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OF THE

BOARD OF ARTS AND MANUFACTURES

FOR

UPPER CANADA.

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1865.

BOARD OF ARTS AND MANUFACTURES FOR UPPER CANADA,

FOR THE YEAR 1865.

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THE JOURNAL
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Board of Arts and Manufactures
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JANUARY, 1865.

THE EDUCATION OF OUR CHILDREN.

In reference to a variety of subjects we often hear the question asked, "Whither are we tending?" It might be productive of a world of good, if we would seriously seek an answer to it, in reference to the future prospects of our children and our hopes for the good of posterity. We have received the basis of our present progress and mental superiority from our ancestors, and the most practical way in which we can testify our veneration and gratitude, is to make all the provision in our power for those who are to succeed us. Every man is desirous of doing this for his own immediate children in the matter of a good and unencumbered estate; but beyond this we have a duty of a more universal kind to perform. We have to bequeath the *world* to society. Not only the material with its unimaginable riches and its wonderful and brilliant progress, but the moral world such as we may make it. Nor is this all; we shall bequeath human organisations and constitutions which we transmit to our offspring; whether these shall consist of sound minds in sound bodies or the reverse depends upon us, and ours is the responsibility. Ours is therefore the *duty* to ourselves and to posterity to be chaste, temperate, pure in body and mind—to cherish all the virtues, as truthfulness, unselfishness and honour, in our most secret thoughts and feelings, that we may ensure the transmission of those qualities to our children. Every well informed physiologist *knows* that this has a far deeper meaning than the world generally believes, and well indeed would it be for us if our popular teachers and advisers were in a position to explain those inevitable laws of nature, the violation of which most surely leads to the visitation of the sins of the parents upon their children to the third and fourth generation. The world to-day is full of sad experience of the truth of this. Having but few faithful teachers to enlighten them, error and misery are perpetuated without reasonable hope of their termination. Our chief hope lies in the education of the masses, and for that purpose we have in this country a school system perhaps not inferior to school systems in general, though like others inadequate to the requirements of the age. This however is not so much the fault of the system, as of the want of that kind of information amongst the adult population which would enable them to work it up to its highest capability of usefulness. The prevalent predilection in favour of purely intellectual to the exclusion of physical culture is one of the cardinal errors of our *time*, and an error of so insidious a character as, if persisted in, must, by producing first physical and its consequent mental degeneracy retard the world's progress. It therefore becomes the duty of all who desire that the world should be handed down to the next generation in a state of accelerated progression, including that of man, to enquire into the tendency of over taxation of the brain and prolonged inaction of the body, especially in childhood and youth; and in prosecution of their investigation they should bear in mind that, in nearly all cases, both the action of the brain and the inaction of the body are not spontaneous or voluntary, for then comparatively little harm would be done, but both are *compulsory*, producing cessation of that reciprocal action between the brain and muscles and viscera which constantly reiterated leads to the most lamentable results. To the professional man it is apparent that brain work in the young, even when it is not carried to extremes, is productive of injury to the physical system; the abstraction of blood to the brain from other parts of the system preventing the necessary circulation in those parts.

When the action of the brain is very great, as it often is in all schools, the mischief is correspondingly great, and a state almost death-like exists through the system—the brain alone excepted—and that is labouring on through algebraical analysis to insanity, or at best to premature structural development and cessation of growth in that organ, even in early youth. It is within the experience of nearly all, that persons do sometimes stop growing very suddenly, years before they were expected to do so; and so boys and girls who were regarded as prodigies of learning, have all at once come to a dead stand, and were left standing there by the dullest scholars of their acquaintance as they passed by.

If, aided by the lights of modern science, we could look into the economy of our nature, and behold the myriad beautiful contrivances for carrying on all the functions of our organisation—its endless variety of wonderful adaptation of means to ends—remembering that nothing is there in vain, but that all is indispensable to healthy vitality; remembering too, that upon the uninterrupted discharge of all these functions, the mind itself depends for its normal manifestations, we should no longer need to be told that "the first requisite to success in life, is to be a good animal."

If we continue to pursue the course which has unhappily been inaugurated nearly all over the civilised world, we may reasonably expect to reap the bitter fruits of degeneracy and premature decay. If we continue to violate the laws of nature, by educating the mind at the expense of the body, its sad effects will be transmitted to a puny generation, utterly incompetent to discharge those momentous duties which must arise out of the events with which this age is pregnant. In the great battle of life the victory will be with the strongest.

Enough is known to guide us in the work of reform, and if we fail to transmit to the future a superior race, capable of securing for themselves the greatest amount of happiness, the blame will rest with us. The first most practical step to be taken is, for the *people* in every school section to insist on and secure the introduction of gymnastics into their public schools. That this has all along been contemplated by the system is clearly shewn by the fact that the pupil-teachers, male and female, in the Normal School, are instructed in gymnastics, so that they may be capable of teaching others. It is also introduced in the male and female departments of the Model School, which, as its name implies, is intended as a pattern for the common schools throughout the country. Let parents look to these things—the physical as well as the mental development of their children—and they will realise that the well developed normal man and woman are infinitely more virtuous and pure, and worthy to become the parents of those to whom great works are to be committed.

In conclusion we would ask the serious attention of the young, and all concerned, to the subject of the article in our last number, entitled "Books and Reading," and would warn those whose tastes are not yet perverted by flash literature, to beware that they lose not all relish for those "feasts of reason" to be found in the works of our best authors.

RESIN AND TURPENTINE.

We have received from Mr. Peter Irish, of Brighton, County of Northumberland, several samples of resin and one of spirits of turpentine, of his manufacture. Mr. Irish took the first prize for both these articles at the late Provincial Exhibition in the city of Hamilton. The samples of resin comprise black and white, with many intermediate shades, both transparent and opaque.

We regret not having an analysis of Mr. Irish's turpentine; we have, however, Professor Croft's analysis of the specimens exhibited by Messrs. Connell & Cotter of Hastings, which was awarded the second prize, and of Mr. Luke's specimen, of Angus, highly commended by the judges. The notes of analysis on Messrs. Connell & Cotter's turpentine are, "smell much like pure turpentine, boiling point 154°c, specific gravity 0·865," and on Mr. Luke's "smell of oil from pine-wood by distillation, boiling point 153°c, specific gravity 0·868." The boiling point of pure spirits of turpentine is 155°c, specific gravity 0·865.

In a communication from Mr. Irish, accompanying his samples, he gives a description of his process of procuring the raw article, which corresponds very nearly to the description we gave in the number of this Journal for August 1864. He says he obtains it from the white (not the Norway) pine, by cutting notches or boxes, about two feet from the ground, with long-*billed* axes—a good axe-man cutting about 300 boxes per day. These boxes are made *dishing*, so as to hold from a gill to a half pint each, and should be cut between the twentieth of May, and the end of June. During the hot weather it will be necessary to gather the sap from these boxes at least once a week. In a tree one foot in diameter he cuts one box, two feet in diameter two boxes, and so on—this he says will injure the trees but little, as the boxes he cut in some forty years ago are now completely grown over.

During the past year Mr. Irish paid $10 per barrel for the raw article, and we believe will be prepared to purchase, during the coming season, any quantity that may offer, or will distil it on shares with any parties who may furnish it. The price obtained by him for resin during the past year averaged 8 cents per lb., and spirits of turpentine $1.75 per gallon.

We suggest to parties possessing facilities for entering into these manufactures, the fullest consideration of their importance before next season's operations commence. There is no danger of the supply exceeding the demand. In the year 1863, as per Trade and Navigation returns for the Province, the imports of spirits of turpentine were 13,913 gallons, valued at $26,312, and of resin 3,650 barrels, valued at $63,484, showing that for these two articles alone we paid in cash the sum of $89,796. The computed value of resin and turpentine imported into the United Kingdom for the same year, as shown by tables published in the November number of this Journal, was $2,846,445, of which $35,000 worth alone was imported from thence to this Province, the remainder coming principally from the United States. Here then, for the United Kingdom and Canada, was a demand in the year referred to for resin and turpentine amounting in value to no less a sum than $2,811,422.

It is by the promotion of such manufactures as these, for which we possess both the raw material and the HOME MARKET, that the country will prosper. The capitalist who thus invests his money, confers, beyond comparison, a greater benefit upon his country than he could possibly do by investing it in the importation of the luxuries and superfluities of life, to pay for which the capital is sent directly out of the country, impoverishing it to the extent that the balance of imports exceeds its exports.

HAND-LOOM WEAVING.

A gentleman, resident in this city, who has long taken a deep interest in matters of public benefit, is anxious to know the price of hand-looms for weaving plain woollen or linen fabrics, and where such looms can be obtained. He is of the opinion, and rightly so, that a large measure of the distress prevalent amongst portions of the working population of this country, is owing to the absence of any regular means of employment during the winter months; and that if an inexpensive loom of simple construction, suitable for the manufacture of common woollen cloths and flannels, or linen bagging, towelling, bed-ticking, &c., could be introduced amongst them, their winter days would be spent in productive labour, and themselves, their families and the state, would be equally benefited.

We remember the *good old times* we had in our native village, in a rural district in England, when the old-fashioned *bombazines* were worn by the ladies, that every man, woman, and youth, not engaged in other employment, was working at the hand-loom at their own fireside.

With a view to furnishing the gentleman referred to the information he seeks, we have waded through encyclopœdias, dictionaries of art and manufactures, and treatises on weaving, without meeting with success. The subject is an important one, and if any of our readers are sufficiently acquainted with it to furnish the information sought, we shall feel obliged by their doing so.

We notice that in April of the year 1859, Mr. Joseph Brickly, of S. Dorchester, patented a self-acting hand-loom, which was at the time highly spoken of. In the year 1862, there were exhibited at the Provincial Exhibition held in Toronto, a hand-power loom by Mr. Thomas Welsh, of Brantford; which was awarded an extra prize; and a double-box loom by Mr. James Davidson, of Cobourg, to which was awarded an extra prize and a diploma. These machines were in operation, and we believe gave satisfaction to the judges and to the public.

We beg to suggest the formation of a joint-stock company, as the only sure means of introducing domestic weaving amongst the working classes. The company should obtain and furnish to the operatives all necessary information, purchase looms and let them out to hire to trustworthy individuals, purchase yarn and other necessary material and furnish to the weavers at the lowest possible price, and assist them in finding a market for their goods when ready.

Here is an opportunity for gentlemen of pecuniary means and philanthropic feelings, which we hope to see taken advantage of ere another year shall pass away.

