00
	Stoves.		
24	Cooking Stove, for wood, with furniture	5 00	3 00
25	Cooking Stove, for coal, with furniture	5 00	3 00
26	Hall Stove, for wood	4 00	2 00
27	Hall Stove, for coal	4 00	2 00
28	Parlour Stove, for wood	4 00	2 00
29	Parlour Stove, for coal	4 00	2 00
30	Parlour Grate	5 00	3 00
31	Extra entries		

Class 51—Miscellaneous.

Sect.		1st Prize.	2nd Prize.
1	Brushes, an assortment	5 00	3 00
2	Combs, an assortment	3 00	2 00
3	Model of a Steam Vessel	4 00	3 00
4	Model of a Sailing Vessel	4 00	3 00
5	Extra entries		

Class 52—Musical Instruments.

Sect.		1st Prize.	2nd Prize.
1	Harmonium	7 00	5 00
2	Melodeon	6 00	4 00
3	Organ, Church	15 00	8 00
4	Piano, Square	10 00	6 00
5	Piano, Cottage	10 00	6 00
6	Violin	3 00	2 00
7	Extra entries		

Class 53—Natural History.

Sect.		1st Prize.	2nd Prize.
1	Birds—Collection of stuffed Birds of Canada, classified, and common and technical names attached	7 00	5 00
2	Fishes—Collection of Native Fishes, stuffed or preserved in spirits, and common and technical names attached	7 00	5 00
3	Insects—Collection of Native Insects, classified, and common and technical names attached	6 00	4 00
4	Mammalia—Collection of stuffed Mammalia of Canada, classified, and common and technical names attached	7 00	5 00
5	Minerals—Collection of Minerals of Canada, named and classified	7 00	5 00
6	Plants—Collection of Native Plants, arranged in their natural families, and named	7 00	5 00
7	Reptiles—Collection of Reptiles of Canada, stuffed or preserved in spirits, classified, and common and technical names attached	7 00	5 00
8	Stuffed Birds and Animals of any country, collection of	7 00	5 00
9	Woods—Collection of the Woods of Canada, in boards two feet long, one side polished; also, a portion of the tree cut in sections, showing the bark	7 00	5 00

Class 54—Paper, Printing, Bookbinding, and their Materials and Tools.

Sect.		1st Prize.	2nd Prize.
1	Bookbinding, (blank-book)	5 00	3 00
2	Bookbinding, (letterpress)	5 00	3 00
3	Bookbinders, leather, &c., assortment	5 00	3 00
4	Cartridge Paper	2 00	1 00
5	Letterpress Printing, plain	5 00	3 00
6	Letterpress Printing, ornamental	5 00	3 00
7	Paper Hangings, (Canadian paper,) grounded, one dozen rolls	5 00	3 00
8	Paper Hangings, (Canadian paper,) self-grounded, one dozen rolls	3 00	2 00
9	Paper manufactured from straw, an assortment	6 00	4 00
10	Printing Paper, one ream	5 00	3 00
11	Printing Ink	2 00	1 00
12	Printing Type, an assortment	5 00	3 00
13	Wrapping Paper, one ream of stout	3 00	2 00
14	Wrapping Paper, one ream of fine	3 00	2 00
16	Extra entries		

Class 55—Pottery, Building and Paving Materials.

Sect.		1st Prize.	2nd Prize.
1	Bricks for building purposes, one dozen, hollow	5 00	3 00
2	Building and Flagging Stones, Canadian, collection of	10 00	6 00
3	Filterer for water	3 00	2 00
4	Pottery, an assortment	8 00	4 00
5	Sewerage Pipes, stoneware, assortment of sizes	6 00	4 00
6	Stoneware, an assortment	6 00	4 00
7	Slates for roofing	5 00	3 00
8	Extra entries		

Class 56—Saddle, Engine Hose and Trunk Makers' Work, Leather, &c.

Sect.		1st Prize.	2nd Prize.
1	Engine Hose and Joints, 2¾ inches diameter, 50 feet of copper rivetted	5 00	3 00
2	Harness, set of double carriage	6 00	4 00
3	Harness, set of single carriage	5 00	3 00
4	Harness, set of team	5 00	3 00
5	Horse Collars, six assorted carriage and team	3 00	2 00
6	Saddle, Ladies' full quilted	6 00	4 00
7	Saddle, Ladies' quilted safe	4 00	3 00
8	Saddle, Gentlemen's full quilted	6 00	4 00
9	Saddle, Gentlemen's plain shaftoe	4 00	3 00
10	Trunk, solid leather	5 00	3 00
11	Trunk, millboard, leather covered	5 00	3 00
12	Trunk, wood, leather covered	3 00	2 00
13	Valises, an assortment	3 00	2 00
14	Whips, an assortment	5 00	3 00
15	Whip Thongs, an assortment	3 00	2 00
16	Hames, four pairs of iron carriage or gig	3 00	2 00
17	Hames, three pairs of iron cased team or cart	3 00	2 00
18	Hames, six pairs of wooden team	3 00	2 00
19	Saddle Tree, Ladies'	3 00	2 00
20	Saddle Tree, Gentlemen's	3 00	2 00
	Leather.		
21	Belt Leather, 30 lbs	3 00	2 00
22	Brown Strap and Bridle, one side of each	3 00	2 00
23	Carriage Cover, two skins	3 00	2 00
24	Deer skins, dressed	2 00	1 00
25	Harness Leather, two sides	3 00	2 00
26	Hog skins, for saddles, three	3 00	2 00
27	Lacing Leather, one hide	2 00	1 00
28	Patent Leather, for carriage or harness work, 20 feet	5 00	3 00
29	Skirting for saddles, two sides	3 00	2 00
30	Extra entries		

Class 57—Shoe and Boot Makers' Work, Leather, &c.

