THE JOURNAL

OF THE

Board of Arts and Manufactures

FOR UPPER CANADA.

MAY, 1867.

THE HARRISON CAST-IRON BOILER.

The London *Engineer* of 13th May, 1864, contains an illustration of this boiler, and also a paper descriptive of it, communicated by Mr. Zerah Colburn, the eminent engineer, to the Manchester *Institution of Mechanical Engineers.*

These boilers are made up of a series of spheres, eight inches in diameter, by three-eighths of an inch thick. These are strung on bolts like beads, and the necks, where the bolts pass through, are three inches in diameter. The spheres weigh each about 22½ lbs., or about one hundred of them to the ton; and the boilers are rated as "4-ton boilers," &c. Each shell holds seven pints of water, and presents about one square foot of heating surface, while a ton of one hundred spheres represents three nominal horse-power.

Mr. Colburn says:—"It was the object of the inventor, Mr. Joseph Harrison, of Philadelphia, U. S., to provide great strength against bursting, and to obtain, also, a large extent of heating surface in proportion to the weight and external dimensions of the boiler. It was important, moreover, to obtain perfect circulation for the water. An experience of several years in America, and for upwards of two years in London and Manchester—in one case with a boiler supplying steam to the extent of 200 indicated horse-power—has proved that these objects, as well as other important advantages, have been secured."

Trials of these boilers were made in Brussels, in 1852, when a pressure of 1,440 lbs. the square inch was applied, without bursting any one of the spheres. Subsequent trials were made in England, at a pressure of 1,470 lbs., with the same result; they were, however, finally burst at a calculated pressure of 1,650 lbs. per square inch.

In a series of one hundred spheres, bolted together, the "bolts being upwards of 9 feet in length, the application of a strain considerably below the bursting pressure, so stretched the bolts as to cause the joints to open everywhere, and relieve the pressure. In this way every joint becomes a safety valve. This never occurs with any practicable steam pressure, but it did take place in many of the earlier experiments made to burst the spheres, although leakage seldom commenced until a strain of nearly half a ton per square inch had been applied."

According to Mr. Colburn, this boiler is as safe under a pressure of 225 lbs. per square inch, as a 7 feet Lancashire boiler is under 50 lbs. pressure. If, however, one of the spheres should burst, it could but empty itself, and open one or more 3-inch apertures into the adjacent spheres. In the bursting of an ordinary boiler, however, containing perhaps 20 tons, more or less, of highly heated water, the consequences are generally very disastrous.

Mr. Colburn considers this boiler satisfactory as to the absence of leakage, under ordinary working; the absence of scale in the spheres after many months' working; entire freedom from corrosion; and the facility with which the horse-power of a boiler may be either increased or diminished, by adding to or reducing the number of spheres; but one strong recommendation of this boiler is, the apparent impossibility of an explosion occurring, under any known circumstances—a very important consideration, in view of the large number of inexperts now-a-days having charge of steam-boilers.

The *Mechanics' Magazine* of the same year, in an article quite as commendatory as the paper already quoted, says:—"Strange as it may appear, no deposit ever collects thickly or permanently on the interior of the spheres. That it is formed is proved beyond doubt, as the scales are blown out. The truth seems to be that the cast-iron spheres expand in every direction—dilate in fact, when heated. It is at such a time that the deposit is formed"; and deposit, or scale being inelastic, the moment "the fire is drawn, and the boiler cooled down, the iron contracts, and the deposit within being unable to do the same thing, is broken up like an egg shell, and of course can be blown out at the end of each week." Boilers worked for upwards of two years were practically as free from scales as when they were first set to work.

After an interval of upwards of two years from the time of making the European experiments, a committee of the Franklin Institute, U. S., having been appointed for the purpose, have made a report (*See Scientific American* March 30th) on a series of Experiments and thorough inspection of these boilers, fully confirming the opinions of the authorities already referred to. Sections of from sixty to eighty spheres were tested by them, by hydrostatic pressure, one sphere bursting at six hundred lbs. per square inch, another at six-hundred and twenty-five, another at nine hundred, and another at eleven hundred pounds.

A section, equal to six horse-power, was "placed in an extemporary furnace, built in a clay bank, and set in the usual manner for a boiler of this kind.

"The boiler was filled with water to the regular height, say about two-thirds full, with no outlet or safety-valve of any kind, and sealed up tight, a small tube leading from the upper ball to a high-pressure gauge, placed at a safe distance, say about two hundred feet from the boiler. A fire was made under and around the boiler, with the fuel of dry pine wood. The wind was very high at the time of the experiment, blowing from the west directly into the furnace, thus fanning the flames to an intense heat.

"The guage soon gave indicaton of the formation of steam, the pressure steadily increasing up to four hundred and fifty pounds to the square inch.

"At this pressure there seemed to be a sudden discharge of steam, as from a small opening. The discharge did not continue for many seconds, and the committee are not certain that it proceeded from the boiler; there may have been some water discharged from the bank of wet earth into the fire. The pressure then increased at a uniform rate until it had reached the enormous strain of eight hundred and seventy-five pounds per square inch, when a sudden discharge of steam took place, seemingly no greater in volume than might issue from a safety-valve of two and a half inches diameter, or even less; after which the pressure fell to four hundred and fifty pounds, at which it stood when the fire was drawn for examination.

"While the boiler was being uncovered for examination, a boiler of about twelve-horse power, consisting of two sections, similar to the ones previously experimented upon, was fired and steam raised to one hundred and twenty-five pounds pressure. This boiler had no safety-valve, but was provided with a globe valve of one inch capacity or area, as an escape valve to regulate the pressure in the boiler. When the committee examined this boiler at time of firing, it had two full gauges of water, the escape-valve was opened so as to reduce the pressure to one hundred pounds per square inch, and regulated from time to time to keep the pressure uniform at this point. The fire was pushed, and no more water was injected into the boiler. In due time the lowest gauge-cock gave no indication of water. Soon afterward a slight leak was observed in one joint of the left-hand section. This closed in a few minutes and one opened in a similar manner in the right-hand section; this also closed in a short time. No other leaks showed themselves during the experiment. As the water boiled away, the soot began to burn off the upper balls of the sections, that is, off those of the upper balls of the lowest row, visible through a peep-door above the fire-door provided for inspection. The boiler then became gradually red hot, and even when all the water seemed to be exhausted, and the pressure slowly fell, the gauge stood for some minutes at thirty pounds, as if from the vaporization of some water in the lower courses of the sections, showing that in this red-hot condition, the boiler was tight enough to hold pressure. After the fire had been drawn, and the boiler cooled, the bolts holding the units together were found to be loose, as if stretched by the unusual heating of the cast iron surrounding them. During the time of the experiment with low water, the escape-cock was many times closed to increase the pressure, then opened quickly to reduce it to the one hundred pound standard, but with no deleterious result. When the gauge stood at thirty pounds, all of the boiler visible from the peep-door and fire doors, down to the bridge-wall of the furnace, was at a bright red heat. This was unmistakable, as when the fire was drawn, the boiler was hot enough to ignite a piece of wood held against it."

On the day following the trials, these boilers were carefully examined, and found to have sustained no material injury. The committee were of opinion, that the extreme pressure of eight hundred and seventy-five pounds had stretched some of the bolts, thus opening some of the joints, so as to act as safety-valves and relieving the strain on the boiler.

A third boiler, of twelve-horse power was tested, by filling with water to the upper water-line; it was thus "fired until pressure was raised to ninety pounds, at which it was blowing off freely. The water was then all blown out by the blow-off cock, the pressure falling to sixty pounds while blowing off, at which it stood until steam reached the blow-off pipe, when the pressure fell to zero. It was kept empty for three minutes, with the fire still burning, and was then rapidly filled with cold water, and steam raised to one hundred pounds pressure in thirty minutes, blowing off at one hundred pounds, and was quite sound and tight."

A number of other experiments, of a character even more severe than the above were conducted, and with similar satisfactory results. The committee state that, "during the experiments, the employés of Mr. Harrison seemed quite fearless in their manipulations of the boilers, showing a confidence in their safety truly remarkable.

Mr. Zerah Colburn, as to the strength of these cast-iron spheres, compared with wrought-iron cylinder boilers, says,—

"The strength of a hollow sphere to resist internal pressure is exactly twice that of a hollow cylinder of the same diameter, material and thickness, and it can be shown that even a cast-iron sphere, seven feet in diameter and seven sixteenths of an inch thick, is as strong as the shell of a Cornish boiler of the same dimensions." "The plane in which rupture, if it happens at all, will take place in a hollow sphere, is the largest plane that can be drawn through it, and the metal resisting the strain tending to cause rupture is the whole section of metal bounding the plane." "In a hollow cylinder the area upon which the greatest pressure tending to cause rupture will be exerted is that represented by the product of the length into the 'diameter of the cylinder.'"

In closing their report to the Institute, the committee state that they "are impressed with the great utility of the boiler, as one perfectly safe and free from all danger of explosion even when carelessly used. This recommendation alone, in a humanitarian point of view, must strongly commend it to public favor. During the experiments, its steam-making qualities were favourably noticed, and such boilers in actual use as your Committee have had an opportunity to examine, seem to give satisfaction in point of economy; but in the absence of all experiments in this direction, conducted under their immediate supervision, they do not feel qualified to report in figures as to its steam-making efficiency.

"Comparing cast-iron plates with wrought-iron ones of the same thickness, the transmission of heat is known to be in favour of the former; hence the material, if in a safe form, is better adapted to economical steam-making than wrought iron. Ordinary boiler-plate is seldom less thon one-fourth of an inch thick, and more commonly three-eighths, particularly for high-pressure. The castings used in the experiments for safety, were not over three-eighths of an inch thick, and in one boiler set up in a form adapting it to marine purposes, some of the units were only three-sixteenths of an inch thick, and were worked successfully at one hundred pounds pressure, driving all the machinery in Mr. Harrison's factory in an efficient manner. The principle of enlargement of the boiler by addition of units, and the fact that it can be constructed in any shape or style, just as various kinds of buildings are constructed of ordinary bricks, places it in the power of the engineer to adapt it in its form to the requirements of each particular case; so that with the known advantage of the use of cast iron, and the unlimited scope in the arrangement of heat absorbing surface, coupled with the demonstrated fact of safety, your Committee unhesitatingly approved and heartily recommend it to public favour."

We would here ask our boiler-makers and steam engineers, if this form of boiler, so highly recommended by good authorities, both in Britain and the United States, is not worthy of their best consideration and investigation?

PEAT, IN THE MANUFACTURE OF IRON, AND AS STEAM FUEL.

In the last number of the Journal, we briefly alluded to the immense Peat bogs of Canada, and the possibility of utilizing them for fuel in manufacturing and domestic purposes. We also referred particularly to the patented process lately put in operation by Mr. Hodges, at Arthabaska, for the cutting and preparation of Peat; and noticed experiments recently made with it in the manufacture of iron, promising in this issue to give the report thereon, and also the results of other experiments.

The report referred to was made by Mr. Campbell, Manager of Messrs. Morland, Watson and Co's. Puddling and Rolling Mills, Montreal, to his employers, and published in the Montreal *Gazette* of December 1st., 1866. He says:—

"The peat fuel was tested in an ordinary puddling furnace, and no alteration or adaptation was made, although this might have been done, and a large saving of fuel effected.

The pig iron used was Dallmellington brand A, a strong iron, soft and very tough. The quantity of peat fuel consumed was nearly double the weight of coal used on ordinary occasions.

In my opinion, and with the present furnaces, by mixing peat with Pictou coal, we could produce iron equal to the best charcoal iron, and at no more expense than the present cost of our iron, the quality of which is equal to the best refined English iron.

With the furnaces as at present constructed we could not use peat alone. The combustion of the gas given out not being sufficiently perfect to produce the heat required for puddling to advantage, resulting in waste of fuel and additional labour to the men.

If we could get the extra price for the quality of iron turned out, there would be no doubt about the result, but, I fear this could not be obtained, as almost any description of iron seems to suit this market, so long as it can be sold cheap.

I send you samples of the iron made at the trial, which I consider equal in quality to BEST CHARCOAL IRON, and superior almost to any description of iron imported."

In a paper read by D. K. Clarke, of London, before the British Association, on a new preparation of Peat, at the Horwich Works, and to which the name of "Torbite," from the Latin *torbo* (peat), is given, says:—

"The charcoal made from torbite is extremely dense and pure; its heating and resisting powers have been amply and severely tested, and with the most satisfactory results. At the Horwich works pig-iron has been readily melted in a cupola. About 80 tons of superior iron have been made with it in a small blast furnace measuring only 6 feet in the boshes, and about 26 feet high. The ore smelted was partly red hematite and partly Staffordshire, and the quantity of charcoal consumed was 1 ton 11 cwt. to the ton of iron made, but in a larger and better constructed furnace considerably less charcoal will be required. It has also been tried in puddling and air furnaces with equally good results, considerably improving the quality of the iron melted. For this purpose the fuel was only partially charred, in order not to deprive it of its flame, which is considerably longer than that from coal. Some of the pig-iron made at Horwich was then converted into bars, which were afterwards bent completely double without exhibiting a single flaw. Messrs. Browne & Lennox, in testing this iron for chain cables, have reported that its strength was proved to be considerably above the average strength of the best brands.

"In Germany peat mixed with wood charcoal is very extensively used in the production of iron, the peat as prepared there not being sufficiently solid to do the work alone, but it is found that the greater the proportion of peat that can be used, the better is the quality of the iron produced. The gas delivered from the high furnaces has also been satisfactorily employed in the refining of iron and the puddling of steel. The value of peat in the production of iron has long been established. Iron metallurgists are agreed in the opinion that iron so produced is of very superior quality. In every stage of iron manufacture, and in welding, peat charcoal is most valuable. At Messrs. Hick & Son's forge, in Bolton, a large mass of iron, about 10 in. square, was heated to a welding heat with peat charcoal made at Horwich. The time occupied was less than the operation would have taken with coal; the whole mass was equally heated through without the slightest trace of burning on the outside, and in hammering out the mass, as much was done with one heating as ordinarily required two heatings to effect. The importance of obtaining an abundant supply, at cheap rates, of peat charcoal, cannot, therefore, be too highly estimated."

This evidence is very encouraging, from so high an authority. The process of manufacture is very much the same as by Mr Hodges' process, except that the raw peat has to be brought to the mill instead of the mill floating to and keeping up with the raw material; and also that owing to the dampness of the climate, artificial heat has to be applied in drying. One result of charring in close ovens, however, is, that a considerable quantity of valuable chemical products are yielded, as ammonia, acetic acid, pyroxylic spirit, paraffin oils, the sale of which alone will nearly cover the expenses of the whole process.

"The fatty matter separated by distillation forms an excellent lubricating grease, the yield of which averages about 5 per cent. of the weight of charcoal produced; in its crude state it has been sold for £12 per ton at Horwich.

For the generation of steam, Mr. Clarke declares it to be superior to coal, both in locomotive and stationary engines. On the Northern Counties' Railway, of Ireland, a saving of 25 to 30 per cent of weight consumed, over the average of three months' working with coal, was effected. In experiments with stationary engines, on two consecutive days, "coal got up steam to 10 lbs. pressure in 2 hours 25 minutes, and to 25 lbs. pressure in 3 hours; peat fuel got up steam to 10 lbs. in 1 hour 10 minutes, and to 25 lbs, in 1 hour 32 minutes; 21 cwt. of coal maintained steam at 30 lbs. pressure for 9¾ hours; 11½ cwt. of peat fuel maintained steam at the same pressure for 8 hours. But in addition to this a large economy is effected by the use of peat fuel for the generation of steam in the saving of boilers and fire-bars from the destruction caused by the sulphur in coal, from which peat is free. In Bavaria peat fuel has been used on the railways for several years past, and the economy effected by its use in the wear and tear of the engines is stated by the officials in their reports to be very considerable."

One of the experiments made in burning Peat on the Grand Trunk Railway, November 14th, 1866, is thus recorded:—

"Work performed by engine No. 158, burning peat fuel, with a mixed train of 18 cars, from Montreal to Prescott Junction, 112 miles. Prescott Junction being 260 feet higher than Montreal.

The train consisted of.............	16	freight cars
	1	passenger car
	1	van
Total...........	18	cars.
Weight of freight............	320,000	lbs.
Do of cars................	345,000	"
Total weight of train, cars and freight......	665,000	lbs.
Distance run........................	112	miles
Lost time made up in running between Vaudreuil and Matilda, 75 miles	110	minutes
Total weight of peat fuel consumed, 3½ tons.....................	7,450	lbs.
Value of fuel at $3½ per ton	$11,65	
Fuel consumed per mile run.....	66½	lbs.
Cost of fuel..........................	10	cents.
Number of car miles run.....	2,016	miles
Fuel consumed per car mile run	3.69	lbs.

