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FOR UPPER CANADA.

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THE COTTON SUPPLY.

British manufacturers, and others interested in the Cotton Trade, have long been alive to the necessity of being able to procure the requisite supply of raw material from more sources than one, in order that they may be insured against all kinds of contingencies,—against bad seasons, and poor crops, as well as against interruptions caused by political disturbances. This necessity has been more especially felt since the outbreak of the recent civil commotions in the United States; the American supply was always exposed to danger from the effect of natural circumstances, but now events which could never have been anticipated have arisen, and threaten to seriously diminish it, if not to put an end to it entirely for some time to come. How the present state of affairs in that country may end it is impossible to conjecture, but at all events there is no doubt that this year's crop will be sadly deficient, since it has to be raised in the face of a war, and to be exported in spite of a blockade. To remedy this threatened deficiency almost all England is at work. Several private companies have been started for the purpose, and are now in active operation, while the Government likewise has not been idle; all its Ministers, Consuls, and agents in the countries capable of producing cotton, have been officially called upon to stimulate its production to the utmost. Last year, at least three-fourths of the raw cotton consumed in England came from the United States, but this year it is expected that more than one-half can be procured elsewhere. The following are the principal companies that have been organized for this purpose:—

"The Manchester Cotton Company, with a capital of $5,000,000, Thomas Bazley, M. P., from Manchester, President. The company started with £500,000, and it was increased to the above sum as soon as the news of secession in America was received.

"Another company has been formed in London, known as the 'Jamaica Cotton Company,' with a capital of £50,000, Samuel Gurney, M.P., chairman. An 'East India Cotton Company' is also formed in London, with a capital of $1,250,000, and some of the leading capitalists of London are connected with it.

"The 'British Cotton Company,' of Manchester, with a capital of $100,000, has also been formed.

"The 'Coventry Cotton Company,' is also formed, with a capital of $250,000.

"The 'Cotton Supply Association' is also vigorously at work, with its arms extended all over the world.—This is an older association, having been organized for four years. The 'African Aid Society,' of London, recently formed, chairman, Lord Alfred S. Churchill, M.P., brother to the Duke of Marlborough. Lord Calthorpe and the Bishop of Sierra Leone are the vice-presidents. Branches of this Association are formed at Glasgow, Manchester, Birmingham, and other towns of Great Britain."

Of these, the "Cotton Supply Association" is by far the most important. It has recently published its fourth annual report, from which may evidently be gathered some very encouraging information. As we have not ourselves seen the document, we cannot do better than subjoin some remarks from the *Times* upon it:—

"Cotton is a plant which can be grown in so very many countries that the mere selection of soil counts for nothing in the problem. There are hundreds of spots in our colonial empire which could produce cotton enough for the whole of Lancashire; but cotton is of various kinds; it requires peculiar preparation for the market, and, as it is bulky in character, facilities of communication enter very largely into the question. It is probably not every cotton country that could produce cotton equal to the Sea Island kind; but the supply of Sea Island cotton is always small. It forms only about 1-50th part of our whole annual supply; so that the question of quality is not a very critical one. The cleaning process is exceedingly important, but that, again, depends only on instruments which can be easily furnished, and dexterity which can be quickly acquired. In the end we come to this, that the whole problem turns upon facilities of transport. In fact, if India had but good roads, the question would be solved for the present; and that is evidently the opinion of the Cotton Supply Association. It is easy to supply good seeds and good cleaning machines, but it is by no means easy to get the cotton from the field to the coast. Carriage is either impracticable altogether, or so tedious and costly as to absorb an enormous proportion of the whole value of the crop.

Another point to be considered is the immense magnitude of the trade, which calls for a corresponding extent of organization. This is where the United States had so great an advantage. They had got the trade in their own hands, and they had gradually brought it to perfection. They supplied the best cotton with infallible punctuality, and in such quantities as almost t suffice for the entire consumption of the country. To organize a commerce like this, must needs be a work of time. It is a question whether any one country could ever do again what the United States have done. India would make the nearest approach to the mark, beyond a doubt; but then comes another question—whether we should not make a point rather of distributing than concentrating our demands. India has far greater capabilities than any other country, but India might be troubled just like America, and all our anxiety would come over again. Four years ago we should have felt a great deal of uneasiness if all our cotton supplies had been drawn from Bombay."

It is certainly cheering to find that so many new sources of supply have been opened, as very little dread need now be entertained respecting the possibility of a complete failure at any future time. The report of the Association enumerates no less than "fifty-eight different parts from which cotton either never came before, or had ceased to come, or came in insignificant quantities, but which have contributed to the supplies with greater or less success during the last twelve months." It also relates that they have not neglected to pay attention to quality as well as quantity; the committee of the Association have received upwards of one hundred and fifty samples of cotton from various countries throughout the world, for their inspection and appraisement. In fact—to quote again from the *Times*:—

"The Association has been doing for the last year or two all over the world, what the British Government within the last few months has been doing in India. The Committee could not speak with official authority, but they 'agitated,' 'corresponded,' and set things in motion whenever they saw a chance. They let all manner of people understand that cotton was wanted, and that payment would readily be made for it. They described the kind of cotton required, and made grants of the proper seed. They sent out good gins for cleaning the cotton, and presses for packing it. They were ready, in short, to provide everything except roads, and that the India Government itself found a difficulty in doing."

More recent accounts from India, however, state that the difficulties arising from the want of means of transportation are fast disappearing; several railroads are being built into the interior, so that the cotton crop can very soon be moved, as fast as it is gathered, to the sea-coast; and the ship canal across the Isthmus of Suez, from the Red Sea to the Mediterranean, will, it is confidently expected, be completed in twelve months, thus shortening the distance of carriage no less than 6,000 miles. It is even asserted that if the American troubles continue five years, India will be able to export the vast amount of 4,000,000 bales,—a quantity worth about $400, 000,000, thus freeing the English manufacturers from all dependence upon the United States for their supply.

Africa also bids fair to become one of the greatest and best sources of supply. The researches of Dr. Livingstone and other missionaries have revealed the fact that that continent possesses capabilities for the growth and exportation of cotton that can scarcely be surpassed in any other part of the world. "The regularity of the climate, the fact that a new crop can be raised every six months, the adaptation of negro labour to its cultivation, and the ease of its transportation down the large rivers, give Africa peculiar advantages." We learn also that even now the best Western-African cotton can be laid down in Liverpool for four-pence and a farthing per pound, which is cheaper than it can be procured from New Orleans, while at the same time it is of a superior quality. We have already noticed, * in an extract from the *Journal of the Society of Arts*, that cotton can be procured in Queensland, Australia, in large quantities.

From facts like these, then, it can easily be perceived that little or no apprehension need be entertained by the English manufacturers with regard to obtaining the necessary supply of the raw material. But in this country we fear that the manufacture of cotton cannot profitably be carried on, at least in competition with British goods, so long as the supply from the United States is cut off. To procure it from any other quarter would involve a carriage of many additional thousand miles, the cost of which would completely counterbalance any advantage possessed by this country in the way of labor or motive power.

* See the May number of this Journal, p. 140.

AMERICAN COTTON STATISTICS.

An interesting article on "Statistics of Cotton Manufacture," taken from the eleventh annual report of the Boston Board of Trade, by Samuel Batchelder, Esq., has lately been published. We condense the following from its pages:—

In 1860 there were in Massachusetts 1,688,471 spindles and 41,620 looms. Since 1850 there has been a total increase of 31 per cent in the number of spindles; but during the past five years the ratio of the increase has been only 11 per cent, which is much lower than that of the same number of years since 1840.

The consumption of cotton in Massachusetts in 1850 was 95,032,975 pounds, or 73.70 for each spindle; in 1855, the amount consumed was 105,851,749 pounds.

It is stated in this report that there is no positive data by which to determine the present number of spindles in the United States, but according to the census of 1850, there were 272,527,000 pounds of cotton consumed; and by allowing 75 pounds to a spindle, there would have been 3,633,693. "If we add," says Mr. Batchelder, "twenty per cent. for the increase of the next ten years, during which time the spindles in Massachusetts have increased 31 per cent. we shall have 4,380,430 for the number in the United States in 1860."

In Tennessee, Alabama, Georgia and South Carolina, there were 140,602 spindles, according to De Bow, in 1850, and the bales of cotton consumed were 60,000; but statistics for that year make the consumption of bales in these States only 41,778. The report of the Philadelphia board of Trade for 1860 gives the consumption of cotton in States north of Virginia at 760,218 bales, and in States south at 164,700, making a total of 921,918. Mr. Batchelder is of opinion, however, that 900,000 bales is probably nearest the truth.

In 1855 there were 314,996,567 yards of cotton cloth produced in Massachusetts, at a cost, for labor and material, of 7.76 cents per yard. The exportation of American goods is larger than many persons suppose. For the year ending June 30, 1860, the value of such exports amounted to $10,934,796. It is understood that goods to the value of $4,200,000 went directly to China from the ports of New York and Boston. The London *Economist* states that the total cotton goods and yarn exported from Great Britain last year amounted in value to £48,200,000, of which sum the United States took £4,635,000 (about $22, 479,750). We therefore export cotton goods valued at nearly one-half that which we take from England. This is more favorable than most people imagine.

Mr. Batchelder says; "As to the future prospects of our cotton manufacture, the greatest apprehension seems to be on account of our relations with the Southern States. There is little doubt that we shall be able to obtain our supply of cotton at the market price, unless all the laws of trade are *nullified.*" This is no doubt a sound conclusion, but it affords no satisfaction to any person. Cotton can always be obtained at the *market price*, It is stated that the value of the entire cotton manufactures of the United States in 1850 was $16,869,184, of which $57,134,760 was consumed at home and the rest exported; and of this amount the free States produced $52,502,853. About seven per cent. of this only is supplied to the fifteen slave States. Our foreign exports of cotton goods have increased rapidly. In 1850, they were valued at $4,734,424; the increase in ten years is $6,200,372.

A common opinion prevails that the increase of cotton machinery has kept in advance of the supply of cotton. Mr. Batchelder asserts that this is not the case. He gives some statistics of British manufacture in proof of this opinion. In 1856 the number of spindles in England and Wales was 25,818,576; looms, 275,590. In Scotland—spindles, 2,041,139; looms, 21,624. In Ireland—spindles, 150,502; looms 1,633. The increase of spindles in Great Britain in six years was about 30 per cent. At the present time it is believed that there are 33,612,260 spindles in England, Ireland and Scotland, allowing an increase of 20 per cent for the last four years. The increase of cotton machinery in England has been proportionally greater than in the United States. The average number of spindles to the loom in Great Britain is 84, or about twice the proportion of this country. More cotton is exported in the form of yarn, and the looms are driven with greater speed in England. But the whole increase of cotton machinery in Europe and America, from 1850 to 1860, is stated to be no more than 50 per cent, while the average increase of the cotton crop in the same period has been no less than 64 per cent. Instead of the machinery increasing beyond the power of the cotton crop to supply the spindles (as has been predicted for some years past), the supply of cotton has been increasing beyond the spindles. At the close of 1860 there were 403,000 bales of American cotton in Liverpool. Mr. Batchelder states that he had hoped to obtain from Washington some statistics from the census of 1860; but on application at the Census Bureau, the manufacturing statistics had not been made up so as to afford any information on the subject.—*Scientific American.*

THE CHEMICAL HISTORY OF A CANDLE.

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

From the "Chemical News," February 9th, 1861.

LECTURE VI.—CARBON OR CHARCOAL—COAL GAS—RESPIRATION AND ITS ANALOGY TO THE BURNING OF A CANDLE—CONCLUSION.

A lady who honours me by her presence at these Lectures has conferred a still greater obligation by sending me these two candles which are from Japan, and, I presume are made of that substance to which I referred in a former Lecture. You see that they are even far more highly ornamented than the French candles, and, I suppose are candles of luxury, judging from their appearance. They have a remarkable peculiarity about them, namely, a hollow wick,—that beautiful peculiarity which Argand introduced into the lamp and made so valuable. To those who receive such presents from the East, I may just say that this and such like materials, gradually assume a change which gives them on the surface a dull and dead appearance; but they may easily be restored to their original beauty if the surface is rubbed with a clean cloth or silk handkerchief, so as to polish the little rugosity or roughness; this will restore the beauty of the colours. I have so rubbed one of these candles, and you see the difference between it and the other which has not been polished, but which may be restored by the same process. Observe, also, that these moulded candles from Japan are made more conical than the moulded candles in this part of the world.

I told you, when we last met, a good deal about carbonic acid. We found by the lime-water test that when the vapour from the top of the candle or lamp was received into bottles and tested by this solution of lime-water (the composition of which I explained to you, and which you can make for yourselves), we had that white opacity which was in fact calcareous matter, like shells and corals, and many of the rocks and minerals in the earth. But I have not yet told you clearly and chemically the history of this substance, carbonic acid, as we have it from the candle, and I must now take you to that point. We have seen the products, and the nature of them, as they issue from the candle. We have traced the water to its elements, and now we have to see where are the elements of the carbonic acid supplied by the candle: a few experiments will show this. You remember that when a candle burns badly it burns with smoke; but if it is burning well there is no smoke. And you know that the brightness of the candle is due to this smoke which becomes ignited. Here is an experiment to prove this: so long as the smoke remains in the flame of the candle and becomes ignited it gives a beautiful light, and never appears to us in the forms of black particles. I will light some fuel which is extravagant in its burning; this will serve our purpose—a little turpentine on a sponge. You see the smoke rising from it, and floating into the air in large quantities, and remember now, the carbonic acid that we have from the candle is from such smoke as that. To make that evident to you I will introduce this turpentine burning on the sponge into a flask where I have plenty of oxygen, the rich part of the atmosphere, and you see that the smoke is all consumed. This is the first part of our experiment, and now what follows? The carbon which you saw flying off from the turpentine flame in the air we have now entirely burned in this oxygen, and we shall find that it will by this rough and temporary experiment, give us exactly the same conclusion and result as we had from the combustion of the candle. The reason why I make the experiment in this manner is solely that I may cause the steps of our demonstration to be so simple that you can never for a moment lose the train of reasoning if you only pay attention. All the carbon which is burned in oxygen, or air, comes out as carbonic acid, whilst those particles which are not so burned show you the second substance in the carbonic acid, namely the carbon, that body which made the flame so bright whilst there was plenty of air, but which was thrown off in excess when there was not oxygen enough to burn it.

I have also to show you a little more distinctly the history of carbon and oxygen in their union to make carbonic acid. You have now a right to know this to a far greater extent than before, so I have three or four experiments for that purpose. I have here a jar filled with oxygen, and here is some carbon which has been placed in a crucible for the purpose of being made red hot. I keep my jar dry and venture to give you a result imperfect in some degree, in order that I may make the experiment brighter. I am about to put the oxygen and the carbon together. That this is carbon (common charcoal pulverised) you will see by the way in which it burns in the air [letting some of the red hot charcoal fall out of the crucible]. I am now about to burn it in oxygen gas, and look at the difference. It may appear to you at a distance as if it were burning with a flame; but it is not so. Every little piece of charcoal is burning as a spark, and whilst it so burns it is producing carbonic acid. I specially want these two or three experiments to point out what I shall dwell upon more distinctly by-and-by—that carbon burns in this way, and not as a flame.

Instead of taking many particles of carbon to burn I will take a rather large piece, which will enable you to see the form and size, and to trace the effects very decidedly. Here is the jar of oxygen, and here is the piece of charcoal, to which I have fastened a little piece of wood, which I can set fire to and so carry on the combustion, which I could not conveniently do without. You now see the charcoal burning, but not as a flame (or if there be a flame it is the smallest possible one, which I know the cause of, namely, the formation of a little carbonic oxide close upon the surface of the carbon). It goes on burning, you see, slowly producing carbonic acid by the union of this carbon or charcoal (they are equivalent terms) with the oxygen. I have here another piece of charcoal, a piece of bark, which has the quality of being blown to pieces—exploding—as it burns. By the effect of the heat we shall reduce the lump of carbon into particles that will fly off; still every particle, equally with the whole mass, burns in this peculiar way—it burns as a coal, and not like a flame. You observe a multitude of little combustions going on, but no flame. I do not know a finer experiment than this to show that carbon burns with a spark.

Here, then, is carbonic acid formed from its elements. It is produced at once, and if we examined it by lime water, you will see that we have the same substance which I have previously described to you. By putting together 6 parts of carbon by weight (whether it comes from the flame of a candle or from powdered charcoal) and 16 parts of oxygen by weight we have 22 parts of carbonic acid; and, as we saw last time, the 22 parts of carbonic acid combined with 28 parts of lime, produce common carbonate of lime. If you were to examine an oyster-shell and weigh the component parts, you would find that every 50 parts would give 6 of carbon and 16 of oxygen combined with 28 of lime. However, I do not want to trouble you with these minutiæ; it is only the general philosophy of the matter that we can now go into. See how finely the carbon is dissolving away [pointing to the lump of charcoal burning quietly in the jar of oxygen]. You may say that the charcoal is actually dissolving in the air round about, and if that were perfectly pure charcoal, which we can easily prepare, there would be no residue whatever. When we have a perfectly cleansed and purified piece of carbon there is no ash left. The carbon burns as a solid dense body, that heat alone cannot change as to its solidity, and yet it passes away into vapour that never condenses into solid or liquid under ordinary circumstances; and what is more curious still is the fact that the oxygen does not change in its bulk by the solution of the carbon in it. Just as the bulk is at first, so it is at last, only it has become carbonic acid.