Sect.		1st Prize.	2nd Prize.
1	Balmoral Boots, one pair of Ladies'	3 00	2 00
2	Boot and Shoemakers work, an assortment	6 00	4 00
3	Kid Slippers, one pair of Ladies'	2 00	1 00
4	Lace Boots, one pair of Gentlemen's, sewed	3 00	2 00
5	Lace Boots, one pair of Gentlemen's, pegged	3 00	2 00
6	Wellington Boots, one pair of Gentlemen's, sewed	4 00	3 00
7	Boot and Shoemakers tools, an assortment	6 00	4 00
8	Boot and Shoemakers lasts and trees, an assortment	6 00	4 00
9	Shoe Pegs, an assortment	3 00	2 00

Leather.

Sect.		1st Prize.	2nd Prize.
10	Calf Skins	3 00	2 00
11	Calf Skins, two morocco	3 00	2 00
12	Cordovan, two skins of	3 00	2 00
13	Dog Skins, two dressed	3 00	2 00
14	Kip Skins, two sides	3 00	2 00
15	Linings, six skins	3 00	2 00
16	Patent Leather for boot makers, twenty feet	5 00	3 00
17	Sheep Skins, six coloured	3 00	2 00
18	Sole Leather, two sides	3 00	2 00
19	Upper Leather, two sides	3 00	2 00
20	Extra entries		

Class 58—Woollen, Flax and Cotton Goods.

Sect.		1st Prize.	2nd Prize.
1	Bags, from Flax the growth of Canada, one dozen	4 00	3 00
2	Bags, one dozen cotton	3 00	2 00
3	Blankets, one pair of woollen	6 00	4 00
4	Carpet, twelve yards of woollen	6 00	4 00
5	Carpet, twelve yards of woollen stair	4 00	3 00
6	Cloth, twelve yards of fulled	6 00	4 00
7	Cloth, twelve yards of broad	6 00	4 00
8	Counterpanes, two	5 00	3 00
9	Cordage, 28 lbs. of flax or hemp	5 00	3 00
10	Cordage and Twines, from Canadian flax or hemp, assortment of	6 00	4 00
11	Check for horse collars, twelve yards	4 00	2 00
12	Drawers, factory made, one pair of woollen	4 00	2 00
13	Flannel, factory made, twelve yards	5 00	3 00
14	Flannel, not factory made, 12 yards	5 00	3 00
15	Horse Blankets, two pairs	5 00	3 00
16	Kersey for horse clothing, twelve yards	5 00	3 00
17	Linen Goods, twelve yards	5 00	3 00
18	Minsey, twelve yards of checked	5 00	3 00
19	Satinet, twelve yards of black	6 00	4 00
20	Satinet, twelve yards of mixed	5 00	3 00
21	Shawls, three woollen	5 00	3 00
22	Shirts, factory made, three woollen	5 00	3 00
23	Stockings, factory made, three pairs of woollen	4 00	2 00
24	Socks, factory made, three pairs of woollen	2 00	1 00
25	Stockings, factory made, three pairs of mixed woollen and cotton	4 00	2 00
26	Socks, factory made, three pairs of mixed woollen and cotton	2 00	1 00
27	Tweed, twelve yards of Winter	6 00	4 00
28	Tweed, twelve yards of Summer	6 00	4 00
29	Twines, linen and cotton, an assortment	3 00	2 00
30	Woollen Cloths, Tweeds, &c., an assortment	7 00	4 00
31	Woollen Shawls, Stockings, Drawers, Shirts and Mits, an assortment	7 00	4 00
32	Woollen Yarn, white, one pound	2 00	1 00
33	Woollen Yarn, dyed, one pound	2 00	1 00
34	Extra entries		

Class 59—Foreign Manufactures.

Foreign Articles will be admitted for exhibition only; but Certificates will be awarded to any article of worth or peculiar merit.

NOTICES OF BOOKS.

Popular Physical Geology, by J. Beete Jukes, M.A. F.R.S., M.R.I.A. London: Reeve & Co. Toronto: Rollo & Adam.

The illustrations of this excellent little book are admirable. The sketches were made by Mr. G. V. Donoyer, who unites the skill of the artist with the knowledge of the geologist. Mr. Donoyer was the colleague of Mr. Jukes on the Irish Geological Survey. This is not a recent work, it dates from 1853, but the illustrations are widely different from those so frequently met with in works on Popular Geology, that we are induced to recommend it to students as an excellent elementary introduction to the noble science of Geology.

Life in its Lower, Intermediate, and Higher Forms, or Manifestations of the Divine wisdom in the Natural History of Animals.—By Phillip Gosse, F.R.S. New York: Robert Carter & Brother. Toronto: Rollo & Adam.

Mr. Gosse is well known in Canada; his *Canadian Naturalist* is familiar to all our students of nature. The matter of his "Life" is excellent, but the manner in which it has been produced by the American publisher, is not in keeping with the attractive nature of the subject. It has one recommendation—it is cheap, and consequently easily accessible. We give a few paragraphs from the author's introduction:—

"'The works of the Lord are great;' but we must not estimate this greatness by their actual dimensions;

else a man would be of less importance than a hippopotamus, and the Bass Rock would be immensely more valuable than either. It is a greatness not measurable by rule and line; not to be determined by bulk and weight; it is to be estimated by far other qualities,—by the relative importance which the objects bear to each other, by the variety and complexity of their parts, by the elaborateness with which they are constructed, by their fitness for the purposes which they are destined to subserve, and especially by the degree in which they shew forth the power, wisdom, skill, and goodness of Him who made them for His own glory. Many of the animals of which we are about to speak are so minute that the unassisted eye takes no cognizance of their presence; yet most of these,—perhaps all, if we were able to investigate them,—are so curiously fashioned, so elaborately constructed, as to deserve to be included in the category of those works which the adoring Psalmist says are GREAT.