Cost of drawing a car containing over 10 tons of freight, a distance of one mile, a little over half a cent.

The engine was in the same condition as when used for burning wood, with the exception of the blast nozzles, which were *enlarged from 2⅜ inches to 2¾ inches diameter, or 34 per cent.*

William Moore, the engine driver, before going this journey, had never seen peat fuel *burnt.*"

The *American Artisan* says: "A Master Mechanic of the New York Central Railway reports that a large engine worked well with peat, made plenty of steam and kept its grate clear of ashes by shaking. Four cords were used in about 70 miles. He considers that peat, of the quality used, is a good fuel. It will not clinker; and as the ashes are easily got rid of by a shaking grate, the engine can work a long time."

In a paper read before one of the learned British Associations,' by Mr. P. F. Nursey, he proves—so says the *Mechanics' Magazine,* "from well authenticated data, that the heating power of condensed peat is more than that of coal in the proportions of about two to one." On this subject *Leavitt's Peat Journal* says:—

It is an acknowledged fact that peat produces an intense heat—a feature of so much importance as to entitle it to prominent mention and careful consideration. Its virtue in this respect is much increased when properly prepared, solidified and dried, and it reaches its maximum of heating power when solidified and charred or coked. Mention has often been made of its peculiar qualities in this respect, but their importance will be more clearly comprehended when taken in connection with the facts in an interesting article on the "Calorific Value of Fuel," which we find in the *American Railway Times*, and which contains remarks so pertinent on this point that we quote as follows:—

"There are, in all, five important kinds of fuel only—these are, wood, peat, coal, charcoal and coke; the first three being natural, and the last two artificial fuels. The elements of which each of these is composed are practically identical—the difference of character being due to the proportion of those elements entering into the composition of each kind of fuel; and, according to those proportions, each fuel takes its relative position in the scale of value. Taking the comparative chemical composition of the various kinds of fuel, according to Dr. Machaltie, their percentage stands thus:—

	Carb.	Hyd.	Oxyd.	Nitr.	Sulp.	Ash.
Wood (dried at 280 deg. F.)	50.0	6.0	42.9	1.0		1.0
Peat (dried at 220 deg. F.)..	57.0	5.5	31.0	1.5		5.0
Coal	85.0	5.0	4.0		1.0	4.0
Charcoal	87.0	3.0	7.0			3.0
Coke	92.0				1.5	3.0

The *amount* of heat produced by fuels in their combustion does not always constitute their relative value. For some purposes, it is apparent that this would be the best criterion; but, as a rule, in metallurgic processes, the quantity of heat is of far less importance than the intensity, or power to raise substances to the highest temperature—and the fuel which affords the greatest quantity of heat is sometimes incapable of producing the greatest intensity.

In determining the intensity of the heat produced, it is necessary to know the available quantity of heat produced in the combustion of a pound of fuel, the weight of products of combustion, and the quantity or number of units of heat required to raise the products of the combustion of a pound of fuel, one degree Fahrenheit.

Where very high temperatures are required, the fuel which should be selected ought to approach as near as possible to pure carbon in its composition, and for the reason that carbon is the best substance for the purpose.

"We now see the reasons for making coal into coke, and wood into charcoal. Coal cannot produce a temperature equal to that obtained from coke, neither can the temperature of wood be compared with that of charcoal. And this results from the relative accession of carbon, and reduction of oxygen and hydrogen in them. This must be referred to the great difference between *quantity* and *intensity* of heat. If we cannot raise sufficient steam from a boiler by the use of one ton of coal, we can easily meet the point by burning two tons; but, if the fusing point of metal cannot be attained with one ton of coal, it by no means follows that any additional amount of fuel will insure the required result. The great distinction to be observed is between *quantity* and *intensity* of heat. The first of these two conditions depends upon the quantity of fuel, but the last is referred entirely to the quality of fuel.

"Twenty tons of coal will not give a temperature so great as that afforded by one ton of coke."

It should be observed, that in the above statement of comparative composition of fuels no mention is made of peat charcoal. Now it is an established fact, that peat charcoal is of greater density and calorific power than peat, or than wood charcoal, and, calculating the amount of carbon in peat charcoal at no more than the relative amount as between wood and charcoal in the above table, peat charcoal will be represented by 98, which exceeds any of the fuels mentioned in Dr. Machaltie's table.

The intense heat generated by peat fuel is a subject of frequent remark, and will eventually be dwelt upon, we think, as a very important consideration in estimating its value.

THE FOLLY AND DANGERS OF FREQUENT "STRIKES."

A correspondent of the *Scientific American*, in England, referring to the unusual stagnation in many of the leading and important trades, amongst other causes charges it "also to the folly of the workmen in striking for higher wages at a time when the state of business is such that to insist on these is simply to prohibit any work being done at all. The workingmen in many of the trades appear to think the masters can command an unlimited amount of money, and that this is wrongfully witheld from them, and their action is becoming such as seriously to interfere with business and to insure the success of foreign competition. If they could but see it, they are doing their best to deprive themselves of their means of support, which must always be dependant on the ability of the masters to compete successfully for orders with Continental manufacturers."

Another evil of "strikes" is, that a proper classification of workmen is seldom allowed. When men are scarce, the employer has to pay third or fourth class men first or second class wages; but when work is scarce and workmen abundant, then the third and fourth class workmen are immediately thrown out of employment, as no employer will retain such any longer than he is able to do so, at a proportionate rate of wages far higher than for first class workmen. It does often seem that these strikes are but combinations of first class workmen against third and fourth class men.

Another injustice of "strikes" is, that they generally take place while heavy contracts are in progress, and then bring either ruin or serious financial embarrassment upon the contractor, upon whom the workman depends for employment for himself and support for his family. In the summer of 1866, the journeymen builders of the City of Toronto struck for higher wages. The master builders met and formed an association also, and agreed to the rates of wages insisted on by the workmen, on these conditions:—that in the future, no higher rate of wages shall be demanded, nor shall any reduction be made in rates now assented to, except on three months notice from the respective parties proposing the change. This was agreed to by the workmen, and contracts are now taken with confidence that no strikes will intervene during the specified three months.

It is a great pity, that some means can not be devised to do away with this continual conflict between capital and labour, the employer and his employee, on principles that shall be just to both parties—especially as their respective interests are really identical, although to so many of them apparently the reverse. Is there any plan so likely to effect this object as the co-operative one, hinted at in the March number of this Journal?

DISINFECTANTS AND SANITARY PRECAUTIONS.

The arrival of spring, and the breaking up of the winter's frost, has liberated a vast amount of filth, which has been accumulating for some months past; necessitating a general *cleaning* up, and the disinfecting of many spots and localities in our cities and towns, if the health of their inhabitants is to be conserved. The beneficial efforts put forth by the Board of Health and Medical Health Officers for this city, during last summer, was shown by the diminished number of deaths by zymotic or preventible diseases during the year, as compared with previous years (See Health Report, Vol. VI, p. 319); and if similar or more energetic action be taken during the ensuing spring and summer, there is no doubt but the usual death rate may be still further diminished. The duty of Municipal Authorities is, undoubtedly, to see that nothing is neglected that can reasonably be done to improve our rates of mortality, or prevent the spread of any epidemic or contagious diseases, should any such visit our cities or towns during the coming season. The following Report on Disinfectants, by *Dr. Letheby*, the Medical Health Officer for the City of London, England, in reference to last year's operations of the board of Health will be found both interesting and useful:—

"The several disinfectants which I have largely tested are the following:—

1. Chlorine gas.
2. Chloride of lime.
3. Carbolate of lime.
4. Carbolic acid.
5. Chloride of zinc (Sir William Burnett's fluid).
6. Chloride of iron.
7. Permanganate of potash (Condy's liquid).
8. Animal charcoal.

Each of these disinfectants has its own particular value, and may be used on certain occasions in preference to any of the others: thus

1. *Chlorine gas*, being a very diffusive body, is best suited for the disinfection of places which cannot easily be reached by other disinfectants. I have used it largely for the disinfection of the vaults of churches where the atmospere has been so charged with offensive and dangerous organic vapors, let loose from the contents of the decaying coffins, that the workmen could not enter the vaults with safety. In this manner all the vaults of the city churches have been disinfected, and the contents of them put in order and covered with fresh mold. I have found also that chlorine is best suited for the disinfection of rooms where, as is the case with the poor generally, the occupant cannot be removed for a thorough cleansing; and I have employed it with great advantage in places where persons have been sick with fever, scarlet fever, small-pox, and cholera. The process which I adopt is the following:—About a teaspoonful of the black oxide of manganese is put into a teacup, and there is poured over it, little by little, as occasion requires, about half a teacupful of strong muriatic acid (spirit of salt). In this manner the chlorine is gradually evolved, and the action is increased, when necessary, by stirring the mixture, or by putting the teacup upon a hot brick. As chlorine is heavier than atmospheric air, it is best diffused through the room by putting the mixture upon a high shelf. The quantity of chlorine thus diffused should never be sufficient to cause irritation to the lungs of those who occupy the room, and yet it should be sufficient to be distinctly recognizable by its odor. If it be properly managed, the chlorine may be thus diffused through the atmosphere of the room, even during its occupation by the sick.

2. *Chloride of lime* has been very largely used in the city during the recent epidemic of cholera. The inspectors have sprinkled it upon the floors of the houses occupied by the poor, and have scattered it about the cellars and yards. In some cases it has been used with water for washing the paint work and the floors of rooms. Altogether indeed, with an average staff of 45 men, we have used rather more than seven tons of chloride of lime in this manner, in disinfecting every week about 2000 of the worst class of houses in the city, and the results have been most satisfactory.

3. *Carbolate of lime*, which is a mixture or rather a chemical compound of carbolic acid and lime, has been used in many cases where the smell of chloride of lime or its bleaching action has been objected to. It has been used by dusting it by means of a dredger over the floors of rooms and cellars; but as the disinfecting power of this substance is destroyed by chloride of lime, it is of great importance that they should not be used together. The carbolate of lime which we have employed contains 20 per cent of carbolic acid: it is essential that this should be its minimum strength, or its power is not sufficiently efficacious. The strength of it may be ascertained by treating 100 grains of it with sufficient muriatic acid, diluted with its own bulk of water, to dissolve the lime, when the

carbolic acid is set free, and floats upon the liquid; this, when collected, should weigh 20 grains at least. The advantage of carbolate of lime is its continuous action; for the carbonic acid of the air slowly lets loose the carbolic acid, which diffuses itself through the atmosphere in sufficient quantity to act as a disinfectant, and it does not destroy the color of clothing.

4. *Carbolic Acid* has been used as the sole agent of disinfection for privies, drains and sinks, and for the sewers and the public roads. In the former case it has been used in its concentrated state by pouring it at once into the privy or drain, but in the latter case it has been diluted with about 2000 times its bulk of water and sprinkled by means of the water carts upon the public way. In this manner about 1000 gallons of carbolic acid have been used in the city thoroughfares; and the acid getting into sewers, we have observed that the usual decomposition of sewage has been arrested, and instead of a putrefactive change with the evolution of very offensive gases, the sewers have been charged to a slight extent with carbonic acid and marsh gas. As there are many coal tar acids now sold for carbolic acid, it is of importance that the adulteration should be recognized. This may be done by observing the strength of the soda solution which will dissolve the tar acid. All the inferior acids are insoluble in a weak solution of caustic soda.

5. *Chloride of zinc* (Sir William Burnett's fluid, or, as it is sometimes called, Drew's Disinfectant), is well suited for the disinfection of the discharges from sick persons, but it is hardly applicable to any other purpose. The liquid should be of a proper strength, as having a specific gravity of 1594, water besides 1000 and it should contain about from 50 to 54 per cent of solid chloride of zinc. A tablespoonful of this liquid is sufficient to disinfect each discharge from the body.

6. *Chloride of iron* is applicable in exactly the same manner as chloride of zinc, and is only suited for the disinfection of the discharges from the body. It should have a specific gravity of 1470, and should contain about 40 per cent of metallic chloride.

7. *Permanganate of potash* is only suited for the disinfection of drinking water; for not being a volatile disinfectant, and being very slow in its action, and requiring much of it for any practical purpose, it is not available as a common disinfectant; besides which it attacks all kinds of organic matter, and will therefore destroy clothing and be neutralized by every species of organic substance. As a disinfectant of water, however, in localities where good filters of animal charcoal cannot be obtained, It may be usefully employed to disinfect water by adding it thereto until the water retains a very pale but decidedly pink tint. The permanganate which is sold generally has a specific gravity of 1055, and contains about 6 per cent of permanganate of potash. It will take more than a pint of this liquid to disinfect a pint of the rice-water discharge from a cholera patient, and even then the disinfection is very uncertain.

8. *Animal Charcoal.* I may state, that for the disinfection of water and the removal of dangerous organic impurity, I have ascertained by experiment that the best treatment is to filter the water through animal charcoal, and then to boil it for a few minutes. It may then be safely drunk.

The disinfection of bedding and all articles of clothing is best effected by exposing them in an oven to a heat of from 260° to 300 Fahrenheit. The exposure should be sufficiently long to insure the thorough heating of every part of the material to that temperature. When such a process can not be used, the clothing should be put into boiling water, and kept there until the water cools at the common temperature.

I refrain from entering into any explanation of the mode of action of these several disinfectants; for whether the agent of disease is a living germ, capable of reproducing itself, in the human body under certain conditions, as most likely it is, or whether it is an unorganized, or even as Dr. Richardson supposes, a crystalline compound, the practical results are the same and are unquestionable: and in conclusion, I would say by way of summary, that for the disinfection of sick rooms, chlorine and chloride of lime are the best agents; for the disinfection of drains, middens, and sewers, carbolate of lime, and carbolic acid are the best; for the discharges from the body, carbolic acid, chloride of zinc, or chloride of iron are the best; for clothing the best disinfectant is heat, above 260° if a dry heat, and 212° if a wet heat; and for drinking water, filtration through animal charcoal and a boiling temperature.

I may mention that the best disinfectant for stables and slaughter-houses is a mixed chloride and hypochlorite of zinc, and it has the advantage of mixing freely with the liquid matters of the slaughter-house, and not tainting the meat with any unpleasant odors. We have used it very largely for this purpose, and it is also applicable to the disinfection of houses in place of chloride of lime: which it much resembles in its chemical nature and mode of action."

EXIT FROM PUBLIC BUILDINGS.

Proprietors, trustees, or managers of churches and public buildings, should bear in mind that, by Act 29, 30 Vic, cap. 22, it is made imperative that all exit doors thereof, and gates of outer fences, must be so constructed or altered so to open outwards; and that a failure to comply with these provisions of the Law, by the 15th of August next, will involve a penalty of "*Fifty Dollars*, and a further fine of *Five Dollars* for every week succeeding in which the necessary changes are not made."

The duty of seeing that the act is enforced, devolves upon the High Bailiff, Chief Constable, or Chief of Police, in Cities, Towns, and Villages; under a penalty of *Fifty Dollars* for neglecting to perform such duties.

Cholera Animalcules.—Dr. Kolb, of Vienna, has found by microscopic examination that the rice-water discharges contain countless mushroom-like insects, or "entomistic excrescences." To destroy these organisms and arrest their propagation, is the problem now before the profession.

THE ILLUSTRATED MONTREAL HERALD.

We have received a double number, of extra large size, of the *Montreal Herald*, containing some thirteen elaborate wood engravings from 9 inches square to 16 by 12 inches, of churches, public halls, and blocks of business buildings, erected in Montreal during the past year. This publication, which reflects so much credit on the proprietor of the *Herald*, will afford a fair indication of the state of architecture, and of the rapid progress commercially of the business metropolis of Canada.

In the introduction to the descriptions of the buildings illustrated, the writer says:—" Since the appearance of our last illustrated HERALD our new buildings, whether intended for residences, for places of business, or for public purposes, have continued to show a marked progress, both in extent and beauty of design. * * * Though our designs do not include any specimens of domestic architecture, the newer private residences of our citizens have fully kept pace with the general improvement. The buildings illustrated are to be "looked upon only as examples, as there are other buildings just erected, or in course of erection, which are equal in beauty" to those represented. One great improvement mentioned is the widening of Notre Dame Street, "the whole of the northwest side of which, for about the length of two-thirds of a mile, will form rows of stately stone fronts, generally four and five stories high, such as few cities can boast of." May not only Montreal, but every other city and portion of our new "Dominion of Canada," continue to realize a healthy progress!

Board of Arts and Manufactures

FOR UPPER CANADA.

TRADE MARKS.

Trade Marks registered in the office of the Board of Registration and Statistics, and open for inspection at the Library of this Board.