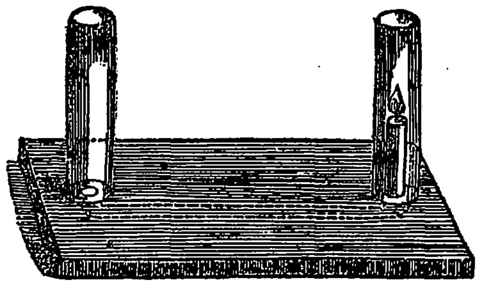
There is another experiment which I must give you before you are fully acquainted with the general nature of carbonic acid. Being a compound body, consisting of carbon and oxygen, carbonic acid is a body that we ought to be able to take asunder. And so we can. As we did with water so we can with carbonic acid,—Take the two parts asunder. The simplest and quickest way is to act upon the carbonic acid by a substance that can attract the oxygen from it, and leave the carbon behind. You recollect that I took potassium and put it upon water or ice, and you saw that it could take the oxygen from the hydrogen. Now, suppose we do something of the same kind here with this carbonic acid. You know carbonic acid to be a heavy gas: I will not test it with lime-water, as that will interfere with our subsequent experiments, but I think the heaviness of the gas and the power of extinguishing flame will be sufficient for our purpose. I introduce a flame into the gas, and you will see whether it will put it out. You see the light is extinguished. Indeed, the gas may, perhaps, put out phosphorus, which you know has a pretty strong combustion. Here is a piece of phosphorus heated to a high degree. I introduce it into the gas, and you observe the light is put out, but it will take fire again in the air, because there it re-enters into combustion. Now let me take a piece of potassium, a substance which even at common temperatures can act upon carbonic acid, though not sufficiently for our present purpose, because it soon gets covered with a protecting coat; but if we warm it up to the burning point in air, as we have a fair right to do, and as we have done with phosphorus, you will see that it can burn in carbonic acid, and if it burns it will burn by taking oxygen, so that you will see what is left behind. I am going, then, to burn this potassium in the carbonic acid as a proof of the existence of oxygen in the carbonic acid. [In the preliminary process of heating the potassium exploded]. Sometimes we get an awkward piece of potassium that explodes, or something like it, when it burns. I will take another piece, and now that it is heated I introduce it into the jar, and you perceive that it burns in the carbonic acid—not so well as in the air, because the carbonic acid contains the oxygen combined, but it does burn, and takes away the oxygen. If I now put this potassium into water I find that besides the potash formed (which you need not trouble about) there is a quantity of carbon produced. I have here made the experiment in a very rough way, but I assure you that if I were to make it carefully, devoting a day to it, instead of five minutes, we should get all the proper amount of charcoal left in the spoon, or in the place where the potassium was burned, so that there could be no doubt as to the result. Here, then, is the carbon obtained from the carbonic acid, as a common black substance; so that you have the entire proof of the nature of carbonic acid as consisting of carbon and oxygen. So now, I may tell you, that whenever carbon burns under common circumstances it produces carbonic acid.

Suppose I take this piece of wood, and put it into a bottle with lime-water. I might shake that lime water up with wood and the atmosphere as long as I pleased, it would still remain clear as you see it;

but suppose I burn the piece of wood in the air of that bottle. You, of course, know I get water. Do I get carbonic acid? [The experiment was performed.] There it is you see, that is to say, the carbonate of lime, which results from carbonic acid, and that carbonic acid must be formed from the carbon which comes from the wood, from the candle or any other thing. Indeed, you have yourselves frequently tried a very pretty experiment, by which you may see the carbon in wood. If you take a piece of wood, and partly burn it, and then blow it out, you have carbon left. There are things that do not show carbon in this way. A candle does not so show it, but it contains carbon. Here also is a jar of coal gas, which produces carbonic acid abundantly,—you do not see the carbon, but we can soon show it to you. I will light it, and as long as there is any gas in this cylinder it will go on burning. You see no carbon, but you see a flame, and because that is bright it will lead you to guess that there is carbon in the flame. But I will show it to you by another process. I have some of the gas in another vessel, mixed with a body that will burn the hydrogen of the gas, but will not burn the carbon. I will light them with a burning taper, and you perceive the hydrogen is consumed, but not the carbon, which is left behind as a dense black smoke. I hope that by these three or four experiments you will learn to see when carbon is present, and understand what are the products of combustion, when gas or other bodies are thoroughly burned in the air.

Before we leave the subject of carbon, let us make a few experiments and remarks upon its wonderful condition, as respects ordinary combustion. I have shown you that the carbon in burning burns only as a solid body, and yet you perceive that after it is burned, it ceases to be a solid. There are very few fuels that act like this. It is in fact only that great source of fuel, the carbonaceous series, the coals, charcoals, and woods, that can do it. I do not know that there is any other elementary substance besides carbon that burns with these conditions, and if it had not been so, what would happen to us? Suppose all fuel had been like iron which, when it burns, burns into a solid substance. We could not then have such a combustion as you have in this fire place. Here also is another kind of fuel which burns very well—as well as, if not better, than carbon—so well, indeed, as to take fire of itself when it is in the air, as you see. [Breaking a tube full of lead pyrophorus.] This substance is lead, and you see how wonderfully combustible it is. It is very much divided, and is like a heap of coals in the fire-place: the air can get to its surface and inside, and so it burns. But why does it not burn in that way now when it is lying in a mass? [Emptying the contents of the tube in a heap on to a plate of iron.] Simply because the air cannot get to it. Though it can produce a great heat, the great heat which we want in our furnaces and under our boilers, still that which is produced cannot get away from the portion which remains unburned underneath, and that portion, therefore, is prevented from coming in contact with the atmosphere, and cannot be consuned. How different is that from carbon! Carbon burns just in the same way as this lead does, and so gives an intense fire in the furnace, or wherever you choose to burn it; but then the body produced by its combustion passes away, and the remaining carbon is left clear. I showed you how carbon went on dissolving in the oxygen, leaving no ash; whereas, here [pointing to the heap of pyrophorus] we have actually more ash than fuel, for it is heavier by the amount of the oxygen which has united with it. Thus, you see, the difference between carbon and lead or iron, if we chose iron, which gives so wonderful a result in our applications of this fuel, either as light or heat. If when the carbon burnt here the product went off as solid body you would have had the room filled with an opaque substance, as in the case of the phosphorus; but when carbon burns everything passes up into the atmosphere. It is in a fixed, almost unchangeable condition before the combustion; but afterwards it is in the form of gas, which it is very difficult (though we have succeeded) to produce in a solid or liquid state.

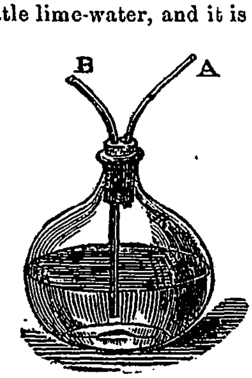
Now I must take you to a most interesting part of our subject—to the relation between the combustion of a candle and that living kind of combustion which goes on within us. In every one of us there is a living kind of combustion going on exactly like that of a candle, and I must try to make that plain to you. For that is not merely true in a poetical sense—the relation of the life of man to a taper, and if you will follow, I think I can make this clear. In order to make the relation very plain, I have devised a little apparatus which we can soon build up before you. Here is a board and a groove cut in it, and I can close the groove cut in it, and I can close the groove at the top part by a little cover; I can then continue the groove as a channel by a glass tube at



each end, there being a free passage through the whole. Suppose I take a taper or candle (we can now be liberal in the use of the word "candle," since we understand what it means), and place it in one of the tubes; it will go on, you see, burning very well. You observe that the air which feeds the flame passes down the tube at one end, then goes along the horizontal tube, and ascends the tube at the other end in which the taper is placed. If I stop the aperture through which the air enters, I stop combustion, as you perceive. I stop the supply of air, and consequently the candle goes out. But now what will you think of this fact? In a former experiment I showed you the air going from one burning candle to a second candle. If I took the air proceeding from another candle, and sent it down by a complicated arrangement into this tube, I should put this burning candle out. But what will you say when I tell you that my breath will put out that candle? I do not mean by blowing at all, but simply that the nature of my breath is such that a candle cannot burn in it. I will now hold my mouth over the aperture, and without blowing the flame in any way, let no air enter the tube but what comes from my mouth. You see the result. I did not blow the candle out. I merely let the air which I expired pass into the aperture, and the result was that the light went out for want of oxygen, and for no other reason. Something or other —namely, my lungs— had taken away the oxygen from the air, and there was no more to supply the combustion of the candle. It is, I think very pretty to see the time it takes before the bad air which I throw into this part of the apparatus has reached the candle.. The candle at first goes on burning, but so soon as the air has had time to reach it it goes out. And now I will show you another experiment, because this is an important part of our philosophy. Here is a jar which contains fresh air, as you can see by the circumstance of a candle or gas-light burning in it. I make it close for a little time, and by means of a pipe I get my mouth over it so that I can inhale the air. By putting it over water in the way that you see, I am able to draw up this air, (supposing the cork to be quite tight), take it into my lungs, and throw it back into the jar: we can then examine it, and see the result. You observe, I first take up the air, and then throw it back, as is evident from the ascent and descent of the water, and now, by putting a taper into the air, you will see the state in which it is by the light being extinguished. Even one inspiration, you see, has completely spoiled this air, so that it is no use my trying to breath it a second

time. Now you understand the ground of the impropriety of many of the arrangements among the houses of the poorer classes, by which the air is breathed over and over again, for the want of a supply, by means of proper ventilation, sufficient to produce a good result. You see how bad the air becomes by a single breathing, so that you can easily understand how essential fresh air is to us.

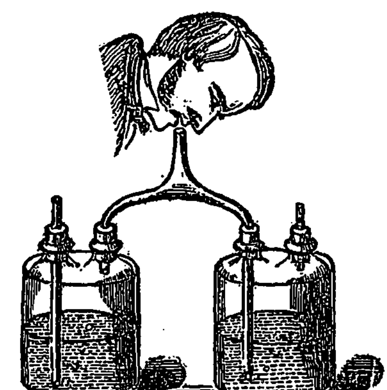
To pursue this a little further, let us see what will happen with lime water. Here is a globe which contains a little lime-water, and it is so arranged as



regards the pipes, as to give access to the air within, so that we can ascertain the effect of respired, or unrespired air upon it. Of course I can either draw in air (through A) and so make the air that feeds my lungs go through the lime-water, or I can force the air out of my lungs through the tube (B) which goes to the bottom, and so show its effect upon the lime-water. You will observe that however long I draw the external air into the lime-water, and then through it to my lungs, I shall produce no effect upon the water—I will not make the lime-water turbid; but if I throw the air *from* my lungs through the lime-water, several times in succession, you see how white and milky the water is getting, showing the effect which expired air has had upon it; and now you begin to know that the atmosphere which we have spoiled by respiration is spoiled by carbonic acid, for you see it here in contact with the lime water

I have here two bottles, one containing lime-water and the other common water and tubes which pass into the bottles and connect them. The apparatus is very rough, but it is useful notwithstanding. If I take these two bottles, inhaling here and exhaling there, the arrangement of the tubes will prevent the air going backwards. The air coming in, will go to my mouth and lungs, and in going out, will pass through the lime water, so that I can go on breathing and making an experiment, very refined in its nature, and very good in its results. You will observe that the good air has done nothing to the lime water; in the other case nothing has come to the lime-water, but my respiration, and you see the difference in the two cases.

Let us now go a little further. What is all this process going on within us which we cannot do without, either day or night, which is so provided for by the Author of all things, that He has arranged



that it shall be independent of all will? If we restrain our respiration, as we can to a certain extent, we should destroy ourselves. When we are asleep, the organs of respiration and the parts that are associated with them, still go on with their action so necessary is this process of respiration to us, this contact of the air with the lungs. I must tell you in the briefest possible manner, what this process is. We consume food: the food goes through that strange set of vessels and organs within us and is brought into various parts of the system, into the digestive parts especially; and alternately the portion which is so changed, is carried through our lungs by one set of vessels, while the air which we inhale and exhale, is drawn into and thrown out of the lungs by another set of vessels, so that the air and the food come close together, separated only by an exceedingly thin surface: the air can thus act upon the the blood by this process, producing precisely the same result in kind as we have seen in the case of the candle. The candle combines with parts of the air, forming carbonic acid, and evolves heat; so in the lungs there is this curious, wonderful change taking place. The air entering, combines with the carbon (not carbon in a free state, but, as in this case, placed ready for action at the moment), and makes carbonic acid, and is so thrown out into the atmosphere, and thus this singular result takes place; we may thus look upon the food as fuel. Let me take that piece of sugar, which will serve my purpose. It is a compound of carbon, hydrogen, and oxygen, similar to a candle, as containing the same elements, though not in the same proportion; the proportions being as shown in this table:—

Sugar		
Carbon	72	
Hydrogen	11	99
Oxygen	88	

This is, indeed, a most curious thing, which you can well remember, for the oxygen and hydrogen are in exactly the proportions which form water, so that sugar is compounded of 72 parts of carbon and 99 parts of water; and it is the carbon in the sugar that combines with the oxygen carried in by the air in the process of respiration, so making us like candles; producing these actions, warmth, and far more wonderful results besides, for the sustenance of the system, by a most beautiful and simple process. To make this still more striking, I will take a little sugar, or to make the experiment shorter I will use some syrup, which contains about three-fourths of sugar and a little water. If I put a little oil of vitriol on it it takes away the water, and leaves the carbon in a black mass. [The Lecturer mixed the two together.] You see how the carbon is coming out, and before long we shall have a solid mass of charcoal, all of which has come out of sugar. Sugar, as you know, is food, and here we have absolutely a solid lump of carbon where you would not have expected it. And if I make arrangements so as to oxidise the carbon of sugar, we shall have a much more striking result. Here is sugar, and I have here an oxidiser—a quicker one than the atmosphere; and so we shall oxidise this fuel by a process different from respiration in its form, though not different in its kind. It is the combustion of the carbon by the contact of oxygen which the body has supplied to it. If I set this into action at once you will see combustion produced. Just what takes place in my lungs—taking in oxygen from another source, namely, the atmosphere, takes place here by a more rapid process.

You will be astonished when I tell you what this curious play of carbon amounts to. A candle will burn some four or five, or six, or seven hours. What then must be the daily amount of carbon going up into the air in the way of carbonic acid! What a quantity of carbon must go from each of us in respiration! What a wonderful change of carbon must take place under these circumstances of combustion or respiration! A man in twenty four hours converts as much as seven ounces of carbon into carbonic acid; a milch cow will convert seventy ounces, and a horse seventy-nine ounces, solely by the act of respiration. That is, the horse in twenty four hours burns seventy-nine ounces of charcoal, or carbon, in his organs of respiration to supply his natural warmth in that time. All the warm-blooded animals get their warmth in this way, by the conversion of carbon, not in a free state, but in a state of combination. And what an extraordinary notion this gives us of the alterations going on in our atmosphere. As much as 5,000,000 pounds, or 548 tons, of carbonic acid is formed by respiration in London alone in twenty-four hours. And where does all this go? Up into the air. If the carbon had been like the lead which I showed you, or the iron which, in burning, produces a solid substance, what would happen? Combustion could not go on. As charcoal burns it becomes a vapour and passes off into the atmosphere, which is the great vehicle, the great carrier for conveying it away to other places. Then what becomes of it? Wonderful is it to find that the change produced by respiration, which seems so injurious to us (for we cannot breathe air twice over) is the very life and support of plants and vegetables that grow upon the surface of the earth. It is the same also under the surface, in the great bodies of water, for fishes and other animals respire upon the same principle, though not exactly by contact with the open air. Such fish as I have here [pointing to a globe of gold-fish] respire by the oxygen in the air, which is dissolved by the water, and form carbonic acid, and they all move about to produce the one great work of making the animal and vegetable kingdoms subservient to each other. And all the plants growing upon the surface of the earth, like that which I have brought here to serve as an illustration, absorb carbon: these leaves are taking up their carbon from the atmosphere to which we have given it in the form of carbonic acid, and they are growing and prospering. Give them a pure air like ours, and they could not live in it; give them carbon with other matters, and they live and rejoice. This piece of wood gets all its carbon, as the trees and plants get theirs, from the atmosphere, which, as we have seen, carries away what is bad for us and at the same time good for them,—what is disease to the one being health to the other. So are we made dependent not merely upon our fellow-creatures but upon our fellow-existers, all nature being tied together by the laws that make one part conduce to the good of another.