We propose in this volume to describe the various phases of animal life, commencing at the foot of the scale, where we catch the first glimmering of the vital spark, and tracing it step by step upwards through its various developments and changes, its forms and functions. But what is LIFE? There is a mystery couched under that little word which all the researches of philosophers has not been able to solve. Science, with the experience of ages, with all the appliances of art, and with all the persevering ingenuity and skill that could be brought to bear upon it, has ardently laboured to lift the veil; but philosophy, and science, and art, stand abashed before the problem, and confess it a mystery still. The phenomena, the properties of life, are readily observable. We take a bird in our hands; a few moments ago it was full of energy and animation; it shook its little wings as it hopped from perch to perch; its eyes glanced brightly, and its throat quivered as it poured out the thrilling song which delighted us. Now the voice has ceased, the eye is dim, the limbs are stiffening, and we know that it will move no more. Chemical changes have already begun to operate upon its organs; decomposition is doing its work, and soon the beautiful little bird will be a heap of dust. We say that *its life* has gone; but *what* is it that has gone? If we put the body in the most delicate balance, it weighs not a grain less than when it was alive; if we measure it, its dimensions are precisely the same; the scalpel of the anatomist finds all the constituent parts that made the living being; and what that mighty principle is, the loss of which has wrought such a change, alike eludes research and baffles conjecture. We are compelled here to recognize the Great First Cause, and to say, 'In Him we live, and move, and have our being.'"

Selected Articles.

ON SOME POINTS IN AMERICAN GEOLOGY.

BY T. STERRY HUNT, M.A., F.R.S., OF THE GEOLOGICAL SURVEY OF CANADA.

Continued from page 137.

The existence of great dislocations in the Appalachian chain is amply illustrated in the sections of Prof. Rogers, and in those given by Safford in Eastern Tennessee, where by the aid of fossils it becomes comparatively easy to trace them. See the Map accompanying his *Geological Reconnaissance of Tennessee*, 1855; where the magnesian limestones of formation IV, are shown to be not only brought up on the east against the Upper Silurian and Devonian, but even to overlap the black shales at the base of the Carboniferous system. It is remarkable to find that as early as 1822, the idea of a great dislocation of this nature in Eastern New York was maintained by Mr. D. H. Barnes in his description of Canaan Mountain. [*American Journal of Science*, (1) v. pp. 15—18.

To the southeast of this great fault in Canada we have as yet no evidence of Lower Silurian strata higher than those of the Quebec group. At the eastern base of the Green Mts. we find limestones of upper Silurian and Devonian age reposing unconformably upon the altered strata of the Quebec group, themselves also having undergone more or less alteration. Immediately succeeding are the chiastolite and mica slates of Lake St. Francis, which as we have long since stated are probably also of Upper Silurian age.

The White Mountains as we suggested in 1849, (*Am.Jour.Sci.*(2) ix. 19) are probably, in part at least, of Devonian age, and are the representatives of the of the 7,000 feet of Devonian sandstone observed by Sir William Logan in Gaspé. Mr. J. P. Lesley has more recently, after an examination of the White Mts. shown that they possess a synclinal structure, and has adduced many reasons for regarding them as of Devonian age. (*Amer. Mining Journal*, January 1861, p. 99.)

It will be seen from what has been previovsly said that we look upon the 1st and 2nd divisions described by Mr. Safford in Eastern Tennessee, as corresponding to the hypozoic series of Rogers and to the Green Mountain gneissic formation, which instead of being beneath the Silurian series, is really a portion of the Quebec group more or less metamorphosed, so that we recognize nothing in New England or southeastern Canada lower than the Silurian system, nor do we at present see any evidence of older strata, such as Laurentian or Huronian, in any part of the Appalachian chain. The general conclusions which we have previously expressed with regard to the lithological, chemical and mineral relations of the Green Mts. rocks remain unchanged. (*Am. Journal of Science* (2) ix. 12.)

The remarkable parallelism between the rocks of Western Scotland and Canada has already been shown in the existence of the Laurentian, and Cambrian (Huronian) systems, over-laid by quartzites containing *Scolithus*, to which succeed limestones containing a numerous fauna, identified by Mr. Salter with that of the Chazy limestone. These strata, with an eastward dip, are covered by other quartzites and limestones, to which succeeds the great gneissoid formation of the western Highlands, consisting of feldspathic, chloritic, micaceous, and talcose schists resembling closely the gneissoid rocks of the Green Mts. and including the chromiferous ophiolites of Perthshire, Banff and the Shetland Isles.

This gneissoid series was by Prof. Nichol suggested to be the older or Laurentian gneiss brought up by a dislocation on the east of the Silurian limestones, but Sir Roderick Murchison, with Messrs. Ramsay and Harkness, has shown not only from the differences in lithological character, but from actual sections, that the eastern gneissoid series is made up of altered strata newer than the Silurian limestones.* Thus in geological structure and age, not less than in lithological and mineralogical characters, the rocks of the western Highlands are the counterparts of the Laurentian and Silurian gneiss formations, as seen

* Murchison, Quar. Jour. Geol. Society, Vol. xv. 353 and xvi. 215.

in the Laurentides and Adirondacks, and in the Green Mts. The same parallelism may be extended to Scandinavia, (where Kjerulf and Forbes have shown much of the crystalline gneiss to be of Silurian age,) marking as it would seem the outer edge of a vast Silurian basin, which may be followed in the other direction across the Atlantic to the Gulf of Mexico. We also remark in Great Britain as in America, that whereas the northern outcrop of the palæozoic basin offers at its base only a series of quartzose sandstones reposing upon the Laurentian system and characterized by fucoids and *Scolithus*, we find farther south in England an immense development of shales, sandstones and conglomerates, which form the base of the Silurian system and correspond to the Primoidial zone and the Quebec group.