(*Continued from page* 90.)

Huckett and Son, Waterloo, C W. Trade Mark:—A circular label, with bust of J. O. Oliver in the centre; surrounding the words "Genuine Yarmouth Water-proof for Boots and Shoes." Recorded in Vol. A, folio 160 (No. 224). April 10th, 1867.

Daniel Young, Conway, Co. Lennox. Trade Mark:—"The Shoshonees Vegetable Restorative Pills." Recorded in Vol. A, folio 161 (No. 211). April 15th, 1867.

Wm. Maynard, Montreal. Trade mark:—"Maynard's Cerine." Recorded in Vol. A, folio 162 (No. 293). April 23rd, 1867.

VOLS. II AND III WANTED.

The Secretary of the Board will pay full price for a few copies of Vols. II and III of this Journal, or either of them, bound or unbound; or their full value will be allowed in subscription for current or future volumes. The same remarks will apply to numbers for January, November and December, 1862; and for March, May, August, September and November, 1863. These volumes, or numbers of volumes, are required to complete sets.

TO MEMBERS OF THE TORONTO MECHANICS' INSTITUTE.

The Directors of the Institute have made arrangements for publishing, every month, on the cover of this Journal, a complete list of all new books added to its Library.

Members of the Institute, by subscribing to the Journal, will thus be supplied with a monthly supplement to the catalogue of the Library.

Subscription 75 cents per annum; or when paid through the Secretary of the Institute, 50 cents per annum, in advance.

Transactions of Societies.

THE TORONTO MECHANICS' INSTITUTE CLASSES.

A public meeting, for distribution of the prizes awarded at the recent Annual Examination of the several Winter Evening Classes, was held in the Music Hall of the Institute, on Wednesday, the 10th of April—the President, F. W. Cumberland, Esq., in the chair. John McDonald, Esq., M.P.P., Hon. John McMurrich, Rev. W. Stephenson, and R. A. Harrison, Esq., severally took part in the proceedings, and delivered interesting addresses in advocacy of the praiseworthy efforts of the Institute, in providing such admirable opportunities of improvement for youths and young men and women, whose time is occupied during the ordinary working hours of the day in various industrial pursuits. After the report of the Class Committee had been read by its Chairman, Mr. W. H. Sheppard, the Secretary of the Institute called up the successful competitors, to whom the President severally presented the various prizes, consisting of a choice selection of valuable books, and introducing each presentation with suitable remarks, complimentary and encouraging to the several parties receiving them. The prizes awarded are as follows:—

ARCHITECTURAL DRAWING CLASS—1st prize, — Wallace; 2nd do., — Anderson; 3rd do., George Roberts.

ORNAMENTAL DRAWING—1st prize, Miss Annie Webster; 2nd do., E. Dack; 3rd do., J. E. Pollock.

MATHEMATICAL CLASS—1st prize, G.W. Hodgetts; honourable mention to be made of Williams, who was almost equal to his competitor; 2nd prize, E. Burke.

BOOK-KEEPING CLASS—1st prize, James Bain; 2nd do., J. Robinson; 3rd do., R. McGregor.

WRITING CLASS—1st prize, R. M. Foster; 2nd do., Geo. Brent; 3rd do., Wm. Rennie.

FRENCH CLASS—1st prize, S. S. Stephenson; 2nd do., Geo. Hume.

Report of Class Committee.

According to the Report, there were 180 pupils in attendance, and seven classes in operation, namely:—Architectural and Mechanical Drawing, taught by Mr. James Smith, Architect; Ornamental and Landscape Drawing, by Mr. Richard Baigent; Mathematics, by Mr. Henry Browne; Book keeping and Penmanship, by the *Principals* of Bryant, Stratton & Odell's College; French, by M. Pernet; Elocution, and Phonography, by Mr. Richard Lewis.

With reference to the conduct of the classes, the Committee quote the report of the Mathematical Master, as indicative of the whole. Mr. Browne says:—"There are very many who, for regularity, punctuality, and diligence, deserve my highest commendation. I must not omit to state that all evinced their good sense by cheerful submission and prompt obedience; and their gentlemanly and respectful demeanour towards myself, commands my admiration." The Committee in their report also speak highly of the efficiency of many of the pupils in the several classes; and "thank the teachers for the zeal and interest they have manifested in their work;" and also "acknowledge the kindness of those who acted as examiners of the classes, and heartily thank them for the valuable time and talents they have devoted to the work;" they also "gratefully acknowledge the annual grant of $100 from the Northern Railway Company," in aid of the classes.

On the subject of adult instruction for those engaged in industrial pursuits, the Committee say:—

"Although so much has been done for the instruction of the industrial population by the Mechanics' Institute, the Committee feel that there is much more to be done—far more than the Institute, with its present resources and prospects can hope to do. It is very desirable that our mechanics and artizans should be instructed in the principles of chemistry and other physical sciences, which not only bear upon their respective occupations, but would also have a powerful moral bearing upon their minds. Much of the low language and profanity which prevails in some of our workshops would be superseded by profitable conversation if the minds of our workmen were furnished with their allotted tasks when they are familiar with the natural laws under which they are working, has been proved by experience.

"The establishment of classes for the study of the natural sciences involves a large outlay at the beginning; and a subsequent expense much larger than can be met by fees from pupils. The great problem is how to obtain means for their support. The Minister of Agriculture in his report of 1866, speaking of the manner in which Mechanics' Institutes, science schools, schools of design, &c., are supported in England, admits "that the government of Canada ought unquestionably to do much more than it has done to promote similar objects and interests; but he thinks that in order to make them successful there must be a liberal and continuous local co-operation.

"We cannot but feel that the intellectual advancement of the industrious classes of our cities has been much overlooked by the government. We see colleges and universities established for the upper classes and due provision made for the proper education of professional men. The agricultural societies get from government for their assistance an amount equal to that contributed by themselves; but mechanics and artizans, who fully bear their share of the burden of public taxation, are left, with the exception of the very small sum allowed to the board of arts and manufactures, to provide as they best can for their scientific and technical education. We do not desire that the government should aid the lighter branches of our Institute, such as novel reading and public entertainments, but we do think it would be only just if in the matter of classes and instructive lectures a subsidy were granted proportional to the amount raised locally, as in the case of agricultural societies, and we think that the benefit thereby conferred on society would more than compensate for the outlay.

"We trust, however, that our country under its new organization will see the desirability of having not only her profesional men well educated, and her agricultural population scientifically instructed, but also in having her artizans (in whose workshops are produced those articles of usefulness, elegance and taste, which mark our social advancement and refinement, and without which all the other interests of society would be incomplete and barbarous) well trained in those branches of knowledge which will make them not only more proficient in their ordinary occupations, but also better and more useful members of society."

The meeting, although not numerously attended, on account of the very unfavourable state of the weather, was of a very interesting character. The subject of Adult Education by Evening Classes, and Education generally as applicable to the pursuit of manufacturing and other industrial pursuits, is a very important one, which we may in a subsequent number discuss at greater length.

Modern majesty consists in work—What a man can do is his greatest ornament, and he always consults his dignity by doing it.

Selected Articles.

CURIOSITIES OF COMBUSTION.

BY PROFESSOR CHARLES A. SEELY.

"Combustion is the disengagement of heat and light which accompanies chemical combination." This is a very good definition, the best one I remember to have seen. I intend this as a high compliment for I have observed that school-book definitions often need more explanation than the thing defined. It is a very interesting and profitable mental exercise, to discover the heterogeneous things that a definition owing to its inaccuracy of languages, is obliged to cover. Any book on the physical sciences will furnish good material. It is a very ancient amusement. Plato once defined man to be a "two-legged animal without feathers," a definition of man about as precise as ever was made. But Diogenes plucked a goose, and throwing it into the Academy, exclaimed, "Plato, behold your man." So I might bring phosphorous and rotten wood which shine in the dark and to a delicate thermometer exhibit heat, as cases of combustion. But Dr. Ure, the author of the definition, might very aptly retort, as did the preacher whose sermon was criticised "better it if you can." And I should be forced to reply, "I cannot unless you allow me to use a great many more words."

The combustion with which we are most familiar is that where oxygen is one of the elements concerned. A very interesting peculiarity of this ordinary combustion is the fact that its beginning requires a high temperature. We consider coal, wood, oil, sulphur, and gunpowder very combustible, but there is no combustion, although oxygen be present, until they be set on fire or ignited, that is, some portion be heated up to a high temperature. Oxygen is very different from other supporters of combustion in this respect, for with them combustion begins at ordinary temperatures. If suddenly chlorine were put in the air in place of oxygen, or if the oxygen should assume its active form known as ozone, every thing combustible upon the earth would take fire and be consumed with fervent heat in a few hours. This property of oxygen, to which I allude, is another of the striking evidences of the adorable Wisdom everywhere to be found in the order of nature.

The temperature of ignition varies greatly for the different combustibles. Phosphorus, sulphur, and sodium take fire below a red heat, while the ignition point with others is so high that we have an opportunity to see them burn. The combustible nature of iron, lead, copper, silver, and gold, was not even suspected until a recent period. We know now that they burn even more readily and fiercely than any common fire, when once they are kindled; if I wanted to make the most gorgeous pyrotechnic display I would make a bon-fire in which I would burn up a few tons of iron. The ignition temperatare have been determined for only a few substances. Here is useful work to be commended to the rising generation of chemists. The facts ought to be determined and put into the form of a table.

The philosophy of spontaneous combustion is now well determined and can be made plain to everyone. Heat is always a product of oxidation, or in other words, heat always accompanies the union of oxygen with another substance. The amount of heat produced is, moreover, exactly proportioned to the amount of oxidation. If a day or a year be employed in burning (oxidizing) a pound of coal the amount of heat in the two cases is precisely the same. The rapidity of burning has nothing to do with quantity of heat; it is a question of intensity, quite another thing. The pound of coal burning in a minute gives an intense heat and consequently light, but let the heat be distributed over the space of a year, and it would require an instrument far more delicate than our senses to detect that which would appear in a second or a day. In slow burning or oxidation the heat is simply diluted in time or space. Let a child's supply of candy be divided and administered constantly, and in the homeopathic doses, he would never suspect that candy had any taste.

The rust which is produced from a pound of iron indicates or represents an amount of heat sufficient to raise nearly 3,000 pounds of water 1° Fah; that is such a quantity of heat was produced by the rusting or oxidation. As the specific heat of iron is one-ninth (nearly) that of water, this quantity of heat is sufficient to raise the temperature of one pound of iron to the temperature of 27,000°, or nine pounds to 3,000° which last is without doubt above the ignition point of iron. Suppose the heat of rusting be retained in rust. Would not we have a spontaneous combustion which would be fearful even to think of?

In ordinary oxidation the heat leaks away by radiation and conduction as fast as it is generated. Let us see how we may retain it. As oxidation takes place only at the surface it is plain that its rapidity will be increased just as we increase the surface. Thus, a pound of iron extended so as to have double the surface will be rusted in half the time, with one-hundreth the surface in one-hundreth the time. Suppose the pound of iron to be originally in the form of a ball and that we divide it successfully into balls smaller and smaller. The surface of balls are to each other as the squares of their diameters, while their weights are as the cubes of their diameters, and the ratio of the surfaces to the weights is constantly increasing as the division goes on. It is evident that by so dividing and increasing the surface a point might be reached where the heat would be generated by oxidation more rapidly than it could leak away, and that thus the ignition temperature would be reached when combustion would ensue.

This is no speculation. I can prove the facts by actual experiments, dividing the iron and exhibiting it taking fire, with far less labor than I have put on this article. Prussian blue is a compound of iron, nitrogen, and carbon. If it be heated to a bright red heat in a tube or crucible from which the air is excluded, till fumes cease to be evolved, the iron is left finely divided. When the apparatus is cool the iron may be taken out and on exposure to the air it will immediately take fire. Ordinary lead is not easily set on fire. But get it in fine powder! Fill a small vial with tartrate of lead, fit in a clay stopper, set the vial in a sand crucible imbedding the vial in sand, and subject the whole to a low red heat for half an hour. The vial now contains lead powder, the particles of which are prevented melting together by other fine particles of carbon. This lead powder takes fire as soon as it is brought into the atmosphere. Dissolve phosphorus in bi-sulphide of carbon, and dip a piece of cloth or paper in the solution and expose it to the air. Instantly as the solvent has evaporated, the phosphorus (now finely divided) takes fire. I might describe hundreds of similar experimental illustrations, but I hasten to the cases of spontaneous combustion which occur in the ordinary routine of life.

Ninety-nine hundredths of these cases originate from the oxidation of linseed oil. This oil in a paint-pot has little surface exposed compared with its whole mass, and the heat generated and diluted over the whole body of the oil, radiates into the air, etc. When the paint is spread on wood, the oil oxidizes rapidly and heat is correspondingly produced but being in contact with the conducting wood it is carried away. But if the wood were a non-conductor and no heat were radiated the oil would speedily take fire. When the oil is mixed with saw-dust or spread on cotton, wool, paper, or clothing, and the mass is kept away from strong currents of air, spontaneous combustion ensues. A painter rolls up his greasy overalls in a bundle, throws them in a corner or on a shelf and the house is set on fire; dozens of cases like this have occurred in this city. Linseed oil is so remarkable in this way that I think it might sometimes be made available for kindling a fire where matches and other conveniences are not at hand.

The spontaneous combustion of nitro-glycerin, gun cotton and pyrotechnic compounds may be brought within the category of oxidation. But in all these cases the oxygen is not supplied from the air. It is part of the substance itself, and is gradually eliminated to the part which is combustible. A complete explanation of these cases would extend this article beyond reasonable limits.

* * * * * *

An ex-coffee manufacturer has given me the particulars of two interesting cases of spontaneous combustion which occurred in the course of his business; and as it seemed to me that the facts might prove useful if widely known I obtained his consent for their publication. For the information of a small number of my readers it is necessary to explain that a coffee manufacturer is one who roasts beans, peas, wheat, barley, rye, corn, chicory, etc., grinds with a few roasted coffee-berries, and divides the mixture in neat paper parcels to suit the demand of the public. Many consider this business illegitimate. I do not, unless the product is represented to be what it is not. The public will always have what they call for.

My friend in various ways had observed a tendency towards spontaneous combustion of some of his roasted material, and had adopted what he supposed sufficient precaution against dangers. One day he roasted about ten bushels of barley. As was then his practice the grain was drawn from the roaster on a large cooling table covered with zinc, spread out and turned over until it was supposed to be cold. It was then late in the day, put into barrels, and shortly the factory was locked up for the night. During the night a watchman discovered smoke issuing from the premises, made a forcible entry, and found the barley in all the barrels on fire. The barrels were promptly rolled into the street and the fire was extinguished by an abundance of water.

After this he adopted further precautions, but failed again. As soon as the roasted grain was spread out it was sprinkled with water from a watering pot, and was left a longer time on the table. A few bushels of roasted wheat were spread on the table, sprinkled with water and left on the table for the night. In the morning in place of his wheat, he found only a heap of clean ashes. There was not a kernel left unconsumed.

In explanation of these cases I would suggest that during the roasting there is generated a substance which has a peculiar affinity for oxygen and in this respect is akin to linseed oil. This substance is probably a volatile oil to which the peculiar aroma of roasted grain is due. Such a substance is known to exist in roasted coffee-berries. The aroma of coffee is soon lost by reason of its affinity for oxygen which changes it into a substance which has little or no odor. Hence also dried coffee grounds are not near so combustible as fresh roasted coffee.—*Scientific American.*

BUSINESS FAILURES.

We copy the following from the *Trade Review*, as suggestive to those who have already made, or are contemplating, to make a start in business, either as Mechanics or in Commercial life:—

The causes which operate to produce failures in business are various—but they are by no means so numerous as many superficial observers suppose. The chief parent of failures are periods of stagnation in the business of a country. During such periods, failures may be considered *legitimate*, inasmuch as in many cases they arise, not from folly on the part of the insolvent, but from derangement in the business of the country. At other times, however, the great bulk of failures arise from over-speculation—want of judgement—personal extravagance—undue credits—want of business education and similar causes. Those who become insolvent from such reasons as these are unjustifiable, inasmuch as the circumstances were not beyond their control and might have been so moulded as to eventuate in success.

During the past year—1866—it is gratifying to know that both Canada East and West have suffered less from failures in business than for many years past. During the years '62, '63, and '64, many business men who had struggled on since the previous commercial convulsion went down; others, too, who had started more recently, found they could not make headway against the "hard times" which the comparative failure of the crops for several successive years produced. The aggregate of the failures throughout Upper and Lower Canada was quite large, both as regards numbers and the amount of losses sustained. The splendid harvest of 1865 was the turning point of the tide, and it is gratifying to know that it still runs in the same direction, for the failures in 1866 were considerably less than during the preceding year. According to the estimates of Dun, Wiman & Co., of the Mercantile Agency, the failures of 1865 and 1866 were as follow:

FAILURES IN 1865.