There is another little point which I must mention before we draw to a close—a point which concerns the whole of these operations, and most curious and beautiful it is to see it clustering upon and associated with the bodies that concern us—oxygen, hydrogen, and carbon, in different states of their existence. I showed you just now some powdered lead, which I set burning; and you saw that the moment the fuel was brought to the air it acted, even before it got out of the bottle,—the moment the air crept in it acted. Now, there is a case of chemical affinity by which all our operations proceed. When we breathe the same operation is going on within us. When we burn a candle the attraction of the different parts one to the other is going on. Here it is going on in this case of the lead, and it is a beautiful instance of chemical affinity. If the products of combustion rose off from the surface, the lead would take fire, and go on burning to the end; but, you remember, that we have this difference between charcoal and lead—that, while the lead can start into action at once if there be access of air to it, the carbon will remain days, weeks, months, or years. The manuscripts of Herculaneum were written with carbonaceous ink, and there they have been for 1800 years or more, not having been at all changed by the atmosphere, though coming under various circumstances in contact with it. Now, what is is the circumstance which makes the lead and carbon differ in this respect? It is a striking thing to see that the matter which is appointed to serve the purpose of fuel *waits* in its action ; it does not start off burning, like the lead and many other things that I could show you, but which I have not encumbered the table with ; but it waits for action. This waiting is a curious and wonderful thing. Candles—those Japanese candles, for instance—do not start into action at once like the lead or iron (for iron finely divided does the same thing as lead), but there they wait for years, perhaps for ages, without undergoing any alteration. I have here a supply of coal-gas. The jet is giving forth the gas, but you see it does not take fire—it comes out into the air, but it waits till it is hot enough before it burns. If I make it hot enough it takes fire. If I blow it out the gas that is issuing forth waits till the light is applied to it again. It is curious to see how different substances wait—how some will wait till the temperature is raised a little, and others till it is raised a good deal. I have here a little gunpowder and some gun-cotton ; even these differ in the conditions under whcih they will burn. The gunpowder is composed of carbon and other substances, making it highly combustible ; and the gun-cotton is another combustible preparation. They are both waiting, but they will start into activity at different degrees of heat, or under different conditions. By applying a heated wire to them we shall see which will start first [touching the gun-cotton with the hot iron]. You see the gun cotton has gone off, but not even the hottest part of the wire is now hot enough to fire the gunpowder. How beautifully that shows you the difference in the degree in which bodies act in this way. In the one case the substance will wait any time until the associated bodies are made active by heat; but, in the other, as in the process of respiration, it waits no time. In the lungs, as soon as the air enters, it unites with the carbon, even in the lowest temperature which the body can bear short of being frozen, the action begins at once, producing the carbonic acid of respiration ; and so all things go on fitly and properly. Thus you see the analogy between respiration and combustion is rendered still more beautiful and striking. Indeed, all I can say to you at the end of these Lectures (for we must come to an end at one time or other) is to express a wish that you may, in your generation, be fit to compare to a candle ; that you may, like it, shine as lights to those about you ; that, in all your actions, you may justify the beauty of the taper by making your deeds honourable and effectual in the discharge of your duty to your fellow-men.

NITROGENOUS, NUTRITIOUS, OR FLESH-FORMING SUBSTANCES USED AS FOOD.

In the tissues of all plants a substance is found which was known to chemists under the names of gluten, legumin, diastase, zymome, &c. These substances were found by Mulder to yield, by the action of potash and acetic acid, a precipitate, which he called protein, and which he also obtained from the animal substances knows as albumen, fibrine, caseine, &c. By this discovery it was demonstrated that the source of the substances forming the flesh of animals is the protein of plants. Whether it occurs in animals or plants, it may be divided for practical purposes into three forms—albumen, fibrine, and caseine.

Albumen is found in plants, in the juice of cabbages, asparagus, chesnuts, wheat, rye, &c. ; in animals, in the blood, nerves, and the white of eggs.

Fibrine is found in plants, in wheat, barley, oats, rye, &c. ; in animals, in their muscular tissue or flesh.

Caseine is found in plants, in peas, beans, lentils, and the seeds of all *Leguminosæ* ; in animals, almost exclusively in the milk of the mammalia.

Flesh-formers in Food.

All the organs of the body contain the four elements, *Carbon, Hydrogen, Nitrogen,* and *Oxygen:* and no ingredients of food can be of use in building up the wasted parts of the body unless these four elements are present. The nutritive or flesh-forming parts of food are Fibrin, Albumen, and Casein : they contain the four elements in exactly the same proportions, and are found both in vegetable and in animal food. Fibrin may be got either by stirring fresh-drawn blood, or from the juice of a cauliflower; Albumen or white of egg from eggs, from cabbage juice, or from flour. Casein or Cheese exists more abundantly in peas and beans than it does in milk itself. Fibrin, Albumen, and Casein, whether they are got from vegetable or animal bodies, have the same composition as dried flesh and blood. The growth and support of an animal is now easily explained: when a flesh-eater, like the tiger, lives on the flesh of another animal, it eats, in a chemical point of view, the substance of its own body, and requires only to give it a new place and form. When a child receives its mother's milk, it does the same thing, eating in fact its mother, and giving her flesh a new place and form in its own body. The nutrition of vegetable feeders is precisely the same: they find in Vegetable Fibrin, Albumen, and Casein the substance of their flesh and blood actually formed, and have only to give it a place and position within their bodies. Vegetables are the true makers of flesh: animals only arrange the flesh which they find ready formed in vegetables. The *nutritive* value of food depends upon its richness in flesh-forming matter. An adult man, in vigor, wastes five ounces of dry flesh daily, and requires the same amount of flesh formers in his food.

The bodies which form the basis of flesh, or any other organized part, are included under the popular name of "Flesh-formers ;" although in reality, besides these, water, fat, and mineral matter are found in flesh, and are, in one sense, necessary to its formation. A piece of clean muscular fibre, or dry blood, free from water, fat, and mineral matter, has the same composition as either Albumen, Fibrin, or Casein, whether they are obtained from substances of Vegetable or Animal origin. 100 parts contain :—

Carbon	54.0
Hydrogen	7.0
Nitrogen	15.5
Oxygen	23.5

1. Albumen, made from eggs and from blood. It forms about 7 parts in 100 of blood, and is always

present in lymph and chyle. Liquid or soluble albumen, as shown in the white of egg, coagulates by heat and various chemical agents.

2. Albumen, as found in the juice of carrots, turnips, and cabbages, and obtained by boiling their juices. It is the same body as albumen from eggs.

3. Fibrin made by stirring blood with a rod. It is the basis of muscle of flesh. Flesh-fibrin probably bears the same relation to blood-fibrin as coagulated albumen does to soluble albumen.

4. Fibrin made from Wheat-flour. It is identical with the fibrin found in flesh, but not exactly the same as that found in blood, and is known as *Gluten*.

5. Casein prepared from milk, in which it is soluble, owing probably to a little alkali: when an acid is added, the Casein curdles or coagulates, and then is known as Cheese. In 100 parts of cows' milk there are 3½ parts of Casein.

6. Casein or Legumin, as found in peas, beans, lentils, coffee, &c. The Casein of Vegetables is now supposed by most chemists to be identical with the Casein or Cheese of Milk, but a few chemists still deny this. 100 parts of peas contain above 20 parts of Casein.

The flesh formers are most abundant in those plants which yield the substantive food of man. These plants belong principally to the group of Cereal grasses and Leguminous plants. Of these the most important is Wheat.

Wheat, (Species? of the genus *Triticum*)

The plants yielding Wheat belong to the natural order of Grasses (*Graminaceæ*). They have never been found in a perfectly wild state, and on that account have been supposed to originate in some other form of Grass at present wild. Although surmises have been made that the wheats originate in a wild plant called *Ægilops ovata*, the fact of the conversion of one into the other has not yet been proved. The Wheat plant is grown all over the world, but flourishes mostly between the parallels of 25 and 60 degrees of latitude. It is more abundant in the northern than in the southern hemisphere.

The varieties of Wheat cultivated in Europe may be divided into those whose flowers produce awns, and those without these appendages, or *bearded* and *beardless* Wheats. The fruits or seeds of these varieties are red or white, hence a further sub-division takes place into *red* or *white*, bearded or beardless, Wheats. Amongst the red bearded varieties is the fingered Egyptian or Mummy Wheat, which presents the peculiarity of several branches bearing fruits proceeding from its central stalk. Wheat is also called hard and soft according to its consistence, and winter and spring as it is sown at those seasons of the year. The red varieties yield the largest amount of grain, but the white the whitest flour.

Wheat is preferred to the other Cereal grasses as an article of food on account of its containing a larger quantity of flesh-forming matters. The flour also may be rendered very white by separating it from the husks, or bran, and the fruit is much more easily separated from the chaff than is the case with the other Cereals. The proportion of flesh-forming matters to those which give heat are more nearly adjusted to the requirements of the system in Wheat than in any other food. Hence, probably, its very general use as an article of food amongst the populations of the hardest working nations in the world.

The quantity of Wheat-corn grown annually in the United Kingdom has been calculated at 14,000,000 of quarters. In 1858, 3,000,000 of quarters of Wheat were imported into this country, exclusive of flour, meal, sago, rice and other grain.

Good Wheat should give three-fourths of its weight of fine flour; but the chemical composition of this depends upon the greater or less quantity which it contains of the outer husks. The finest flour is not so rich in flesh forming matter as the coarser kinds. The average composition in 100 parts may be taken as:—

Water	14·0	or	Water	14·0
Gluten	12·8		Flesh-formers	14·6
Albumen	1·8		Heat-givers	69·8
Starch	69·7		Mineral Matter	1·6
Sugar	5.5			
Gum	1.7			
Fat	1·2			
Fibrine	1·7			
Ashes	1·6			

1. Wheat, of which the chemical composition varies according to the varieties, 21 oz. required to make 1 lb. of flour.

2. Bran, or outer and inner skins of the wheat—5¼ oz.

3. Flour, or the inner part of wheat separated from the outer parts of bran—16 oz.
4. Water from 1 lb. of Flour—2¼
5. Gluten from 1 lb. of flour—2 oz.
6. Albumen from 1 lb. of flour—¼ oz.
7. Starch from 1 lb. of flour—9½ oz.
8. Sugar from 1 lb. of flour—1 oz.
9. Gum from 1 lb. of flour—¼ oz.
10. Fat from 1 lb. of flour—⅛ oz.
11. Fibre from 1 lb. of flour—¼ oz.
12. Ashes from 1 lb. of flour—¼
13. *Carbon from* 1 lb. *of flour—7 oz.*

Bread.

All food is called bread which is made from the flour of grains or seeds made into dough and baked. Bread is either *vesiculated* or *unvesiculated*. The latter is called unleavened bread, and consists of such preparations of flour as are known by the name of biscuits and cakes.

Vesiculated bread is prepared in two ways, either by *fermentation* or *aëration*. In all cases fermented bread is made from the flour of wheat, or a mixture of this with the meal or flour of other grain. Oats, barley, maize, rye, will not alone make fermented bread. The meal of these grains is added to wheaten flour when they are made into bread.

In the making of fermented bread yeast is added to the flour, and the gluten of the flour is put into a state of change, but not decomposed. A small portion of the starch is formed into glucose, which is decomposed, and alcohol formed, and carbonic acid produced. The carbonic acid gas escaping from the mass vesiculates the bread. This process is called the *rising* of the bread. It is in this stage that the starch enters into a state of change which assists its subsequent solution in the stomach.

Bread is vesiculated, without being fermented, by two processes. 1, by the addition of substances which during their decomposition give out carbonic acid, as carbonate of soda and hydrochloric acid. 2, by making the bread with water charged with carbonic acid gas. The first is the process recommended by Dr. Whiting, and sold in London under the name of Dodson's Unfermented Bread. The second process consists in mixing water, containing carbonic acid gas under pressure, with flour, so that when the dough is baked the escape of the carbonic acid gas vesiculates the bread. This process is worked in London under Dr. Dauglish's patent, and extensive machinery for making this bread has been erected by Messrs. Peak, Frean & Co., Dockhead. It is called Aërated Bread.

Both forms of vesiculated bread are adapted for general use. In certain morbid conditions of the stomach fermented bread undergoes changes which are productive of inconvenience, and which is prevented by unfermented bread.

BARLEY, (*Hordeum distichum.*)

Next in importance to Wheat amongst the cultivated grains of this country is Barley.

The barley-plant, like wheat and oats, belongs to the natural order of grasses (*Graminaceæ*). Although there are several species of the genus *Hordeum*, to which barley belongs, it is probable that all the varieties cultivated belong to the species *Hordeum distichum*. This plant appears to be a native of Asia, but it has a remarkable power of adapting itself to a great range of temperature, and it has a wider distribution than either wheat or oats. On the eastern continent its culture extends from 70° north latitude to 42° south, whilst in America its culture reaches as far as 20° to 62° north latitude.

Its use as an article of food is coeval with the history of man, and we learn from the Sacred Writings that it was cultivated and used as food by the Israelites from the earliest period of their history.

The grain of the barley is used in this and other countries of the world for two purposes; first for food, and second for making beer and distilled spirits. As a food barley is less rich in starch and nutritive matters than wheat. It contains a large quantity of ashes, and its meal makes agreeable cakes, which at one time were consumed largely as food by the population of Great Britain. Barley cakes are still eaten in Yorkshire; and the barley, deprived of its husks, is used in cookery under the name of "pearl barley."

The great consumption of barley in this country is in the making of malt. In this process the barley is allowed to germinate; the starch of the seed is changed into sugar, which is subsequently converted into alcohol by fermentation in the manufacture of beer. In this way upwards of 5,000,000 of quarters are annually consumed in Great Britain.

Barley yields a greater produce per acre than any other grain except rice. The counties in England in which it is chiefly cultivated are Norfolk, Suffolk, Cambridge, Bedford, Herts, Leicester, and Nottingham. In Spain, Sicily, the Canaries, Azores, and Madeira, two crops are produced in the year.

In chemical composition, Barley and Wheat are much alike; but Barley does not form such a fine and spongy bread as Wheat, although it is equally nutritive: 100 parts contain:—

Water	14·0	or	Water	14·0	
Gluten	12·8		Flesh-formers	13·0	Carbon 40·0
Starch	48·0		Heat-givers	69.5	
Sugar	3·8		Mineral Matter	3·5	
Gum	3·7				
Fat	0·3				
Fibre	13·2				
Ashes	4·2				

The Case shows the quantities of these ingredients found in 1 lb. of Barley.

1. Barley containing 14 parts of water—1 lb.
1. *a.* Pot Barley got from 1 lb. of Barley—11½ oz.
2. Water obtained from 1 lb. of barley—2¼ oz.
3. Gluten obtained from 1 lb. of barley—2¼ oz.
4. Starch obtained from 1 lb. of barley—7½ oz.
5. Sugar obtained from 1 lb. of barley—½ oz.
6. Gum obtained from 1 lb. of barley—½ oz.
7. Fat obtained from 1 lb. of barley—$\frac{1}{16}$ oz.
8. Fibre obtained from 1 lb. of barley—2¼
9. Ashes obtained from 1 lb. of barley—½ oz.
10. *Carbon in 1 lb. of barley—6½ oz*

Barley Meal was formerly much used in England for making barley cakes, and at the present day barley flour is found to be a useful, nutritious food for children, on account of its laxative action.

OATS.

The Oat is largely consumed in Great Britain as food. Its preparations and analyses are exhibited with the following label:—

The most commonly cultivated species of Oat is the *Avena sativa*, a plant belonging to the natural order of grasses (*Graminaceæ*). Other species of oats are known by the names of *Avena nuda*, the naked Oat pilcorn, or peelcorn; *Avena orientalis*, the Tartarian Oat; *Avena brevis*, the short Oat; and *Avena strigosa*, the bristle-pointed Oat. Only the two last are found wild; and some writers suppose that all forms of oat have taken their origin in the last, which is found wild abundantly in corn-fields all over Europe.

The oat is a much harder plant than either wheat or barley, and ripens its fruit in higher northern latitudes. An insular climate is adapted to its growth, hence it has been extensively cultivated in the British Islands, more particularly Scotland where the best oats are grown.

The oat, like other cereal grains, is well adapted for human food, as it contains the mineral, flesh forming and heat-giving constituents, which are essential to food. The following comparison by Johnston of the composition of the oat with wheat and maize will show the relative quantities of the most important constituents of these plants.

	Wheat Flour.	Bran.	Oat meal.	Indian Corn Meal.
Water	16	13	14	14
Flesh-formers	20	18	18	12
Heat-givers { Starch	2	6	6	8
Heat-givers { Fat	62	63	62	66
	100	100	100	100

Oatmeal is not so digestible as wheaten flour or wheaten meal, hence persons whose occupations are sedentary prefer the latter; but for those who work or take exercise in the open air, oatmeal is a more economical and strengthening diet than wheaten flour. Oatmeal cannot be made into bread, and is usually eaten in the form of a cake or oatmeal porridge. The latter is usually eaten with milk, and is then a very nourishing and healthful article of diet.

Nearly twice as much oats as wheat is raised in the United Kingdom, but comparatively small quantities are imported. Their large consumption depends on their being used as the principal food for horses.

Oats, in the form of Oatmeal, are rich in flesh-formers and heat-givers, and serve as a nutritious and excellent diet, when the occupation is not sedentary. The outer husks of Oats, unlike Wheat, are poor in flesh-formers, so that oatmeal is better than the whole oat as food. In making oatmeal, one quarter of oats (328 lbs.) yields 188 lbs. of meal and 74 lbs. of husks; the rest being water. Oatmeal is remarkable for its large amount of fat. 100 parts contain:—

Water	13·6	or	Water	13·6	
Flesh-formers	17·0		Flesh-formers	17.0	Carbon 43.0
Starch	39·7		Heat-givers	66.4	
Sugar	5·4		Mineral Matter	3·0	
Gum	3·0				
Fat	5·7				
Fibre	12·6				
Mineral Matter	3·0				

1. Shows 1 lb. of Oats with the usual husk.
2. 1 lb. of oatmeal of which about 57 per cent is obtained from oats.
3. Water in 1 lb. of oatmeal—2⅛ oz.
4. Flesh-formers in 1 lb. of oatmeal—2¾ oz.
5. Starch in 1 lb. of oatmeal—6⅓ oz.
6. Sugar in 1 lb. of oatmeal—⅞ oz.
7. Gum in 1 lb. of oatmeal—½ oz.
8. Fat or oil in 1 lb. of oatmeal—⅞ oz.
9. Fibre in 1 lb of oatmeal—2 oz.
10. Ashes in 1 lb. of oatmeal—½ oz.
11. *Carbon in* 1 *lb. of oatmeal*—6⅘

Maize or Indian Corn, (*Zea Mays.*)

This cereal is a native of the New World, where it is extensively cultivated both in the United States and South America.