ADULT EDUCATION AND MECHANICS' INSTITUTE CLASSES.

The Head Master of King Edward's School, Birmingham, having been requested to distribute the prizes to a number of successful candidates, at a recent school examination, observing that there were some fifty or more copies of Smiles' "Self-Help" among the prizes, cautioned his young audience against being misled, by the stirring contents of that book, into supposing that any individual among them, who might be gifted with energy and ability, could therefore have the opportunity of becoming a Watt or a Stephenson. He bade them rather receive and remember this truth, that any working man who learnt to do his daily laborious task from the highest motives of duty and responsibility, was filling his situation and discharging the purpose of his life as honorably and usefully as though he had attained the eminence of either of those great men.

The idea, though not expressed in so many words, is nevertheless prevalent now-a-days, that a labourer has only to obtain an education, to make him either a genius or a gentleman. We do not say that all who possess a laudable desire for knowledge entertain this idea, but we do say that it prevails to too great an extent. The object we aim at in quoting the remarks of the Head Master, is to impress upon the minds of our youth the desirability of acquiring, or of seeking to acquire, knowledge for its own sake, for its own intrinsic value, for the pleasure and increased measure of happiness which it is calculated to impart, as well as the increase in value of the man who has obtained it. No one will deny that knowledge is calculated to impart pleasure, and to increase a man's capacity for enjoyment. Much less will any one deny that, in proportion as a skilled mechanic increases his stock of knowledge, he increases his value both to himself and his employer.

Here, then, is the aim and object of a Mechanics' Institute. It supplies to the illiterate and uneducated man the means of acquiring knowledge, at such rates as he is able to pay. By doing so, it may enable him to rise to the top of his profession, or, what is more probable, it may simply increase his stock of information sufficiently to enable him to do his work with less labour, fewer errors, and much more pleasure to himself and others. The great change produced in the masses of the people within the last half-century, is the effect of reading. Men who labour with their hands all the time, used to be, and are now to a very great extent, disinclined to employ their minds in reading or thinking, and this must always result from an overworked body. On the contrary, those who will engage the mind in reading, and in useful study, in addition to their ordinary labour, will invariably find that they are able to do their work with more pleasure, with less labour, and at an increased pecuniary value.

Young men of the present day have very superior educational advantages over those of days gone by. Let us instance the case of the members and pupils of the Toronto Mechanics' Institute as an example. Classes have been organized for the study and practice of book-keeping, penmanship, English grammar and composition, practical arithmetic, architectural and mechanical drawing, ornamental drawing, and French. Over one hundred pupils have connected themselves with one or more of these classes, at an average cost of two dollars and a quarter per annum. Each class receives forty lessons, meeting two nights per week during the five winter months. At a glance it will be seen that here is the nucleus of a great work. Some thirty are learning book-keeping, which, to the clerk, the employer or man of business anywhere, tends essentially to success in life. How large a proportion of men fail in business, and themselves and their families become ruined, because of their incompetency to take charge of their own books, and to make proper business calculations! About twenty are learning the art of penmanship, one of the most desirable of accomplishments. A few industrious apprentices are working hard to learn mechanical drawing; and so on. Perhaps out of them all, not one Watt or one Stephenson may be produced; but undoubtedly their value to the state, and to themselves, will be immeasurably increased; and their capacity for observation, for understanding, and for enjoying, will be proportionately augmented.

We sincerely hope that the trustees or directors of Mechanics' Institutes in our towns and villages, as well as in the larger cities, will see it to be the interest and welfare of their several institutions to make strenuous efforts to organize one or more classes; and that, at the next annual examination of this Board, instead of two institutions, as last year, ten or a dozen will be sending for the necessary examination papers for their numerous candidates.

CANADA SLATE COMPANY.

We have received the Prospectus of a Company now in course of formation, to be called "The Canada Slate Company," with a capital stock of $100,000 in 20,000 shares of $5 per share.

The property of the Company is situated in the Township of Melbourne, adjoining the Walton Quarry, Richmond County, Canada East, and consists of a block of land of five hundred acres; two hundred acres of which is composed of Argillacious slate-rock, of smooth and even cleavage, and uniform color, suitable for roofing slates, slabs, and every other purpose to which slate is applied.

The demand will no doubt be ample for all the slates that can be quarried from this and the Walton property, should it go into operation. Subscription lists are open at the office of H. Pellatt, 60 King Street East, Toronto.

DUBLIN INTERNATIONAL EXHIBITION.

We have received programmes of an International Exhibition of Arts and Manufactures, to be held in the city of Dublin, Ireland; to be opened in the Exhibition Palace Buildings, on Tuesday, the 9th day of May next, and to remain open until the end of the month of October. The productions of all nations will be admitted; and the general plan for their division will be, as far as practicable, as follows:—Raw Materials, Machinery, Textile Fabrics, Vitreous and Ceramic Manufactures, Miscellaneous Manufactures, Fine Arts.

All goods and articles must be delivered at the Building, at the risk of the exhibitor, some time between the 1st of March and the 15th of April. Rough counters and wall space provided free. Prices of articles may be affixed thereto, except in the Fine Arts section. Medals and certificates will be awarded in all sections but Fine Arts. Distinctive labels will be attached to such works of Art as are intended for sale, the price of which must be entered in a book, to be kept by an officer of the Committee, through whom all sales must be made. A commission of 5 per cent. will be charged on such sales.

In the Machinery department, steam and water motive powers will be provided. The address on packages should be—

> *To the Committee for the*
> *International Exhibition for* 1865,
> *Exhibition Palace,*
> DUBLIN.
> *From* (state country and exhibitor's name).

JERKED BEEF.

We learn from the London *Grocer* of a recent date, that, through the instrumentality of a commission that had been appointed and sent out for the purpose, South American *jerked* and *pickled* beef is becoming a regular article of commerce in the British markets, and that the poor of the north of Ireland, and also in many of the poor districts of England, have been greatly benefited by it. A clergyman near Worcester writes:

"Many of the cottagers about here think and say that the offer of your beef is a great benefit to them, and thank me for introducing it in this neighbourhood. One man says he is much stronger from eating it, and that he does not consume nearly so much bread as formerly."

The *Grocer* says:—"We can speak to the genuine and wholesome character of the meat, and to its excellent keeping properties, although it (the pickled) is not salted to an offensive degree. * * A sample hundredweight was sent to us some months since, and we were surprised at the satisfaction expressed by some of the recipients amongst whom we distributed it. It is a subject of regret that greater efforts are not made to render this, and other wholesome forms of preserved meats, standard articles of food."

Although this is a question that may not directly interest us, with whom good food—both animal and vegetable—is abundant, yet we cannot but rejoice at the introduction amongst the hard-worked and, in many cases, poorly-fed classes at home, of a cheap, wholesome and nutritious article of food, such as is now being imported from the abundant—and hitherto waste—supplies of the South American continent.

The meat is sold at 3d. per lb. in the English market, being about one-third the price of home-produced beef.

French Mines.

France works 400 coal mines, 202 iron mines, and 207 mines of other substances.

Board of Arts and Manufactures FOR UPPER CANADA.

NOTICE TO SUBSCRIBERS.

The present number, commencing a new volume, is sent to almost all the old subscribers. Those who do not return it before the next number goes to press, will be understood as desiring to continue their subscriptions. It is particularly requested that all arrears, as well as new subscriptions, be forwarded to the Secretary of the Board as early as possible.

The issues hereafter printed will be limited to a very small number over those actually subscribed for.

ANNUAL MEETING OF THE BOARD.

According to the requirements of the statute, the Annual Meeting of the Board for the reception of Report of the retiring Committee, and election of office-bearers for the ensuing year, should be held on the first Tuesday of this month (January); but as the various Municipal Elections are held at the same time, it has been usual to adjourn the meeting of the Board to the second Tuesday of the month. The same course will no doubt be pursued this year as formerly, the adjourned meeting being held at 2 o'clock, p. m., on Tuesday the 10th instant.

For the information of Boards of Trade and Mechanics' Institutes, we publish the clauses of the act relating to the electing and certifying of Delegates to the Board.

In addition to the elected Delegates, the *ex-officio* members are the Minister of Agriculture, Professors of Physical Science in Colleges and Universities, Chief Superintendant of Education, and Presidents of all Incorporated Boards of Trade and Mechanics' Institutes in Upper Canada.

A full meeting of the Board is desirable.

(Extracts of Act.)

Sec. 23.—The Board of Trade in each City and Town in Upper Canada, shall, at its first meeting in the month of January, in each and every year, elect and accredit to the Board of Arts and Manufactures for Upper Canada, one of its body as a member thereof.

Sec. 25.—Each incorporated Mechanics' Institute in Upper and Lower Canada respectively, shall, at its first meeting, in the month of January, in every year, elect and accredit to the Board of Arts and Manufactures in Upper or Lower Canada respectively (according as its place of meeting is in Upper or Lower Canada) one delegate for every twenty members on its roll, being actual working mechanics or manufacturers, and having paid a subscription of at least one dollar each, to its funds for the year then last past.

Sec. 27.—The names of the Delegates so elected shall be forthwith transmitted by the Secretary of the Board or Institute electing them, to the Secretary of the Board to which they are elected, who shall thereupon inscribe their names upon the Roll of the Members of the said Board, for the year then about to commence; with the names of the Delegates when transmitted by the Secretory of a Mechanics' Institute, there shall be transmitted a statement verified by the oath of the Secretary transmitting the same, to be taken before a Justice of the Peace, of the names of all the members on the roll of such Mechanics' Institute, being actual working mechanics or manufacturers, and having paid subscriptions of at least one dollar each to its funds, for the year then last past.

TRADE MARKS AND DESIGNS.

We have received from the Department of the Hon. the Minister of Agriculture, copies of all trade marks and titles of designs registered up to the 19th December ultimo, in accordance with 24 Vic. cap. 21, sec. 25, which provides that copies thereof shall be forwarded to this Board and the Board for Lower Canada, from time to time, and that "the same shall be open to the inspection of the public in the offices of such Boards, during the usual office hours of each day, free of charge."

Trade Marks.

Vol. A.

Folio 1—517, R. J. Andrews, "Good Samaritan Balm." (Dated 8th May, 1863).

Fol. 2—477, F. A Whitney & Co., "Patent Prepared Flour." (Dated 8th May, 1863).

Fol. 2—503, J. Ryckman, "Stockwell's Magnetic Oil." (Dated 8th May, 1863).