	No.	Liabilities.	Assets.
Upper Canada	297	$3,108,082	$1,458,608
Lower Canada	130	2,536,052	1,006,853
Total	427	$5,644,134	$2,465,461

FAILURES IN 1866.

	No.	Liabilities.	Assets.
Upper Canada	209	$2,004,154	$ 937,564
Lower Canada	104	1,106,923	683,335
Total	313	$3,111,077	$1,630,890

These figures speak volumes for the improvement which has taken place in the business of Canada. They indicate a large falling off in the number of failures during last year; as compared with 1865, it will be observed, that there were 114 fewer cases of insolvency, and a reduction of over $2,500,000 in the losses. This is a very satisfactory and encouraging exhibit, proving that our commercial affairs are in a sound and healthy condition, and that those failures occurring at present, must as a general rule be attributed to causes appertaining to the insolvents themselves.

What, then, are the principal sources of failure when the general business of the country is good? We reply: *the faults and follies of business men.* Let us glance briefly at some of the most prominent of these.

And first—we would specify: *want of judgement.* This is manifested in many ways, but very frequently by commencing business where business is already overdone. The man who begins a business where there is not a field for it, cannot reasonably look for success. In some new locality, where new settlers are rapidly coming in, the venture may in the end prove successful. But in other places, where the advancement is slower—the increase of business being slight—the new beginner can only be successful by taking away the trade of his neighbor, and whether he succeeds in this or breaks down himself, there is a serious injury done. If more judgment were exercised in finding a suitable opening before commencing business, fewer failures would occur.

Ignorance of business is a fruitful source of insolvency. The days when Smith, Jones, "or any other man," could take up intricate branches of business and succeed, are fast passing away. Before Canada became as wealthy as it now is, and when competition was less keen, sometimes men succeeded in callings of which they knew little. Nowadays, however, the necessity of business education is recognized on every hand, and the individual who neglects it, does so at his peril. Those who enter into the mercantile business or any branch of manufacturing, can hardly expect to compete with their neighbours who thoroughly understand their calling, and unless they happen to be men of more than average business talent and experience, they bid fair to have their names gibbetted in the official *Gazette.* The man who thoroughly understands his business will make money out of it, where the novice will starve; and whenever competition is brisk, and the trained and untrained man come into contact, the latter must go to the wall. The same reasoning applies to all branches of industry, and not a few of the failures throughout Canada during the past three or four years, can be clearly traced to this cause.

The third cause of failures we would mention is, *over speculation.* This may be of two kinds: either in starting business with an inadequate amount of capital to carry it on properly; or, being over-eager to get rich, ruining a good business by striving to do too much. In Canada, the state of business varies considerably. Depending as we do principally on our crops for prosperity, a good crop excites business—a bad one depresses it. Those individuals, therefore, who are given to over-speculation, who are always crowding on all possible sail, are sure to be caught in a gale sooner or later. Under the influence of good crops, they buy far beyond their capital, relying upon another good crop to enable them to make their payments. When their hopes are realised, all goes well; but when the crops turn out bad, as is too frequently the case, these over-speculative individuals topple over like tenpins in an alley.

Trying to amass fortunes with undue haste, is a dangerous experiment, and where one succeeds ninety-nine fail. Better far is it to advance slowly and cautiously, to work within the limits of your capital, and to shun risky speculations. Those who soar too high are apt to meet the fate of Icarus, who flew so near the sun that he melted his wax-bound wings, and soon found himself tumbling into the waters beneath.

The *old credit system* is another of the causes which have afflicted the business of this country. Many a merchant and trader whose transactions were large, and who bade fair to make a competency, has succumbed to this cause. In many such cases, the public, and even the party interested, supposed he was making money. And so he was, if the goods sold had been paid for. But giving twelve, eighteen, and twenty-four months' credit, his book debts soon swelled to large amounts, and trouble in meeting bills payable began to be felt. Then probably the crops failed, creditors demanded payment of his purchases, and not being able to collect his scattered debts, embarrassment ensued, and failure and ruin became unavoidable.

The old system of long credits has now been pretty effectually killed out in Canada, but there are some who still cling to it, much to their own injury, and to the injury of the very parties who obtain it. There is no use in multiplying words on this point. The evils arising from long credits, and consequent bad debts, are admitted on every hand, and the man who at the present day fails from this cause, has himself alone to blame for his misfortune.

The last cause of business failures we would at present refer to is, *personal extravagance.* As a general rule, extravagance among business men does not set in at the commencement of their career. It is after they have begun to make money and attain a position in society, that their annual expenditure is apt to overtop their income. The desire to eclipse the fine house of Mr. Jones, his opponent in business, fills the merchant's heart, or the family horse and carriage must be set up. The old Scotch maxim, "live within your income," is apt to be forgotten, and the close of each year sees the profits of a good business more than swallowed up. It seems strange that failures should occur from this cause, for one would suppose that an individual might easily perceive that he was living above his income, and become more economical before bankruptcy set in. But extravagance once indulged is easier discovered than prevented, and it is notorious that personal extravagance lies at the root of many a case of insolvency which occurs.

As we said at the commencement of this article, the number of business failures throughout Canada is becoming less. At the present time at least, the dullness of Provincial business is not the cause of failures, and those who become bankrupt are generally to blame themselves. We have endeavoured to touch upon a few of the principal causes of insolvency. In a short article, it is impossible to do more than glance hastily at each; but, we feel assured, if the business community abstained from the follies we have pointed out, at least two-thirds of the failures which occur might be avoided.

We believe the *Trade Review* has done good service by its remarks on this and kindred subjects, since it came into existence. But the commercial world of Canada has much to learn yet; and the sooner all classes learn the lessons we have endeavoured to teach in this article, the fewer cases of failures will occur, and the better will it be for the business of the country.

SANITARY ARRANGEMENTS OF THE CITY OF LONDON.

The sanitary arrangements of the City of London are amongst the departments best managed by that municipal government—indeed, they are the best managed in Europe. The cause of this excellence is not far to seek. The active measures are under the control of two officers—an engineer and a medical man—far above the average in activity and ability, and the Commissioners of Sewers have the good sense to allow them a large discretion, and vote liberally the funds needful for improvement and administration. Dr. Letheby's last report is full of matter that may be usefully studied by the governing authorities of every great city of Europe. Within eleven years the inspection of houses in the City of London has risen from 5400, in 1856, to 12,200 in 1866; and in the same time the orders issued for sanitary improvement have increased from about 1200 to over 3000. In 1856, the sanitary work of the City was done by the six inspectors of pavements, who devoted a comparatively small portion of their time to this work. But, in 1858, on the recommendation of the Medical Officer of Health, an additional sanitary officer was appointed, with the sole duty of inspecting and reporting on common lodging-houses. Rules and regulations were drawn up and enforced for their management. In 1864, a further step in advance was taken; a complete change was made in the mode of performing the sanitary work of the City; officers were appointed whose sole duty was to attend to the sanitary business of the City. Still, with three inspectors, there were frequently just complaints of the intervals which elapsed between the inspections of the poorer class of houses, which are not less than 4000 in number. Finally, in 1866, the City was divided into four equal districts, with a sanitary inspector for each. The results of this close attention have been very striking. The Sanitary Act of 1866, not only requires a constant supervision of the houses of the poor, but enlarges the definition of a "nuisance," and adds to the power of local authorities in dealing with it. Previous to the passing of that Act, the word nuisance merely applied to such a state of premises, ditches, gutters, water-courses, privies, urinals, cesspools, drains, or ash-pits, or to any animal so kept as to be a nuisance or injurious to health; but now it includes any house, or part of a house, so overcrowded as to be prejudicial to the health of the inmates; or any factory, workshop, or bakehouse not kept clean, or ventilated, so as to render harmless any gases, vapour, dust, or other impurities likely to be dangerous to health; also black smoke from any workshop. Under this Act, where local authorities neglect to do their duty, the police can be set in motion by one of the Secretaries of State. Local authorities have also large powers for cleansing and disinfecting houses, clothing, and bedding; for providing carriages for the conveyance of persons suffering from infectious disorders, and for the removal of dead bodies from rooms in which persons are living. The powers for regulating lodging-houses are much enlarged. The result of these practical steps for making and keeping the City and its inhabitants more clean, is shown in a marked diminution of the death-rate. The mortality from the diseases connected with cholera has declined in a steady and remarkable manner. In the first six years recorded it was at the rate of 64·2 per 1000 deaths; in the next six years, 14·2 1000 deaths. In 1848 cholera was charged with 63·5 deaths per 10,000; in 1854 it was reduced to 19·7; and in 1866 to 9·5 per 10,000 of the population. The deaths from cholera in all London were in the same year 18 per 10,000, in Paris 39, in Amsterdam 42, in Vienna 51, and in Brussels 163. Dr. Letheby also argues, with a show of reason, that the City has stood as a barrier between the eastern parts of the metropolis, where cholera raged so severely as to cause a mortality of about 64 per 10,000, and the western districts, which suffered only to the extent of 3·6 per 10,000. Dr. Letheby concludes his report by suggestions which will apply to every crowded population. Houses built long ago, when the value of light and air was not at all appreciated—then intended for the residence of one family, and now let in lodgings to the poorest class—and others situated in narrow courts and alleys without a breath of direct ventilation, and where the foul gases generated by filthy habits have no means of escape but by slow diffusion, "will counteract the best efforts at sanitary improvement. Such houses are saturated with the filth of ages; nothing will thoroughly cleanse them." Model lodging-houses are occupied by a superior class of persons to the labouring poor, and there is no house accommodation for those displaced by very needful improvements. But even new buildings and the most active efforts to ventilate, scavenger, and provide water will fail unless the habits of the poor themselves are improved. The poor must be taught how to use the water and the fresh air provided for them. It is not enough to lay penalties on the landlord; the tenant must be made liable to summary punishment for breaking or neglecting the sanitary apparatus provided for his use. This will be a proper subject for clauses in a revised Sanitary Act.—*London Gas Light Journal.*

BREECH-LOADING RIFLES.

The following practical remarks of the *American Artisan*, are worthy the attention of the military and other authorities having charge of our country's defence:—"Now that it is fully decided that the breech-loading gun is wholly to take the place of the muzzle-loader, the next great contest will be between the single shot and the magazine arm. That both kinds have their advantages and each has its advocates we will not deny, but the question at issue seems to be which arm is best adapted for the use of the American soldier. If it be necessary to throw a sudden shower of lead upon an enemy, then the magazine arm must have the preference; but the consciousness of being able to thus hurriedly project a couple of dozen balls, in rapid succession, without stopping to reload his piece or scarcely move it from the shoulder, will render the soldier reckless of his ammunition and careless of his aim, and an enemy knowing this, would take advantage of the lull in the firing that would be requisite for the soldier to fill the magazine of his gun, and would throw his whole force upon him and, as a result, the effort to repel his advance would be feeble and soon broken. But to the skillful and carefully trained soldier, who occupies the extreme of an advancing line, or who is advancing as a skirmisher, the magazine gun will be of great advantage. For cavalry, whose movements are quick and whose fire is to be momentary and rapid, there can be no better weapon of offense or defense than the magazine gun, and by the time that the magazine supply is expended they will have carried their point and obtained their object, or they will have retired beyond the reach of fire.

Let the main body of infantry be armed with a strong, simple, and easy-working breech-loader, of but a single shot between each manipulation for loading, and they will learn that upon that one shot may depend the fate of a day or the turn of a battle, and they will soon exercise care in firing and precision in their aim. The soldier then is conscious of his ability to fire any number of shots at regular intervals, and can continue to do so until his store of ammunition is expended. There will then be no long interval or lull in the firing of a body of troops, and an enemy knowing this will not seek to draw their fi.e as might be done in the case of magazine guns.

We repeat, the main body of an army should be armed with single shot, breech-loading rifles, and as their movements upon an enemy or retreating from him must be constant for some time, this form of rifle will enable their fire to correspond with their movements, steady and unremitting. Cavalry, as we observed, whose movements are quick and sudden, who are seldom long under fire, must of a necessity be armed with a magazine gun. We have seen, in the history of the arms given to our cavalry, that the muzzle-loading "horse-pistol" was thrown aside for the Colt revolver, as a far superior arm. The muzzle-loading percussion rifled gun was also given to the mounted man as a weapon superior to the flint-lock smooth-bore of the infantry soldier. There was, however, one merit which the old horse-pistol had which we always admired, and that is it carried the same sized ball and cartridge that the rifle did, and one cartridge-box would serve for both arms. In the army of a nation there ought to be but one size of bore and one kind of ammunition for the rifle and pistol, for both infantry and cavalry.

As artillery supports are often broken or artillery is without its infantry support, and as a consequence cavalry may drive them from their pieces, or their guns be captured, we would advocate giving the magazine gun to the artillery, or to a portion of them at least. The drivers, in particular, should carry the same weapon as a cavalryman; for if a cavalry charge be made upon artillery, a shower of bullets from a few magazine rifles may tend to check them for a moment and produce a slight confusion, and then a few shells or well-directed charges of grape or canister will turn their line into broken ranks and their confusion into a hurried retreat."

WHAT IS CLAY.

On the table before us, lies a bright piece of sheet metal. It is not as bright as silver, and it has not the intense blue tinge that distinguishes zinc. Its surface soon get soiled and dull, otherwise it would probably assume a place as one of the precious metals. But nitric acid, in which silver dissolves almost as easily as sugar does in water, has no action upon this metal, and beyond the first mere dulling of the surface it remains for years without rusting or tarnishing. But by far the most singular feature of the metal before us is its lightness, or as a chemist would say, its low specific gravity; for while osmium, the heaviest body in existence, is nearly 21½ times as heavy as water, silver ten times, lead eleven times, steel eight times, and zinc nine times, aluminium is only two and one half times as heavy as water.

Hence a teapot made of aluminum would weigh but one-fourth that one of the same size made of silver would do, and this property of the metal has caused it to be used in France in the construction of helmets and of the eagles which surmount the standards of the Imperial forces, it being of great consequence in these cases that the weight to be carried should be diminished as much as possible.

As yet, however, this beautiful metal, of which the soil beneath our feet may be regarded as one vast mine, has not been brought into anything like general use, and we presume that many of the readers of this article have never seen it. It has, it is true, been made into spoons, which have been sold as curiosities, but the only really useful purpose to which it has been applied in ordinary life is the manufacture of pens. For this purpose we understand aluminum is but little inferior to gold.

One gentleman in England took a brick from an old Roman wall and extracted from it a sufficient amount of aluminum to manufacture a pen, with which he wrote a very interesting book.

But although in those days a metallic base is an attractive subject, we must pass on. When this bright metal is burned it forms a beautiful white powder—alumina. It seems strange to talk of a metal burning. When men wish to make a fireproof building, they employ iron for shutters, stair rails, etc. And yet in some conditions iron is more easily ignited than gunpowder. We have seen a popular scientific lecturer pour iron in fine powder out into the air, and it took fire itself, which gunpowder will not do. He then held up a large bunch of iron filings, set them on fire with a match, and they burned like tinder, falling down in splendid burning flakes. All this was in the open air and without the aid of chemicals. Then again, we saw him take a brilliant silvery metal—magnesium ; it was in the form of a slender ribbon, which he ignited with a spirit lamp, when it continued to burn, giving out a light of dazzling brilliancy—the famous magnesium light which can be seen at a distance of sixty miles.

Alumina, as we have said is a beautiful white powder. It is but very rarely found in nature uncombined with other substances. We do not say unmixed, but we use the stronger term uncombined. The sapphire, the amethyst, the topaz, the ruby, and the emerald are nearly pure alumina and it is curious that the soft clammy earth alumina, should produce gems which, in hardness exceeds quartz, and rank next to the diamond.

It also occurs combined with water in a few minerals as Diaspore, Gibbsite, etc., but it does not occur uncombined in any quantity in nature, and we might just as well say that water is the breath of life because it contains oxygen, as to say that clay is alumina.

Alumina, in its general character, has a strong resemblance to the earths, but on the other hand it seems on some accounts to have a greater affinity to the group of which iron and manganese are members.