We have said that upon Lakes Huron and Superior the sandstones of the upper copper-bearing rocks are the equivalents of the Quebec group. The clear exposition of the question by Mr. J. D. Whitney in the *Am. Mining Jour.* for 1860 (p. 435) left little more to be said, but the sections made last year by Mr. Alex. Murray of the Canada Geological Survey place the matter beyond all doubt. On Campment d'Ours, a small island near St. Joseph's, the sandstones of Sault St. Mary are seen reposing horizontally on the upturned edges of the Huronian rocks, and overlaid by limestones which contain in abundance the fossils of the Black River and Birdseye divisions. The only fossil as yet found in these sandstones is a single *Lingula* from near Sault St, Mary, which may be either of Potsdam or Chazy age. The sandstones in question form the upper member of a series of strata which on Lake Superior attain a thickness of several thousand feet, and passing downwards we find a succession of limestones, marls and argillaceous sandstones, interstratified with greenstone and amygdaloid, and followed by about 2000 feet of bluish slates and sandstones, with cherty beds containing grains of anthracite, the whole underlaid by conglomerates, and reposing unconformably upon rocks of the Huronian system. The presence of such slates is the more significant from the occurrence already mentioned of fragments of green and black slates in the coarse grained sandstones near the base of the Potsdam, at Hemmingford mountain, showing the existence of argillaceous shales before the deposition of the quartzites of the Potsdam; these are perhaps more recent than the lowest shales of the Primordial zone, to which however, palæontologically they appear to belong.

This Quebec group is of considerable economic interest inasmuch as it is the great metaliferous formation of North America. To it belongs the gold which is found along the Appalachian chain from Canada to Georgia, together with lead, zinc, copper, silver, cobalt, nickel, chrome and titanium. I have long since called attention to the constant association of the latter metals, particularly chrome and nickel, with the ophiolites and other magnesian rocks of this series, while they are wanting in similar rocks of Laurentian age. (*American Journal of Science* (2) xxvi. 237.)

The immense deposits of copper ore in Eastern Tennessee, and the similar ones in Lower Canada, both of which are for the most parts in beds subordinate to the stratification, belong to this group. The lead, copper, zinc, cobalt, and nickel of Missouri, and the copper of Lake Superior, also occur in rocks of the same age, which appears to have been preeminently the metalliferous period.

The metals of the Quebec group seem to have been originally brought to the surface in watery solution, from which we conceive them to have been separated by the reducing agency of organic matter in the form of sulphurets, or in the native state, and mingled with the contemporaneous sediments, where they occur in beds, in disseminated grains forming *fahlbands*, or as at Acton, are the cementing material of conglomerates. During the subsequent metamorphism of the strata these metallic matters being taken into solution by alkaline carbonates or sulphurets, have been redeposited in fissures in the metalliferous strata, forming veins, or ascending to higher beds, have given rise to metalliferous veins in strata not themselves metalliferous. Such we conceive to be in a few words the theory of metallic deposits; they belong to a period when the primal sediments were yet impregnated with metallic compounds which were soluble in the permeating waters. The metals of the sedimentary rocks are now however for the greater part in the form of insoluble sulphurets, so that we have only traces of them in a few mineral springs, which serve to show the agencies once at work in the sediments and waters of the earth's crust. The present occurrence of these metals in waters which are alkaline from the presence of carbonate of soda, is as we have elsewhere pointed out, of great significance when taken in connection with the metalliferous character of certain dolomities, which as we have shown, probably owe their origin to the action of similar alkaline springs upon basins of sea water.

The intervention of intense heat, sublimation and similar hypotheses to explain the origin of metallic ores, we conceive to be uncalled for. The solvent powers of solutions of alkaline carbonates, chlorids and sulphurets at elevated temperatures, taken in connection with the notions above enunciated, and with De Senarmont's and Daubrée's beautiful experiments on the crystalization of certain mineral species in the moist way, will suffice to form the basis of a satisfactory theory of metallic deposits.*

The sediments of the carboniferous period, like those of earlier formations, exhibit towards the east a great amount of coarse sediments, evidently derived from a wasting continent, and are nearly destitute of calcareous beds. In Nova Scotia Sir Willian Logan found by careful measurement, 14,000 feet of carboniferous strata; and Professor Rogers gives their thickness in Pensylvania as 8000 feet, including at the base 1400 feet of a conglomerate, which disappears before reaching the Mississipi. In Missouri Prof. Swallow finds but 640 feet of carboniferous strata, and in Iowa, their thickness is still less, the sediments composing them being at the same time of finer materials. In fact, as Mr. Hall remarks throughout the whole palæozoic period we observe a greater accumulation and a coarser character of sediments alongst the line of the Apalachian chain, with a gradual thinning westward, and a deposition of finer and farther transported matter in that direction. To the west, as this shore-derived material diminishes in volume, the amount of calcareous matter rapidly augments. Mr. Hall concludes therefore that the coal-measure sediments were driven westward into an ocean, where there already existed a marine fauna. At length, the marine limestones predominating, the coal measures come to be of little importance, and we have a great limestone

* *Quarterly Journal*, Geological Society, vol. xv. 580.

formation of marine origin, which in the Rocky Mountains and New Mexico occupies the horizon of the coal, and itself unaltered, rests on crystaline strata like those of the Appalachian range. In truth, Mr. Hall observes, the carboniferous limestone is one of the most extensive marine formations of the continent, and is characterized over a much greater area by its marine fauna than by its terrestial vegetation.