Fol. 7—529, W. Rodden & Co., "Prince of Stoves." (Dated 14th January, 1862).

Fol. 9—529, Do., "Queen's Choice" Stove. (Dated 14th January, 1862).

Fol. 11—529, W. Rodden, "Plantagenet" Water. (Dated 14th January, 1862).

Fol. 15—493, S. J. Lyman & Co., "Elliot's Dentifice" (Dated 13th August, 1863).

Fol. 15—493, Do., "Arctusine" (Dated 13th August, 1863).

Fol. 17—506, B. L. Judson & Co., "Mountain Herb Pills." (Dated 11th May, 1863).

Fol. 19—506, Do., "Mountain Herb Worm Tea." (Dated 11th May, 1863).

Fol. 23—506, Do., "Dr. Morse's Indian Root Pills." (Dated 8th May, 1863).

Fol. 25—506, Do., do. (Dated 8th May, 1863).

Fol. 27—501, Allen, Taylor & Co., "The Lion of the North" Stove. (Dated 3rd October, 1862).

Fol. 31—501, Do., "Prince of Wales" do. (Dated 3rd October, 1862).

Fol. 33—501, Do., "The Mammoth" do. (Dated 3rd October, 1862).

Fol. 35—501, Do., "Young Canada" do. (Dated 3rd October, 1862).

Fol. 37—500, J. Mathewson & Son, "The Royal Amber Soap." (Dated 8th May, 1863).

Fol. 39—500, Do., "Soaps, Candles and Oils." (Dated 8th May, 1863).

Fol. 41—500, Do., "Soaps." (Dated 8th May, 1863).

Fol. 43—506, B. L. Judson & Co., "Carlton's Condition Powders." (Dated 8th May, 1863).

Fol. 45—577, N. Samuel, "Pens." (Dated 8th May, 1863).

Fol. 47—502, DuBerger & Co., "A Medicine." (Dated 29th March, 1864).

Fol. 49—539, A. Savage & Son, "Bons Machinery Oil." (Dated 13th April, 1864.)

Fol. 51—539, Do., "Lax's Heavy Engine Oil." (Dated 13th April, 1864).

Fol. 53—528, Robert Stark, "Nelligan's Worm Candy." (Dated 19th July, 1864).

Fol. 55—524, W. & R. Griffith, "Ground Coffee." (Dated 27th September, 1864).

Fol. 57—485, S. J. Lyman & Co., "The Adirondack Grape Vine." (Dated 24th October, 1864).

Fol. 59—477*, E. Murdoch, "Patent Prepared Flour." (Dated 17th December, 1864).

Bureau of Agriculture and Statistics,
Quebec, December 19, 1864.

Titles of Designs.

H. Bernier & Cie., of the parish of Lotbiniere, "Design for treble and double Stoves." Dated 26th December, 1861, Vol. A, Fol. 2).

J. G. Beard & Son, of the city of Toronto, "Design of a pattern for stoves made of cast iron, and of a reservoir for hot water thereon affixed, composed of sheet copper." (Dated 18th May, 1863, Vol. A, Fol. 9).

William Clendenning & Co., of the city of Montreal, "Design of castings for double or single box stoves." Dated 26th December, 1861, Vol. A, Fol. 1).

Auguste A. Meilleur, of the city of Montreal, and Jean Baptiste Alphonse Meilleur, of the town of Sorel, "Design of a pattern for bedsteads composed of metal or mixed metals." (Dated 20th March, 1863, Vol. A, Fol. 7).

John McGee, of the city of Toronto, "Design of a pattern for coal cooking stoves." (Dated 22nd September, 1863, Vol. A, Fol. 13).

John McGee, of the city of Toronto, "Design of a pattern for dampers for the Canadian cooking stove." (Dated 1st October, 1864, Vol. A, Fol. 15).

T. Parrot & Cie, of the parish of Ste. Emilie de Lotbiniere, "Design of a treble or double stove." (Dated 13th July, 1863, Vol. A, Fol. 10).

Wm. Rodden & Co., of the city of Montreal, "Design of castings for double or single box stoves." (Dated 26th December, 1861, Vol. A, Fol. 1).

* This cancelled No. 477, Folio 2, issued 8th May, 1863.

BOOKS ADDED TO THE FREE LIBRARY OF REFERENCE.

Shelf No.		
F. 52 & 53.	The Illustrated Catalogue of the Industrial Department of the International Exhibition of 1862. Imp. 8vo, 2 vols.	*Official.*
G. 59.	The Practical Cotton Spinner and Manufacturer, and comprehensive system of Mill Gearing and Machinery, from the primary moving power through all the various processes. 8vo	*Scott & Byrne.*

BOOKS ADDED TO THE FREE LIBRARY OF REFERENCE—*Continued.*

G. 60.	The Arts of Tanning, Currying, and Leather Dressing; theoretically and practically considered in all their details. 8vo	*C. Morfit.*
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CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. Crace Calvert, F.R.S., F.C.S.

Lecture V.

Delivered on Thursday Evening, May 5, 1864.

Bile, its properties. *Blood*, its composition, and application in the refining of sugar and manufacture of albumen. *Albumen*, its application to calico-printing and photography. *Milk*, its composition, properties, falsification, and preservation. *Urine*, its uses. A few words on putrefaction.

In this lecture we shall examine the composition of the various liquids secreted in the human body and in those of animals, and the uses to which these fluids are applied in arts and manufactures.

Bile.—The composition and appearance of bile vary greatly in different animals. Usually it is a yellow, green, or brown, thick fluid, with a marked alkaline reaction, and containing about 14 per cent. of solid matter, the most important constituents of which are, in human bile, mucus, two colouring matters, one yellow (*cholepyrrhine*) the other green (*biliverdine*), sugar, albumen, two organic acids (*cholic and choleic*), combined with soda, oleate and margarate of soda, a non-saponifiable fatty matter (*cholesterine*), and several mineral salts. The two most interesting substances in bile are choleic acid and cholesterine, which, when produced in undue proportion, give rise to those calculi, the passage of which through the biliary duct is so dangerous and painful. One of the most valuable papers published of late is that of Mr. G. Kemp, in the Transactions of the Royal Society, on the conversion of the hepatic bile into cestic—thus he has shown that as the former is secreted by the liver, and arrives by the biliary duct in the gall bladder, it is there converted into cestic bile by means of a special fermentation, induced by a mucus secreted in the walls of the gall bladder. It is believed by most physiologists that the principal function of bile is to neutralize the acid fluids resulting from digestion in the stomach, as they enter the small intestines, rendering them better adapted for their sojourn there, and also facilitating their fermentation, one of the most important phenomena of digestion. The employment of bile as a scouring agent has much diminished of late years, owing to the substitution for it of benzine and Sherwood spirit.

Blood.—The study of this all-important fluid is most interesting in a physiological point of view, for the 27 pounds of blood (the average amount in an adult) which travels through the whole of the human frame in about three minutes, fulfils three distinct functions, viz.,—it carries the various elements of food, as modified by digestion, into the different parts of the body requiring them; it helps to remove from the system those substances which have fulfilled their required functions in it, and which have been rendered useless by the wear and tear of life; and it conveys through the system the heat generated by the oxidation, through respiration, of the substances which have been absorbed during digestion, as well as of those which have performed their part in the human economy, and require to be removed therefrom. It will, therefore, be easily understood that blood must be a complicated fluid; and the following table will give an idea of the truth of this assertion:—

1,000 parts of blood.

130·85 of clot	Fibrine	2·95	130·85
	Globules	125·63	
	Hematosine	2·27	
869·15 of serum.	Water	790·37	869·15
	Albumen, Soda	67·80	
	Phosphate of Soda	10·98	
	Lactate of do.		
	Carbonate of do.		
	Chloride of Sodium		
	" of Potassium		
	Carbonate of Lime		
	" of Magnesia		
	Ammoniacal Salts		
	Phosphate of Lime		
	" of Magnesia		
	Sulphate of Potash		
	Fatty Acids, free or combined		
	Cholesterine		
	Lecithine (phoshuretted fat)		
	Ceribrine, or nitrogenated fat.		
1000·00			1000·00

It will facilitate our study of this complicated fluid if we class the various compounds existing in it under six different heads. Firstly, if blood, immediately after being drawn from an animal, is whipped with a birch-rod, the ends of the twigs will have hanging from them a stringy mass, which after being well washed, is grey and elastic, and is called *fibrine*. Secondly, if the blood so treated is mixed with a solution of sulphate of soda of sp. gr. 1·16, and the whole thrown on a filter, the *corpuscules* and the colouring matter called *hematosine*, will remain on the filter, and these substances with the fibrine, form, as shown in the table, the clot of blood. Further, if the matter left on the filter is treated with concentrated acetic acid, the colouring matter is dissolved and the corpuscules are left as yellow discs. Thirdly, on boiling the fluid which passes through the filter, albumen is coagulated and can be easily separated, leaving water and a few saline substances, which are easily separated by evaporating the liquid portion. Allow me now to add a few remarks on some of the substances above mentioned. Fibrine represents the fibrous or muscular part of animals, but has no direct application in manufactures. The blood corpuscules in man are ellipsoid discs, containing the colouring matter of blood. The most interesting fact connected with the latter is that it is united with a compound containing iron; and although iron does not appear to be an integral part of the colour, still its presence appears essential to the existence of the colour itself. The external part of the discs is composed of fibrine, whilst the interior contains an albuminous fluid (which differs from the albumen of the serum in the fact that it is not coagulated by heat) and which is called globuline. The relative proportions of fibrine, globuline, and hematosine, vary considerably in different individuals, according to health, age, and sex, and even during the process of digestion. When blood is examined under the microscope, large colourless globules are found to float with those just described. Dr. William Roberts, of Manchester, who has examined the corpuscules of blood, has observed that when they are dipped into a solution of magenta, they assume not only a pink colour, but that the nucleus of the disc acquires a much deeper shade. Further, that on the sides of the disc there are small projections which he calls pullulations, and which acquire a much deeper tint than the remainder of the discs when plunged into the magenta solution. Another curious fact lately observed by M. Pasteur is that if blood is kept for several weeks in a cold situation, air being excluded, the corpuscules disappear, and are replaced by myriads of beautiful red well-defined crystals. Lastly, there is a slight difference of composition between arterial and venous blood.