Like these metals, it combines with acids to form phate of alumina, like sulphate of iron, has always a slightly acid reaction. And like iron and mansalts, but never fully neutralizes the acids so that sulganese, aluminum, can form the base of an acid as well as the base of an earth, and thus forms salts, of which it can play the part of an acid or a base. Thus with sulphuric acid, it form a beautiful crystaline salt—sulphate of alumina. With potassa, it forms the equally definite compound aluminate of potassa, while in the known substance, alum, it assists in forming a double salt—sulphate of alumina and potassa. This peculiar property of alumina, or perhaps of aluminum, probably confers upon its charactures whose value has not yet been fully appreciated. It probably gives it to a mobility which enables it to perform important, though hitherto but little understood functions in the nutrition of plants, even though alumina itself is not plant food.

Pure alumina is rare, except in combination with silica or quartz, it forms the great bulk on many soils. In this combination the silica plays the part of an acid, and the resulting compound is not in any sense a mixture. Even the beautiful white clay which is sometimes called pure clay, contains a large portion of silica, and this silica cannot be separated by any mechanical means. It forms a chemical compound—silica of alumina.—*Country Gentleman*

Machinery and Manufactures.

The Management of Boilers—Explosions.

We have received through Mr. W. P. Slensby, of New York city, an article on boiler explosions which contains some statements worthy the attention of those who have steam boilers in charge. Owing to the press of matter on our columns, we have not room for the communication in its entirety, but give the principal points.

He ridicules the idea that explosions are inevitable, and that they cannot be prevented. Steam is a powerful but governable element, not a mysterious or unknown power. The great cause of explosions, in his opinion, can be laid to the material, workmanship, size, and form of the boilers. A small boiler will withstand more pressure to the square inch than a large one, and a cylindrical boiler, than one with flat surfaces, unless the latter is well stayed with bolts. The bottoms of large boilers are subjected to from three to five pounds more pressure to the square inch than the upper surfaces, owing to the weight of the water.

When a portion of a boiler becomes red hot its strength is impaired and it is in a state to yield to a gradually increasing pressure and also to a suddenly produced force similar to that generated by the metamorphosis of a solid into a gas. When the solid body of the water gets below the iron surfaces exposed to the heat of the furnace there remains a foaming matter composed of about one-third water, and two thirds steam, a thick, saturated, moist steam, incapable of keeping the iron cool, but capable of being expanded by the heat into super-heated steam very rapidly. Thus lowness of water decreases the strength of the iron and increases the pressure of steam.

The idea that if a portion of a boiler begins to give way the rupture acts as a safety valve is not correct. When the iron begins to go it requires much less force to complete the rupture, just as when forcing the hand through a sheet of strong paper, if the material be once parted, very little force is required to send the hand through.

The deposition of scale preventing the water from reaching the iron is another cause of explosion, although the water may be retained at the requisite height.

Suddenly opening throttles when starting should never, except in cases of great emergeancy, be practiced. It is similar to firing a gun by letting the steam rush suddenly by at a high pressure into the cylinder. It there meets with an opposing force, and like the exploded gas in a gun, recoils with a force similar to that with which it struck the piston.

Boilers should be cleaned as often as once a month, and if the water is very dirty, more frequently, as the dirt held in solution does not pass off with the steam, but is deposited.

A boiler will make steam faster when the pressure is high than when it is low, with the same fire, so it is economical to carry a high pressure—even if it is not necessary to do the work— and to work the steam expansively.

Steam engines running at high speeds return a less per-centage of power in proportion to the steam used than engines running slower, as velocities decrease the power of the steam.

Tubular boilers make steam faster with less fuel than others, and if properly constructed and cared for will last as long.

The crank pin of an engine travels over one-third faster than the piston, which accounts for the uneveness of the power at certain parts of the stroke. The piston is never at half stroke when the crank is vertical.—*Scientific American*

Liquid Fuel.

"Practical trials, and experiments on an extended scale, have demonstrated beyond all doubt that petroleum is admirably adapted, as a substitute for coal, for the purpose of generating steam. But notwithstanding the convincing proofs we have had of this fact, we have not yet an example of an independent practical application. It is true the question of petroleum as a steam fuel is a comparatively young one, and in such a case it is always a hard matter to find any one who will take the initiative. Besides, there are prejudices to be overcome, and conflicting interests to be disposed of, and until the way is clear in this respect, the most perfect method of effecting an improvement in any department of applied science, is not likely to progress very rapidly. But the question which meets us at the outset in the present case is, Have we arrived at the most perfect method of burning liquid fuel? There are various systems by which it is proposed to effect this object, and there has been some deep thinking and hard working about the matter. But, although excelllent results of the working of petroleum furnaces have been recorded by us, it is only within the last few days that we have felt an honest conviction that our question was answerable in the affirmative. This conviction has been induced by a careful investigation of the working of a new method of burning petroleum in the furnace of a steam boiler, at a large works in Lambeth. The apparatus with which these trials are now being carried on—which we need hardly observe forms the subject of a patent—is the invention of Messrs. Wise and Field, of the Adelphi, and Mr. Aydon, and, like most inventions possessing real utility, is very simple in its character. The principle consists in the use of petroleum or any other liquid fuel for raising steam by injecting it, by means of superheated steam, into the furnace. This is effected in such a way that it is vaporised and dispersed over the surface of the fire, and its combustion completely effected. * * * We have thus a stream or jet of superheated steam, air and petroleum, which is forcibly injected into the furnace through a pipe just above the fire-door. This jet impinges upon a bridge of fire-clay placed a couple of feet or so from the door. The fire-bars are covered with an iron plate, and on this a shovelful of live coal is placed for the purpose of igniting the jet of petroleum spray. The air required for the combustion of the petroleum is admitted through openings in the fire-doors, there being no upward draught through the fire-grate. In the present instance the apparatus is fitted to the ordinary single-flued Cornish boiler; its attachment, however, involves no alteration to the furnace except tapping a hole or two over the fire-door, and placing a sheet of iron on the fire-bars. In half an hour the apparatus could be cleared away, and the furnace be made ready for burning coal.

"In the trials we witnessed with petroleum the combustion was of the most perfect character. An intensely brilliant violet flame filled the space beyond the bridge, indicating the thorough decomposition of the constituents of the fuel, whilst the entire absence of smoke and unconsumed carbon added further testimony to the soundness of the principle upon which the invention is based. The result of the experiment, which lasted about two hours, was the evaporation of 19½lb. of water by every pound of oil used. During the trial the boiler supplied steam at 35lb. pressure to the engines driving the various machines on the works. The oil used was of the cheapest kind; in fact, we believe, only refuse. The apparatus requires but very little attention, and is completely under control, the flame being increased or diminished in intensity almost instantaneously by regulating the flow of oil or steam. We know what the maximum evaporation obtained from the best coal is, and when we find it more than doubled, as in the present instance, by the application of petroleum to a coal-burning furnace, what may we not expect when the principle is developed in a specially constructed furnace and boiler? It is early times yet with the inventors, but they have succeeded in thoroughly mastering the principle of perfect combustion with, to a certain extent, imperfect apparatus. They have already achieved a success in burning petroleum in an ordinary furnace far beyond anything we had previously witnessed. Considering, therefore, the many advantages petroleum offers as a steam fuel, we may predict that with a perfect development of the principle, and, with a modified form of boiler, its application must rapidly become general."—*Mechanics' Magazine.*

Enamelling Iron.

Enamelling iron is almost a new art. No metal is capable of receiving a coating of vitrified porcelain or enamel unless it is capable of withstanding a red heat in a furnace. Articles of cast iron, as a preparation for enamelling, are first heated to a low red heat in a furnace, with sand placed between them, and they are kept at this temperature for half an hour, after which they must be allowed to cool very slowly, so as to anneal them. They are then subjected to a scouring operation with sand in warm dilute sulphuric or muriatic acic, then washed or dried, when they are ready for the first coat of enamel. This is made with 6 parts by weight of flint glass broken in small pieces, 3 parts of borax, 1 of red lead, and 1 of the oxide of tin. These substances are first reduced to powder in a mortar, then subjected to a deep red heat for four hours, in a crucible placed in a furnace, during which period they are frequently stirred, to mix them thoroughly; then toward the end of the heating operation the temperature is raised, so as to fuse them partially, when they are removed in a pasty condition and plunged into cold water. The sudden cooling renders the mixture very brittle and easily reduced to powder, in which condition it is called frit. One part of this frit by weight is mixed with two parts of calcined bone dust, and ground together with water until it becomes so comminuted that no grit will be sensible to the touch when rubbed between the thumb and finger. It is then strained through a fine cloth, and should be about the consistency of cream. A suitable quantity of this semi-liquid is then poured with a spoon over the iron article, which should be warmed to be enamelled, or, if there is a sufficient quantity, the iron may be dipped into it and slightly stirred, to remove all air bubbles and permit the composition to adhere smoothly to the entire surface. The iron article thus treated is then allowed to stand until its coating is so dry that it will not drip off, when it is placed in a suitable oven, to be heated to 180 deg. Fah., where it is kept until all the moisture is driven off. This is the first coat; it must be carefully put on, and no bare spots must be left on it. When perfectly dry, the articles so coated are placed on a tray separate from one another, and when the muffle in the furnace is raised to a red heat they are placed within it and subjected to a vitrifying temperature. The furnace used is similar to that used for baking porcelain. This furnace is open for inspection, and when the enamel coat is partially fused the articles are withdrawn and laid down upon a flat iron plate to cool, and thus they have obtained their first coat of dull, white enamel, called biscuit. When perfectly cool they are wet with clean soft water, and a second coat applied like the first, but the composition is different, as it consists of 32 parts by weight of calcined bone, 16 parts of China clay and 14 parts of feldspar. These are ground together, then made into a paste, with 8 parts of carbonate of potash dissolved in water, and the whole fired together for three hours in a reverberatory furnace, after which the compound thus obtained is reduced to frit and mixed with 16 parts flint glass, 5½ of calcined bone, and 3 of calcined flint, and all ground to a creamy consistency with water, like the preparation for the first coat. The articles are treated and fired again, as has been described in the preparation coat, and after they come out of the furnace they resemble white earthenware. Having been twice coated, they now receive another coat and firing, to make them resemble porcelain. The composition for this purpose consists of 4 parts by weight of feldspar, 4 of clear sand, 4 of carbonate of potash, 6 of borax, and 1 each of oxide of tin, nitre, arsenic, and fine chalk. These are roasted and fritted as before described, and then 16 parts of it are mixed with the second enamel composition described, excepting the 16 parts of flint glass, which is left out. The application and firing are performed as in the other two operations, but the heat of vitrification is elevated so as to fuse the third and second coats into one, which leaves a glazed surface, forming a beautiful white enamel. A fourth coat, similar to the third, may be put on if the enamel is not sufficiently thick. The articles may be ornamented like chinaware, by painting coloured enamels on the last of the coats, and fusing them on in the furnace. A blue is formed by mixing the oxide of cobalt with the last-named composition; the oxide of chromium forms a green, the peroxide of manganese makes a violet, a mixture of the protoxide of copper and red oxide of lead, a red, the chloride of silver forms a yellow, and equal parts of the oxide of cobalt manganese, and copper form a black enamel when fused. The oxide of copper for red enamel is prepared by boiling equal weights of sugar and acetate of copper in four parts of water. The precipitate which is formed after two hours' moderate boiling is a brilliant red. The addition of calcined borax renders all enamels more fusible.—*Mechanics' Magazine.*

Iron Works at Barrow-in-Furness.

The Iron Works at Barrow-in-Furness, by the natural advantages of their position, and the grand scale and symmetrical simplicity of their arrangement, seem to be fitted almost to defy competition. They are situated on the shore, projecting their slag constantly into the sea, and forming new and valuable land as sites for workshops and additional furnaces. Railways with improved coal and ore cars bring all the materials of the manufacture direct from the neighboring mines, and minor railways on inclined bridges carry them to the tops of the blast furnaces. Practically unlimited capital applies every possible arrangement of economy in point of method or scale of operations, regardless of present cost, for the most profitable working in the long run. A reserve of 40,000 tons of coke is kept in stock, to guard against any possibility of interruption by mining accidents or strikes.

Eleven blast furnaces are completed, thus far, standing in a straight line, each a gigantic cylindrical column, 56 feet high and 16½ feet in diameter, with the base of its pedestal formed by a circle of massive iron pillars; the whole united by their capitals in a grim porch worthy of some temple of Titans. A series of inclined railways carry all materials from the mixing sheds to the great roof, where they are dumped into the fiery throats of the furnaces. We had thought to complete our picture with a rolling canopy of mixed smoke and flame, carrying the dark pile to the clouds. But no: the gases are entirely "taken off" the tops of the furnaces, and conducted away to be consumed under the boilers and hot-blast ovens, all of which are heated solely by these waste products, which formerly served but to darken the sky and light up the night.

Each furnace has six tweers 2½ to 3½ inches in diameter, through which a blast heated to 600° or 650° is impelled at a pressure of 3 to 3½ lbs. to the square inch. There are thirteen blowing engines, with 30 to 52-inch cylinders, and with blowing cylinders of 72 to 100 inches diameter and 9 feet stroke. Four winding engines serve the four inclines for charging the furnaces. Forty-two boilers, all fired with the waste gases, supply steam to the different engines.

Each furnace is tapped every six hours, or four times in the day, and at each tapping runs off 40,000 lbs. of iron, or 650 tons a week—all together over 6,000 tons—into the pig beds, which are arranged with the same convenience as everything else in the system, so as not only to receive the molten stream direct from the furnace, but to deliver the product direct upon the cars that take it to market without so much as changing its level. A large proportion of this vast amount is used by the Barrow Hematite Steel Company, whose works are adjacent, in the manufacture of Bessemer steel.

The whole works (remarks *Engineering*) are at present in the state of rapid growth. Understood as a beginning, merely, we have no hesitation in saying that the establishment we have outlined will "do" for the present.

What makes Iron Fibrous.

When Mr. Bessemer began to manufacture wrought iron from cast, by blowing air into the molten metal, it was objected to the product that it had no fibre, as common puddled iron had, and that iron without fibre must necessarily be weak. In this inference—which was wholly theoretical—we did not concur, and the question then arose, what does fibrous iron really mean? When the particles of wrought iron are brought to a high temperature, without the presence of any intervening material, they cohere in every direction, and the iron is not fibrous. But when slag is intermingled, as in common iron is the case, there are intervening layers of cinder, which, when the iron is passed through the rolls, are not wholly expelled, but are only greatly attenuated; and as these planes are then very numerous, and pass in every longitudinal direction, they prevent to some extent the lateral adhesion of the particles, which, however, adhere end to end, and a fibrous iron is thus produced. It is now well known that homogeneous iron is much stronger than fibrous iron. But at the beginning of the manufacture, fibre was accounted as necessary in iron as in ropes or thread—a theory resulting merely from the accident of the production of fibre by the modes of manufacture then exclusively employed. In the case of iron produced by the common process, any bubble or vacuity in the metal becomes filled with slag, which hinders the sides from being effectually welded under the hammer. But in the Bessemer iron, as the slag is absent, the sides of the bubble cohere when the ingot is subjected to pressure while still hot. It is better to hammer the ingots while still hot, after having been poured, than to allow them to cool and to beat them afterwards. For in the one case the heart of the ingot is the hottest part, and in the other the coldest.—*Engineering.*

Dion's Patent Fire-alarm.

A few days ago we witnessed at the office of Bunting & Co., of this city some experiments with Dion's patent fire-alarm—the invention of Mr. Charles Dion of Montreal, C. E. It consists of an arrangement of wires connected with a bell which is sounded by means of certain clock-work mechanism. Upon the appearence of a fire in the room or apartment where this apparatus is placed, the heat acts upon the metallic wires and the alarm is immediately sounded. We saw a few fragments of newspaper lighted in a pan some distance from the connecting wires, and in about fourteen seconds the bell was ringing, and so continued until the weight which operated the hammer of the mechanism had run down.

The object of the apparatus is to give timely notice of a fire that may occur in any part of a public building or private dwelling. The wires may be conducted to every room and the alarm apparatus placed where it can be observed, or where it will arouse those that can proceed to the place where the faithful instrument tells that the fire is burning. The arrangement of this alarm is almost without limit. The wires may be conducted to a certain point, similar to a fire alarm telegraph, and they may be placed in each room, or centered into the room which the guardian or janitor of the building occupies. They may be placed in the state-rooms or holds of a vessel, and there be as effective as in a dwelling house. If the wires be extended through heaps of grain, any undue heat occasioned by an increase of temperature of the pile may be made known in the same manner as if a fire had commenced in the apartment.

The invention has been put to use in the bishop's palace and chapel at Montreal, and numerous other places. The Board of Fire Underwriters of New York City have certified to the merits of the invention, and recommend its general employment. —*American Artizan.*

Beet Sugar.