What Wheat is in Europe, Rice in Asia, Maize is in America. It belongs to the natural order of Grasses (*Graminaceæ*), and is remarkable in this group for the large size of its grains, and the heads into which they are collected. The stem of the Maize grows from five to seven feet in length. The stamens are placed in terminal flowers at the top of the stalk, whilst the fruit-bearing flowers are placed on the side of the stalk.

The Maize is a native of the New World, and grows wild in the neighbourhood of Mexico and the Rocky Mountains. It was not known in other parts of the world till after the discovery of America. It has now been introduced into every quarter of the globe. It is cultivated extensively in the south of Europe, on the African coasts of the Mediterranean, in Turkey, Egypt, Hindostan, China, the Islands of the Eastern Archipelago, and in the West Indies.

Several varieties are cultivated, which differ in the form, and colors of their grains.

Although Maize will grow in the British Islands, it cannot be relied on as a field-crop.

Maize was not much consumed in Great Britain till the year of the potato famine, 1846, when considerable quantities of the grain, and meal of the Maize, called "hominy," were imported. There is now a regular demand, and about 2,000,000 of quarters are imported. Of this the larger quantity comes from the ports of the Black Sea and the Mediterranean.

Maize is an excellent food for man and beast. The meal will not form bread alone, but it may be made into porridge, puddings, cakes, and other forms of diet. Maize contains less flesh forming matter than wheat, but it contains more fat. It is largely used in this country on account of its starch, which is separated and used as an article of diet in place of arrow-root and amylaceous foods.

Maize yields a large return of food on a given extent of land. It contains less flesh-forming matter than other cereals, but is rich in heat-givers, and consequently has remarkable fattening qualities. 100 parts contain:—

Water	14·0	or	Water	14·0	
Gluten	12·0		Flesh-formers	12·0	Carbon 36·4
Starch	60·0		Heat-givers	73·0	
Sugar, Gum	0·3		Mineral Matter	1·0	
Fat	7.7				
Fibre	5·0				
Mineral Matter	1.0				

The case shows the ingredients in 1 lb. of Maize, or Indian Corn.

1. Shows 1 lb. of Maize, or Indian corn.
2. 1 lb. of Indian meal.
3. Water in 1 lb. of Indian meal—2 oz. 105 gr.
4. Gluten in 1 lb. of Indian meal—1 oz. 402 gr.
5. Starch in 1 lb. of Indian meal—9 oz. 263 gr.
6. Sugar and Gum in 1 lb. of Indian meal—21 gr.
7. Fat or oil in 1 lb. of Indian meal—1 oz. 101 gr.
8. Woody fibre in 1 lb. of Indian meal 350 gr.
9. Ashes in 1 lb. of Indian meal—70 gr.
10. *Carbon in* 1 *lb. of Indian meal*—5¾ *oz.*

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

The Board of Arts & Manufactures

FOR UPPER CANADA.

PROCEEDINGS OF THE BOARD.

Board Room, Mechanics' Institute,
Toronto, July 2nd, 1861.

The Board met at half-past one o'clock, p.m., present:—The President (Dr. Beatty), the Vice-President (Mr. J. E. Pell), and Messrs. W. Hay, T. Sheldrick, Professor Buckland, Rice Lewis and W. Edwards.

The Secretary read the following Report:

The Sub-Committee beg to submit the following report:—

The draft of Bill to amend the Act constituting the Boards of Arts and Manufactures, and the various Agricultural Associations, as adopted by the Board at the last Annual Meeting, and by the Board of Arts and Manufactures for Lower Canada; and also, with two trifling exceptions, by the Board of Agriculture for Upper Canada, was submitted to the Government during the late session of Parliament.

Your Committee have adopted, as their report thereon, the following portion of the Report of the Lower Canada Board, of the 28th of May:—

"After several interviews with members of the government, by Professor Hind on behalf of the Upper Canada Board, and your Vice-President and Secretary on behalf of this Board, the draft of Bill to amend the Act constituting the Boards of Arts and Manufactures was confided to the Hon. Mr. Ferrier, and by him introduced in the Legislative Council. At the beginning of the session the Board of Agriculture, through Major Campbell, introduced the bill of last session to amend the act constituting that Board, but without the portions relating to the Boards of Arts and Manufactures. In committee, however, the bill relating to this Board was incorporated with it, and further proceedings upon Mr. Ferrier's bill stayed in the Council. The two bills thus amalgamated passed the Lower House without opposition, and received a second reading in the Council. Having been referred to a committee, however, it was never reported, the committee deeming that the amendments in the constitution of the Board of Agriculture and the abolition of the Provincial Agricultural Association would not be acceptable to the farmers of Upper Canada. The other bill, relating solely to the Boards of Arts and Manufactures, was then moved to a second reading, with the assent of the Government, and referred to a committee, where all but the more important clauses were cut out. In its reduced form it received a third reading, and was sent to the Lower House, where, however, the Agricultural influence revenged itself upon the Upper Canada members of the Council representing the Agricultural interest, who had defeated their bill, by refusing to suspend the rules and allow the bill of the Boards of Arts to become law. They declared that both bills should go through, or neither."

Your Committee remark that in the draft of Bill as submitted by this Board, full provision was made for the permanency and harmonious working of the "Provincial Agricultural Associations." The leaving out this portion of the Bill in the Lower House, was undoubtedly owing to Lower Canadian influence. Your committee strongly urged upon the Government the inexpediency of abolishing the Associations, and were assured that it would not be consented to by the Government.

Your committee were not aware that the Hon. Mr. Ferrier's Bill had been reported by the Committee of the Upper House, and subsequently passed its third reading, and are therefore quite ignorant of its provisions. Your committee united with the Board for Lower Canada in asking for increased grants to the respective Boards, so as to enable them more satisfactorily to prosecute the several objects imposed upon them by their Act of Incorporation; but owing to the financial position of the Province, the Government did not feel justified in recommending any increase for the current year.

Your Committee approved of the movement made by the Lower Canada Board in preparing a bill, and urging upon the Government the necessity for the changes proposed in the laws regulating the issuing of letters patent for inventions and designs in Canada, especially as the laws of the United States have recently been so far modified as to allow of letters patent being taken out by the subjects of any country, on the same terms as by American citizens; provided the same privileges are extended to citizens of the United States by the Government of the country of which the applicant is a subject. Your committee cannot but regret that the exertions of the Lower Canada Board have been unsuccessful, as citizens of Canada are now excluded, under any circumstances, from obtaining patent rights in the United States; it is satisfactory, however, to report that the portion of the bill relating to the registration of trade marks, and designs, was introduced as a separate measure, and became law.

In April last a special committee was appointed, who reported a number of suggestions on the best mode of action to be adopted by this Board, in relation to the International Exhibition of 1862; these suggestions contained an outline of a scheme of operations proposed to be carried out, with such modifications as might thereafter be found necessary, in conjunction with a Provincial Commission which your committee then had no doubt would be appointed.

The Board for Lower Canada concurred generally in the report of your committee, but suggested a different classification of some of the objects to be exhibited; these reports, and the memorials of both Boards praying for the appointment of a Commission, and the appropriation of a sufficient sum of money from the revenue of the Province to ensure the successful carrying out of the objects contemplated, were published in the April and May numbers of the *Journal*; the Government, however, refused to insert in the estimates for the year any appropriation for the purpose, nor has any Commission been appointed to act in conjunction with Her Majesty's Commissioners; in consequence of which the enterprise of private individuals will be effectually checked, as they will not be allowed to exhibit, nor will any communication be held with them, except through the medium of a Provincial Commission.

Your Committee agree with the Committee of the Lower Canada Board, as to the disastrous effect this "unwise economy" will have upon the interests of the Province.

"When the eclat of the visit of the heir apparent is still fresh in the minds of the people of Britain, to put in an apparent admission that we have already culminated and are beginning to decay, that we can not do as well now as we did ten years ago, is to submit to humiliation, to lose ground, and accept defeat in the contest for industrial rank."

Your Committee have to report that no Candidates presented themselves for the Examinations which the Board proposed to hold in May last; this probably is not to be wondered at considering the short notice given, and the difficulties experienced by Mechanics' Institutes in this country in establishing class instruction amongst their members.

In answer to the advertisement offering two prizes for the first and second best essays on "the Manufactures which are most suited to the circumstances and capabilities of Upper Canada," the Secretary reports that but one essay has been received. Your committee have appointed C. S. Gzowski, Esq., Professor Buckland, and Rev. Professor Lillie, a committee of judges to report on the merits of the essay sent in.

A contribution from Messrs. Maw & Co., of Broseley, Salop, England, has just been received for the museum of building materials of this Board, being four large frames of Encaustic Tiles, examples of their manufactures, showing the effect of the complete pavement when laid. Framed Patterns, Pattern Books and Price Lists, have also been received.

A considerable number of valuable and expensive works on Architecture, Mechanics and Manufactures, Ornament and Decoration, &c., &c., have been added to the library since last report, and will be open to the public for reference as soon as the fitting up, (now going on) in the Board rooms, in the New Hall of the Mechanics' Institute, is completed. A full catalogue of the books will be published in either the August or September number of the Journal.

The Journal of the Board has now reached its seventh monthly issue, and from the favourable notices of the press, and from other sources, your committee conclude that the expectations of its friends have been in some respects realized; your Committee cannot, however, but express their surprise that of upwards of fifty Mechanics' Institutes in Upper Canada, but twelve have as yet obtained from among their members any subscribers to the Journal, although furnished at the low rate of fifty cents per annum; nor has a single communication been received for its pages from members of any Institute out of Toronto.

Your Committee made satisfactory arrangements with the Board for Lower Canada, whereby their proceedings are regularly published in the Journal; said Board subscribing for 250 copies.

One free copy is sent to each Mechanics' Institute, and to the members of both branches of the Legislature, by the respective Boards.

The Treasurer's balance sheet, herewith submitted, shows total receipts for the past six months, including balance from last year, of $2,621 36; Expenditure, $1,353 26; balance in hand, $1,268 10.

JOHN BEATTY,
President.

Resolved—That the Report be received and adopted.

Resolved—That the Sub-Committee be instructed to memorialize the Governor in Council to appoint a Provincial Commission to act on behalf of contributors to the proposed International Exhibition of 1852.

Resolved—That the Secretary be instructed to advertize the Library and Model Rooms as open to the Public, so soon as the rooms now being fitted up, in the New Hall of the Mechanics' Institute, are ready; also inviting donations to the Museum of the Board of Examples of the Manufactures of the Province, and of such of its natural products as may be made available for Art or Manufacturing purposes.

The meeting then adjourned.

WM. EDWARDS,
Secretary.

MEETING OF THE SUB-COMMITTEE.

The Monthly meeting of the Sub-committee was held on Thursday, July 25th: present—the President and Messrs Dr. Craigie, T. Sheldrick and W. Hay.

After reading the minutes of previous meeting, and transaction of routine business, it was—

Resolved,—That the President and the Secretary be instructed to prepare and forward to his Excellency the Governor General, in Council, a Memorial praying for the appointment of a Provincial Commission, to act on behalf of private contributors to the International Exhibition of 1862.

Resolved,—That the Programme of Examinations of Members of Mechanics' Institutes, issued in December, 1860, (See Journal for January, 1861) be adopted as the Programme of Examinations for 1862; and that Tuesday, Wednesday, Thursday and Friday, the 27th, 28th, 29th and 30th of May be appointed the days for holding such examinations, and at the same hours as specified in the time table for 1861.

Resolved,—That the Secretary be instructed to send to each Mechanics' Institute in U. C. copies of the Programme of Examinations; and to intimate that a sum of ten dollars will be awarded to each Institute establishing, and keeping in operation for three months, a class, of not less than six members, for the study of any of the subjects mentioned in the Programme, and submitting at least two members of said class as candidates for the final examinations by the Board in May next.

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

WM. EDWARDS,
Secretary.

LIBRARY AND MODEL ROOMS.

The Library, Model and Board Rooms, have been removed to a commodious suite of Rooms in the New Hall of THE TORONTO MECHANICS' INSTITUTE, situated on the north-east corner of Church and Adelaide streets, and are open to the public free, from 10 a.m. till noon, and from 1 to 4 o'clock, p.m.

The Library contains several hundred volumes of valuable books of Reference in Architecture, Decoration and Ornament, Designing, Encyclopedias, Engineering and Mechanics, Manufactures and Trades, General Science, Patents of Inventions of Great Britain and Canada, &c., &c., &c.

The Model Rooms contain several hundred models of Patented Canadian Inventions, and the commencement of a Museum of specimens of Foreign and Canadian Manufactures.

The Board respectfully solicits from the manufacturers of Canada, specimens of their various productions, or of any natural products capable of being used in Manufactures.

Specimens of Machinery, or of other bulky articles, are requested to be furnished in model.

EDITORIAL NOTICES.

CANADIAN ROOFING SLATE.

It has always struck us as the height of imprudence in the erection of many a handsome building, where the walls have been built substantially and of materials proof against fire, that the roof should be covered with wood shingles, the most flimsy and dangerous of substances. The effect of a blazing sun upon a roof presenting a right angle to its rays, is to convert the thin chips of wood with which it is covered into a species of tinder, that a single spark would ignite.

Wood, when much heated, evolves a highly inflammable gas. It was observed during the raging of the great fire at St. John's, Newfoundland, when the greater part of the town was destroyed, that the roofs of the houses, although the whole of the buildings were of wood, were always first ignited, and by this means the fire spread with amazing rapidity. A single spark, in many instances, was observed to kindle a roof as if it had been thatched with touchwood.

It is thought that a thin coating of mortar under the shingles is sufficiently fire-proof, but this is often delusive. The mortar, however well prepared, after a few years becomes pulverized from the vibration of the roof, and is thus rendered useless.

The cost of a slate roof is very little more than a shingled one, and it is surprising that this material is not in more general use, considering the saving in the matter of insurance.

The opening of the Walton Slate Quarries, near Richmond, in the township of Melborne, Canada East, will bring the article within the reach of the most thrifty house-builder. The slates from this quarry are equal to the best Welsh slate in formation and color, but they appear to us to have greater density, and consequently are more durable. For several years the Americans have had the monopoly of the slate market in this Province, limited as it was. Perhaps the inferiority of the American slate may in some measure account for the general preference hitherto given to shingle, tin and iron roofs. The American slate is uneven on the surface, and therefore does not fit well together. It is objectionable also to those who desire uniformity in the color of the roof; and besides, it is expensive. The Canadian slate is perfectly flat on the surface, easily laid on the roof, and of a beautiful uniform blue color. A roof of this slate costs little more than a good shingle roof, is ten times more durable, and is perfectly fire-proof.

The comparative cost of 100 superficial feet of the various kinds of roofing now in use in Toronto, from the best information we can obtain, is as follows;—Good shingle roof (the shingles laid in hair mortar), $4 50; Walton slate (12×6 in.), $5 50; do. do. (14×7 in.), $6 13; Iron roof, $14; Galvanized iron, $17. Of course, nearer the quarries the cost would be less.

It affords us great satisfaction to find that this valuable branch of Canadian industry is being vigorously prosecuted, and we wish its enterprising proprietor, Mr. B. Walton, every success.

EXHIBITION OF MANUFACTURES, &c.

The Toronto Mechanics' Institute, and the Toronto Electoral Division Society, have United to hold a Grand Exhibition in the New Hall of the Institute, commencing on Monday the 7th of October next, one week after the closing of the Provincial Exhibition in London, and to be continued open every day, from 10 a.m., to 10 p.m., for two weeks.

The rooms to be devoted to the purpose will be the Music Hall, in size 76ft. 6 inches by 54 ft 8 inches; the Lecture room, 51ft. by 42 ft.; and a suite of five other smaller rooms.

The total amount of prizes offered is nearly $1,000, with the option on the part of the holders of 1st prizes to accept a handsome diploma instead of money: and as the prizes will be open for competition to ALL THE PROVINCE, we have no doubt but there will be a good show.

The Mechanics' Institute will also hold a Bazaar in connexion with the exhibition, and solicit donations of articles for that purpose, the profits arising from which, as well as their share of the profits accruing from the Exhibition, will be devoted to the purchase of a suitable Organ for their Music Hall. The Secretary, Mr. Edwards, will furnish prize lists and Rules and Regulations to any parties applying for them.

The following is the classification of the prize list:—

ARTS AND MANUFACTURES.

Class
1. Cabinet Ware and other Wood Manufactures.
II. Fine and Decorative Arts.
III. Furs and Wearing apparel.
IV. Ladies' Work.
V. Machinery and Manufactures in Metals.
VI. Miscellaneous.
VII. Musical Instruments.
VIII. Paper, Printing, and Bookbinding.
IX. Saddlers' and Trunk Makers' Work.
X. Shoe and Boot Makers' Work.
XI. Woollen, Flax, and Cotton Goods.

HORTICULTURAL.

XII. Fruits.
XIII. Plants and Flowers.
XIV. Vegetables.

AGRICULTURAL.

XV. Dairy Products.
XVI. Grains.
XVII. Roots.

Correspondence.

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

Sir,—In my letter inserted in last month's Journal, I referred in general terms to the great importance of connecting classes with every Mechanics' Institute. I beg now to direct the attention of your readers to the respective subjects of study which ought to commend themselves to the favour of the Directors and the members of these Institutes, and to suggest some of the methods that might be adopted for organizing such classes profitably and economically.