"The accumulations of the coal period were the last that gave form and contour to the eastern side of our continent, from the Gulf of St. Lawrence to the Gulf of Mexico; and as we have shown that the great sedimentary deposits of successive periods have followed essentially the same course, parallel to the mountain ranges, we naturally inquire: What influence this accumulation has had upon the typography of our country, and whether the present line of mountain elevation from north-east to south-west is in any way connected with the original accumulation of sediments?" (*Hall's Introduction*, p. 66.)

The total thickness of the palæozoic strata along the Appalachian chain is about 40,000 feet, while the same formations in the Mississippi valley, including the carboniferous limestone, which is wanting in the east, have according to Mr. Hall, a thickness of scarcely 4000 feet. * In many places in this valley we find the Silurian formations exposed, exhibiting hills of 1000 feet, made up of horizontal strata, with the Potsdam sandstone for their base, and capped by the Niagara limestone, while the same strata in the Appalachians would give to them sixteen times that thickness. Still, as Mr. Hall remarks, we have there no mountain of corresponding altitude, that is to say, none whose height like those of the Mississippi valley, equals the actual vertical thickness of the strata comprising them. In the west there has been little or no disturbance, and the highest elevations mark essentially the actual thickness of the strata comprising them. In the disturbed regions of the east on the contrary, though we can prove that certain formations of known thickness are included in the mountains, the height of these is never equal to the aggregate amount of the formations. "We thus find that in a country not mountainous, the elevations correspond to the thickness of the strata, while in a mountainous country, where the strata are immensely thicker, the mountain heights bear no comparative proportion to the thickness of the strata." "While the horizontal strata give their whole elevation to the highest parts of the plain, we find the same beds folded and contorted in the mountain region, and giving to the mountain elevations not one-sixth of their actual measurement."

Both in the east and west, the valleys exhibit the lower strata of the palæozoic series, and it is evident that had the eastern region been elevated without folding of the strata, so as to make the base of the series correspond nearly with the sea level, as in the Mississippi valley, the mountains exposed between these valleys, and including the whole palæozoic series, would have a height of 40,000 feet; so that the mountains evidently correspond to depressions of the surface, which have carried down the bottom rocks below the level at which we meet them in the valleys. In other words, the synclinal structure of these mountains depends upon an actual subsidence of the strata along certain lines.

"We have been taught to believe that mountains are produced by upheaval, folding and plication of the strata, and that from some unexplained cause these lines of elevation extend along certain directions, gradually dying out on either side, and subsiding at the extremities. We have, however, here shown that the line of the Appalachian chain is the line of the greatest accumulation of sediments, and that this great mountain barrier is due to original deposition of materials, and not to any subsequent forces breaking up or disturbing the strata of which it is composed."

We have given Mr. Hall's reasonings on this subject, for the most part in his own words, and with some detail, for we conceive that the views which he is here urging are of the highest importance to a correct understanding of the theory of mountains. In the *Canadian Naturalist* for Dec. 1859, p. 425, and in the *American Journal of Science* (2) xxx, 137 will be found an allusion to the rival theories of upheaval and accumulation as applied to volcanic mountains, the discussion between which we conceive to be settled in favour of the latter theory by the reasonings and observations of Constant-Prevost, Scrope and Lyell. A similar view applied to mountain chains like those of the Alps, Pyrennees and Alleghanies, which are made up of aqueous sediments, has been imposed upon the world by the authority of Humboldt, Von Buch and Elie de Beaumont, with scarcely a protest. Buffon, it is true, when he explained the formation of continents by the slow accumulation of detritus beneath the ocean, conceived that the irregular action of the water would give rise to great banks or ridges of sediments, which when raised above the waves must assume the form of mountains; later, in 1832, we find De Montlosier protesting against the elevation hypothesis of Von Buch and maintaining that great the mountain chains of Europe are but the remnants of continental elevations which have been cut away by denudation, and that the foldings and inversions to be met with in the structure of mountains are to be looked upon only as local and accidental.

In 1856 Mr. J. P. Lesley published a little volume entitled *Coal and its Topography*, (12 mo. pp. 224,) in the second part of which he has, in a few brilliant and profound chapters, discussed the principles of topographical science with the pen of a master. Here he tells us that the mountain lies at the base of all topographical geology. Continents are but congeries of mountains, or rather the latter are but fragments of continents, separated by valleys which represent the absence or removal of mountain land [p. 126]; and again "mountains terminate where the rocks thin out," (p. 144.)