We think we have important news regarding beet sugar. Last year a number of enterprising capitalists of Springfield, Ill., organized a company for the purpose of making beet sugar. The place selected was at Chatsworth, Ill., and the works were under the direction of the Messrs. Gennert, the original projectors. They planted 400 acres, mostly fresh prairie, and raised a crop of 4,000, tons of fine beets at the cost of $4 a ton in the pits. The varieties were the White Silesian and Imperial, and upon a test of various parts of the crop the average yield of fair refining sugar is 7½ per cent. This is confirmed by analysis made at Belcher's sugar refinery, St. Louis. When refined the yield is 5½ per cent. of sugar equal to New York "refined B." Quite a number of barrels have been made, and the works are in operation this winter. When all the beets are worked up the yield must reach nearly 400,000 pounds of refined sugar. The starting of new works and expensive machinery is always difficult, and this company has had its share, and there has been delay. But this delay has been of use in settling the question whether beets can be kept in large quantities during the fall and winter months. They find that the loss during four months is only one per cent. The conclusion of this vast experiment, worthy of the Prairie State, is that beets can be grown on the raw but rich soil of the West as well as the highly fertilized soils of Belgium and France, that yield of sugar is almost precisely the same, and that the beets can be kept until they can be used. The importance of these facts scarcely can be over-estimated. That prairie region is equal in extent to England, France, Spain, and Portugal combined, and on almost every acre the beet can be cultivated. Underlying are inexhaustible beds of coal, and a people fully competent to enter upon this new enterprise are ready. Sugar is next in importance to wheat. A beet sugar crop on these prairies will be of greater value than the corn crop. Granting these to be facts, the time cannot be distant when sugar will be sent from the West to New York and exported to foreign countries.—*New York Tribune.*

Gutta-percha Bank-Notes.

Mr. L. M. Crane, who has a paper mill near Balston, Spa., N. Y., has recently perfected an invention that will interpose a greater bar to counterfeiting than any yet made. He has invented machinery by which minute threads of gutta-percha are run into sheets of bank-note paper, in the course of its manufacture, whereby the printing becomes indelible, and cannot be counterfeited. He proposes to offer his invention to the United States Government, so that it can manufacture the paper for all national bank-notes, the same as it does the engraving and printing. His plan contemplates making each denomination differently, as is perfectly practical with his machinery. Thus one-dollar bills will have one thread through each, two-dollar bills two threads, five-dollar bills three threads; then four threads for ten, five for twenties, six for fifties, seven for one hundreds, eight for five hundreds, and nine for thousands. If the United States Government secures this invention, it can be used for bonds and coupons also. Mr Crane has in operation in his mill (where he is now making paper collars) a machine by which a thin layer of gutta-percha is incorporated within each sheet of paper. A company has been formed with a capital of one hundred thousand dollars to work this invention.—*Times, Troy, N. Y.*

The Art of Inlaying.

The process of inlaying iron-work with mother-of-pearl, by which the higher priced sewing machines are ornamented, is an illustration of the improved methods of doing work which was formerly the result of close application and patient labor. Inlaying is one of the oldest styles of ornamenting metals, and is now extensively practised in precisely the same way as it was by the Saracens in the time of the crusades and by the armorers of Europe. Fire-arms, daggers, and sword-blades are often very beautifully inlaid with gold and silver. In this work the metal to be ornamented is chiseled to the pattern required, and the gold or silver forced into the recess and secured by riveting or dove-tailing. But the sewing machine and articles of papier-mache, which are so beautifully decorated with flowers and fruits composed of the irridescent shell of the pearl oyster and gilding, are ornamented in quite a different manner. Thin scales of the shell are selected for their color or shade, and cemented to the surface of the material. The rest of the surface is covered with successive coats of Japan varnish, generally black, being subjected to a baking process after each application. When the varnish is as thick as the shell, it is polished, the gilding and painting added, and a flowing coat of varnish put over the whole. The surface, if well done, is almost as hard as the metal.—*American Artizan.*

A Fire Escape.

A valuable fire escape has been introduced in England in a form convenient for travellers, and as safe and easy to use as a flight of stairs. Within a thin metallic case only 7½ inches in diameter, are coiled on a pulley thirty feet of light, strong and flexible steel-wire rope or tape, passing out between rollers adjusted by a hand screw to any desired pressure, and terminating in a hook for fastening to a window seat. A chair for the body, formed of leather straps, is attached to the case, and the hook being secured to the window seat, the person seated in the chair may regulate or arrest at pleasure his own descent, by means of the screw. By using fine steel wire, woven into a tape, sixty feet might be coiled in a smaller case than that above described, making a perfect fire escape portable in every one's carpet bag.—*Scientific American.*

Elastic Glass.

Mr. Wortley, one of the speakers at the cable banquet in London, alluded to an interview he had some years ago with the late Prince Consort in reference to the undertaking. After discussing the matter for a while, His Royal Highness alluded to the question of what was the best insulator, and said that what they wanted was a material called elastic glass. Mr. Wortley expressed some surprise at the suggestion, and observed that he had not heard elastic glass mentioned by scientific men. Prince Albert replied that this substance was spoken of by a rare obscure classic author, Petronius Arbiter, and taking down a book he searched for and found the passage to which he called attention. This was the story of the man who exhibited before one of the Cæsars a glass phial which was thrown upon the ground and bent in like a brazen vase. The ingenious inventor then pulled a hammer out of his pocket and at leisure beat the phial perfectly into its original shape. This being accomplished, he thought himself in the seventh heaven; but Cæsar having ascertained that he alone possessed the secret of making this kind of glass, ordered him to be beheaded.

British Inventions.

The English Correspondent of the *Scientific American* says :—" England is *par excellence* the nation of wealth, and this not in any great degree from its titled land proprietors, but from its far more important class of merchant princes. The one idea pervading all her action is the extension of commerce both at home and abroad, and the importance of any thing that may be proposed is judged of according as it tends to promote this object. Let it be shown that a greater facility of communication for mercantile purposes may be obtained by a given innovation, and they will assuredly take the lead of all other nations in introducing it, though it require an expenditure of millions of money. The government seems to understand and share fully the feeling of the people, and considers it its duty to further what will tend to fulfil these demands. And furthermore, as what is done is meant for use, and for continual use, it must be well done. Other things meet with less encouragement. If any great increase of personal comfort or domestic convenience can be forcibly shown to result from any improvement, it is very likely that an Englishman will sometime adopt it, but he will probably not make haste to do so, nor will he turn aside to investigate beforehand what it may be likely to accomplish. Such things he is quite willing to allow everybody else to experiment with before him: when they have reached a good result he will begin to take some notice of them."

In contrast to this he describes the American people as giving their attention to inventions tending to lighten the load of household duties, and for the quicker performance of mechanical and other operations; and says "It is in America therefore that we should naturally expect such great and useful inventions as sewing machines, clothes wringers, cooking stoves, hot-air furnaces, sleeping cars, luxurious steamboats,, and the host of similar appliances which are so frequently and well illustrated in the pages of the *Scientific American*; nor is it but a step further to such as steam fire engines, breech-loading rifles and the like."

New Mode of Glass Engraving.

We are indebted to Judge Paschal, of this city (late of Texas), for specimens of window glass engraved by a process patented by C. C. Stremme, of Austin. The process consists in forming the design upon ground glass with glue or other strongly adhesive and contractile paste, which in contracting detaches laminæ of irregular shape and thickness from the surface of the glass, and leaves the design wrought in a style of peculiar beauty, resembling hard frostwork The design in glue may be formed by means of a stencil plate, and the work thus executed as rapidly as the brands on packing boxes, etc. Or, if the design be too complex to be stencilled in a satisfactory manner, the drawing or print to be copied may be laid under the glass and traced in *fac simile* with a lead pencil, after which the lights within and around the design may be covered with a protecting varnish and the glue then applied to the shades, giving the picture in frostwork; or the shades may be protected and the lights etched, leaving the picture in ground glass, set in frostwork. It will be seen that the requisite apparatus and skill are within the reach of every one. Glassware may thus be very chastely marked with the name or cipher of the owner, as readily as linen. So says the *Scientific American*. Try it.

The Manufacture of Russia Leather.

Russia leather, otherwise called "juft leather," is inimitable; at least, hitherto nothing has been produced in any way approaching it. The pains taken by Polish, Austrian, French, and English tanners to imitate the juft leather has met with no success; and though some persist in their endeavours, it is evident that, unless they employ the same means and bestow a like care, their efforts must remain fruitless. This leather is not made of goats skins, only, as some suppose, but also of the largest ox, cow, or rams' skins, though the best quality is made from goat skins, which is preferred to all others for the manufacture of red leather, on account of its softness and smoothness. It is well-known that this leather emits a very peculiar and agreeable odour; this it derives from an extraction of the birch tree with which the skins are impregnated. The manufacturing process is as follows:—The hides or skins are put into running water for one week. Each day they are taken out and thoroughly beaten with a wooden brake, and then returned to the water. At the expiration of the time named, they are transferred into a lye made either of lime or ashes, where they are left for about a month or more, till they are ready for depilation. This done, the next care is to rid them of their alkaline properties, which is effected by putting them into the "Raksha" for twenty-four hours The Raksha is "white gentian," diluted in fresh water, one pail of which is sufficient for twenty-five skins. The Russian tanners lay great stress on the swelling of the skins; for this purpose they prefer a solution of oatmeal and water, in which they soak the skins for four or five days, and then transfer them to a first solution of tannin, which is extracted from the bark of the willow tree.

In the first solution the skin remains three days; they are then taken out and beaten with the brake, and placed in the second solution which is stronger than the first. After eight or ten days, they are taken out and dried, leaving the fleshy side turned upwards. After being dried, they are again beaten, then greased, dyed, and finished. The red color is produced by uniting alum with logwood, and the dark by mixing alum with green vitriol.

Graining follows the dyeing. This is done with a notched stick passing through the length and breadth of the skin till small furrows are gradually produced. Previous, however, to this operation, the skins are greased on the fleshy side, and after the graining they are again greased, either with birch oil or the oil of linseed, and then they are put on the wooden horse to be smoothed. The Russians have a singular way of dyeing this leather. They sew up the skins together like a sack or bag, closed on all sides, and having but a small aperture through which the dyeing fluid is introduced. The bags are put in motion for some time, so that the fluid shall reach all parts, and the balance is left to run out; the skins are then dried, and again dyed with a sponge. This is repeated two or three times, always leaving them to dry first, before the next colouring is given.

It requires no particularknowledge to distinguish the real Russia leather from the many imitations, a good nose being all that is required. The agreeable smell is the property of no imitation leather, though why the others have it not we are unable to state.

Austria and the German States greatly patronize this staple article. At the yearly fair of Leipsic many Russia leather merchants change their commodity and go away heavily laden with hard cash. The prices are regulated by the sorts or qualities, of which there are three: first, or best; second, or middle; third, or inferior sort. The last two sorts are not subdivided; but the first is subdivided into four or five different classes, according to the suppleness and smoothness of the leather. Italy consumes the most of the heavier, or lower grades of this leather The sales are effected by weight; the Russian pūd is 40-lb. weight. The best skins generally averages seven skins to the pūd, the other four or five, which are packed in small packages of ten skins each, and then ten packages are made up into a ball, and tied up into mats. When brought into the market they are examined, to see whether they have been damaged through the voyage. This is known by the white spots that appear on the surface.—*Stationer and Fancy Trades Reporter*.

Useful Receipts.

Dressing Sheep-skins for Mats, Robes, Mittens, &c,

Make a strong suds, using hot water; when it is cold wash the skins in it to get the dirt out of the wool; then wash the soap out with clean cold water. For two skins dissolve alum and salt, of each ½lb., with a little hot water, which put into a tub of cold water sufficient to cover the skins, soaking 12 hours, then hang over a pole to drain, when well drained, spread or stretch carefully on a board to dry, tacking them down if necessary. When yet a little damp, have one oz. each of salpetre and alum, pulverised, and sprinkle over the flesh-side of the skin, rubbing in well; then lay the flesh-side together and hang in the shade for two or three days, turning the underskin uppermost every day, until perfectly dry; then scrape the flesh-side with a blunt kinfe, to remove any remaining scraps of flesh, trim off projecting points, and rub with pumice and rotten stone, and with the hand. Lamb-skins, thus prepared, will make beautiful and warm mittens for ladies and gentlemen.

Dressing Fur and other Skins.

First.—Remove the legs and other useless parts, and soak the skin soft; then remove the fleshy substances and soak in warm water for an hour; then:

Take for each skin, borax, salpetre, and glauber-salts, of each ½oz., and dissolve or wet with soft water sufficient to allow it to be spread on the flesh side of the skin. Put it on with a brush, thickest in the centre or thickest part of the skin, and double the skin together, flesh side in, keeping it in a cool place for twenty-four hours, not allowing it to freeze.

Second.—Wash the skin clean, and then:

Take sal-soda, 1 oz.; borax, ½oz.; refined soap 2 oz. (white hard soap); melt them slowly together, being careful not to allow them to boil, and apply the mixture to the flesh side as at first—roll up again and keep in a warm place for twenty-four hours.

Third.—Wash the skin clean, as above, and have saleratus two ounces, dissolved in hot rain water sufficient to well saturate the skin; thus:

Take alum 4 ozs.; salt 8 ozs.; and dissolve also in hot water, when sufficiently cool to allow the handling of it without scalding, put in the skin for twelve hours; then ring out the water and hang up, for twelve hours more to dry. Repeat this last soaking and drying from two to four times, according to the desired softness of the skin when finished.

Lastly.—Finish by pulling, working, etc., and finally rubbing with a piece of pumice-stone and fine sand paper.

This works admirably on sheep-skins, as well as on fur-skins, dog, cat, or wolf-skins, making a durable leather well adapted to washing.—*A. W. Chase.*

Water-proof Packing Paper

The following is a German recipe:—Dissolve 680·4 grammes (about 1·82 lbs.) of white soap in a quart of water. In another quart of water dissolve 1·82 oz. of gum-arabic, and 5·5 ozs. glue. Mix the two solutions, warm them, and soak the paper in the liquid. Pass it between rollers, or simply hang it up to drip, and then only at a gentle temperature.

To Mend Broken Glass.

A much better process for mending broken glass, china and earthenware with shellac than heating them, is to dissolve it in alcohol to about the consistency of glue or molasses and with a thin splinter of wood or pencil brush touch the edges of the broken ware. In a short time it sets without any heating, which is often an inconvenient process. It will stand every contingency but a heat equal to boiling water.

Another Gunpowder.

Nitrate of potash, 10 parts; picric acid, 10: bichromate of potash, 8·5—intimately mixed—give, according to Dr. Borlinetto, professor of chemistry in the University of Padua, an excellent gunpowder of the best sporting quality.

Black Varnish for Iron.

Pulverized gum asphaltum 2 lbs.; gum benzoin ½ lb.; spirits of turpentine 1 gal.; to make quick keep in a warm place and shake often; shade to suit with finely ground ivory black.

Apply with a brush. Suited for either outside or inside iron-work. Or:

(2.) Asphaltum 8 lbs.; melt it in an iron kettle, slowly adding boiled linseed-oil 5 gals., litharge 1 lb.; and sulphate of zinc ½lb.: continuing to boil for three hours; then add dark gum amber 1½ lbs., and continue to boil 2 hours longer. When cool reduce to a proper consistence with spirits of turpentine, and apply with a brush.

Application for Cuts, Wounds, etc.

It is not generally known that the leaves of a geranium are an excellent application for cuts, where the skin is rubbed off, and other wounds of that kind. One or two leaves must be bruised and applied to the part, and the wound will be cicatrized in a short time.

Burnishing Powder.

A burnishing powder in use in Belgium is composed of ½ lb. of fine chalk, 3 ounces of pipe clay, 2 ounces of white lead, ¾ of an ounce of carbonate of magnesia, and as much of jeweler's rouge.

To Write upon Iron, Steel, Gold, etc.

Muriatic acid 1 oz.; nitric acid ½ oz.; mix. Cover the place you wish to mark, or write upon, with melted bees-wax; when cold, write the name plain with some pointed tool, cleaning all the wax out of the letter; then apply the mixed acids with a feather, filling each letter. Let it remain from one to ten minutes, according to the depth of letter required; then pour in some water to dilute the acids and stop the process. Either of the acids will cut iron or steel, but it requires the mixture to take hold of gold or silver. After you wash off the acids, apply a little oil.

Arsenical Soap.

This preparation is used to preserve the skins of birds and other small animals. Take of carbonate of potash 12 oz.; white arsenic, white soap, and slacked lime, of each 4 oz.; powdered camphor, ¾ oz. Add sufficient water to form a paste.

Practical Memoranda.

Linear Expansion of Metals.

Of the Linear Dilatation of Solids by Heat. Dimensions which a bar takes at 212°, whose length at 32° is 1·000000.