	Arterial.	Venous.
Carbon	50·2	55·7
Nitrogen	16·3	16·2
Hydrogen	6·6	6·4
Oxygen	26·3	21·7
	99·4	100·0

It is strange that while blood is so extensively employed on the Continent in various branches of manufacture that in Paris 2,000 tons of blood are used by sugar refiners alone, hardly any such application of this fluid is made in our own country. It appears to me that the explanation is to be found in the fact that on the Continent beasts are generally slaughtered in public abattoirs, by which means many of the refuse matters can be collected with advantage, and without being spoilt or polluted by unscrupulous persons, whilst in this country, where animals are slaughtered in innumerable private slaughter-houses, the difficulty and expense of collection, together with the absence of guarantee of quality, render the successful use of blood on a large scale impracticable. There is an additional advantage in the system of public abattoirs, which I cannot help noticing *en passant*, viz., the guarantee thereby obtained that the public food is not furnished from diseased animals. The only employment of blood in its integrity in this country is as an article of diet, and to some extent in the manufacture of prussiate of potash. The serum of blood is sometimes used in England, as well as on the Continent, as one of the substances essential in the process followed to communicate to cotton the magnificent colour called "Turkey red."

Albumen (blood).—The employment of this substance in the art of calico printing is of comparatively recent date, as it is chiefly due to the introduction of the tar colours and pigment styles into that art. To fix colours with this albumen (or that of egg) it is only necessary to dissolve in a gallon of water several pounds of albumen and gum Senegal, adding a little tar colour such as magenta, &c., or a pigment, such as ultramarine blue, these mixtures are then printed on the cotton fabric, and the colour fixed by the coagulation of the albumen under the influence of high pressure steam. But the quantity of albumen used for this purpose has greatly decreased of late years, owing to the introduction of tannin by Mr. Charles Lowe and myself, Messrs. Roberts, Dale, and Co., and Mr. Gratrix, and also that of the arseniate of alumina by Mr. W. A. Perkin. The substitution of blood albumen for that of egg is chiefly due to Messrs. Rohart, Roger, and Co., who, I believe, prepare it by separating carefully the serum of blood from the clot, adding to it a small quantity of alum to separate any colouring matter that may be mixed with it, and evaporating the water of the serum by a current of air heated to 100°, which leaves the albumen in the form of yellowish scales, freely soluble when placed again in contact with water. The most abundant source of albumen, however, is the white of egg, and therefore let us glance at a few facts connected with this substance, doubly important as an article of manufacture, and as one of food. To give some idea of the extensive use of eggs, I may state that in Paris there are annually consumed 178,000,000 eggs, weighing 28,000,000 pounds. The composition of a hen's egg may be stated to be as follows:—

Shell	11·5
White	58·5
Yolk	30 0
	100 0

The following are the respective compositions of the yolk and white:—

Yolk.		White.	
Water	51·47	Water	86·34
Vitelline	15·76	Albumen	12·50
Oleine, Margarine, Cholesterine	28·97	Membrane	0·50
Phospho-glyceric acid	1·26	Phosphates, Chlorides, &c.	0 66
Colouring matters	1·20		
Mineral salts	1·34		
	100 00		100·00

An egg may be considered as consisting of four parts, the shell, membrane, white, and yolk. The shell is composed of carbonates of lime and magnesia, phosphate of lime, and oxide of iron, the whole bound together by a nitro-sulphuretted substance. The presence of sulphur in this substance, as well as in albumen, explains why eggs give off sulphuretted hydrogen when boiled. The membrane lining the shell is also a nitrosulphuretted substance, much resembling in its composition that of horn. I have already had occasion to speak of the interesting composition of the yolk of egg, when mentioning its application in the glove manufacture, and on that occasion I drew your attention to the remarkable substance called vitelline, and to the peculiar nature of the fats contained in yolk of eggs, but more especially the phospho-glyceric acid, attributing to them the peculiar properties imparted to leather through their use. The white of egg chiefly consists, as the above table shows, of a substance called albumen, which you will remember is also found in blood, and, I may add, that it exists in the sap of all plants. Albumen is a fluid of an alkaline reaction, soluble in water; and coagulates at 160° when undiluted, but when dissolved in water the temperature at which it coagulates is raised according to the extent of its dilution. Albumen gives a precipitate with all metallic salts, but one of the most characteristic and delicate tests for albumen in solution, is bichloride of mercury or corrosive sublimate. In fact, albumen is the best antidote known to the action of this violent poison, when taken internally, as was proved by its saving the life of a most eminent chemist (Baron Thenard) in 1825. All acids, except phosphoric and acetic, precipitate albumen from its solutions, but that which separates it with the greatest nicety is nitric acid. When placed in contact with hydrocholoric acid for a few hours, it assumes a very beautiful purple colour. When albumen is placed in shallow vessels, and then stored in a chamber where air at 100° is allowed to circulate, the water evaporates and leaves the solid albumen in the form of yellowish semi-transparent scales, which, strange to say, will, if kept dry, resist putrefaction for any length of time, although in its liquid form the large amount of nitrogen it contains renders it highly putrescible. It is this solid albumen which is used by calico printers, as it is easily dissolved in water and rendered applicable to their purposes. Albumen is often used in manufactures to clarify fluids. In some instances the albumen in solution is added to the fluid and carried to the boil, when the dissolved albumen coagulates, and in falling through the fluid carries with it mechanically the matters in suspension, when it is only necessary to decant the clarified fluid. In others it is added at natural temperature, as in the case of wines, where the tannin, alcohol, and acids are agents which coagulate the albumen. Albumen was first applied to photography by Niepce de St. Victor, in the following form: he mixed together intimately 10 fluid oz. of distilled water with the white of 10 fresh eggs; to this he added 200 grains of chloride of sodium or chloride of ammonium. The whole was well shaken in a bottle for about ten minutes, and then allowed to stand. All that was then required was to decant the clear liquor, and apply it to the surfaces intended to receive the photographic image. [Here the lecturer shortly described this photographic process, and alluded to the recent application of the light resulting from the combustion of magnesium wire, manufactured by Messrs. J. Mellor and Co., of Salford, showing its applicability to photography, by using this light to take photographs during the lecture, stating that the cost was only a few pence.] A great many attempts have been made to preserve eggs from decay, the most successful of which have been those of La Maison Cormier du Mans, who covers the egg with an impermeable varnish, packing them in sawdust, so that the egg shall always rest on one end. Another process is that of immersing the eggs in limewater. Lastly, the whole of the egg has been emptied out of the shell and evaporated to a solid mass. I must not conclude the subject of the albuminous and vitelline substances without calling your attention to the following table, which will give an idea of the different albumens and vitellines which Mr. E. Fremy has succeeded in insolating and characterising:—

EGGS OF BIRDS.

Albumen	coagulated by heat	All these substances are characterized by containing sulphur.
Eudophacine	" "	
Albumen	" acid	
Meta albumen	" neither	
Exophacine	" "	

EGGS OF FISHES.

Ray	Ichthine.	All these substances are characterised by containing phosphorus.
Goldfish, Carp	Ichthidine.	
Salmon	Ichthuline and Salmonic acid.	
Turtle	Eurydine	

Milk.—The composition of this important fluid varies not only in different classes of animals, but also in different individuals of the same class. Further, the composition of milk is modified by the influence of food, climate, degree of activity, and health. Notwithstanding these variations an average can be arrived at by numerous analyses, and the following table will give a general idea of milk:—

	Woman's.	Cows'.	Asses'.	Goats'.	Ewes'.
Dried Caseine	15·2	44·8	18 2	40·2	45·8
Butter	33·5	31·3	1·1	33 2	12 0
Sugar of Milk	65·0	47·7	60·8	52·8	50·0
Salts	4·5	6·0	3·4	5 8	6·8
Water	881·8	870·2	916·5	868 0	885·4
	1000·0	1000·0	1000·0	1000·0	1000·0

The various substances comprised in milk may be classified under three heads—cream, curd or caseine, and whey.

Cream, according to Dr. Voelcker's* analysis, is composed of:—

Water	61·67	64·80
Butter	33·43	25·40
Caseine	2 62	7·61
Sugar of milk......	1·56	
Mineral matters ...	0·72	2·19
	100·00	100 00

And may be considered as consisting of small, round, egg-shaped globules, composed of fatty matters, enclosed in a thin cell of caseine, which, being lighter than the fluid containing them, rise to the surface and constitute cream, and in proportion to the quantity of this removed from the milk, the latter becomes less opaque, and assumes a blue tinge. When exposed to the air for a short time in a dry place it loses water, becomes more compact, and constitutes what is called cream cheese. When churned, cream undergoes a complete change; the caseine cells are broken, and the fatty globules gradually adhere one to the other and form a solid fatty mass, called butter, and it is found, on an average, that 28lbs. of milk will yield one pound of butter. Fresh butter is composed of:—

Fatty matters	Margarine, Oleine, Caproine, Caprine, Butyrine, Caproleine,	77·5
Caseine		1·6
Whey		20 9
		100 0

* For further particulars on this subject the reader is referred to Dr. Voelcker's paper. published in the *Journal of the Royal Agricultural Society of England*, volume 24.

But as butter rapidly becomes rancid, it is necessary to adopt means to prevent this as much as possible, and the following are the usual methods, viz.—working the butter well with water, and then adding 3 or 4 per cent. of common salt, or, melting the butter at a temperature below 212°; but the following method, employed by M. Bréon, appears to give general satisfaction. It consists in adding to the butter, water containing 0·003 of acetic or tartaric acid, and carefully closing the vessels containing it. The rancidity of butter is due to a fermentation generated by the caseine existing in it, which unfolds the fatty matters into their respective acids and glycerine, and as the volatile acids, butyric, caproic, &c., have a most disagreeable taste and odour, it is these which impart to butter the rank taste. Allow me to add, *en passant*, that whilst butyric acid possesses a repulsive smell, its ether has a most fragrant odour, viz., that of pine apple, for which it is sold in commerce.