The arrangement of the sedimentary strata of which mountains are composed may be either horizontal, synclinal, anticlinal or vertical, but from the greater action of diluvial forces upon anticlinals in disturbed strata it results that great mountain chains are generally synclinal in their structure, being in fact but fragments of the upper portion of the earth's crust, lying in synclinals, and thus preserved from the destruction and translation which have exposed the lower strata in the anticlinal valleys, leaving the intermediate mountains capped with lower strata. The effects of those great and mysterious denuding forces which have so powerfully modified the surface of the

* In Michigan, according to the late report of Prof. Winchell, the total observed thickness of the strata from the top of the Sault St Mary sandstones to the top of the carboniferous series is little over 1700 feet, divided as follows:—Trenton and Hudson River groups, 50 feet, Upper Silurian 185, Devonian 782, Carboniferous 700; of this last the true coal measures constitute 123 feet, including from 3 to 10 feet of workable bituminous and cannel coals, while near the base of the carboniferous series are found 169 feet of gypsiferous marls, which yield strong brine springs.

globe become less apparent as we approach the equatorial regions, and accordingly we find that in the southern portions of the Appalachian chain many of the anticlinal folds have escaped erosion, and appear as hills of an anticlinal structure. The same thing is occasionally met with further north; thus Sutton mountain in Canada, lying between two anticlinal valleys, has an anticlinal centre, with two synclinals on its opposite slopes. Its form appears to result from three anticlinals, the middle one of which has to a great extent escaped denudation.

The error of the prevailing ideas upon the nature of mountain chains may be traced to the notion that a disturbed condition of the rocky strata is not only essential to the structure of a mountain, but an evidence of its having been formed by local upheaval, and the great merit of De Montlosier and Lesley, (the latter altogether independently,) is to have seen that the upheaval has been in all cases not local but continental, and that the disturbance so often seen in the strata is neither dependent upon elevation nor essential to the formation of a mountain. The synclinal structure of portions of the Alps, previously observed by Studer and others, has been beautifully illustrated by Ruskin in the fourth volume of his *Modern Painters*, and in a late review of Alpine geology we have endeavoured to show that the Alps, *as a whole*, have likewise a synclinal structure. (*American Journal of Science*, xxix. 118.)

(*To be concluded in our next.*)

VARNISHES.*

The following Recipes for the preparation of Varnishes will be found useful to a large class of the readers of this Journal. It is proposed, in subsequent numbers, to introduce under the headings Cements, Alloys, Plastering Glues, Papers, Bronzing, Polishes, Bookbinders' Recipes, Gilding, Inks, Waxes, &c., &c., a variety of practical information, which will no doubt be appreciated by Mechanics and others engaged in different branches of industry.

Preparations of Lac.—Stick-lac consists of twigs of several kinds of trees encrusted a resinous matter, produced by the puncture of an insect called the *Cocus lacca*. This, triturated with water, and dried, forms seed-lac. The seed-lac, when heated and pressed in cotton bags, forms shell-lac. Lac dye is the coloring matter extracted from stick-lac by water, and evaporated to dryness, with the addition of earthy matters, and formed into square cakes. Seed-lac and shell-lac are chiefly used in varnishes, dissolved in rectified spirits, or rectified wood naphtha. The alcoholic solution is rendered paler, so that it may be used for polishing ilght colored woods, by digesting it in the sun, or near a fire, for two or three weeks, with good animal charcoal, and then filtering it through paper in a funnel heated with hot water. Shell-lac may be bleached by dissolving it in a solution of potash, or soda, and passing chlorine into the solution. The precipitated lac is collected, and well washed. Kastner directs 3 parts of carbonate of potash to be dissolved in 24 of water, and 3 of lime added, and the whole digested in a close vessel for twenty-four hours. The clear liquor is poured off, and boiled with 4 parts of shell-lac. When cold, dilute with 4 times its bulk of water and filter; then add chloride of lime, and afterwards diluted muriatic acid. With these preliminary remarks we come now to the lacquers, or varnishes.

The Famous Brilliant French Varnish for Boots and shoes.—Take ¾ of a pint of spirits of wine; 5 pints white wine; ½ pound of powdered gum senegal; 6 oz. loaf sugar; 2 oz. powdered galls; 4 oz. green copperas. Dissolve the sugar and gum in the wine. When dissolved, strain; then put it on a slow fire, being careful not to let it boil. In this state put in the galls, copperas, and the alcohol, stirring it well for five minutes. Then set off, and when nearly cool strain through flannel, and bottle for use. It is applied with a pencil brush. If not sufficiently black a little sulphate of iron, and half a pint of a strong decoction of logwood, may be added, with 1/16 oz. pearl ash.

Black Varnish.—Take any varnish, of the class you wish, 16 parts; lamblack 2 parts. Grind the black in a small quantity of the varnish, then mix it with the remainder.

Cabinet-makers' Varnish.—Pale shell-lac 700 parts; mastic 65 parts; strongest alcohol 1000 parts. Dissolve. Dilute with alcohol.

Callott's Soft Etching Varnish.—Linseed oil 8 parts; benzoin 1 part; white wax 1 part. Melt and keep it heated until reduced to two thirds.

Pale Carriage Varnish.—Copal 32 parts; pale oil 80 parts. Fuse and boil until stringy; then add dried white copperas 1 part; litharge 1 part. Boil again, then cool a little, and mix in spirits of turpentine 150 parts. Strain. While making the foregoing, take of gum animé 32 parts; pale oil 80 parts; dried sugar of lead 1 part; litharge 1 part; spirits of turpentine 170 parts. Pursue the same treatment as before and mix the two compositions while hot.

Second quality of Carriage Varnish.—Take of gum animé 32 parts; oil 100 parts; spirits of turpentine 150 parts; litharge 1 part; dried sugar of lead 1 part; dried copperas 1 part. Proceed as above.

Copal Varnish.—Copal 30 parts; drying oil 25 parts; spirits of turpentine 50 parts. Put the copal into a vessel capable of holding 200 parts, and fuse it as quickly as possible, then add the oil, previously heated to nearly the boiling point. Mix well, then cool a little, and add the spirit of turpentine; again mix well, cover up until the temperature has fallen to 140° Fah.; then strain.