Cast iron	1·00111111
Steel (rod)	1·00114470
Steel, not tempered	1·00107875
Steel, tempered yellow	1·00136900
Steel, at a higher rate	1·00123956
Iron	1·00118203
Soft iron, forged	1·00122045
Gold	1·00150000
Copper	1·00191000
Cast brass	1·0018750
Silver	1·0018900
Tin	1·0028400
Lead	1·00284836
Zinc	1·00294200
Glass from 32° to 212°	1·00086130
Glass from 212° to 392°	1·00091827
Glass from 392° to 572°	1·00101114

Expansion of Liquids.

Expansion of Liquids in Volume from 32° to 212° Fahrenheit.

10000 parts of		water	become	1046
"	"	oil	"	1080
"	"	mercury	"	1018
"	"	spirits of wine	"	1110
"	"	air	"	1373

Sizes of Nails.

The following table will show any one at a glance the length of the various sizes and the number of nails in a pound; they are rated "3-penny" up to "20-penny." The first column gives the name, the second the length in inches and the third the number per pound:—

3-penny.	1 inch.	557	nails	per lb.
4- "	1¼ "	353	"	"
5- "	1¾ "	232	"	"
6- "	2 "	167	"	"
7- "	2¼ "	141	"	"
8- "	2½ "	101	"	"
10- "	2¾ "	98	"	"
12- "	3 "	54	"	"
20- "	3½ "	34	"	"
Spikes	4 "	16	"	"
"	4½ "	12	"	"
"	5 "	10	"	"
"	6 "	7	"	"
"	7 "	5	"	"

From this table an estimate of quantity and suitable sizes for any job can be easily made.

Glass-engraving Ink.

M. Kessler's successful experiments in engraving flint glass by means of alkaline fluorides and acids led to the preparation of an ink from hydrofluate of ammonia and hydrochloric acid, with which characters and designs may be written ineffaceably upon glass.

Anaethesia applied to Horses.

Horses are beginning to receive the benefit of anæthesia in surgical operations. It has been applied with success locally, both by means of ether, and of the rhigolene spray. Many horses may thus be saved by operations which otherwise would be impossible or fruitless.

How to cleanse a Cistern.

A simple thing I have accidentally learned, and if not generally known, ought to be, relating to stagnant odorous water in cisterns. Many persons know how annoying this sometimes becomes. After frequent cleaning and other experiments, all to no permanent utility, I was advised to put, say, two pounds caustic soda in the water, and it purified it in a few hours. Since then when I tried what is called concentrated lye I had quite a good result. One or both of these articles can be obtained at any druggist's.—*Exchange.*

Friction of Metals.

The friction of iron journals in brass boxes, with a film of good oil interposed, has been found in some cases to be as little as 1-60th of the weight. Ordinarily it is about 1-30th of the weight, while if the surfaces are wiped dry from oil it is about 1-10th.

The friction of metals upon each other becomes a larger proportion of the pressure as the pressure is increased. The friction of wrought-iron on wrought-iron, at a pressure of 32½ lbs. per square inch, was found by Mr. G. Rennie to be ·14 of the pressure. At 4¾ cwt. per square inch it was ·400 of the pressure.—*Engineering.*

Fastening for Belts.

Two thin metal plates, their inner faces roughened like those of a vise, and held together by screws, form a cheap, strong, and convenient fastening for driving-straps. If the strap stretch, the screws (which pass between the ends of and not through the strap) have only to be loosened, the ends of the leather cut shorter, and clamped anew. —*Ibid.*

To protect Trees from Insects.

A correspondent of *The Country Gentleman* asserts that red cedar twigs bound around the bodies of fruit trees, butts upward, will effectually protect the trees from insects. And if fruit trees, why not shade trees? Col. Dewey, of Hartford, writes to *The Horticulturist* that, in his vineyard, grapes twined upon red cedar posts and trellices are free from mildew and insects, and those growing closest to the posts have the most healthful appearance and are the most productive.

Statistical Information.

The Population of Great Cities.

"In 1866, censuses were taken in Great Britain and France, and the reports show the following population of the principle cities: London, 3,037,991; Paris, 1,825,274; Liverpool, 484,337; Glasgow, 432,265; Manchester, 358,855; Birmingham, 335,798; Lyons, 323,954; Dublin, 318,437; Marseilles, 300,131; Leeds, 228,187; Sheffield, 218,257; Bordeaux, 194,241; Edinburgh, 175,128; Bristol, 163,680; Lille, 154,779; Toulouse, 126,936; Newcastle-on-Tyne, 122,277; Salford, 112,904; Nantes, 111,956; Hull, 105,233, and Rouen, 100,671. New York and Philadelphia have each a much greater population than any of these cities after London and Paris."

In London the range of population density reads as follows, according to the Registrar General's 16th annual report-

Districts or Parishes.	Persons to square mile. Mean from 1848-50
London (the whole metropolis)......	17,678
East London	175,816
The Strand................................	161,156
St Luke's	151,104
Holborn	148,705
St. James', Westminster...............	134,008

The Metropolitan District of London extends over nearly 122 square miles, and its 3,037,991 inhabitants are distributed upon the whole area, at an average of about 25,000 to the square mile,

The tubular results appended to the Registrar-General's Annual Summary for 1866, show that the estimated population of the metropolis was composed of 1,416,919 males, and 1,621,072 females. Without distinction of sex, there were 1,285,041 persons under 20 years of age; 1,023,549 of 20 and under 40 years of age; 542,812 of 40 and under 60 years of age; 175,031 of 60 and under 80 years of age; and 11,558 of 80 years of age and upwards. The population increased in 1851–61 at the annual rate of 1·73 per cent., and since 1861 it is estimated that London has received an accession of 234,002 souls. If the population continues to increase at this rate, while the area remains the same, new and improved sanitary arrangements will yet have to be provided for this constant accumulation of human beings, in order that the great increase to the population of the metropolis may become a blessing. The birth of 54,956 boys, and 53,036 girls, were registered in London in the year. The proportion of births to population was 35 per 1,000; the death rate was 26 per 1,000 population, and the deaths of 40,978 males and 39,151 females were recorded.

The city of Philadelphia embraces within its limits about 106 square miles, consequently its population, if equally distributed over that area, would have a density of only about 6,000 to the square mile. In that city, as in New York and Brooklyn, the most unhealthy districts conform, on the one hand, but in exceptional instances, to the law of density, and on the other hand, to the unwholesome chances of sparsely settled, undrained and badly cleansed suburban districts.

In the city of New York there is a population of nearly 1,000,000, irregularly distributed over the area of Manhattan Island, which comprises in all, but little more than 22 square miles, or 14,502 acres. But, as less than one-half of this is now occupied by built up of blocks of dwelling houses, it is manifest that the city population is packed at the rate of nearly 60,000 persons to the square mile. Statistics show, however, that the population density ranges from less than 5,000 square miles in the Twelfth, to 145,715 in the Fourth and Sixth wards. And in the latter wards nearly one half of the entire area is now occupied by warehouses and manufactories. The actual rate of crowding, therefore, in those tenant-house regions is close upon 250,000 to the square mile. And in the Eleventh and Thirteenth wards, in which storehouses have not yet encroached, the population density is 190,000 to the square mile.

Mortality in Great Cities.

The Registrar General says that, according to the returns received for 1866, the great cities may be thus arranged according to their rates of mortality:—To 1,000 persons living, the deaths in London were 24, Birmingham 24, Hull 24, Bristol 25, Edinburgh 27, Sheffield 28, Dublin 28, Glasgow 30, Manchester 32, Newcastle 32, Leeds 33, and Liverpool 42. The mortality was lower than in 1865 in Manchester, Birmingham, Hull, Edinburgh, and Glasgow, and higher in other places mentioned.

Frosts in the Good Old Times.

A catalogue of great European frosts has been published, from which it would seem as if the glacial period in Europe need not have been indefinitely remote in the past, after all. Some of the experiences of the Middle Ages have not been matched since, in this line. The last time the Thames was frozen over at London, was in 1838. This has occured four times in the present century, viz., in 1813, 1820, 1823, and 1838. From elder time, we have notice of only very remarkable frosts, which in the eighteenth century occurred six times, viz., in 1708, April of 1709, 1716, 1740, 1788, and 1794. At the second of these dates the Mediterranean froze at Genoa and Leghorn, in the third the Thames was used as a solid pavement from Nov. 24th to Feb. 9th, and during the same term, to a day, in 1413. In 1063, the Thames was frozen over for more than three months, and in 1334 a frost continuing 80 days froze the rivers in Italy. In 1622 the Hellespont was frozen.

Number of Words in use.

Prof. Max Müller quotes the statement of a clergyman that some of the laborers in his parish had not 300 words in their vocabulary. A well-educated person seldom use more than about 3,000 or 4,000 words in actual conversation. Accurate thinkers and close reasoners, who select with great nicety the words that exactly fit their meaning, employ a much larger stock, and eloquent speakers may rise to a command of 10,000. Shakespeare, who displayed a greater variety of expression than probably any other writer in any language, produced all his plays with about 15,000 words. Milton's works are built up with 8,000, and the Old Testament says all that it has to say with 5,642 different words.

Ship-building at Quebec.

The following statement shows the amount of tonnage of vessels building in the district of Quebec, for the quarter ending 31st March, from the year 1860 to 1867, inclusive:—

Year.	Tonnage.
1860	17,050
1861	19,650
1862	21,160
1863	45,850
1864	55,960
1865	38,680
1866	40,900
1867	19,900

—*Quebec Gazette.*

Population of Turkey.

The whole Turkish empire according to the census made for the assessment of the "tenths," comprises in the aggregate a population of nearly 42,000,000, of which 18,000,000 are in Europe and 24,000,000 in Asia. Servia, Moldavia, and Wallachia number 6,000,000 inhabitants, so that there remains a population of 36,000,000 for Turkey proper. Setting aside the provinces enjoying self-government, this population is divided into eleven different races: Greek rayas, 2,000,000; Armenians, 2,500,000; Syrians and Chaldeans, 300,000; Sclaves, 6,000,000; and Albanians, 2,000,000; total, 12,800,000. These constitute the Christian element. Including in it the Syrians and Chaldeans, we cannot reasonably add to it the 300,000 Jews found in those countries. Now follows the Mussulman portion, composed, of 15,800,000 souls, without reckoning 160,000 Tartars, 100,000 Turcomans, 5,600,000 Arabians, 40,000 Druses, and 1,000,000 Kurds; or, in all, 6,900,000 Mohammedans of different kinds. To sum up, there are Christians, 12,800,000; Mohemmedans, 6,900,000; and Mussulmen, 15,800,000; or a total population of 35,500,000; to which must be added, to make up the number of 36,000,000, the 300,000 Jews, and about 200,000 Gipsies, who have no religion.

Miscellaneous.

Nutriment of various kinds of Food.

"A Food Committee has been sitting at the Society of Arts, and taking evidence, which, if sifted and translated into the vulgar tongue understood by ladies and cooks, may be made into really useful knowledge for village and other schools, where so much useless knowledge is elaborately taught. For instance, at the beginning of this month, Dr. Thudichum made a series of statements which upset many popular opinions on the subject of food. He was asked as to the nutritious value of Liebig's *Extractum Carnis.* The doctor said: "Extract of meat lacks the essential properties of nutriment." The body wants every twenty-four hours a given quantity of carbon, nitrogen, oxygen, hydrogen, phosphates, &c. Liebig's extract of meat contains these elements in very small quantities, and in an oxidized state. Therefore this "extract would not nourish, and could not be called food. Extracts of meat, like tea and coffee, are simply stimulants. The extract is simply strong beef-tea; and if you were to dissolve a teaspoonful in a cup of water and drink it, you would not receive so much nutriment as you would derive from a single mouthful of meat. Beef-tea has an important effect upon the nerves of taste and digestion, but it is not nourishment. The extract of meat mixed with water should not be too strong. This is a mistake. Too strong a solution of extract of meat is as bad as too strong tea or coffee. Meat contains 75 per cent of water, and 25 per cent of solids. Of these 25 per cent., 15 to 18 are insoluble in water, 7 to 10 soluble in water, but of these, 4 become again insoluble by boiling; so that it is not far wrong to say that only from one-eighth to one fifth of the whole of the solid constitutents of meat pass into extract, or beef-tea.

It seems that, after eggs, the nearest nourishment to meat is contained in Indian corn and various kinds of pulse and seeds *grown in southern climates.* Beans do not grow well in this country, "but form magnificent food in southern climates." It is the advantage of meat that it supplies food in the smallest compass, and it is dissolved early in the intestinal canal. Vegetable food requires more digestion. The house cat has gradually had its intestine lengthened to adapt it to the digestion of bread and potatoes. If sufficiently fed, vegetarians become big-bellied. Beans, lentils, and such food require careful preparation, if not they pass through the stomach undigested. The labouring people have neither the knowledge nor the means of cooking such food, therefore, practically, there is nothing like bread for them. It is soft, it gives no trouble, it is most easily digested, and no other grain food can enter into composition with it. To produce an equivalent to meat, add eggs to beef-tea, or boil beans, peas, lentils, or millet. Boil them in soft water a sufficient length of time, add them to the *Extractum Carnis* at the end of boiling just before serving. Dr. Thudichum also said, "I have for a long time conceived the idea of preparing a little book which might be called 'The Spirit of Cookery,' and which should contain the elementary principles of cooking. No good or economical cookery can be done on grates as at present constructed." Bread and cheese is the cheapest and most nutritive food for a labouring man. It is a great pity that some of the religious philanthrophic tract-publishing societies do not add to their list some really plain pleasant treatises on the principles of roasting, boiling, frying, broiling, and stewing, such as the late Miss Acton or Mrs. Beeton could have written. We should like to see competitive examinations, with money prizes, at all schools subsidized by the State, where the questions should turn on the principles and practice of cooking, with such questions as—If you had to boil a piece of salt beef, weighing 12 lbs., with carrots, how should you proceed? What is the difference between boiling and stewing? How would you proceed to cook a chop? How do you make butter; and what precautions in winter and summer? But very plain and really pleasant treatises are wanted for this purpose, and should be written by the best practical writers of the day, paid to put a great deal of information in a few pages. Such treatises are the proper subjects for tract societies, because they will not pay ordinary publishers."—*London Gas Light Journal.*

East Indian Patent Laws.

The *Homeward Mail* reports a singular affair which has just occurred in Calcutta. Under the Indian Patent Act, every exclusive privilege must cease if the Governor-General of India in council shall declare that the same is generally prejudicial to the public. This has accordingly been done in the case of a petition filed by W. G'Ivor, who wishes a patent for an alleged new invention, for producing and preparing the different species and varieties of cinchona bark, for the manufacture of quinine, quinidine, cinchonidine, and other alkaloids.—*Mechanics' Magazine.*

Hydro-propulsion.

We observe a recent change of tone among English engineers in regard to the possibilities of this form of motor. The official result of the trial of the *Waterwitch* with the *Vixen* seems to show that with a very crude and wasteful arrangement of her water jets—wasting power both in lifting and short turns of the water ejected—she did quite as well as the steamer, making 9 knots with 750 indicated horse-power. At a subsequent trial with deeper draft she did better, and "the results, bad as they are," says *Engineering*, "have led to sanguine predictions as to the final success of the jet system."—*Scientific American.*

Bad Books.

Beware of bad books. They are traitors in the household. They are "the enemy" who snatches away the wheat, and sow tares in its stead. They are poisoned sweets, destroying the healthy appetite. They have the semblance of knowledge, but not the reality. They are blind guides that lead to the ditch. Are we known by the company we keep? Our books are our company. In reading the works of an author, our minds come in direct contact with his mind. For good or for evil, we are under his most direct influence. It has been well said, that we reflect the color of the rock on which we lean; and it is so. When Moses came down from the mount after talking with God, how his face shone. Be jealous, then, of the books you read. Weigh them in the balances of the sanctuary, and if found wanting, discard them from a place in your libraries, homes, and hearts. A clergyman of New York once visited a State prison, where a young man who had thrown away many advantages was confined for the crime of murder, and was there awaiting his trial. His shelves were lined with books. What kind of books were they! Bibles, tracts, histories, works of science and true taste! No; corrupt novels, licentious poetry, revealed the rock which had imparted its colour to the criminal's life and character. Let the young avoid bad books as they would bad men and bad women.

Surgical Poisonings.