Curd of Milk or Caseine has, according to Dr. Voelcker, the following composition:—

Carbon	53·57
Hydrogen	7·14
Nitrogen	15·41
Oxygen	22·03
Sulphur	1·11
Phosphorus	0·74
Total	100·00

And is easily recognisable by its white flocculent appearance. It is insipid and inodorous, like albumen, from which it differs in its insolubility in water, though it is dissolved by a weak solution of alkali or acid. But what chiefly distinguishes caseine is that it is not coagulated on boiling, and that rennet precipitates it from its solutions. Dr. Voelcker has proved, however, in his researches on cheese, that the commonly-received opinion, that rennet coagulates milk by decomposing the lactine into lactic acid, is incorrect, for he has coagulated milk while in an alkaline condition, and it is owing to the difference in the action of rennet on albumen and caseine, that chemists have been able to detect the presence of ½ to ¾ per cent. of albumen in milk. This important organic substance not only exists in milk, but is also found in small quantities in the blood of some animals, such as the ox, and in a large class of plants, but more especially in the leguminous tribe, such as peas, beans, &c. Caseine is the basis of all cheeses, and when these are made with milk from which the cream has been previously taken, the cheese is dry, but when part of the cream has been left the cheese is rich in fatty matters as well as in caseine; and I may add that the peculiar flavours characterising different cheeses are caused by modifying the conditions of the fermentations which the organic matters undergo. The following researches made by M. Blondeau illustrate this point, as well as the modifications which cryptogamic life under peculiar circumstances may effect in the composition of organic substances, and his interesting results were obtained in studying the conversion of curd into the well-known cheese of Roquefort. He placed in a cellar some curd of the following composition:—

Caseine	85·43
Fatty matters	1·85
Lactic acid	0·88
Water	11·84
	100·00

to which he added a small quantity of salt. After a month, and again after two months, he analysed portions of the same, with the following results:—

	After 1 month.	After 2 months.
Caseine	61·33	43·28
Fatty matters	16·12	32·31
Chloride of Sodium	4·40	4·45
Water	18·15	19·16
Butyric acid	......	0·67
	100·00	99·87

The above figures show a most extraordinary change in the caseine or curd, for we observe that the proportion of caseine gradually decreases, and is replaced by fatty matters. Considering the circumstances under which this phenomenon has occurred, there can be no doubt that this curious conversion of an animal matter into a fatty one is due to a cryptogymic vegetation or ferment; and if the Roquefort cheese be exposed to the air under a bell jar for 12 months, the decomposition becomes still more complete; for it is no longer the caseine which undergoes a transformation, but the oleine of the fatty matters. The following analyses clearly illustrate this curious action. Composition of the cheese after 2 and 12 months:—

	After 2 months.	After 12 months.
Caseine	43·28	40·23
Margarine	18·30	16·85
Oleine	14·00	1·48
Butyric acid	0·67	......
Common salt	4·45	4·45
Water	19·30	15·16
Butyrate of ammonia	......	5·62
Caproate of ammonia	......	7·31
Caprylate of ammonia	......	4·18
Caprate of ammonia	......	4·21
	100·00	99·49

The substances to which cheeses owe their peculiar flavour are ammoniacal salts, chiefly composed of various organic acids, such as acetic, butyric, capric, caproic, and caproleic. I cannot better conclude my remarks on cheese than by extracting from Dr. Voelcker's interesting papers a few of his numerous analyses of different kinds of cheese:—

	Cheshire	Stilton.	Old Cheddar.	Double Gloster.	Single. Gloster.	American.
Water	32·59	20·27	30·32	32·44	28·10	27·29
Butter	32.51	43·98	35·53	30·17	33·68	35·41
†Caseine	26·06	33·55 (Caseine, Sugar of milk, Lactic acid)	28·18	31·75	30·31	25·87
Sugar of milk. / Lactic acid	4·53		1·66	1·22	3·72	6·21
†Mineral matter	4·31	2·20	4·31	4·42	4·19	5·22
	100·00	100·00	100·00	100·00	100·00	100·00
†Nitrogen	4·17	3·89	4·51	5·12	4·85	4·14
†Common salt	1·59	0·29	1·55	1·41	1·12	1·97

The principal application of caseine in arts and manufactures is that first introduced by Mr. R. T. Pattison, who used it under the name of lactarine for fixing pigments in calico printing. His process consists in drying the washed curds of milk, which he sells to the calico printer, who mixes it with a solution of ammonia or weak alkali, which swells it out and renders it soluble in water. To a solution of this substance, of proper consistency, he adds one of the tar colours, prints it, submits the goods to the action of steam, which drives off the ammonia, leaving fixed on the fabric the caseine and colour. In consequence of the insoluble compound which caseine forms with lime it has often been used as a substitute for glue or linseed oil in house painting, and it may be useful to some of my audience to know that when caseine is dissolved in a concentrated solution of borax, an adhesive fluid is formed, which is capable in many cases of serving the purposes of glue or starch. Mr. Wagner has made another useful application of caseine, mixing it with 6 parts of calcined magnesia, and one part of oxide of zinc, and a sufficient quantity of water to make a pasty mass, which he leaves to solidify, and when dry it is extremely hard, susceptible of receiving a high polish, and is sold as a substitute for meerschaum.

Whey.—According to Dr. Voelcker, the composition of whey is as follows:—

Water	89·65
Butter	0·79
Caseine	3·01
Sugar of Milk	5·72
Mineral Matters	0·83
	100·00

When whey is concentrated to the state of syrup, and kept in a cold place, it gradually deposits fine well-defined crystals, which, on further purification and re-crystallisation, yield white quadrangular prisms of a substance called lactine, or sugar of milk, which is highly interesting. It is remarkable that while sugar of milk has only been known in Europe for a comparatively short period, where homœopathists are its principal employers, in India lactine has been known for a great number of years. Let us now study some of the chemical facts connected with sugar of milk. Thus cane sugar, when acted upon by nitric acid, gives oxalic acid, whilst lactine gives mucic acid; cane sugar, when unfolded under the influence of a ferment, gives alcohol and carbonic acid; lactine yields lactic acid. As the latter transformation is most important, in a physiological and chemical point of view, allow me to dwell upon it for a few minutes. The substance which possesses the property of most readily converting lactine into lactic acid, is caseine after it has undergone some peculiar modification, which renders it a ferment. Thus when milk leaves the cow it is alkaline, but when exposed to the air it rapidly becomes acid, and this is due to the conversion of lactine into lactic acid, a change most interesting as a chemical fact, since both lactine and lactic acid have the same composition, the only difference being that two equivalents of oxygen and two of hydrogen cease to exist as such in the acid, but may be considered as combined in the form of water with the remaining elements—

Lactine	$C_{12} H_{12} O_{12}$
2 Lactic acid	$(C_6 H_5 O_5 HO)$

M. Pasteur has shown that this lactic fermentation is not merely confined to milk, but that it is a peculiar fermentation, differing from the previous one, which frequently occurs during the decomposition of organic matters, and is due to a distinct ferment of its own; and his researches on lactic fermentation have explained the fact, observed by M. Pelouze, some years since, that when a vegetable substance, such as sugar or starch, was put in contact with chalk or other alkali and an animal substance, lactic fermentation ensued, but until the researches of M. Pastéur, we did not know why sugar and starch, in these circumstances, should give a lactic acid instead of alcohol and carbonic acid, which would be the result of a fermentation produced by yeast. Lactic acid is a most interesting substance to the physiologist, for it is found in large quantities, free or combined with lime, in gastric juice, in the muscular part of animals, or with soda, in blood, and its production is easily accounted for when we remember that it can be produced from the starch and sugar existing in our food. When lactic acid is purified by various chemical means and separated from the fluid in which it is combined, it presents itself as a syrupy fluid, of an intensely acid reaction, which, when submitted to the action of heat, first loses its one equivalent of water, and becomes anhydrous lactic acid, and on a further application of heat loses still one equivalent of water, and is transformed into a neutral substance called lactide. This acid, in a free state, has not yet received any important application in arts and manufactures, but I have little doubt that it will some day be largely employed, for we have noticed in a former lecture its advantageous use when produced from rye and other amylaceous substances in removing the lime from various skins intended to be tanned or prepared as there described, and Mr. E. Hunt has used it in the form of sour milk for the conversion of starch into dextrine (see *Journal of the Society of Arts*, December 23rd, 1859). I wish now to say a few words on the mineral substances existing in whey, and which play a most important part in milk as a nutritious substance. We are all of us too apt to overlook the importance of the mineral elements in food, and to consider as essential the organic matters only. In milk, however, its alkaline salts, and especially the phosphate of lime, are as essential (as food) as caseine or fatty matters, for if an infant requires the lactine to maintain respiration and the heat of the body, the caseine to contribute to the formation of blood, the phosphate of lime is equally essential to the production of bone; permit me here to state that the practice adopted by some mothers of feeding infants upon amylaceous substances, such as arrowroot, sago, tapioca, &c., in place of milk, is most pernicious, for these contain neither flesh nor bone forming element, and milk is the only proper food for infants.

Having now examined the general properties of some of the most important constituents of milk, let us say a few words on that fluid in its integrity. We all know how rapidly milk becomes scur, especially at a temperature of 70° to 90°, and as this is owing, as already explained, to the formation of lactic acid, the best way to preserve milk sweet for domestic purposes is to add to it every day a few grains per pint of carbonate of soda, to keep the milk alkaline. The possibility of preserving milk for a lengthened period has repeatedly occupied the attention of scientific men, as a most important problem to solve for the benefit of persons undergoing long sea-voyages, but up to a recent date with very imperfect success. One of the best plans proposed is to add to milk seven or eight per cent. of sugar, and evaporate the whole, agitating all the time to prevent the formation of the skin, and when reduced to one-fifth of its bulk to introduce it into tin cans, which, after being subjected for half an hour to a temperature of 220°, are hermetically sealed. In 1855, L'Abbé Moigno drew the attention of the members of the British Association at Glasgow to this milk, which he stated contained nothing injurious, and which would keep for a long period. This statement has proved correct, for I have here some milk which has been in the hands of the secretary of this Society since that period, and which, on being opened to day, was found perfectly sweet. But if l'Abbé Moigno's process has remained a secret, M. Pasteur has succeeded in effecting the same end, and probably by the same method. Thus he has found that if milk be heated to 212° it will only remain sweet for a few days, if heated to 220° it will remain sweet for several weeks, but if to 250° (under pressure, of course) the milk will keep for any length of time. This, according to M. Pasteur, is owing to the spores or eggs which generate lactic fermentation being destroyed by the high temperature, and thus the possibility of fermentation is put an end to. The adulteration of milk by various substances stated to have been discovered therein, has, I think, been greatly overestimated, as I have never found any of them in the samples of milk which I have analysed, in fact the most easy and cheapest of all is the addition of water. It is comparatively easy to ascertain if milk has been tampered with; but, without entering into details of the methods necessary to estimate the exact extent of adulteration, I may mention the following plan:—If a glass tube, divided into 100 equal parts, is filled with milk and left standing for twenty-four hours, the cream will rise to the upper part of the tube, and, if the milk is genuine, will occupy from 11 to 13 divisions. Another practical method is to add to the milk a little caustic soda, and agitate the whole with a little ether and alcohol, which dissolves the fatty matters; this ethereal solution is removed from the milk and evaporated, when the fatty matters remain, and experience has shown that 1,000 parts of good milk will yield 37 parts fatty matters. Any milk leaving no more than 27 must have been tampered with. Dr. Voelcker suggests the employment of a hydrometer as a means of ascertaining the quality of milk, as the specific gravity of that fluid is an excellent test. From a great number of experiments he has ascertained that good new milk has a sp. gr. of 1.030, whilst if good milk is adulterated with 20 per cent. of water, its sp. gr. 11 fall to 1.025.