To Dissolve Copal in Spirit.—Take the copal and expose it in a vessel formed like a colander to the front of a fire, and receive the drops of melted gum in a basin of cold water; then well dry them in a temperature of about 95° Fah. By treating copal in this way it acquires the property of dissolving in alcohol.

Black Copal Varnish.—Take lamp-black or ivory-black, in fine powder, and mix it with the varnish.

Blue Copal Varnish.—Indigo, Prussian blue, blue verditer, or ultra-marine. These substances must be powdered fine. Proceed as before.

Fine Pale Copal Varnish.—Pale African copal 1 part. Fuse, then add hot pale oil 2 parts. Boil until the mixture is stringy, then cool a little, and add 3 parts of pale spirits of turpentine. Mix well.

* The Mechanic, Machinist, and Engineer's Practical Book of Reference. Edited by C. W. Harkley, Professor of Mathematics in Columbia College, N. Y.

Flaxen Grey Copal Varnish.—Ceruse, which forms the ground of the paste, mixed with a small quantity of Cologne earth, as much English red, or carminated lake, and a particle of Prussian blue, and color the varnish therewith.

Green Copal Varnish.—Verdigris, crystallized verdigris, compound green (a mixture of yellow and blue). The first two require a mixture of white in proper proportions from a fourth to two-thirds according to the tint intended to be given. The white lead used for this purpose is ceruse, or the white oxide of lead, or Spanish white. Proceed as before.

Improved Copal Varnish.—Caoutchoucine (white and scentless), strong alcohol, equal parts; copal in the proportion of two pounds to a gallon. Digest in a close vessel, without heat, for one week.

Pearl Grey Copal Varnish.—White and black; white and blue; for example, ceruse and lamp-black; ceruse and indigo. Mix them with the varnish, according to the tint required.

Purple Copal Varnish.—Prussian blue and vermillion, or any other blue and red; then proceed as before.

Red Copal Varnish.—1. Vermilion, red oxide of lead (minium), red ochre, or Prussian red, &c., and proceed as before.

2. Dragons's blood, brick red, or Venetian red, &c., and prooceed as before.

Violet Copal Varnish.—Vermillion, blue, white, in proportions required to color the varnish.

White Copal Varnish.—Copal 16 parts; melt, and add hot linseed oil 8 parts; spirits of turpentine 15 parts; finest white lead to color.

Yellow Copal Varnish.—Yellow oxide of lead, or Naples and Montpelier, both reduced to impalpable powder. These yellows are hurt by contact with iron or steel. In mixing them, therefore, a horn spatula, with a glass mortar and pestle, must be employed. Or gum guttæ, yellow ochre, or Dutch pink, according to the nature and tone of the color to be imitated, and proceed as before.

Mastic Varnish.—Gum Mastic 5 pounds; spirits of turpentine 2 gallons. Mix with a moderate heat (carefully applied), in a close vessel, then add pale turpentine varnish 3 pints. Mix well.

Another.—Mastic 1 pound; white wax 1 ounce; oil of turpentine 1 gallon. Reduce the wax and mastic small, then digest in a close vessel, with heat, until dissolved.

Common Oil Varnish.—Resin 4 pounds; genuine beeswax ½ pound; boiled oil 1 gallon. Mix with heat, then add spirits of turpentine 2 quarts.

Turpentine Varnish.—Resin 1 part; boiled oil 1 part. Melt, then add turpentine 2 parts. Mix well.

White Hard Spirit Varnish.—Gum sandarach 2½ pounds; alcohol (65 op.) 1 gallon. Place them in a strong, well closed vessel, and apply the heat of warm water, with occasional agitation, until dissolved; then add pale turpentine varnish 1 pint. Mix well, and let the whole rest for twenty-four hours, when it will be ready for use.

White Spirit Varnish.—Strongest alcohol 100 parts; sandarach 25 parts; tears mastic 6 parts; elemi 3 parts; Venice turpentine 3 parts. Dissolve in a closely corked vessel.

Varnish for Toys.—Copal 7 parts; mastic 1 part; Venice turpentine ½ part; strongest alcohol 11 parts. Dissolve the copal first, with the aid of a little camphor, then add the mastic, &c., and thin with alcohol, as required.

To Clean Varnish.—Use a ley of potash, or soda, mixed with a little powdered chalk. Do not make the liquor too strong of the alkali.

Te Polish Varnish.—Take 2 oz. powdered tripoli, put in an earthen pot, with water to cover it; then take a piece of white flannel, lay it over a piece of cork or rubber, and proceed to polish the varnish, always wetting it with the tripoli and water. It will be known when the process is finished by wiping a part of the work with a sponge, and observing whether there is a fair even gloss. When this is the case, take a bit of mutton suet and fine flour, and clean the work.

Varnish for Harness.—Take ½ pound of India-rubber; one gallon of spirit of turpentine; dissolve enough to make into a jelly; then take equal quantities of good hot linseed oil, and the above mixture. Incorporate them well on a slow fire, and it is fit for use.

A Varnish for Fastening the Leather on Top Rollers in Factories.—Dissolve 2¾ oz. of gum arabic in water; and a like amount of isinglass dissolved in brandy, and it is fit for use.

A Varnish to Preserve Glass from the Rays of the Sun.—Reduce a quantity of gum tragacanth to fine powder, and let it dissolve for twenty-four hours in white of eggs well beat up; then rub it gently on the glass with a brush.

A fine Black Varnish for Coaches and Iron Work.—Bitumen of Palestine 2 oz.; resin 2 oz.; umber 12 oz, Melt them separately, and then mix together over a moderate fire. Then pour upon them, while on the fire, 6 oz. clear boiled linseed oil, stirring the whole from time to time. Take it off the fire, and when moderately cool pour in 12 oz. of essence of turpentine.