In selecting the subjects of instruction we may be best and most safely guided by the experiences of other Institutes, and the Report to the British Council of the Society for the encouragement of Arts, &c., furnishes abundant materials for forming the necessary estimate. This Report presents, among other very interesting subjects, a tabular view of the papers worked during the four years ending 1861, by the various candidates for certificates of merit and for prizes. The subjects of study amount altogether to thirty-two, but which when classified according to their relation with each other, may be reduced to seven or eight. This classification of kindred studies is of importance in the economy of the organization, since in most cases the same class, the same room, and the same Teacher would suffice for the study of all kindred subjects. Thus for example, there are twelve subjects mentioned under the heads of Arithmetic, Algebra, Geometry, &c., which any mathematical teacher of fair attainments could undertake in one class, whilst the subjects headed under the general terms of History, English, Logic and mental science, might be safely confided to the charge of a properly qualified English Teacher. Three or four qualified teachers might thus undertake the management of a very large number of studies, especially when it is remembered that the great body of the pupils would probably be earnest working students, and that the teacher would have little else to do than to give the necessary instruction.

In the report from which I am drawing the information, the subjects of study that have had preference are the following, the preference being given in the order in which I present them, viz: Arithmetic, Book-keeping, Algebra, French, English Literature, Geography and Drawing. The various branches of the physical sciences do not appear to have claimed much attention whilst the students of these subjects have generally not pursued them with the same successful results as the students of the other subjects. Amongst these physical sciences I may name Chemistry as not only the most popular, but that in which the students have been the most successful in obtaining certificates. The study of chemistry does not demand such abstract reasoning nor are its problems generally of such difficulty as those of some of the other sciences, and as its pursuit is attended by so many interesting and exciting results in experimentalization, these circumstances may account for the preference given to it. It is possible that this and many other subjects may not be equal in their practical claims to some of the subjects mentioned in the Report, but the directors of all such institutes are not to forget that, whatever practical advantage may attend any special study, whatever necessity there may be for its pursuit, the great end, the highest object is *the moral issue won by engaging the working classes in the pursuit of knowledge.* In the Salford Institution Phonography has a first class work, and in other instances Music, Discussion, Chess, and pursuits of a similar necessary and practical character hold a prominent position. The result is, in most of these cases, satisfactory; the Institute by consulting and satisfying the legitimate tastes of its members advances its own prosperity and aids the great work of progress by encouraging the intellectual tendencies of the people. The first difficulty to overcome in the education of adults is their indisposition to any study. They fail in perseverance and the power of concentrativeness so necessary to the successful pursuit of any branch of knowledge; and the surest way to win them to enter the contest and to pursue it to its triumphs, is to let them enter upon it in their own fashion and according to their special tastes. In most cases study will grow into a habit, and the student beginning with a wayward and child-like mind will gather vigor and perseverance, and rise into the intellectual manhood which renders him capable of grappling with every difficulty and accomplishing every purpose.

As to the methods of conducting these classes, I am disposed to think that in all cases a system of systematic but familiar lectures, with constant examination, should be combined with class teaching. This method in the study of the physical sciences, and in the study of English Literature, of general or English History, and in fact of every subject which depends upon the explanation of principle and a memory of facts, is the best that can be adopted. A series of lectures for example on English History, a very popular subject in the British Institute, and one which secured for its students a very large proportion of certificates, might embrace an entire outline of Blackstone's Commentaries, combined with Hallam's Constitutional History, while the students might store their memories with all necessary facts and dates from a good text book, and a comprehensive and excellent knowledge of great historical events and principles could thus be acquired in one winter session, available for almost any position which the student might fill in after life. I make this brief reference to a method because it is too often the practice for teacher and student to go on the old beaten track of sitting at the desk night after night and passing through all the dull and dry details of a text book with no pleasing or satisfactory result. The friends of Mechanics' Institutes cannot be too often reminded that to make the classes successful the instruction must be made attractive, clear, and satisfactory, and the student must be interested and enabled to feel that he is making progress.

I have other suggestions to make on these subjects, but for the present I presume I have trespassed quite enough on your columns.

I am, Sir,
Very respectfully yours,
R. L.

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

Sir,—The time is approaching for the holding of the next Provincial Exhibition, which it is announced will take place in the city of London, during the last week of September next.

I see by the "Rules and Regulations" of the Association, as published in the last number of your Journal that entries in all but Horticultural, Ladies' and Foreign Classes, must be sent in to the Secretary by the 31st of August instant. I trust, sir, that these regulations will be strictly carried out, and that entries will not be taken, as heretofore, up to the very hour appointed for opening the Exhibition.

The evils arising from the systematic departure from the rules must have been apparent to every one who has had any thing to do with these Exhibitions; and always result in throwing excessive labour upon the Secretary and his assistants at a time when other duties require their attention, whereby numerous mistakes in the entries, and in the filling up of competitors' tickets, and dissatisfaction on the part of Exhibitors suffering from these mistakes, are sure to be the consequence. I would also urge upon your readers, and especially those intending to exhibit in the Arts and Manufactures' departments, not only to see that their entries are made in good time, but that their articles are delivered on the exhibition grounds a day or two before the exhibition opens, whenever such delivery is possible, so that the parties in charge of this department may have sufficient time to properly classify and arrange the goods.

Having had to act as a judge on two or three former occasions, I can speak of the difficulties often experienced in finding the goods that have been entered; and this is not to be wondered at when we see a large proportion of the articles coming in up to the very moment that the judges commence their duties. Complaints are often heard from visitors of the absence of a proper classification of goods, but considering the want of punctuality on the part of exhibitors in making their entries, and in delivering the articles entered, the only wonder is that, from the chaos usually presented on the mornings for opening these exhibitions, anything approaching a correct and systematic classification can be effected.

E. S.

Toronto, July 14th, 1861.

NOTICES OF BOOKS.

The Theory and Practice of Landscape Painting in Water Colours, by Geo. Barnard. London: Routledge, Warne & Routledge. Toronto: Rollo & Adam. 3rd edition.

A new edition of this work, valuable to art students, has recently issued from the press. Among the many works which the revived taste in water-colour painting has of late years called forth, none possesses more eminently than that under notice the qualities so desirable in a book of this description, affording as it does elementary instruction in an easy and simple manner, and being also a compendious guide and admirable book of reference to the more advanced student.

The study of colour, on truly scientific principles, is seldom presented to the mind of the young artist. Examples of colour treatment, even by the best artists, are not in themselves sufficient to form the basis of a well grounded education in the art. It is necessary that the student should acquire a thorough knowledge of the natural philosophy of colour, which the author has taken much pains to elucidate at the commencement of the work, by a variety of colored diagrams, and several well written chapters, which cannot fail to accomplish this most important object. The work contains a great variety of examples from the best masters, to illustrate the different effects of light and shade in the picture. The book is also ornamented by several beautiful landscapes, printed in oil.

A very important feature in the preparation of this edition, is a lengthened series of notes, containing answers to correspondents, who had addressed the author on certain difficulties. We select the following as an example:

Question 12.—"Why do artists so often introduce into their pictures the red cloak and blue kerchief, so prevalent in many of the rustic districts of England?"

Ans.—"Every one has heard of the good effect of a little bit of red contrasted with a large quantity of green. It is in fact so well known, and so much used, that it is not advisable to employ it too often. Blue, as a piece of positive colour, gives force and life to a picture, and serves to repeat the blue of the sky or distance. Of the two, red would appear conspicuous the largest in the distance; the blue contrasted with the warmer tones of the foreground, might be made the most striking."

The Life of North American Insects. By Prof. B. Jaeger, assisted by H. C. Preston, M. D.,; with numerous illustrations from specimens in the cabinet of the author. 1 vol., 12 mo.; New York: Harper & Bro.

There is no doubt that the difficulties attending the prosecution of a pursuit deter many from entering upon it. Such is especially found to be the case in the study of the Natural Sciences,—in this country more particularly, inasmuch as so few elementary books on these subjects, that are adapted to our wants, can be procured.

It is therefore with feelings of great satisfaction that we wish to draw attention to the work before us, one of the first of the kind that has appeared on this side of the Atlantic. Hitherto those among us who have been desirous of commencing the study of Entomology, have been compelled to seek for information chiefly from English books, describing only British insects, very few of which are of the same species as those found in this country. No work, at all intelligible to beginners, prior to the one before us, has given descriptions of Canadian insects, with the exception of Gosse's Canadian Naturalist,—a truly charming book, but not easily obtained here. A few papers on butterflies have appeared in the Canadian Naturalist, published by the Natural History Society of Montreal, and some also on *Coleoptera*, in the early volumes of the Canadian Journal. With these few exceptions, the Canadian student has been forced to put up with the little information he could glean from English books; though we by no means wish it to be inferred that we despise the other works mentioned above,—on the contrary, we found them in our own case, when we first began the study of Entomology, eminently serviceable; but we fear that they are not generally accessible to those of our youth who are desirous of commencing this pursuit. While we hail this little work as the precursor of, it is to be hoped, many others on kindred subjects, we cannot regard it as entirely free from faults, nor as even coming up to what might justly have been expected.

The author treats of seven of the orders of insects, namely:—*Coleoptera*, (Beetles); *Hemiptera*, (Bugs); *Orthoptera*, (Straight-winged Insects); *Lepidoptera*, (Butterflies and Moths); *Neuroptera*, (Net-winged Insects); *Hymenoptera*, (Vein-winged); and *Diptera*, (Two-winged). He writes with all the enthusiasm of one devoted to the study of this department of science, though he not seldom goes off into long digressions, introducing matter quite foreign to the subject in hand. On the whole, however, we recommend it to beginners in Entomology, as a book that will prove useful to them at first; of course one who has made some advance in the science will not expect to learn much from a book of this kind, written as it is in a popular style, and designed for the use of the public in general.

The Scientific American. Editors & Proprietors: Messrs. Munn & Co., No. 37, Park Row, New York.

This excellent periodical has recently entered upon its *fifth* volume (New Series), and is now in its *seventeenth* year. It is, we understand, the only journal at present published in the United States devoted to the mechanical arts and popular sciences. The volume lately closed has been in a preëminent degree remarkable for the richness and varied nature of its contents, containing as it has done accounts and descriptions, not only of domestic improvements and inventions, but also of those of foreign countries, all, too, profusely illustrated. To Mechanics, Artizans and Manufacturers, in every branch of industry, this work is, we may say, indispensable, since it furnishes the most authentic and complete intelligence respecting all new devices of inventive genius and fresh marvels in scientific discovery. The Inventor, Builder, Artist, Engineer, Manufacturer, in fact persons of almost every class, will find this periodical most useful and instructive, as well as exceedingly entertaining, and, to crown all, it is a perfect marvel of cheapness. Two beautifully printed volumes are published every year, containing upwards of four hundred pages each of reading matter, illustrated with a great number of very well executed engravings, designed expressly for the work; and all at the low price of *two* dollars a year, paid in advance. We can confidently assert that no one who subscribes to this journal will regard money so spent as wasted or thrown away.

Selected Articles.

A NEW METHOD OF PRODUCING ON GLASS, PHOTOGRAPHS OR OTHER PICTURES, IN ENAMEL COLOURS.

BY F. JOUBERT.

Of all the inventions to which the genius of man has given birth, and which have been progressively developed and brought, by his industry, to a high degree of perfection and usefulness, the art of glass making is certainly one of the most interesting and extraordinary, at the same time as it is doubtless one which has tended to increase our comforts and our enjoyments in a degree almost unequalled by any other discovery of modern civilization.

If we look back to dark ages, and find that in those days even the rulers of the earth had no means of keeping rain and bad weather from their habitations, except by also shutting out the light, we shall be ready to acknowledge the astonishing results, as compared with the present state of things around us, which the persevering efforts of man have, under the guidance of an ever merciful Providence, been able to accomplish.

Before entering into the description of the process which is more immediately the subject of our meeting this evening, I would, in a concise manner, recapitulate the history and progress of the invention of glass itself, and of glass painting which has led to the process before us.

We have no distinct evidence to show what nation first used glass, and we must therefore be satisfied with the various traditions transmitted to us, from age to age, on the subject. One fact, however, seems established beyond the possibility of a doubt, viz.: that the greatest antiquity can be assigned to this invention, since the Egyptians and the Phœnicians had both vessels and ornaments made of glass, crude in form but of a substance so perfect, by whatever means obtained, that it has stood the trial of several thousand years, and may be pronounced to have suffered no deterioration. Might we not, in consequence, assign to glass a place in the list of useful inventions far higher than that which it occupies; for in this we have a discovery the first inventors of which attained at once, the very condition—durability—which human kind is incessantly bent upon obtaining for any produce of its hands.

But still more remote is the mention of glass in the Holy Scripture; for if the interpretation of the text be a correct one, in the 18th chapter of Job, as also in several other parts of the Bible, is found an allusion to a substance which we imagine must have been glass. Next to this Alexander Aphrodisius amongst the ancient Greeks, Lucretius, Flavius Vopiscus, and other Latin authors, have left us a correct description of glass. Aristophanes also alludes to glass in one of his plays, and Aristotle brings out two problems on the subject; the first, why is it we see through glass? the second, why can we not bend glass?

Admitting that these two propositions emanate from the celebrated philosopher, they appear to give conclusive evidence that glass was familiar to the Greeks.

But we may, perhaps, even trace the origin of this invention far earlier, and to the remotest period of the existence of man, by associating it with the art of making bricks, which was, it is believed, practised by the earliest inhabitants of the earth; and it is not difficult to imagine how such an art would originate.

Man was led, for his subsistence, to seek a mode of preparing animal food for his use by roasting it over the fire, and having, in course of time, built, rudely, a sort of oven made of earth, and the earth having become hardened through the action of the fire, our forefathers would soon discover all the advantages which might be derived from such a process for making bricks or pots, and utensils for common use. Specimens of the potters art in ancient times we have in plenty, and in a variety of forms or shapes, which for elegance have not been surpassed. We need only allude to the Etruscan vases in the collection of the British Museum.

In firing bricks it will not unfrequently happen that some kind of vitrification takes place in the bricks placed in the hottest part of the fire, and one might naturally suppose that one process would lead to the other, but such does not appear to have been the case, at any rate, for many centuries. Later, horn and skins were in use down to the third or fourth centuries of the Christian era, and oiled paper or mica was also used in lieu of window glass, nearly up to the time of the reign of Elizabeth. If we are to give credence to the narrative of Pliny, to accident alone, as in many other instances, are we indebted for the discovery of glass. Some traders, being weather-bound landed on the banks of a river in Syria, and began to prepare a place in the sand for cooking their meals, after having gathered for fuel a great quantity of an herb, known there by the name of *kali*, which plant must have contained a large proportion of carbonate of soda, and this being mixed with the sand, yielded, through the agency of fire, a sort of vitreous substance. Such is one of the accredited versions of the origin of glass.

Glass has at all times, until recently, been thought a substance of great importance, and even amongst the primitive inhabitants of South America and of the Indian continent who were, when first visited by the early European navigators, found to possess gold and silver ornaments in great abundance, it is well known that the first discoverers of those countries who happened to land in search of food or water, had no difficulty in obtaining from the natives gold in exchange for some valueless pieces of glass, or a few glass beads which they would immediately use as an ornament round their necks or their wrists. As late as the middle of the last century, glass beads of various descriptions and of all sorts of colours, were extensively manufactured in France, principally for exportation to the colonies of South America and the islands of the Pacific Ocean.

It may be said that although glass is an article of first necessity to us, it is at the same time one with the nature of which very few persons are well acquainted, and the learned have even been often at variance as to the exact classification glass ought to belong to. It is not a mineral, since it has never been found in a primitive state in any country, neither can it be placed in the vegetable kingdom.

Glass has become with us an article so singularly cheap and common, that we are apt to lose sight of its immensely diversified qualities; but if only considered from a philosophical point of view, we shall find that few of the substances which we have in daily use, either in a simple or compound state, can be compared to glass in point of importance and of usefulness. Firstly, unlike any mineral, it is inodorous and clean to the fingers, and does not lose any of its weight by usage or wear; it is always transparent, whether in a cold or red-hot state; it can take any shape whatever while in a state of fusion, and it retains it absolutely after it has cooled. It is capable of receiving the highest polish, and of taking any coloured tint, either on its surface or in its body; and it also has this peculiar and invaluable advantage that it does not retain the taste of any liquid or acid it may have contained; it is the most flexible of substances while in fusion, and becomes harder than any pure metal when once it has become cold; lastly, it is not liable to rust, nor to be consumed by fire.

The applications of glass are now so numerous that it is difficult to imagine any one branch of industry or of manufacture which could be carried on for a single day without the use of glass in one shape or another. To some of the most important amongst the sciences, such as chemistry, physics, astronomy, the use of glass is a matter of absolute necessity; and in proportion to the gradual and increasing requirements of these last-named sciences, especially astronomy, it will be found that the glass manufacturer has been obliged to perfect his mode of manipulation, and, by the aid of chemistry, has of late years obtained such magnificent results that the field for astronomical observation has thereby been considererably enlarged.

It appears that, although vessels made of glass had been in use for a considerable time previously, it was only about the third century of our era that glass began to be used for glazing windows. These consisted of an infinite number of small panes of various shapes, which were arranged to as to form certain designs for the ornamenting of windows in places of worship; glass having, on account of its rarity then been almost, if not entirely, confined to that use.

St. Jerome, who wrote in the fourth century, speaks of glass in church windows; and Grégoire de Tours relates, two hundred years later, in the year 525, that a soldier of the army of the King of the Visigoths, which had invaded Auvergne, entered a church through a window, of which he broke the glass. Fortunatus, Bishop of Poictiers, towards the end of the seventh century, describes with admiration the painted windows of the Cathedral of Paris. St. Philibert, also in the seventh century, had the windows of the celebrated Abbey of Jumieges, on the banks of the Seine, near Rouen decorated with glass.