Urine is a fluid secreted by the kidneys, which organs separate from the blood as it circulates through them any excess of water it may contain, as well as many organic substances which have fulfilled their vital function in the animal economy, and which require to be removed from the system. The composition of urine varies greatly in different individuals, and in the same individual at different times, and is influenced by diet, exercise, state of health, &c., as shown by Dr. Bence Jones and Dr. Edward Smith; but without detailing these variations, which would occupy far more time than the limits of a lecture would permit, allow me to call your attention to the following table, showing the composition of human and herbivorous animals' urine:

HUMAN.

Water	933·000
Urea	30·100
Lactic acid; Lactate of ammonia; Extractive matter; Kreatine; Kreatinine; Hippuric acid; Indican; Colloid acid (W. Marcet)	17·140
Uric acid	1·000
Nuccus	0·320
Mineral salts	18·440
	1000·000

HORSES.

Water	910·76
Urea	31·00
Hippurate of potash	4·74
Lactate of do.	11·28
Do. of soda	8·81
Bicarbonate of potash	15·50
Carbonate of lime	10·82
Carbonate of magnesia	4·16
Other salts	2·93
	1000·00

The substances in human urine which call for special notice are urea and uric acid; in herbivorous animals, hippuric acid; and in birds, uric acid.

Urea is a substance crystallizing in various derivative forms belonging to the prismatic system; it is very soluble in water and alcohol, and gives beautiful and well defined salts with nitric and oxalic acids. Urea, under the influence of a mucous substance secreted at the same time, and which is easily modified into a ferment, is rapidly converted, by the fixation of two atoms of water, into carbonate of ammonia, as seen by this formula:

Urea	C_2	O_2	N_2	H_4
Water		O_2		H_2
Carbonate of ammonia	C_2	O_4	N_2	H_6

This will explain the strong ammoniacal odour arising from urine after being kept for a short time; and as it may be most important for medical men to be able to preserve urine in its normal condition for several days, I observed a few years since a most effectual method of preserving it, which is merely the addition of a few drops of carbolic acid immediately after the production of the urine. Urea is peculiarly interesting to chemists, as it was the first organic substance which they succeeded in producing artificially from mineral compounds. This interesting discovery was made by Wöhler, in 1820, in acting upon cyanate of silver by hydrochlorate of ammonia. Since then Baron Liebig has devised a more simple process, which consists in decomposing cyanate of potash by sulphate of ammonia, which gives rise to sulphate of potash and cyanate of ammonia or urea. The average quantity of urea ejected daily by an adult man is about an ounce, or 2½ per cent. of the fluid itself. Although human urine does not contain more than 1 per cent. of uric acid, and this generally combined with soda, still I deem it my duty to say a few words respecting it; for it is often the principal source of gravel and calculus, owing to various influences which make the urine strongly acid before its rejection, whereby the soda is neutralized, the uric acid liberated, and this, being nearly insoluble, separates, and has a tendency to form gravel or calculus. In fact, the deposit which occurs in this fluid is generally represented by uric acid, phosphate of lime, and magnesia, mucus, and colouring matter. It may be here stated that calculi were formerly held in great estimation, especially those formed in the intestine, and called bezoards, and this was the case in Eastern countries until very recently. Thus it is related that a Shah of Persia sent to Napoleon the First, among other valuable presents, three bezoards, which were considered to be of great antiquity, and capable of curing all diseases. The urine of birds and reptiles being almost entirely composed of urate of lime, explains why their refuse is of such value as a manure, which arises from its transformation into carbonate of ammonia. When large masses of this refuse undergo a slow and gradual decomposition, as in the dry climate of the Pacific islands, on the coasts of Peru and Chili, it constitutes guano. It may be interesting to know that in 1855, '6 and '7, a most beautiful colour was prepared from the uric acid contained in guano, and used largely by calico printers and silk dyers, under the name of Roman purple or muroxide.*

Before leaving the study of this important animal secretion, let me say a few words on the urine of herbivorous animals. It is generally alkaline, and contains, besides an aromatic principle, an acid, discovered by Liebig, and called hippuric acid, together with urea and uric acid, also found in human urine. Hippuric acid is easily obtained, in the form of well defined crystals, by rapidly evaporating the fluid containing it. This acid does not exist in the food of the animal; but benzoic acid, or its homologues, are found there, and during the phenomena of digestion the nitrogenated principles produced by the wear and tear of life, fix themselves on the benzoic acid, and convert it into hippuric, as seen by this formula:

Benzoic Acid. Hippuric Acid.

$$C_{14}\ H_5\ O_3 + HO. \ldots\ldots C_{18}\ H_8\ O_5\ N_2 + HO.$$

A further proof of the correctness of this view is, that when hippuric acid is treated with strong acids or alkali, it transforms itself into benzoic acid, which can be easily extracted.

* See, for further details, the paper read by Dr. Calvert before the Society, February 5th, 1862.—*Journal*, vol. x. p. 169.

Useful Receipts.

Mounting Fluid for Microscopical Objects.

Best gelatine, 1 oz.; honey, 5 oz.; distilled water, 5 oz.; rectified spirits, ½ oz.; creosote, 6 drops. Dissolve the gelatine in the water by heat, and add it to the honey, previously made boiling hot. When cooled a little, add the creosote dissolved in the spirit, and, while still hot, filter through coarse filtering paper, or fine flannel. For use, the bottle in which it is contained may be set in a vessel of hot water.—*Deane.*

Metallic Vegetation.

(*Tin Tree*) Muriate of tin, 3 drs.; nitric acid, 10 to 15 drops; distilled or rain water, 1 pint. Dissolve in a white glass bottle, and hang in it by a thread a small rod of zinc.

(*Silver Tree.*) Nitrate of silver, 20 grs.; water, 1 oz. Dissolve in a vial, and add about ½ dr. of mercury. Very brilliant and beautiful.

In the above experiments the laminæ are observed to shoot out, as it were, from nothing, assuming forms resembling real vegetation.

Tinning.

Plates or vessels of brass or copper, boiled with a solution of stannate of potassa, mixed with turnings of tin, become, in the course of a few minutes, covered with a firmly attached layer of pure tin. 2. A similar effect is produced by boiling the articles with tin filings and caustic alkali, or cream of tartar. In the above way chemical vessels made of copper or brass may be easily and perfectly tinned.

A Substitute for India-ink.

A substance much of the same nature and applicable to the same purposes as india-ink may be formed in the following manner:—Take of isinglass three ounces: make it into a size by dissolving over the fire in six ounces of soft water. Take then Spanish liquorice one ounce, dissolve it in two ounces of soft water over the fire in another vessel, then grind up on a slab with a heavy muller one ounce of ivory-black with the Spanish liquorice mixture. Then add the same to the isinglass size while hot, and stir well together till thoroughly incorporated. Evaporate away the water, and then cast the remaining composition into a leaden mold slightly oiled, or make it up in any other convenient way. This composition will be found quite as good as the genuine article. The isinglass size, mixed with the color, works well with the brush. The liquorice renders it easily dissolvable on the rubbing up with water, to which the isinglass alone would be somewhat reluctant; it also prevents its cracking and peeling off from the ground on which it is laid.—*British Journal of Photography.*

Silvering.

Cold silvering may be performed on brass and copper which is well cleaned and quite bright, by rubbing with a moistened cloth, dipped in the following powder:—1. Chloride of silver, 2 parts; pearlash, 6 parts; salt, 3 parts; whiting 2 parts; mix. Or, 2. Precipated silver, 1 part; common salt and cream of tartar, each two parts; mix. When the metal is silvered, it should be washed in a hot weak solution of alkali, and then washed dry. Other silvering powders are:—3. Nitrate of silver and salt, of each 1 part; cream of tartar, 7 parts. 4. Nitrate of silver, 1 part; cyanide of potassium, 3 parts. 5. Bath. Nitrate of silver, 15 parts; sulphate of soda, 100 parts; dissolve in water, and dip the article into the solution.

Staining Wood and Ivory.

Yellow.—Dilute nitric acid will produce it on wood.

Red.—An infusion of Brazil wood in stale urine, in the proportion of a pound to a gallon for wood; to be laid on when boiling hot, and should be laid over with alum water before it dries. Or, a solution of dragon's blood, in spirits of wine, may be used.

Black.—Strong solution of nitric acid, for wood or ivory.

Mahogany.—Brazil, madder and logwood, dissolved in water and put on hot.

Blue.—Ivory may be stained thus:—Soak it in a solution of verdigris in nitric acid, which will turn it green; then dip it into a solution of pearl-ash boiling hot.

Purple.—Soak ivory in a solution of sal-ammoniac into four times its weight of nitrous acid.

Imitation of Mahogany.—Plane the surface smooth and rub with a solution of nitrous acid. Then apply with a soft brush one ounce of dragon's blood, dissolved in about a pint of alcohol, and with a third of an ounce of carbonate of soda, mixed and filtered. When the brilliancy of the polish diminishes, it may be restored by the use of a little cold drawn linseed oil.

Day and Martin's Blacking.

According to Mr. W. C. Day, the method of making the famous "Day and Martin's" blacking is as follows:—The bone black, in a state of powder, is mixed with sperm oil until the two are thoroughly incorporated. The sugar or treacle is then mixed with a small portion of vinegar and added to the mass. Oil of vitriol is next added, and when all effervescence has ceased, vinegar is poured in, until the mixture is of a proper consistence. This constitutes the liquid blacking of Day and Martin.

To Galvanize.

Take a solution of nitro-muriate of gold (gold dissolved in a mixture of aquafortis and muriatic acid) and add to a gill of it a pint of ether or alcohol, then immerse your copper chain in it for about fifteen minutes, when it will be coated with a film of gold. The copper must be perfectly clean, and free from oxide, grease, or dirt, or it will not take on the gold.