Varnish for Clock Faces.—Spirits of wine 1 pint; divide it into four parts; mix one part with ½ an oz. of gum mastic in a bottle by itself; one part of spirit and ½ oz. gum sandarach in another bottle; and one part spirit and ½ oz. whitest part of gum benzoin. Mix and temper them to suit; if too thick add spirit; if too thin a little mastic; if too soft some sandarach or benzoin. When about to use it warm the silver plate before the fire, and with a flat camel-hair pencil stroke it over till no white streaks appear; this will preserve it for many years.

MISCELLANEOUS.

Iceland Cod Fisheries

Upwards of one hundred small vessels, employing about 1,200 or 1,500 men, are annually fitted out at Dunkirk for these fisheries, the value of the produce of which is estimated at £120,000 to £160,000. It is principally used for home consumption, and Paris is the chief mart. What is unsold at the approach of a new fishing season, is dried and shipped to the colonies—and also to the Portuguese ports, the French Government accord a premium of from 12 to 20 francs per 100 kilos, the amount varying according to distinction.

The Oreide of Gold.

This substance, of which so many articles called Jewellery are now made, is simply an alloy of copper and zinc—a brass of a peculiar color resembling "jeweler's gold" of about 16 carats fine—copper and gold mixture. It is the invention of MM. Mourier and Vallent—two Frenchmen. It was pateuted in France in December, 1854, and in the United States in March, 1857. Some of our daily papers have lately referred to this substance as if it were some new discovery; whereas, if they had consulted the pages of the *Scientific American*, they would have found it described in full on page 308, Vol. XII., old series, (June, 1857). It is composed of 100 parts (by weight) of pure copper, 17 of zinc, 6 of common magnesia, 3.60 salammoniac, 1,80 quick lime and 9 of crude tartar. The copper is first melted in a crucible, then the magnesia added, then the salammoniac, lime and tartar separately, and in powder. These are kept from contact with the air, and all well stirred for about 20 minutes, until they are incorporated together. The zinc is now added in strips, which are thrust under the scurf formed on the top of the crucible. The mass is now stirred, the lid put on the crucible and its contents kept fused for about 25 minutes; after which the crucible is opened, the slag skimmed carefully from the surface, then the molten alloy is poured out into ingot molds if it is required to be rolled, or into iron rolls if designed for castings. When designed for works of art, however, it is best to cast it into ingot form first, then melt it in a furnace and cast it. This alloy is very beautiful, an d well deserves the name of "oreide of gold," as it greatly resembles the precious metal. It is very ductile, and may be rolled into very thin leaf; but it is nearly as easily tarnished as common brass.—*Scientific American.*

The Whaling Business.

An article in a recent issue of the Boston *Commercial Bulletin*, contains some very interesting information on this subject. For many years New Bedford, Mass., has been known, not only as the greatest whaling port in the United States, but the whole world; it is now, however, falling fast from its former oily greatness. In 1857 there were 329 vessels of 111,364 tons belonging to New Bedford; but at the present time there are only 291 vessels of 98,760 tons, a decrease of 38 vessels and 12,604 tons. This reduction has not been caused by losses of ships at sea, but by their withdrawal from the trade, as the business has been very unprofitable for the past four years. The price of whale oil has been greatly affected by substitutes, especially coal oil, and the more general adoption of gas in cities and large villages. In 1860, the price of whale oil was only 50 cents per gallon, while in 1857 it was 73 cents, and this reduction of price was accompanied with another blow at whaling, namely, a very limited catch of whales. In 1857, the average catch was 800 barrels; last year it was only 500 barrels.

One-half of the whaling fleet is devoted to the sperm whale fishery, the other half to the right whale fishery. One-half of all the sperm oil obtained goes to England, and amounts to about 75,500 barrels annually, valued $81,500,000. The right whale produces the whalebone, most of which goes to Germany; the annual value of it is $1,000,000 The amount invested in the whaling trade in new Bedford is $10,000,000. Many of the merchants in that place are now looking around to see if they cannot enter upon a more profitable business. The total whaling fleet of the United States now comprises 514 vessels of 158,476 tons. There has been a total decrease of 141 ships in four years. In 1858 two hundred ships went to the North Pacific for whale oil; it is expected that only one hundred will go this year.—*Ibid.*

Water-proof Cloth.

The Paris *Moniteur Industriel* states that 20,000 tunics rendered water-proof and yet porous, were served out to the French army during the late war with Russia. They were prepared in the following manner: Take 2 lbs. 4 oz. of alum, and dissolve it in 10 gallons of water; in like manner dissolve the same quantity of sugar of lead in a similar quantity of water, and mix the two together. They form a precipitate of the sulphate of lead. The clear liquor is now withdrawn, and the cloth immersed for one hour in the solution, when it is taken out, dried in the shade, washed in clean water and dried again. This preparation enables the cloth to repel water like the feathers of a duck's back, and yet allows the prespiration to pass somewhat freely through it, which is not the case with gutta-percha or India-rubber cloth.

Starch from Potatoes.

At Stowe, Vt., there are five factories in which starch is made from potatoes. Each consumes about 20,000 bushels per annum, and eight pounds of starch is the yield of each bushel.—*Scientific Amer.*

TO INVENTORS AND PATENTEES IN CANADA.

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

TO CORRESPONDENTS.

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

TO MANUFACTURERS & MECHANICS IN CANADA.

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

TO PUBLISHERS AND AUTHORS.

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