At the beginning of the eighth century glass was unknown in England, and it was Wilfrid, Bishop of York, who died in 709, who first introduced glass into England, by sending for some glass-makers from France, according to a record kept to this day. A few years later, St. Bennet, Abbot of Wearmouth, wishing to decorate the windows of his monastery, sent for some glass-makers, also from France, for it appears, from some authentic records, that the art of decorating windows with glass was practised in several parts of France, especially in Normandy, long before it was adopted in other countries.

It would seem that the art of staining glass was very early discovered, although no date can be correctly assigned to the period when stained glass for church windows was first used, The practice generally adopted was to make a sort of mosaic design, by placing an infinite number of small pieces of coloured glass together. This was in use for several centuries before the art of painting on glass, properly speaking, was discovered, which seems to have soon extensively spread and to have been cultivated by many excellent artists, to judge by the numerous specimens still in existence on the continent. But for the 16th century, so rich already in artistic talent, was reserved the glory of carrying glass painting to a degree of excellence which has never been equalled since, and the names of Jean Cousin and Bernard de Palissy will be honoured for ever, amongst the large phalanx of glass painters in all countries. The most remarkable painted windows, perhaps, in this country, are the windows of the various Colleges at Oxford, which were executed during the 17th century by Bernard Van Linge and his pupils. William Price also repaired some of the glass paintings in Queen's College, Oxford, and in Christ Church painted a remarkable composition from the design of Sir James Thornhill. Besides these may be mentioned the windows of Lichfield Cathedral, and several other very ancient windows in Christ Church, and especially in the residence of the Dean of Westminster, near the Abbey.

Having been for many years, professionally acquainted with printing in connection with the fine arts, and having observed the immense development the new art of photography has taken, and the large field it has opened for representing all sorts of subjects, of animated, as well as still life, it occurred to me that if a means could be found to print the photographic image on glass, as easily as it is done on paper, and through the agency of some chemical composition which would admit of employing ceramic or vitrifiable colours, and burning then in, a great result would be attained, and a new and considerable branch of industrial art might thereby be opened. Considering the numerous and various attempts which have, from time to time, been made to introduce a substitute for glass painting in the decoration of houses, I believe it can be said that a want was generally felt for supplying the growing taste for pictorial decoration; for glass painting is an expensive process, and requires also a considerable time to obtain a perfect result. There is a process known as lithophany, or transparent china, or biscuit slabs, which are now made, in Germany principally. and some very good specimens can be seen, but although any kind of subjects, on a small scale, can thus be represented, and with good effect, the slabs are heavy and thick, and can never come into use as a substitute for glass painting. Some few years ago, a new mode, which was then termed, "potichomany," was introduced, which had for a short time very great success—I allude to the mode of pasting coloured prints inside a large glass bowl, or jar, and applying a thin layer of plaster Paris, in a liquid state, so as to fix the paper firmly, and create an opaque back-ground, by giving substance to the whole, when seen from a distance. Some very good specimens of this were obtained, and it afforded for a time an agreeable occupation to many a young lady. Another mode has also been tried, and some very pretty results produced, by applying prints obtained by lithochromy, or lithographic printing in colours, on a pane of glass, and varnishing them at the back with copal or some such varnish; these will for some time resist the effects of the weather when placed in a window, and this is perhaps the nearest approach to glass painting in point of effect yet achieved, but practically it does not answer, for the varnish will not stand exposure to the weather from outside, and the constant cleaning glass requires renders it liable to be injured, so that the design soon perishes.

In the mode which is now for the first time introduced, no such danger or liability need be feared, since the colour has been firmly fixed in the substance of the glass by fire, and, being composed of the same elementary materials, has become part of glass itself, and can only be destroyed by the glass being annihilated by breakage.

In order that the process may be very distinctly understood, I shall now describe it by reading that part of my specification which relates to the placing the image on the glass, fixing it, and passing it through the fire.

This invention has for its object improvements in reproducing photographic and other pictures, engravings, prints, devices, and designs, on the surface of glass, ceramic, and other substances requiring to be fired to fix the same thereon.

For this purpose, I proceed in the following way:—A piece of glass, which may be crown or flatted glass, being selected as free from defect as possible, is firstly well cleaned; and held horizontally while a certain liquid is poured on it. This liquid is composed of a saturated solution of bichromate of ammonia in the proportion of five parts, honey and albumen three parts each, well mixed tegether, and thinned with from twenty to thirty parts of distilled water, the whole carefully filtered before using it. The prepartion of the solution, and the mixing up with other ingredients, should be conducted in a room from which light is partially excluded, or under yellow light, the same as in photographic operating rooms, so that the sensitiveness of the solution may not be diminished or destroyed.

In order to obtain a perfect transfer of the image to be reproduced, the piece of glass coated with the solution, which has been properly dried by means of a gas stove (this will only occupy a few minutes) is placed face downwards on the subject to be copied in an ordinary pressure frame, such as is used for printing photographs.

The subject must be a positive picture on glass, or else on paper rendered transparent by waxing or other mode, and an exposure to the light will, in a few seconds, according to the state of the weather, show, on removing the coated glass from the pressure a frame, a faintly indicated picture in a negative condition. To bring it out, an enamel colour, in a very finely divided powder, is gently rubbed over with a soft brush until the whole composition or subject appears in a perfect positive form. It is then fixed by alcohol in which a small quantity of acid, either nitric or acetic, has been mixed, being poured over the whole surface and drained off at one corner.

When the alcohol has completely evaporated, which will generally be the case in a very short time, the glass is quietly immersed horizontally, in a large pan of clean water, and left until the chromic solution has dissolved off, and nothing remains besides the enamel colours on the glass; it is then allowed to dry by itself near a heated stove, and when dry is ready to be placed in the kiln for firing.

It may be stated that enamel of any colonr can be used, and that by careful registering, a variety of colours can be printed one after the other, so as to obtain a perfect imitation of a picture; also that borders of any description can be subsequently added, without any liability to remove or even diminish the intensity of the colour in the first firing.

It will be easy to perceive that this mode of obtaining an image on glass, in an absolutely permanent substance, and of any description, colour, or size, may prove of considerable advantage and utility for the decoration of private houses, and also for public buildings. Now that, by means of the photographic art, the most correct views of any object or of any building or scene—even portraits—can be faithfully and easily obtained; when we see every day the results of the labours of photographers in all parts of the world, in the shape of beautiful prints; when we can be made acquainted, without leaving home, with the actual costume, habitations, scenery, manners almost of all countries, for instance, China and Japan, which have but recently opened their doors to European civilisation: when, through the same means, we are able to see for the first time, and the learned are able to translate from, the graphic reproduction with which photography furnishes us of those early inscriptions engraved on the rocks in Asia, and by the Egyptians on their splendid monuments, I need only point out the usefulness of the mode of fixing those images, in an indelible manner, for ornamental as well as for scientific purposes.

In large cities, like London, where houses are built so close to one another, in how many places may not the process become available, by enabling any one to introduce, for a moderate expense, pleasing or instructive images where common plain ground glass is now used, to shut out the sight of a disagreeable object, a dead wall, or an unpleasant neighbour, without diminishing the amount of light more than is convenient.

In the library, fitting subjects might be introduced on the windows by a judicious selection of the portraits of favourite authors, or of famous scenery at home or abroad. In the dining room, also, appropriate pictures could be selected, such as flowers, fruit, or game subjects, so disposed as to harmonise with the decoration of the room. Even for domestic purposes, for lamps. or screens, or any object in glass, the process will be found useful, especially on account of its rapidity, which will enable the manufacturer to execute and to deliver an order at a very few days notice.—*Journal of the Society of Arts.*

ON FILTRATION AND FILTERING MEDIA.

The following article on this subject will be found worthy of the perusal and consideration of all those who are interested in obtaining pure water for consumption. We may remark that animal charcoal has long been employed as a filtering agent, not only for water, but also for the purpose of removing impurities from other liquids:—

A paper was recently read before the the Society of Arts of London, "On Filtration and Filtering Media," by Julius G. Dahlke. From various modern works upon the civilization of the Egyptians, Chinese, Japanese, and other ancient Oriental nations, we learn that at a very early period filters were used by them. These appear to have been vessels made of unglazed earthenware, or of porous stone. There is no evidence to show either that they were acquainted with the true nature of those matters which should be separated from water intended for the use of man, or that they had studied the subject of filtration in a scientific spirit. In this neglect Europe imitated them until near the close of the seventeenth or beginning of the eighteenth century, when the French began to pay attention to the subject, and employed silk, wool, cotton, sponge and sand as their filtering media. But about the middle of last century a lias was discovered in Picardy, which, owing to its effective action, came largely into use. The mode of using it was particularly simple, being in the form of a false bottom placed in the cistern, through which the water descended. Afterwards the attention of Englishmen was directed to the subject, and about seventy years ago filters were introduced which contained three layers of media, viz., sand, gravel and charcoal. These were for filtering by descent, but another system was subsequently adopted and patented for filtering by ascent; this however, was complicated, and never became in any way largely known.

During the past seventy years, gravel, sand, and charcoal used as a mixture have been the agents most in vogue amongst filter makers, and it is only lately that due attention has been paid to charcoal as the most efficient filtering medium. Its use is much more frequent now, because not only has it a powerful detergent effect, but it possesses also the peculiar advantage of not becoming foul, while it protects from decomposition other bodies in contact with it. It has been often asked why animal charcoal is so effective as a filtering medium? Some attribute this to the presence of so much carbon; but that is an insufficient reason, as shown by the fact that, although coke contains more carbon than sand, yet it is not superior as a filtering agent. Animal charcoal filters about three and a half times more rapidly than either coke or sand, while it is also greatly superior in this, that it removes many inorganic impurities held in solution, over which the former substances exert no power. It appears that the more porosity a filtering medium possesses in itself, the more rapidly does it filter, and the greater is the effect it produces on the water. The latter will be still more decided when, with a greater porosity, peculiar substances are combined. This leads me to believe that we may attribute the extraordinary filtering quality of animal charcoal to the fact that its principal component parts are lime and carbon, so combined as to secure a wonderfully fine porosity. Vegetable charcoal, although very porous and containing far more carbon, has less effect upon water.

The art of filtration may be classed into three systems, viz:—1st, where the action takes place simply on the surface of the filtering medium; 2nd, where the whole bulk of the filtering medium is calculated to operate on the water, and the detergent effect in its most delicate form may be produced; and 3rd, where both of these systems are conjointly employed. The first system requires a filtering medium of such a fine porosity that its pores must be smaller than the minute particles composing the impurities suspended in the water. Such an agent of course must sooner become clogged than a filtering medium of coarser porosity, and which is meant to act with its whole bulk on the water. But both systems employed together may prove to be useful in several instances, as in the case of domestic filters. The greatest failing of these is that they must become clogged, and the more they are liable to this the more effectively they act. We often hear of self-cleansing domestic filters, but the fact is that no invention of the kind has been made yet without involving complications too great for the purposes of ordinary domestic use.

However, it is not difficult to make a filter for general domestic purposes—although the effective self-cleansing of such an apparatus is still a problem to be solved.

The difficulty, or rather the impossibility, of keeping water which is stored in cisterns entirely free from accidental contamination, should lead us to provide a domestic filter capable of removing chemical impurities, as, for example, any lead which may be held in solution; in fact, the practice of filtering water preserved in cisterns, and intended for domestic use, cannot be too warmly recommended. To remove lead from water, Professor Faraday recommends the practice of stirring up animal charcoal with water so contaminated, the same being then allowed to settle.

It will not be necessary to dwell upon the filtering processes required for large water-works as the supply is generally taken from such sources that the common sand filter-bed answers the purpose; and where the water is too hard for domestic uses the beautiful process of Dr. Clark will meet and remedy the evil.

Experience shows that it is not prudent to adopt the same means of purification for every kind of water, and I should make a difference in the treatment of the water used for domestic and that employed for manufacturing purposes. In the latter it will be often of the greatest importance to have the water pure as possible, whereas certain so-called impurities in water may not be at all injurious to health. When we consider that no one would call human blood impure which contains 420 grains of saline matter per gallon, we are not, perhaps, justified (of course, speaking in relation to health) in calling water impure which contains small quantities of certain saline matters, particularly as when we have no medical evidence that the small portions of them drunk in such water ever did any harm. Besides which, it should be remarked that the quantity of lime and magnesian salts drunk in water must be greatly exceeded in amount by that which enters the system in the food. Only those waters which contain much sulphate of lime and magnesia have been observed to derange the process of digestion—as, for instance, the waters of the New Red Sandstone.

Too pure water is distasteful, and unfitted for drinking purposes. In one case the water taken from a certain well, having a flat and disagreeable taste, proved, on analysis, to be remarkably free from impurities. In order to make this water more fit, or perhaps only more agreeable for use,—such arrangements were made that before it was filtered through a body of animal charcoal, some finely dissolved organic impurities were added to it, and which were, of course, acted upon by the charcoal. It was found that the mixed water had a pleasant taste, after filtration, and even that it was somewhat sparkling, though no difference was recognized in the unmixed water after it had passed through the same filter.

Experience has demonstrated that we could not employ a more powerful and efficient filtering medium than pure animal charcoal, in a well regulated, fine, porous, and solid state. Unfortunately, however, no method has yet, to my knowledge, been discovered by which this substance can be moulded into a convenient shape without diminishing more or less its filtering qualities. What is required is some material which will bind the particles together without glazing them. Attempts had been made to produce solid animal charcoal filters by moulding the charcoal with the aid of bitumen and carbonizing the latter; but it appears that the object in view cannot be arrived at in this way. In the first instance, as the proper consistency is not gained; next, by becoming glazed, the charcoal loses many of its good qualities, and at least, its rapidity in action will be diminished from its becoming less porous. Another serious objection to this medium, which is really a mixture of charcoal and coke, is to be found in the fact that the filtering power of charcoal to coke stands as 15 to 4. Mineral bitumen (*i. e.*, coal-tar and coal-pitch) will produce this fatal defect in a higher degree than vegetable bitumen, as it leaves more solid residue after carbonization. But animal charcoal will not adhere to it, and will not bind sufficiently, even when a great quantity of it is used, unless some vegetable charcoal is added. This in itself might not be looked upon as a great drawback, although it has not the filtering quality of animal charcoal, if it served to preserve the latter from the glazing effects of the carbonized bitumen; but it does not do this.

A composition which Mr. Dahlke had used successfully, was then described. He said: "Being in some degree familiar with the use of the residue which the Torbane hill mineral, sometimes called Boghead coal, leaves after distillation, I turned my attention to it. After some experiments, I found that this substance, when moulded with bitumen, ceased to be effective, as in the case with animal charcoal. I, however, eventually discovered that this material, when saturated with oily or fatty matter, will easily adhere by the addition of a comparatively small quantity of clay, and to be readily moulded. When well burnt, this mixture furnishes a very powerful filtering medium; it will remove color and smell from water, and will reduce its hardness considerably, while at the same time its rate of filtration equals that of charcoal. In fact, recent discoveries have led me to the belief that the residue of the Torbane-hill mineral alluded to deserves more attention than has hitherto been paid to it, for it appears to possess many valuable properties which have been vainly sought in other bodies; but having not yet finished my researches, I must confine myself on this occasion to speaking of it merely with regard to its application to filtering purposes. To make the mixture more effective, I add to it bone-dust, not only for the sake of animal charcoal, but because it must necessarily shrink in the charring—an effect which enables me to regulate with great nicety the porosity of the filtering medium beforehand; for I find that the porosity of the mixture mainly depends upon the quantity and grain of the bone dust which enters into its composition. I have also found that the use of oil instead of water for moistening the clay, prevents the too great shrinking of the moulded mass in the drying and firing process. By means of the process just described, I can produce filter blocks of considerable size and of various shapes, by the use of which I am enabled to overcome a great many difficulties, and to work large quantities of water with a comparatively small filtering apparatus."

If the quantity of water to be filtered be so great that a very large filter-bed is required, Mr. Dahlke prefers employing the preparation of the Torbanehill mineral, as described in a granular state, rather than sand; for this reason, that it filters more than three times as quick, and is five times as light as the latter; consequently a ton of it will, by a layer of equal thickness, filter about sixteen times the quantity of water that a ton of sand would filter, with the advantage that the filtering would produce at the same time a greater decolorizing effect and a considerable softening of the water. A clogging from the precipitation of chalk is not likely to take place, as this substance is separated in a crystalline and granular state. Moreover, those particles of the material which become saturated with organic impurities may, through calcination, regain the greater part of their former efficiency.

Mr. Dahlke remarked, in conclusion, that filtration was not often resorted to on the Continent, with the exception of France and Holland. Manufacturers were very much afraid of adopting any improvements that demand an outlay of capital, and so in this case they would often prefer using impure water to spending their money upon apparatus for purifying it. As for the water used for domestic purposes in Germany, the people are so apt to look up to a paternal government, even in matters concerning their health, that they never think of purifying the water supplied to them. To this apathy of the public may be ascribed, in a great degree, the comparative failure of the English water-works at Berlin.—*London Engineer.*

CEMENTS.

(*Concluded from page* 189.)

Engineer's Cement.—Equal weights of red and white lead, with drying oil, spread on tow or canvas. This is an admirable composition for uniting large stones in cisterns, &c.

Iron Cement for Closing the Joints of Iron Pipes.—Take of Iron borings, coarsely powdered, 5 lbs; of powdered sal-ammoniac 2 oz.; of sulphur 1 oz.; and water sufficient to moisten it. This composition hardens rapidly; but if time can be allowed it sets more firmly without the sulphur. It must be used as soon as mixed, and rammed tightly into the joints.