Machinery and Manufactures.

THE USE OF STEAM EXPANSIVELY.

There are many strange things to be found in engineering practice, and possibly there is nothing more strange than the general ignorance which exists of the true value of expansion in the use of steam, and the principles upon which that value depends and can be realised. The subject has unfortunately been invested with a certain amount of mystery, consequent upon the profuse employment of algebraical symbols by standard authors. We have no intention of deprecating this use of mathematical phraseology, but it is certain that not only may every question connected with the use of steam be explained and solved by the aid of the simplest formulæ, but that the use of this phraseology is distasteful and repulsive to the vast majority of the *employers* of steam power. In order that steam may be used with due economy it is absolutely necessary that a considerable proportion of its power be developed during its expansion while yet in the cylinder, but unless considerable attention is bestowed upon the observance of particular conditions, it is practically impossible to secure fair results from any measure of expansion great or small; and we find that the non-observance of these conditions has tended to bring a great principle into disrepute.

In order to illustrate the action of expanding steam, we will suppose the existence of an engine having a piston exactly one square foot in area, making 1,000 strokes, each twelve inches long, in the space of one hour. 1,000 cubic feet of steam will therefore pass through such a cylinder per hour. Let us further suppose that the steam has an initial pressure of 100 lbs. per square inch, and that the cylinder is so situated that the steam passing through it will suffer no loss of pressure from condensation due to frigorific influences. In a recent article we pointed out that the mere development of energy or performance of work occasioned a certain loss of heat; but for the present it will simplify matters if we neglect this loss altogether. Now the whole amount of work done by the piston during one hour represents 14,400 lbs. raised to the height of 1,000 feet, the gross distance traversed by the piston in the stated time, or 14,400,000 foot pounds. It will be understood that 1,000 cubic feet of steam of an initial pressure of 100 lbs. per square inch, will be discharged from the cylinder into the vacuum, which may be supposed to exist in absolute perfection in the condenser. Perfectly dry and clean steam in all respects obeys the laws which regulate the action of fixed gases. One of the most important of these laws is that originally discovered by Mariotte, and which may be briefly stated in the following terms. The pressure of any quantity of gas varies in the inverse ratios of the spaces which it is made to occupy; that is to say, a cubic foot of dry steam having a pressure of 100 lbs. per inch, will, if suffered to expand to double its volume, have half the pressure. If then, instead of discharging the steam at 100 lbs. pressure, the moment the piston had made each stroke, into the condenser, we discharge it into a second cylinder, a further amount of work might be obtained from it. We may perhaps put this in a clearer light by supposing the case of a cylinder of an indefinite length, fitted with a piston one square foot in area. If, now, 1,000 cubic feet of steam at 100 lbs. pressure are passed into this cylinder, the piston will rise and develope 14,400,000 foot pounds in its ascent. If the further influx of steam is stopped, we shall then have 1,000 cubic feet of steam isolated within the cylinder. If the load upon the piston be now reduced one-half, the piston will move through another 1,000 feet, and at the end of that time the pressure of the steam will have fallen to 50 lbs. upon the square inch, and by continuously reducing the load the piston will continue to ascend until, we will say, the pressure is reduced to 1 lb. on the inch; and we thus find that the whole distance traversed by the piston will be 100 times 1,000 feet, or 100,000 feet, and the work done during 99,000 feet is accomplished independently of all aid from the boiler, other than that originally furnished to cause the motion of the piston through the first 1,000 feet, and this constitutes the gain to be derived from expansion. The pressure upon the piston through any given portion of the expansion stroke, as we may term it, may be approximately estimated by taken the mean between the pressures at the beginning and the end of that section—the exact method of finding this average we shall find presently to be very simple. Thus during the second 1,000 feet the average pressure may be found by adding together the initial pressure 100 and the terminal pressure 50, and dividing the result by 2, which gives 75 as a quotient, and 75 × 144, area of piston in inches, and by 1,000, length of stroke in feet, gives 10,800,000 foot pounds as the approximate mechanical result obtained by this first measure of expansion. On the completion of the stroke so far, we find that 2,000 cubic feet of steam remain in the cylinder, having a pressure of 50 lbs.; and in order to reduce this one-half again, or to 25 lbs., it must be suffered once more to double its volume. The work done in doing so will be found, as before, by multiplying the area of the piston in inches by the mean between the initial and terminal pressure, or say, 37·5 tenths pounds per inch, and the foot pounds of work done will therefore be once more 10,800,000, the piston in this instance moving through double the distance under half the pressure. We find, then, that the amount of work done by expansion so far is equivalent to 21,600,000 foot pounds, the piston moving through a distance of 3,000 feet, while the work done by the steam without expansion is but 14,400,000 foot pounds, and even under these conditions we still have 4,000 cubic feet remaining in our suppository cylinder, with a pressure of 25 lbs. per square inch. Having thus briefly illustrated the principle of expansion, we may proceed to consider its practical application. Before doing so it is as well to give a very simple rule for estimating the average pressure within the cylinders of engines worked expansively. Let 1 in all cases represent the full-pressure part of the stroke; add to this the Napierian or hyperbolic logarithm corresponding to the ratio of expansion as given in readily accessible tables, and the result, multiplied by the pressure, and divided by the ratio of expansion, will give the mean pressure per square inch; this, multiplied by the area of the piston, and by the speed in feet per minute, and divided by 33,000, will give the actual horse power, including all resistances. Thus the initial pressure on a piston being 80 lbs. per inch, and the steam expanded 5 times, to find the average pressure: the hyp. log. of 5 is 1·609, and $1.609 + 1 = 2{\cdot}609$,

and $\frac{2{\cdot}609 \times 80}{5} = 41{\cdot}74$ pounds.

The results to be obtained in practice from the expansive use of steam are never so great as those given above, the amount of the difference, or loss of effect, being mainly determined by the skill and care with which the principle is carried out. Were it possible to retain all the heat which the steam had at the commencement of its work, to the end, and that no such things as clearance spaces had existence, then would the useful effect obtained in practice exactly correspond with that deduced from mathematical investigation. It is obvious that physical conditions of perfection cannot be secured under any circumstances, and therefore it only remains to approximate to them as closely as possible. But after all has been done which possibly can be done, it will still be found that the gain to be derived from expansion, in practice, falls short of that promised by theory. In an article like the present, any very profound investigation of the subject would be out of place, and we must therefore rest content with pointing out the general tendency and bearing of the results obtained by those who have conducted their inquiries on a strictly philosophical basis.

Apart from every external frigorific influence, steam loses heat in two ways, namely, in the performance of work, and in the mere act of expanding; but the exact nature of the changes which steam undergoes within a cylinder while expanding, and the causes which lead to these changes, are yet far from being quite as accurately determined as might be desired. Even in the calculated results obtained by the most scientific men of the age, very startling discrepancies will be found to exist. The fact is, that we still stand on the confines of scientific truth, and that, until we can plunge fairly in, many things, doubtless simple enough, must remain to a great extent involved in mystery. Every question, however, connected with steam has been determined with sufficient accuracy to satisfy most practical purposes; and with this we have every reason to rest content for the present.

We have said that steam loses heat in the performance of work, simply because heat and work are interchangeable. The total quantity of heat required to evaporate one pound of water from and at a temperature of 212 deg. Fahr., represents 745,812 foot pounds; and conversely, for every 745,812 foot pounds of work done by the engine, one pound of steam must be condensed. With an increase of pressure the quantity of heat rendered latent by evaporation slightly diminishes, and consequently a slight gain is realised from this fact alone by the use of the higher pressures. But the operations of external and internal cooling influences are far more powerful in reducing the efficiency of steam than the mere performance of work. Steam in the act of expanding becomes condensed, or, in other words, a certain portion of the sensible heat necessary to maintain the steam in its initial approximate condition of a gas, is converted into latent heat, and as a result, a proportionate quantity of the steam is converted into vapour or mist, pervading the space within the cylinder. Thus steam, which, on entering the cylinder, and even at the moment the cut-off valve closed, was dry and clear, becomes fully saturated by the act of expansion, provided the expansion is carried far enough, and that no external source of heat acts through the metal of the cylinder. The reason is, not that heat is necessarily lost, but that a proportion of that which was known as heat to the thermometer is converted into work, which the thermometer of course cannot recognise; and this work, it must be understood, is not expended in giving motion to the engine, but in separating the ultimate atoms of the water of which the steam expanding is composed to a greater distance than they were before. This work is done on the steam itself, and is wholly distinct from the work also done in driving the piston against a given resistance. We may put this into more strictly scientific phraseology by saying that with decrease of density the latent heat of steam diminishes faster than the sensible increases, and therefore, when it is reduced by expansion from one density to another and lower, the latent heat, or work done internally on its molecules, increases, and to an extent annihilates an equivalent of sensible heat, and the amount of this equivalent can in all cases be determined by the consideration of the entire quantity of heat necessary to evaporate the given weight of water at the two pressures—initial and terminal.

As steam is employed in practice, however, we cannot neglect the influence which the temperature of the cylinder exerts on the changes in the condition of the steam. The cast iron absorbs heat when the steam first enters at its full temperature, and it subsequently restores this heat towards the end of the stroke when the pressure falls, and thus, to a certain extent, we may regard every unjacketed cylinder as acting the part both of a boiler and a condenser. Dry steam absorbs heat with extreme slowness—in this, as in other respects, obeying the laws which obtain with the true gases. Professor Tyndal states, for example, that moist air absorbs heat with not less than 6,000 times the power of perfectly dry air. On first entering the cylinder the steam, fresh from the boiler, comes in contact with the cool piston and cooler cylinder lid. A portion is at once condensed; and we shall show presently that, strange as it may seem, the entire loss with the best engines must take place while the cut-off is open, and not subsequently to its closing, as commonly believed. The result of this primary condensation, as we may term it, is that the steam is—unless previously super-heated—rendered damp, and it therefore imparts yet more of its heat to the metal with which it is in contact. As a consequence the cylinder lid and the piston are raised to the full temperature due to the pressure with the speed of lightning. This action is of course confined to one end of the cylinder. The other, from which the piston has just come, is in contact with moist steam or vapour from the condenser, at a temperature of little more than 100 degrees, and as this absorbs heat, its pressure rises sufficiently to cause it to flow into the condenser. Moisture is deposited on the interior of the cylinder and re-evaporated, and thus heat is carried to the condenser, not by radiation, as commonly stated, but by the direct convection of the most powerful cooling agent known—moist vapour. This vapour pervades the whole cylinder, and if time enough is allowed the surface of this last will be reduced to the temperature of the condenser. In practice, the piston commences its return immediately upon the completion of the forward stroke, and the vapour is thus swept into the condenser and the sides of the cylinder are perfectly dried. Even with the highest attainable speed, however, the cooling action of the vapour is so energetic that a very considerable loss must take place; and the amount of this loss increases as the speed of the piston becomes less, and thus we find that short strokes and high velocities are important direct elements of economy.