M. Maisonneuve, in a paper read in December before the French Academy of Sciences, maintained the startling position that at least 85 per cent of persons who die in consequence of surgical operations, die of poison. The poisoning is communicated by the lymph and other living liquids which become exposed in the wound, and after putrefying penetrate the cellular tissue and the orifices of the lymphatic vessels, producing the inflammation which is so prominent a cause of death in surgery, or else enter the circulation, vitiate the blood, and remain in the capillary vessels, giving rise to secondary symptoms of dangerous character, such as erysipelas, anthrax, etc. These consequences are prevented by the various improved means of arresting the putrefying process, destroying its products, or shutting them out of the system, and the mortality in hospitals where these methods have been introduced, has already been greatly diminished.

Keeping his Word.

The head clerk of a large firm in Charlestown promised an old customer, one day, half a bale of Russian duck to be on hand precisely at one o'clock, when the man was to leave town with his goods. The firm were out of duck, and the clerk went over to Boston to buy some. Not finding a truckman, he hired a man to take it over in his wheel-barrow. Finishing other business, on his return to Charlestown, the clerk found the man not half-way over the bridge, sitting on his barrow half dead with the heat.

What was to be done? It was then half-past twelve, and the goods were promised at one. There was not a moment to lose. In spite of the heat, the dust, and his light summer clothes, the young man seized the wheelbarrow and pushed on.

Pretty soon a rich merchant whom the young man knew very well, riding on horseback, overtook him.

"What," said he, "Mr. Wilder turned truckman!"

"Yes," answered the clerk, "the goods are promised at one o'clock, and my man has given out; but you see I am determined to be as good as my word."

"Good, good!" said the gentleman, and trotted on.

Calling at the store where the young man was employed, he told his employer what he had seen.

"And I want you to tell him," said the gentleman, "that when he goes into business for himself, my name is at his service for thirty thousand dollars."

Reaching the store, which he did in time, you may be sure the high price set on his conduct made amends for all the heat, anxiety and fatigue of the job.

Keeping his word. You see how it is regarded. It is one of the best kinds of capital a man can have. To be worth much to anybody, a boy must form a character of reliability. He must be depended upon. And you will like to know, perhaps, that this young man became one of the most eminent men of his day, known far and wide, both in Europe and in this country. His name was S. V. S. Wilder, and he was first President of the American Tract Society.

Combustion of Fuel.

Perfect combustion of Fuel is claimed in a new English stove, with which no flue or chimney is is used; although vent is provided for a small residuum of gas, if desired, through a half-inch pipe. The effective principle consists in making all the gaseous products of combustion pass into a chamber filled with the patent molded peat charcoal, which is said to have the property of absorbing carbonic acid and other gases and burning with a very small supply of air, until entirely consumed. In all stoves, wherever the strength of draft, the form of the grate or the nature of the fuel admits of lighting the fire at the top, a material saving of otherwise lost gases may thus be effected, the mass of fuel being roasted and a large portion of its gases disengaged and burned before it becomes itself incandescent.

Putting out a Fire.

During the process of extinguishing the fire in the colliery of Clackmannan, near Stirling, England, in 1851, about 8,000,000 cubic feet of carbonic acid gas were required to fill the mine, and a continuous stream of impure acid gas was kept up night and day for about three weeks. The mine extended over a surface of twenty-six acres, and had been thirty years on fire.

Effects of Alcohol.

Experiments made by Drs. Ringer and Rickards on men and animals go to show that the temperature of the body falls nearly as fast after the use of alcohol in doses sufficient to produce intoxication, as after death itself. The facility with which drunkards freeze to death, is explained by this fact. Dr. Jolly declares that an increasing tendency towards mental disease has been generated by the increasing consumption of spirits. Official reports show that the abuse of alcohol accounts for one fifth of the insanity in France.

Oiling the Sea.

An experienced sea captain writes to the New York *Herald* that he has been at sea for twenty eight years, and master of a vessel for the last ten years, and during that time he saved the vessel under his command twice by "oiling the sea." He writes that "when the master of a ship cannot get out of a storm—that is, when a ship is disabled and he has to take the heft of the gale—if he has oil on board, start two or three gallons over the side of the ship. This will give the ship smooth water to the windward, and then the oil allowed to run drop by drop is all that is required, for as soon as the sea comes in contact with the oil it breaks, and the ship is in smooth water as long as the oil is allowed to run. In 1864, in the heaviest gale of wind I ever saw, I lost all my sails, then the rudder; and I know the vessel could not have ridden the sea for another hour if I had not had oil on board. Five gallons of oil lasted me fifty six hours, and this saved the vessel, cargo and lives of all on board. Let ships of heavy tonnage have two iron tanks of forty gallons each, one on each side, with faucet so arranged that the oil can be started at any time; small vessels, ten gallon tanks, and all ship's boats tanks of five gallons each, well filled, so that in case the ship founder or burn, the boats will have oil to smooth the sea in case of a gale. With these tanks of oil on board of ships and a good man for master—one who knows the laws of storms and handles his ship so as to get it out of the center of the storm, you will have no more foundering of good ships at sea, with the loss of many lives and millions of money."

Engineer and Machinist Apprentices.

The *Scientific American* says;—"The directors of the North Eastern Railway (English) have made an arrangement for the instruction of the apprentices in their locomotive department, at the York School of Arts, at a reduced rate, half of which is borne by the Company. To educate their own engineers and machinists scientifically and practically from boyhood, is a shrewd liberality for corporations whose interests depend so much on the capacity and fidelity of such employees. There are many concerns in this country that might improve and economize their service materially by such means."

Early Measures.

In a primitive state of society, measures are simple enough, and the thumb, the palm, the foot, shod or bare, lie at the base of every system. "Let the ditch be 5 ft. wide by 7 ft. in length, one foot shod, the other bare." Such are the directions in an old Brunswick document and there was accordingly a slight difference between the "fuss" and the "schuh," to which some of the minor variations in the old German land-measures may be traceable. Long after the establishment of a regular standard in England, this kind of measurement remained in force as "customary;" for "le messuage de Crabhus" was measured by a pole "sixteen *pes d'home* in length," and in width the messuage was 35 poles and 4 large feet, "the feet of a tall man." A "day's work" was often the equivalent of an acre, at other times of half an acre; varying again accordingly as the work was reaping or mowing, plowing or hoeing; hence the frequent difference in measurements that go by the same name.—*The Gentlemen's Magazine.*

Wet Seasons.

The usual impression that wet seasons are unhealthy, is contradicted on the authority of compared meteorological and medical records, showing that the more rain the fewer deaths, and *vice versa.* Intermittent fevers in malarious localities, have been observed to prevail worse in dry than in wet seasons. Diarrhea and cholera are asserted to follow the same law, What say the doctors? If their proverbial diversity cannot yield us at least three contradictory opinions on this question, we shall have made a remarkable approximation to definite assurance.—*Scientific American.*

A Scotch blacksmith thus defines metaphysics:—"Twa men are disputin' thegither—he that's listenin' disna ken what he that's speakin' means and he that's speakin' disna ken what he's sayin' himself—that's metaphysics."

Italian Petroleum.

This valuable mineral product is abundant in Italy, and remarkably pure. The city of Genoa was long lighted with crude mineral oil. In the provinces of Modena and Parma, it issues from the mud volcanoes, or from parts adjacent. A Mr. Fairman, of Pisa, has obtained from the Government the exclusive right of search in the rich oil districts of Reggio and Modena, besides an increased duty on the importation. He is now offering privileges on liberal terms to English capitalists. The U. S. consul at Ancona (Mr. Charles Ribighini), has lately placed upon the English market a very fine oil found in Southern Italy, which he calls from the place of its nativity "Toccolina." It is described as perfectly limpid, of a bright yellow, without smell, and of a gravity of 80° to 85°.

Cheese as food.

On page 54 we published an article on this subject from the *Scientific American*, a later issue says:—We remarked not long since upon the superior nutritive qualities of this food, as evidenced by the experience of laborers in certain countries, where it forms the strongest staff of life. We have since observed certain researches of a French chemist, M. Charles Mene of Lille, from which we learn that certain cheeses, specified as Dutch, Gruyère and Roquefort, contain from 26 to 40 per cent of nitrogenized matters, which are considered the most highly nutritive constitutents of food. Consequently these cheeses are from twenty-five to a hundred per cent more nutritive than bread or meat, which is set down at 22 per cent of nitrogen. In the combustible or fatty elements for heating the body by respiration, cheese yields only to butter or other fats. Again, in point of mineral nutrition, cheese is found pre-eminent, containing 7 to 8 per cent of ashes, whereas meat and bread contain only one per cent. The very richness of this article, however, prejudices its utility in delicate stomachs, where it is often found indigestible. The strongest food suits only the strongest digestion. The attention now given to an improved, economised and increased manufacture of cheese, is justified, and will naturally be stimulated by these facts.

Oil Tanks.

The foundation and part of the bottom of the second Iron Tank at the station is now laid, and if any one wants to see buisness and hear a clatter, let them make a visit to those iron tanks, whose appearance and gigantic proprtions are now astonishing the natives. The first one is completed inside, and the oil is now being pumped into it at the rate of 500 barrels per day. The oil is conveyed in pipes from the receiving tank, a distance of 60 rods, and forced over the top of the tank. The tank will hold nearly 6,000 barrels when full.—*Ibid.*

Dangers of Burning American Oil.

A well informed correspondent of a New York paper supplies the following:—

Very little of the refined petroleum sold by the retail dealer is even of fair quality. All, or nearly all, the prime oils are sold for export. If a refiner or commission merchant has a lot of inferior oil, either in colour or fire test, which latter is the index of its safety for use, he sells it to the jobber, who in turn sells it to the retailer; and thus it goes into consumption. Very few of those who use petroleum ever get a prime article or anything near it. The standard fire test for export is now fixed at 110 degrees Fahrenheit, which means that the oils standing that test will not give off a vapor that will burn until they have reached that point of heat. But their is an explosive vapor or gas generated at about ten degrees below this, or at about 110 degrees Fahrenheit. Now, oils that will stand the requisite fire test for export are very seldom sold for home consumption, the principal reasons being that the inferior oils of less fire test do not cost so much to manufacture, and hence are sold for a less price. I think I am safe in saying (and I have had long experience in the trade) that nearly all the oil sold at retail is under one hundred degrees fire test, which makes the explosive point about 90 degrees, and consequently dangerous to use: for at that temperature the lamp will be filled above the oil and may contain a gas that explodes the instant it comes in contact with the flame. In summer, when the temperature of the atmosphere is often above 90 degrees, all receptacles containing these light oils are simply magazines of danger only awaiting some unwary or careless hand to apply the match to spread death and destruction around. Furthur than this, much, very much, of the oil that is sold and retailed out for use to unsuspecting people will not stand a fire test of over eighty degrees, and samples can be obtained from almost any dealer in the trade of oils ranging from that up to one hundred degrees. Of course the lighter the oil the greater the danger. Another fruitful source of disaster in this connection arises from the use of a new class of illuminators called (Heaven save the mark!) "non-explosive oil." These are nothing more nor less than naptha, which is said to be rendered non-explosive by the use of chemicals. This naptha is so volatile that if left in open vessels it very soon disappears entirely, passing off by evaporation. This vapour will so saturate or surcharge the atmosphere as to cause the most terrific explosion. A lighted match or lamp in an atmosphere so surcharged has often produced the most disastrous results, as witness the fires at our oil yards, at the wells and in many refineries that are burned. Nearly all these fires can be traced to the surcharged condition of the atmosphere at the time with these carbon gases. Good refined petroleum is as safe to burn in a lamp as whale oil. It generates no explosive gas, except at a heat that is never produced by any ordinary use, and it is deplorable that an article of such vast consumption, and so benificent in its influence in all the world, should have to bear the odium which inevitably attaches on account of the many terrible disasters arising from the cupidity and dishonesty of those who cheat the public with those inferior and dangerous compounds.—*Petrolia Sentinel*

Harden a steel bar to its maximum, and it will expand to a degree which may be represented by 84; the same piece of steel rendered as soft as possible will only expand to 62.

Wholesale Manufacture of Ozone.

It has long been an idea of ours that ozone might be manufactured on a great scale for the purification of close courts, and other cholera and fever haunts; and we pointed attention to the enormous electrical powers of Sir W. Armstrong's electrical boiler, in order to shew the possibility of this being done. It is interesting now to note, in connexion with our idea, that a sugar-refining firm in Whitechapel is setting up one of Wilde's extraordinary electric machines on their premises for the bleaching of sugar; and we do not despair of seeing the same power soon applied as we originally suggested. Wilde's machine has recently been exhibited to the Royal Society at Burlington House It is worked by a 15-horse power engine, and possesses wonderful power. The form is magneto-electric, and it has coils 4 ft. high and 10 in. thick, containing 14 cwt. of copper wire. The armature rotates 15,000 times in a minute. The intensity of the light produced by the machine is something almost appalling. It required, like the sun, to be gazed at through coloured glasses. By means of lenses the mere rays of light set fire to paper, and its heat could be felt 50 yards off. It melted the refractory platinum as if it were lead! Various uses for it are being suggested. The total cost of its light is said not to exceed 6d. or 8d. an hour, cost of the machine itself included. The same sort of machine is used in Manchester for photographic purposes, being preferable, it is said, to the sun for taking photographs! It can also, of course, be made available by night as well as by day.—*The Builder.*

Mechanics in Southern Society.

The *American Artizan* says, under this heading the Atlanta (Ga.) *New Era* recently published some able remarks, which were copied into the *Daily Press*, of Augusta (same State), with the following indorsement:—"Rich men do much for the good of the community if they have the right sort of public spirit; but the 'mainstay' of society is its bone and sinew—its *mechanics.* Knowing this, how careful of their conduct, of their good example, of their education, ought to be this class of people! They should spare no pains to fit themselves for the high position to which the working-man belongs." The article in the *New Era* reads thus:—

"The parvenu 'Shoddy' may turn up his nose at the smell of the workshop, and lay his kid glove lightly in the hand of the horny-fisted son of toil; but for all that *the mechanics are the stoutest props of the social fabric.* Some of the most prominent luminaries in the world's gallery of science have strode from the workshop to fame. Roger Sherman found it no disgrace to be reminded of the lapstone on which he hammered out his fortune. The humbler Collier, who applied steam to the purpose of land transportation, is a greater benefactor to the human race than half of the millionaires of the world. The great instrument which brings planets almost within the reach of astronomers was invented over the loom of Holland, the London weaver, who was too poor to afford a tallow dip to furnish light for the prosecution of his studies. Hugh Miller, a stone-cutter, has enriched science by the tremendous truths that he has quarried from the earth. Clark Mills, an humble house-plasterer, ranks among the first artists in the world. Few who are familiar with the name of Sir Humphry Davy know that at one time he was a boot-black and errand-boy in the Royal Academy, in which he was first professor when he died. Franklin, the great philosopher of our country, was at one time an humble disciple of "the art preservative of all arts;" yet he drew a voice from the thunder-storm which is now breathing intelligent whispers throughout the length and breadth of the civilized world! The list could be pursued further—for names in it are legion—but it is unnecessary. The examples we have given are sufficient to prove that no man is humbled by his vocation—that from some of the most menial employments have arisen geniuses which astonished the world with their brilliancy. But apart from these prominent examples, *mechanics—as a mass—are the most useful and profitable members of society.* Whether hewing the beam, rearing the massive walls, shaping the shoe or heavy bar, delving in mines, guiding the engine on its track, or toiling amid the heat and smoke of the furnace, they are the architects of our social fabric, and occupy positions entitled to the highest consideration. Theirs is an independence of heart and hand. They shape their own fortunes, and shape the destiny and influence of a country or community. The sweat of their brows brings an emolument of wealth to the society in which they reside. Show us a city where there is a large element of mechanics, and we will show you one that is in a high degree prosperous. Our own city is an evidence of this. We have among us not less than five thousand mechanics, and it is admitted by all parties that we are going forward with marvellous strides.

"*Mechanics are a direct source of revenue.* They attract money to their community, and disburse it among home tradesmen. Deprive Atlanta of this class of her population, and it would have a woeful effect upon her trade. Their weekly or monthly expenditures keep an incredible amount of money in circulation, which is the support of many prosperous merchants."

A mass of iron weighing 1000 pounds at the equator would weigh 1005 lbs. at the poles, and but 500 lbs. at a distance of 2,000 miles below or 1650 miles above the earth's surface, and only 160 lbs. on the moon. On the planet Jupiter, however, its weight would be increased to 2,600 lbs., while if placed on the sun, it would gain 27,000 pounds.

At the Farmer's Club of the N. Y. American Institute, a sample of milk from the United States Condensing Co. was exhibited and drew out quite a discussion. This milk can be used for all purposes for which ordinary fresh milk is employed, and is considered of a superior quality of purity, etc., to that generally sold and used in the city.

Professor Faraday has demonstrated that the electricity evolved during the combustion of a few grains of charcoal or a common candle would, if arranged in a continuous circuit, exceed that of the most powerful batteries.