Cement for Steam Pipes.—Good linseed oil varnish ground, with equal weights of white lead, oxide of manganese, and pipeclay.

Gad's Hydraulic Cement.—Powdered clay 3 lbs. oxide of iron 1 lb; and boiled oil to form a stiff paste.

Cements for Masonry of Chambers of Chlorine &c.—Equal parts of pitch, rosin, and plaster of Paris.

Roman Cement.—1 bushel of slacked lime; 3 ½lbs. of green copperas; and ½ bushel of fine gravel sand. The copperas should be dissolved in hot water. It must be stirred with a stick, and kept stirred continually while in use. Care should be taken to mix at once as much as may be requisite for one entire front, as it is very difficult to obtain the same shade or colour a second time. It ought to be mixed the same day it is used. This is the English Roman cement.

The genuine Roman cement consists of the pulvis puteolanus, or puzzolene, a ferruginous clay from Puteoli, calcined by the fires of Vesuvius, lime, and sand mixed with soft water. The only preparation which the puzzolene undergoes is that of pounding and sifting; but the ingredients are occasionally mixed with bullock's blood and suet, to give the composition greater tenacity.

Seal Engravers' Cement.—Resin 1 part; brickdust 1 part. Mix with heat.

Marine Cement, commonly called Marine Glue.—Cut caoutchouc into small pieces, and dissolve it, by heat and agitation, in coal naptha. Add to this solution powdered shell-lac, and heat the whole, with constant stirring, until combination takes place; then pour it, while hot, on metal plates, to form sheets. When used, it must be heated to 280° Fah., and applied with a brush.

Liquid Glue.—Dissolve bruised orange shell-lac in ¾ of its weight of rectified spirit, or of rectified wood naptha, by a gentle heat. It is a very useful as a general cement and substitute for glue. Another kind may be made by dissolving 1 oz. of borax in 12 oz. soft water, adding 2 oz. of bruised shell-lac, and boiling till dissolved stirring it constantly.

Bank Note Glue.—Dissolve 1 lb. of fine glue, or gelatine, in water; evaporate it till most of the water is expelled; add ½ lb. of brown sugar, and pour it into moulds. Some add a little lemon juice. It is also made with 2 parts of dextrine, 2 of water, and 1 of spirit.

Maissiat's Cement, as an Air-Tight Covering for Bottles, &c.—Melt india-rubber (to which 15 per cent. of wax or tallow may be added), and gradually add finely powdered quick-lime, till a change of odor shows that combination has taken place, and a proper consistence is obtained.

Cement for Attaching Metal Letters on Plate Glass.—Copal varnish 15 parts; drying oil 5 parts; turpentine 3 parts; oil of turpentine 2 parts; liquified glue 5 parts. Melt in a water bath, and add 10 parts of slacked lime.

Japanese Cement.—Mix rice flour intimately with cold water, and boil gently.

French Cement.—Mix thick mucilage of gum arabic with powdered starch.

Stone Cement.—River sand 20 parts; litharge 2 parts; quick lime, one part. Mix, with linseed oil.

Plumbers, Cement.—Resin 1 part; brick-dust 2 parts. Mix, with heat.

Parisian Cement.—Gum arabic 1 oz.; water 2 oz.; sufficient starch to thicken.

Cement for Floors.—The following style of floor is well adapted for plain country dwellings: Take two thirds of lime, and one of coal ashes, well sifted, with a small quantity of loam clay; mix the whole together, temper it well with water, and make it up into a heap; let it lie six or seven days, and then temper it again. After this, heap it up for three or four days, and repeat the tempering very high, till it becomes smooth, yielding, tough, and gluey. The ground being then levelled, lay the floor therewith about 2½ or 3 inches thick, making it smooth with a trowel. The hotter the season is the better; when thoroughly dried it makes a capital floor. Should a *better looking* floor be desired, take lime of rag stones, well tempered with white of eggs, and cover the floor half an inch thick with it before the under flooring is too dry. If this be well done, and the floor thoroughly dried, it will look, when rubbed with a little oil, as transparent as metal, or glass.

Common Paste.—To a table-spoonful of flour add gradually half a pint of cold water, and mix till quite smooth; add a pinch of powdered alum (some add a small pinch of powdered rosin), and boil for a few moments, stirring constantly. The addition of a little brown sugar, and a few grains of corrosive sublimate, will, it is said by practical chemists, preserve it for years.

Soft Cement.—Melt yellow wax with half its weight of common turpentine, and stir in a little Venetian red, previously well dried and finely powdered. This cement does very well as temporary stopping for joints and openings in glass and other apparatus, where the heat and pressure are not great.

Lutes, or Cements, for closing the Joints of Apparatus.—Mix Paris plaster with water to a soft paste, and apply it immediately. It bears nearly a red heat. It may be rendered impervious by rubbing it over with wax and oil.

Another.—Slacked lime made into a paste with white of egg, or a solution of gelatine.

Another. Fat Lute.—Finely powdered clay, moistened with water, and beaten up with boiled linseed oil. Roll it into cylinders, and press it on the joints of the vessels, which must be perfectly dry. It is rendered more secure by binding with strips of linen moistened with white of egg.

Another.—Linseed meal beaten to a paste with water.

Another.—Slips of moistened bladder, smeared with white of egg.

Fire and Waterproof Cement.—To half a pint of milk put an equal quantity of vinegar, in order to curdle it; then separate the curd from the whey, and mix the latter with four or five eggs, beating the whole well together. When it is well mixed add a little lime through a seive, until it has acquired the consistance of a thick paste. With this cement broken vessels may be united. It resists water, and to a certain extent fire.

Fire Lutes.—The following composition will enable glass vessels to sustain an incredible degree of heat: Take fragments of porcelain, pulverise, and sift them well, and add an equal quantity of fine clay, previously softened with as much of a saturated solution of muriate of soda as is requisite to give the whole a proper consistence. Apply a thin and uniform coat of this composition to the glass vessels and allow it to dry slowly before they are put into the fire.

Another.—Equal parts of coarse and refractory clay, mixed with a little hair, form a good lute.

A Cement for stopping the Fissures of Iron Vessels.—Take two ounces of muriate of ammonia, 1 ounce of flour of sulphur, and 16 ounces of cast iron filings or turnings. Mix them well in a mortar, and keep the powder dry. When the cement is wanted, take one part of this and twenty parts of clean iron filings, or borings; grind them together in a mortar, mix them with water to a proper consistence, and apply them between the joints. This cement answers for flanges of pipes, &c., about steam-engines.

Genuine Armenian Cement.—"The jewellers of Turkey, who are mostly Armenians," says Mr. Eaton, a very intelligent traveller, and at one time a resident and consul in that country, "have a singular method of ornamenting watch cases, &c., with diamonds and other precious stones, by simply gluing or cementing them on. The stone is set in silver or gold, and the lower part of the metal made flat, or to correspond with the part to which it is to be fixed. It is then warmed gently, and the glue applied, which is so very strong that the parts thus cemented never separate. This glue which will firmly unite bits of glass, and even polished steel, and may of course be applied to a vast variety of useful purposes, is thus made: Dissolve five or six bits of gum mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid; in another vessel dissolve as much isinglass previously a little softened in water (though none of the water must be used), in French brandy or good rum, as will make a two ounce phial of very strong glue, adding two small bits of gum galbanum or ammoniacum, which must be rubbed or ground till they are dissolved. Then mix the whole with a sufficient heat, keep the glue in a vial closely stopped, and when it is to be used set the vial in boiling water."

Another.—Thick isinglass glue 1 part; thick mastic varnish 1 part. Melt the glue, mix, and keep it in a closely corked phial. For use, put the phial in hot water.

Elastic Cement for Bells.—Dissolve in good brandy a sufficient quantity of isinglass, so as to be as thick as molasses.

A very strong Carpenters' Glue.—Dissolve an ounce of the best isinglass, with a moderate heat, in a pint of water. Take this solution, and strain it through a piece of cloth, and add to it a proportionate quantity of the best glue, which has been previously soaked for about twenty-four hours, and a gill of vinegar. After the whole of the materials have been brought into a solution, let it once boil up, and strain off the impurities. This glue is well adapted for any work which requires particular strength, and where the joints themselves do not contribute towards the combinations of the work; or in small fillets and mouldings, and carved patterns, that are held on the surface by the glue.

A Glue for inlaying Brass or Silver Strings, &c.—Melt your glue as usual, and to every pint add of finely powdered rosin and finely powdered brick-dust two spoonfuls each; incorporate the whole together, and it will hold the metal much faster than any common glue.

A strong Glue that will resist moisture.—Dissolve gum sandarac and mastic, of each ¼ of an ounce, in ¼ pint of spirit of wine, to which add ¼ of an ounce of clear turpentine. Now take strong glue, or that in which isinglass has been dissolved; then, putting the gums into a double glue pot, add by degrees the glue, constantly stirring it over the fire till the whole is well mixed; then strain it through a cloth, and it is ready for use. You may now return it into the glue pot, and add ½ an ounce of very finely powdered glass; use it quite hot. If you join two pieces of wood together with it, you may, when perfectly hard and dry, immerse it in water and the joint will not separate.

A paste for laying Cloth or Leather on Table Tops.—To a pint of the best wheaten flour add two table spoonfuls of finely powdered rosin, and one spoonful of powdered alum. Mix them well together, put them into a pan, and add by degrees rain water, carefully stirring it till it is of the consistence of thinish cream; put it into a saucepan over a clear fire, keeping it constantly stirred, that it may not get lumpy. When it is of a stiff consistence, so that the spoon will stand upright in it, it is done enough. Be careful to stir it well from the bottom, for it will burn if not well attended to. Empty it out into a pan, and cover it over till cold, to prevent a skin forming on the top, which would make it lumpy. This paste is very superior for the purpose, and adhesive. To use it for cloth or baize spread the paste evenly and smoothly on the top of the table, and lay your cloth on it, pressing and smoothing it with a flat piece of wood; let it remain till dry: then trim the edges close to the cross-banding. If you cut it close at first it will, in drying, shrink and look bad where it meets the banding all around. If used for leather, the leather must be first previously damped and the paste then spread over it; then lay it on the table, and rub it smooth and level with a linen cloth and cut the edges close to the banding with a short knife. Some lay their table-cover with glue instead of paste, and for cloth perhaps it is the best method; but for leather it is not proper, as glue is apt to run through. In using it for cloth, great care must be taken that your glue is not two thin, and that you rub the cloth well down with a thick piece of wood made hot at the fire, for the glue soon chills. You may by this method cut off the edges close to the border at once.

Cement Stopping.—Mix equal quantities of sawdust, of the same wood required to be stopped, and clear glue; and with this stop up the holes or defects of the wood. Where the surface is to be japanned or painted, whiting may be used instead of sawdust. Be sure to let the stopping dry before you attempt to finish the surface.

Mahogany-coloured Cement.—Melt two ounces of beeswax, and half an ounce of rosin, together; then add half an ounce of Indian red, and a small quantity of yellow ochre to bring the cement to the desired colour. Keep it in a pipkin for use.

A Cement to stop Flaws or Cracks in wood of any colour.—Put any quantity of fine sawdust, of the same wood your work is made with, into an earthen pan, and pour boiling water upon it, stir it well, and let it remain for a week or ten days, occasionally stirring it; then boil it for some time, and it will be of the consistence of pulp or paste; put it into a coarse cloth, and squeeze all the moisture from it. Keep for use, and when wanted mix a sufficient quantity of thin glue to make it into a paste; rub it well into the cracks, or fill up the holes in your work with it. When quite hard and dry, clean your work off, and, if carefully done, you will scarcely discover the imperfection.

Fireproof Stucco for Wood, &c.—Take moist gravelly earth (previously washed), and make it into stucco with the following composition: Pearlashes two parts; water, five parts; common clay, one part. It has been tried on a large scale and found to answer.

Terra Cotta.—Potter's clay, Ryegate sand, and water, each a sufficient quantity. Model and bake.

Pew's Composition for covering Buildings.—Take the hardest and purest limestone (white marble is to be preferred), free from sand, clay or other matter; calcine it in a reverberatory furnace, pulverize and pass it through a seive. One part, by weight, is to be mixed with two parts of clay well baked and similarly pulverized, conducting the whole operation with great care. This forms the first powder. The second is to be made of one part of calcined and pulverized gypsum, to which is added two parts of clay, baked and pulverized. These two powders are to be combined, and intimately incorporated, so as to form a perfect mixture. When it is to be used, mix it with about a fourth part of its weight of water, added gradually, stirring the mass well the whole time, until it forms a thick paste, in which state it is to be spread like mortar upon the desired surface. It becomes in time as hard as stone, allows no moisture to penetrate, and is not cracked by heat. When well prepared it will last any length of time. When in its plastic or soft state, it may be coloured of any desired tint.

Miscellaneous.

Corn-Leaf and Grass Paper.

Paper has been and is now manufactured somewhat extensively from dry grass and straw, but P. W. Runel, of Plumstead, England, states he has made the discovery that paper pulp can be manufactured at less cost, by using green, instead of dry grasses, for its production He has taken out a patent for the improvement, and he states that when grass becomes dry its silica becomes hard and difficult of solution, whereas, when it is taken green, the silica and other unfibrous substances in it are more easily separated. He takes any green plants, such as sea grasses, which are abundant and cheap, and first mashes, then steeps them in warm water, and after this he boils them in a weak alkaline solution. They are now easily reduced to pulp by passing them between crushing rollers, or through the common beating engines used in paper mills. The pulp is bleached in the usual manner with chlorine.

The leaves of Indian corn are now used for making good paper, in Europe. There is one paper mill in operation in Switzerland, and another in Australia, in which paper is made from such leaves exclusively. The husks, which envelope the ears of corn, make the best quality. It is stated by the London *Mechanics' Magazine* to be excellent, and in some respects superior to that made from rags. As we are dependent upon Europe, in a great measure, for our supply of rags to make our paper, if we can obtain as good qualities from Indian corn leaves, we may yet become the manufacturers of paper for the whole world, as the greatest supply of cheap raw material is found in America. This is a subject worthy of deep attention, as we import rags to the value of about $1,500,000 annually, and paper manufactures to the value of about one million of dollars.

It is really wonderful to what uses paper may be applied, and what a field there is still left for improvements in its manufacture. We may take some instructions from the Japanese in this department of the arts. A writer in *Blackwood's Magazine*, in describing the manners of the Japanese, says:—"It is wonderful to see the thousand useful as well as ornamental purposes for which paper is applied in the hands of these industrious and tasteful people. Our *papier mache* manufacturers should go to Yedo to learn what can be done with paper. We saw it made into material closely resembling Russian and Morocco leather; it was very difficult to detect the difference. With the aid of lacker, varnish and skilful painting, paper makes excellent trunks, saddles, telescope-cases, the frames of microscopes; and we even saw and used excellent water-proof coats made of paper, which did keep out the rain, and were as supple as the best macintosh (india rubber). The Japanese use neither silk nor cotton handkerchiefs, towels or dusters; paper in their hands serves as an excellent substitute. It is soft, thin, and of a pale yellow colour, plentiful and cheap. The inner walls of many a Japanese apartment are formed of paper, being nothing more than painted screens. Their windows are covered with a fine translucent description of the same material. We saw what seemed to be balls of twine which were nothing but long shreds of tough paper rolled up. If a shopkeeper had a parcel to tie up he would take a strip of paper, roll it up quickly between his hands, and use it for twine. In short without paper, all Japan would come to a dead lock." The writer says "Japanese mothers-in-law invariably stipulate in the marriage settlement, that the bride is to have a certain quantity of paper allowed her."

The Japanese do not use rags for making paper, but the inner bark of trees.—*Scientific American.*

Machine-made Unfermented Bread.

Raised bread, resembling common loaves made from fermented and baked flour, is manufactured at present upon a somewhat extensive scale, on the corner of Fourteenth-street and Third avenue, in this city. The flour and water for making a batch of bread, are run into a large globular cast-iron vessel, and thoroughly mixed by a stirrer revolving inside, and driven by a steam engine. The lid of the iron vessel is then rendered perfectly air tight, and all the air is extracted by an air pump when the flour is thoroughly wet.

The mixed flour is thus expanded and rendered porous. Carbonic acid gas, under a considerable pressure, is now admitted among the dough, which is still continually stirred, until the whole mixture is charged with the gas. When this is effected, the operator takes his seat at the table under the vessel, and piles of tin pans are laid at his side. A tube projects down at the bottom of the iron vessel containing the dough. The operator now shoves a pan under this tube, opens the cock, when the pressure of the gas inside forces out the mixed dough in a stream, and the pan is filled in half a second. The pans are handed to the baker, who instantly places them in the oven. From the time the flour is placed in the iron vessel to be mixed, until it comes from the oven in the form of bread, the time occupied is only one hour. This is a rapid method of making bread, and as the labour is mostly performed by machinery, the cost of its manufacture is less than for making fermented bread. We have seen raised bread made by charging the water with carbonic acid gas, instead of charging the dough, but the bread by the latter method was considered much the better. We understand that there is now a very large demand for this bread, and that the machinery is kept running day and night to supply it. The taste is slightly different from bread made by fermentation. There are no fears of the dough becoming sour during warm weather by the carbonic acid gas process.

The inventor (Mr. E. Fitzgerald) of this system of bread making, has also devised an apparatus which will soon be applied, by which the loaves will be weighed by self-acting mechanism, and the pans filled with the dough, at one continuous operation.—*Scientific American.*

Working in Aluminum.

The following valuable article is from the *Ironmonger* (English). The information was obtained from Messrs. Bell & Brothers, of Newcastle-on-Tyne, manufacturers of aluminum, by Professor Deville's process, and will be very useful to many of our readers:—

The peculiar properties of this substance having been so little understood, has hitherto hindered its general employment, but now that it is sold in a pure state at as low a rate as 50s. per pound avoirdupois, it is likely to be much more frequently used.

Aluminum is a metal of fine white colour, slightly inclining to blue, especially after being well hammered when cold.

Aluminum, like silver, is susceptible of a very fine "matting," which is not affected by exposure to the air, or by any of the impurities usually present in the atmosphere of towns. To obtain this matting, the aluminum objects (being previously washed in benzole or essence of turpentine) must be plunged into a weak solution of caustic soda, thoroughly well washed, and exposed to the action of strong nitric acid. When the desired matting has been obtained, it must be well washed again, and dried in sawdust.

Aluminum is easily polished or burnished. To do this, it is necssary to use a mixture of equal parts of rum and olive oil, as an intermediate substance between it and the polishing stone or powder used. The polishing stone is steeped in this mixture, and will then burnish aluminum in the same manner as gold and silver is burnished, care been taken not to press too heavily upon the burnishing instrument.

Aluminum can be beaten out, either hot or cold, to the same extent and as perfectly as gold or silver; and it is susceptible of being rolled in much the same way as either of the above metals. Leaves as thin as those used for gilding and silvering can be made of aluminum. Covered ingot moulds of iron answer best for receiving aluminum intended to be used in the rolling mill. Aluminum quickly loses its temper, and therefore requires frequent reheating. The temperature of this reheating is a dull red heat, and when the plates become very thin, this demands the greatest attention.

Aluminum is easily drawn into wire. For this, the ingots are run into an open mould, so as to form a kind of quadrangular shape of a little less than half-inch section, which is then beaten upon the edges by the hammer very regularly; the operation of drawing out is then commenced on a horizontal bench, by very gradually reducing the diameter of the metal intended to be drawn into wire, and by frequent reheating, and then the ordinary process of wire-drawing can be proceeded with. When the threads are required extremely fine—as, for example, for the manufacture of lace—the heating becomes a very delicate operation, on account of the fineness of the threads and the fusibility of the metal. The heat of the current of air issuing from the top of the glass chimney of an Argand lamp will suffice for the heating.

The elasticity of aluminum is very much the same as that of silver, and its tenacity also about the same. The moment after it has been melted, aluminum possesses about the hardness of pure silver; when it is hammered out, it almost resembles that of soft iron; it becomes elastic, acquiring, at the same time, considerable rigidity, and emits the sound of steel when suffered to fall upon a hard body.

A property which aluminum manifests in a high degree is that of excessive sonorousness. This property has already rendered it of service in the construction of several musical instruments.

Aluminum is much lighter than ordinary metals. Its density is 2·56, a quarter that of silver, and about a third that of iron. By the action of the hammer, the density of aluminum increases sensibly, so as to become equal to 2.67.

Aluminum melts at a higher temperature than zinc, and a lower one than silver: to melt it, an ordinary earthenware crucible must be employed, without the addition of any sort of flux.

Its lower point of fusion, along with its slowness of heating, require that for melting it a less intense fire should be used, but applied for a longer time than in melting silver.

It is easily melted in an open crucible, which facilitates the removal of the dust and other impurities which appear on the surface of the metal; and for the purpose of stirring the entire mass a clean iron spatula is used.

Aluminum is easily run into metallic moulds; and still better, for objects of a complicated form, into moulds of dry porous sand, formed so as to allow an easy passage for the air expelled by the metal, which is viscous when melted. It ought to contain a greater number of passage holes, and should be so managed as to run it in one long and perfectly cylindrical git. When heated to a red heat, it ought to be poured out with tolerable rapidity. A small portion of the fused metal should be caused to run into the git itself when full, to compensate for the contraction of the substance of the metal at the moment of solidification.

By following all these precautions, castings of the highest degree of fineness may be obtained; but, at the same time, to succeed perfectly, an especial acquaintance with the subject is needed.

In the production of work where the use of the lathe becomes necessary, any scratching or tearing of the metal by the tool is avoided by covering the surface to which the tool is applied with a varnish composed of stearic acid and essence of turpentine.

When aluminum is soiled by greasy matters, it can be cleaned by benzole; if it be soiled by dust only, india-rubber or very weak soap and water may be used.

The pieces of aluminum intended to be soldered must be prepared in the same manner as objects are treated for soldering with tin, viz., by a "tinning;" but it must be remembered that it is indispensable that this tinning must take place with the solder itself. The pieces to be soldered, thus tinned beforehand, are afterwards joined together and exposed to the flame either of a gas blowpipe, or any of the ordinary sources of heat used in such cases. In order to unite the solderings, small tools of aluminum are used. These tools are used as little soldering instruments, and they facilitate at the same time the fusion of the soldier and its adhesion to the previously prepared aluminum.

The use of tools of copper or brass used when soldering gold and silver, must be strictly avoided, as they would form colored alloys with the aluminum and the solder. It is of the greatest importance never to use any flux to cause the solder to melt, as all those at present known attack aluminum, and prevent the adhesion of the pieces to be soldered. The use of the little tools of aluminum is an art which the workmen must acquire by practice; in fact, at the moment of fusion the soldering must have the friction applied, as they melt suddenly in a complete manner. In soldering aluminum, it is well to have both hands free, and to use only the foot for the blowing apparatus.

Solders of different compositions and degrees of fusibility have been employed in soldering aluminum. The following are those which have been generally used, ranged according to their order of fusibility:—

	1.	2.	3.	4.	5.
Zinc	80	85	88	90	94
Copper	8	6	5	4	2
Aluminum	12	9	7	6	4

No. 4 is the one usually preferred, particularly for soldering smaller objects.

In order to make the solder, the copper is first melted, the necessary aluminum is added, and stirred by means of an iron spatula, unpolished, as it comes from the blacksmith, adding also a little tallow; the zinc is then added, avoiding too much heat, as this last metal is easily oxydized and is very volatile.

The Nova Scotia Gold Fields.

Gold was discovered last year in the river Tangier, a rather inaccessible part of Nova Scotia. The announcement of this discovery, as is usual in such cases, created great excitement in the neighbouring country; but that reliable information might be afforded to those interested in the matter, a scientific investigation has been made by a geologist, who has arrived at the conclusion, after having made careful examinations on the spot, that gold does not exist in sufficiently large quantities to remunerate searchers after it, unless the aid of machinery were employed, which would, of course, require the outlay of some capital. Further investigation, however, has served to show that gold exists in larger quantities than was at first imagined. The following extract from the Halifax *Chronicle* will serve to shew what is now being done at these mines:—

"While much of the excitment attending the first few weeks of the Tangier gold fever has passed away, still a lively interest exists in the community on the subject, kept up by reports reaching the city almost daily, of the increasing productiveness of the Tangier mines, or of new discoveries at other places along the coast. Within the last week, rumors of such findings at Tangier have reached town, all of which rumors it would perhaps be absurd to believe; but after making a liberal allowance for exaggeration, enough remains to show that the quartz vein from which the chief quantity has been obtained, appears to grow richer the further it is followed from the surface, and also that other veins which near the surface appear to contain no gold, have proved, after a further trial, to be auriferous. The number of men at work at that locality at the present time is estimated at about five hundred. A good road has been constructed from the shore to the scene of operations. Shanties of a more comfortable character than the brush camps and canvas tents in which the diggers at first sheltered themselves from the weather, are being erected. Shops for supplying the miners with provisions and other necessaries are being opened. These indications all speak of the belief of those at work on the spot, in the value of the discoveries; and indeed there is no longer room to doubt that gold in considerable quantities exists there; but still we see no reason to change the opinion expressed some weeks ago, as to the improbability of single handed labour proving other than ruinous to nineteen-twentieths of those who seek by individual efforts to make a fortune at the gold diggings. The geological structure of the district in which the gold is found, is such that the precious metal can only be obtained in valuable quantities by the application of capital and skilled labour, and that on a pretty extensive scale. The prevailing rock is a species of coarse clay slate, interspersed with numerous small veins of quartz, the whole being, at the spot where the gold is found, nearly vertical, or dipping at an angle of not less than 70 or 80 degrees to the southward. The system of mining pursued is the rudest and most primitive possible. A trench is opened in the rock, three or four feet wide, and across the whole width of a claim, or twenty feet along the strike of the vein. In this the diggers work with pick and crowbar, patiently picking away the slate from each side of the quartz, the richest vein of which yet discovered, is only from three to five inches thick, and when a few inches of the vein is exposed it is broken off in lumps of a few pounds weight, and thrown to the surface, where a man with a hammer reduces it to small pieces, and picks out such specks of gold as he may discover with the naked eye. This, up to the present time, has been the whole system of gold mining at Tangier. Primitive as is the mode of working, however, it has served to prove that gold does exist there and in considerable quantities: and if the quartz taken out by this process has yielded an average of twenty ounces per ton, which we believe is the fact, then it only needs that the business of mining should be conducted on proper principles and on a sufficiently extensive scale, and approved machinery used for crushing the rock and and extracting the gold, in order that Tangier should rival some of the famed quartz regions of California and Australia."

Rock Oil as fuel for Steam-Engines.

A correspondent of the *Scientific American* says: An application of the rock oil of Pennsylvania for generating steam for motive power under steam-engine boilers is exciting much attention in the oil region. The following is a description of the apparatus used: A series of iron pipes are laid in the fire arch of the boiler, which pipes are perforated in their upper surface with minute holes: the oil is supplied to those pipes by means of a force pump, aided by an air receiver, to preserve a constant pressure. A spray, so to speak, of oil is thus made to fill the space usually filled by the flame of wood or coal used to rise steam; this, once ignited, fills the fire arch and flues of the boiler, and maintains the amount of heat in the boiler.

If this fuel is not found to be too expensive, it will prove a good thing for the use of steamers on sea voyages. Its practical use has been proved, and it remains for chemists and others to test it on ships, &c., in a large way.

There can be but little doubt that this oil will be found cheaper than coal for gas-making for lighting dwellings, streets, &c.; its price, under the influence of the vast supply raised, will soon come down to a matter of fifteen or twenty cents per gallon.

Adolph Berger, C. E.

Buffalo, N. Y.

Steam Superheating.

All the benefits obtained from superheating steam by passing it through tubes in a furnace before it is admitted into the cylinders, it is stated to be obtained by keeping steam in a jacket surrounding the cylinder, and maintaining it at a temperature somewhat above that which operates the piston. It has been found in practice that the very dry steam which is produced in the tubes running through a furnace cuts the cylinders and packing. The London *Engineer* states that steam jacketting has lately been introduced into the British navy, and has been applied to two vessels, the *Gibraltar* and *Atlas*. "In commercial steamers jacketted cylinders are being extensively adopted."—*Scientific American.*

Iron in Buildings—Useful Rules.

The London *Building News* publishes an abstract of a very useful paper by Mr. Wm. Stubbs, lately read before the Liverpool Architectural Society. We quote the following extract from it:—

The golden age is past: we are now in the age of iron. * * * It may be truly said that gravity is the ultimate source of all the strains that arise in buildings, but for convenience it is necessary to resolve the resultant into compression and tension. It was formerly usual to employ iron chiefly to resist the latter, but economy of space and length of bearing have brought both into its service. * * * The first point to be ascertained by an architect with a casting of iron is to find out what it has to do.

The practical man wants simple tools. Science is always consistent with successful practice, therefore simple rules are sufficient. The following for iron pipes of ordinary sizes answers well, and it never has been published before. It is based upon the fact that a 10 inch pipe one inch thick will stand the pressure of 100 yards head of water. The coincidence of one inch of metal to every 10-inch diameter and 100 yards pressure should be remembered. For every inch in the diameter of pipe, increase or deduct one-tenth of an inch, and for every yard of pressure increase or deduct one hundredth of an inch.

In calculating the strength of columns great care is necessary. The safe plan is to find the diameter of a solid column necessary to bear the compression, and then distribute the same area of metal in tube form as a hollow column. * * * A solid column 10 feet long, and having an area of 10 square inches (good metal,) will bear 10 tons pressure. This rule can be conveniently carried out, and it is safe and practical. It is really not so much what we know as what we can successfully use that is valuable in science and art.—*Scientific American.*

Ventilating Water-proof Cloth.

India-rubber and oilcloth capes and coats, although perfectly water-proof, are unfit for wearing during warm rainy weather, because they retain the prespiration and prevent the necessary ventilation required for the body. The best light capes for soldiers and travelers when marching during wet weather, are made of what is called "Tweed cloth," prepared as follows:—Take 2lbs 4 oz. of alum, and dissolve it in 10 gallons of water; in like manner dissolve the same quantity of sugar of lead in a similar quantity of water, and mix the two together. The cloth is immersed for an hour in the solution, and stirred occasionally, when it is taken out, dried in the shade, washed in clean water, and dried again. This preparation enables the cloth to repel water like the feathers of a duck's back, and yet allows the prespiration to pass somewhat freely through it, which is not the case with gutta-percha or india-rubber cloth.

The sulphate of lead is formed in this manner, and enters into the pores of the cloth. It is an insoluble salt; hence, the reason why it makes the cloth waterproof, while, at the same time, there is sufficient room in the interstices to allow the perspiration and heat from the body to escape.

Tweed cloth is light, and not expensive; it is also soft and pliable, and capable of being rolled up into small bulk without permanent wrinkles being formed in it. We have frequently prepared cloth in this manner, and have found it to answer an excellent purpose in rainy weather; while at the same time, in color and appearance, it does not differ from unprepared cloth.—*Scientific American.*

Corrosion of Lead in Water Pipes.

The following article, containing important information for a large class of the community, is from a late number of the Boston *Medical and Surgical Journal:*

"Mr. J. R. Nichols calls attention to a source of danger attending the use of leaden pipes used for the conveyance of drinking water, which seems to have been hitherto disregarded. Even if it be admitted that the water which is supplied to the city of Boston from Lake Cochituate, like that of most New England ponds, be such that it may be safely used after having passed through lead pipe under ordinary circumstances, it would nevertheless be wrong to infer that this water can be employed with entire safety at all points of delivery, without first inquiring whether special conditions may not exist in some localities by which the character of the water may there be changed. Having observed several instances in which the inmates of a single house had suffered from lead disease induced by the use of aqueduct water, while the inhabitants of other parts of the city, supplied with water from the same original source, were unaffected, and having in one instance detected the presence of considerable quantities of lead in one of the cases first mentioned, while no reaction for lead could be obtained from a specimen of the same aqueduct water taken from another locality, the author proceeded to inquire into the cause which produces this lead impregnation in certain houses or districts, while the general waters of a supply remain unaffected. He has noticed in the leaden pipes removed from cess-pools, sinks and wells, that the intensity of corrosive action had been in a great measure confined to the sharpest bends and depressions in the pipe, while in some instances other portions remained intact. "I have in my possession," he says, "a section of supply pipe, removed from the aqueduct of a neighboring city, in a portion of which corrosive action had proceeded so far as to cause leakage. The part thus acted upon was confined to an acute angle, and there is evidence to show that the plumber, in placing it in position, bent it in the wrong direction, thus creating the necessity for another turn in the opposite. This pipe had doubtless been subjected to two violent turns, which seriously impaired the homogeneity of the metal. An examination of lead pipe removed from buildings will certainly show that where there has been any perceptible amount of decomposition, it has been confided to the angles and depressions in its course There are three causes or agencies which may perhaps be sufficient to produce these results:—1. The disturbance in the crystalline structure of the metal by bending, whereby its electrical condition is changed and voltaic action promoted, giving rise to chemical decomposition. [Together with the galvanic action which must be induced wherever connections or faucets of copper, or alloy, are fastened to the leaden pipe, or where a crack or fissure in the latter has been filled with solder.] 2. The presence of organic matter, such as fragments of leaves, and impurities pervading pervading all pond waters, and which may be detained in angles and depressions of the pipes. 3. Corrosions may be produced in lead pipes by the accidental presence of pieces of mortar. Where mortar is present, the lime would assist in oxydizing the metal, and also aid in the solution of the oxyd. Considerable portions of fresh mortar are frequently deposited in lead pipes, during the erections of buildings. When the family commence the use of the water, it holds the salts of lead in solution, and its presence may be detected for months. The process of oxydation, which is retarded or prevented altogether by the presence of neutral salts in water, could not be materially interfered with under the conditions considered. It is obvious, if these observations and conclusions are correct, that much care should be exercised in placing pipes in position in buildings. In those leading to the culinary department, angles and depressions should be avoided. Violent twists and turns should not be permitted, and during the erection of houses, the open ends of protruding pipes should be carefully closed. Assuming the general fact that pipes, conveying the waters of our New England ponds become coated and protected by an insoluble lead salt, the question arises, how long before this protection is secured, or, how soon may a family commence the use of water passing through new pipes, with safety? In view of the manifest danger from local disturbances, the most sensible reply would be, never. A section of new lead pipe, immersed in Cochituate water one hour, at a temperature of 65° Fah., gave a decided lead reaction with sulphydric acid. Removed and placed in six fresh portions of water one hour each, the waters, when tested, give similar results. The experiment continued during two weeks. Varying the time of immersion in fresh portions of water from one to ten hours the lead indications continued, although at last feeble. These results are sufficient to show that individuals or families should not commence the use of water flowing through new pipes, until considerable time has elapsed, and much water contact secured."

TO INVENTORS AND PATENTEES IN CANADA.

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

TO CORRESPONDENTS.

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

TO MANUFACTURERS & MECHANICS IN CANADA.

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

TO PUBLISHERS AND AUTHORS.

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