As the steam follows up the piston, successive portions of the now cool cylinder are uncovered, and, so long as the sensible heat of the steam is in excess of that of the metal, condensation and a deposit of moisture will take place. As the pressure falls, however, so does the temperature, and, once a certain point in the stroke is reached, condensation will cease. As the piston proceeds, and as the pressure and temperature of the steam continue to fall, the heat which the cylinder has received will be restored, and the deposited moisture will be re-evaporated. The cylinder then really becomes a boiler, and we find that, so far from an immediate loss ensuing on the first condensation, this re-evaporation actually tends to keep up the pressure to the end of the stroke. If no condensation or re-evaporation took place the curve of the indicator diagram would be a nearly true hyperbola, corresponding to the operation of Mariotte's law; but it is a fact that actual diagrams show a considerable departure from this law apparently favourable, the terminal pressures being higher than they ought to be. This gain is only apparent, however, and is due to the re-evaporation of the large quantity of water condensed at the commencement of the stroke, with a corresponding loss. Apart from the influence of external radiation, all the loss of useful effect is due to the presence within the cylinder during the exhaust, of vapour of only the same temperature as the condenser.

From the foregoing it will be evident that al true waste of steam must take place while the cylinder is in communication with the boiler. Practical diagrams show that, so far from any loss ensuing upon expansion, the pressures are really greater than those given by theory. It is true that the indicator in all cases shows, when properly fitted, a slight increase on the true pressure, but the error is so slight that it may be wholly disregarded. With the Richard's indicator it becomes all but evanescent. It is evident, therefore, that waste is not to be sought for during the expansion portion of the stroke. It is also evident that during this period, the boiler being completely isolated from the cylinder, nothing going on within the one can at all effect the other. Yet we know that the practical use of the engine proves that nearly three times as much fuel is used, even under the most perfect system, as that laid down by theory as necessary. In other words, three times too much steam enters the cylinder. But the steam can only enter the cylinder during the full pressure portion of the stroke; and it follows that it is during this portion of the stroke all the drain on the boiler must take place. Now during this period but a small portion of the cylinder is uncovered; and we find, therefore, that the surplus steam introduced is employed in re-heating the cylinder lid cooled down by radiation (external) and by convection to the condenser (internal); the piston cooled down by convection only; so much of the cylinder as is uncovered during this portion of the stroke; and re-evaporating all the water found between the cut-off valve and the piston. The water is evaporated during the first instant of admission, and doubtless is, in part at least, re-deposited again before the valve closes, through the agency of the chilled metal; and the fact is that the cylinder contains on the steam side at the moment the cut-off valve closes nearly three times as much steam and water as the boiler should theoretically supply in the form of steam alone, and it is the partial re-evaporation of this water which feebly compensates for a portion of the loss during the remainder of the stroke.

In the high pressure non-condensing engine the vapour present within the cylinder can never fall below 212 deg., and this fact will go far to account for the circumstance that the comparative advantage to be derived from the condenser falls short of that deduced from theoretical investigation. When steam is super-heated moderately we find that the cylinder is always maintained at too high a temperature to permit the deposition of moisture, and thus there is a direct and considerable gain over and above that derived from the increased efficiency of the boiler. We have not dwelt on the influence of external radiation or on that of the clearance spaces. It will easily be perceived, however, that clothing or jacketing a cylinder is comparatively useless while the ends or lids are left unprotected. Clearance operates most injuriously with the higher measures of expansion, and it should therefore be invariable reduced to the lowest possible limit compatible with safety. A cylinder 32 in. stroke and one square foot in area, expanding the steam eight times, should receive, apart from condensation, but 576 cubic inches of steam; but we must add for ·5 in. clearance space, one-eighth of this quantity, or 72 in., and if we include the space between the cut-off valve and the cylinder, the whole amount will hardly fall short of one-fourth of the entire quantity supplied. The loss from this cause alone frequently amounts to as much as 20 per cent. of all the steam supplied from the boiler.—*Mechanics' Magazine.*

DEVELOPMENT OF COLONIAL RESOURCES.

Sawing Machinery.

Perhaps there are few countries in the world so well provided with timber suited to the purposes of man as New South Wales, and certainly nowhere until within a very recent period was so little effort made to turn natural capabilities to account. Three or four years ago almost all the window sashes, doors, flooring, and other carpenters' and joiners' work used in the colony were imported, as well as most of the ordinary articles of furniture and cabinet-maker's goods. Now, on the contrary, owing to colonial enterprise and ingenuity, almost every article of this kind is made in Sydney, and at a much lower price than it can be imported for. Two years since the market was glutted with imported doors, sashes and furniture, since then no articles of the former description and very few of the latter have been introduced; and owing to the adaptation of machinery to cabinet-making and carpentry, there does not now exist the slightest chance of the revival of such an anomalous state of things, as a colony producing the finest timber in the world, importing inferior articles manufactured from inferior timber, from a country thousands of miles distant. It is all the more gratifying that this change has been brought about, not by absurd protective duties, not by excluding by legislative enactment the products of the industry and commerce of other countries, but by colonial energy and capital acting in open competition with the world; and, for that very reason, certain to be more permanent in its effects and successful in its operations.

We think it due to those to whom the colony is mainly indebted for producing the beneficial change alluded to, that attention should be drawn to their efforts; and we feel sure that a notice of the machinery used, and a description of the process by which a log of wood is changed into doors, bed-steads, or packing cases, will be read with interest.

There are are several establishments in Sydney for machine-sawing and the manufacture of wood-work, but by far the most extensive is that of Messrs. Moon & Co., at the foot of Bathurst street, and to a description of this we shall at present confine ourselves. The premises occupied in the operat ons of this firm covers several acres of ground, and the number of persons in their employment is upwards of 150. Their machinery is driven by three steam-engines, and all their engineering and machine making is done on the premises. Most of the machines used were not only made under the direction of Mr. Nicolls, their engineer, but several of the most important are of his own invention. To understand perfectly the operation of the various mechanical appliances, it will be necessary to watch the progress of a log of wood—say of cedar or pine, for nearly all the timber used is the produce of the country—from the time it is drawn from the water at the foot of Liverpool street, until it is changed into chairs, bed-steads, and tables, ready for the purchaser. The log of timber is drawn from the water up an inclined plane, and placed on the moveable frame of an engine, called a breaking-down machine. This is the invention of Mr. Nicolls, and is one of the most powerful sawing machines in the world. It is remarkable for the simplicity of its construction, and works very much on the principle of Nasmyth's steam hammer. The blade of the saw is a mere extension of the piston-rod, so that its action is perfectly direct. It is capable of sawing a log eight feet in diameter, with as much ease as a man would cut with a handsaw through a plank of an inch in thickness. After being broken down, as it is called, by this machine, the timber is sawn into thinner portions by other more complicated ones. For this purpose there are two perpendicular sawing machines, each capable of carrying from eight to sixteen vertical saws, according to the required thickness of the planks. The perfect truth and smoothness with which these machines turn out their work is admirable. We may remark that it is necessary that wood intended to be planed, grooved, tenoned and morticed by machinery, should be perfectly square and true, and of a uniform thickness throughout. All these conditions, which could not be obtained by hand sawing, are incidental to machine work.

As soon as the log has been broken down, and cut into boards of the requisite thickness, it is, if wanted for immediate use, placed in the seasoning house. This is a steam-tight building, constructed of rivetted iron plates, in the same manner as the boiler of an engine. It is fitted with steam-pipes, and it is by the action of the steam that the wood is seasoned—a few hours being sufficient to produce the same effect by this process, as would require months in the ordinary way. When seasoned it is handed over to the department by which it is intended to be worked up.

There are separate buildings, each having the necessary staff of workmen, for the manufacture of each description of article. One set of men make nothing but bedsteads, another only chests of drawers, a third packing cases, a fourth doors, a fifth sashes, a sixth doors, and so on. The wood for each kind of article is sawn out by the machinery and stacked separately. It may give some idea of the amount of work produced in this establishment by this division of labor, when we state that a thousand bedsteads are undergoing the process of manufacture at once; that a single boy, with a morticing machine, is capable of morticing one hundred doors in a day; that, on an average, four hundred pairs of sashes are sent out, glazed, and ready for use every week; that the wood consumed annually in making soap, candle, wine and other cases, alone, amounts to four million feet, and that the value of this single article of production is over £6,000 annually.

The rapidity and ease with which the circular saws, working on rack benches, reduce heavy pieces of timber into boards is something startling. A log, say fifteen inches square, and fifty or sixty feet long, is reduced into strips as easily, and almost as rapidly as a lady could cut a sheet of paper with a pair of scissors. These rack-benches are among the most expensive machines used. They were made on the premises, at a cost of about £1,500 each. The men attending them have little else to do than look on, and supply the machine with fresh timber as often as required.

Another ingenious tool, and one peculiar to this establishment—the invention of Mr. Nicolls, and made on the premises—is a machine for cutting laths. It is capable of producing ten thousand laths per day, and is said to be superior to any thing of the kind ever before invented. To enumerate all the purposes to which steam machinery is here applied would be tedious. In addition to the large sawing machines there are others for planing, for cross-cut sawing, for grooving and tongueing, for morticing, for cutting tenons, for moulding and for various other purposes.

The consumption of cedar amounts to 80,000 feet of cedar and 40,000 of pine weekly. No imported wood is used, unless, from some unusual circumstance, colonial cannot be procured—as the latter is deemed preferable on many accounts. The stock on hand usually amounts to about 2,000,000 feet. The consumption in 1862 was upwards of 4,000,000 feet, and is fast increasing. A considerable export trade is rapidly springing up to Victoria, Queensland and other places. The Sydney made articles are fast driving the American out of the market to the other colonies, as they can be produced much cheaper than foreign goods can be imported, and are very superior in finish and general quality.

It is somewhat surprising to know that notwithstanding the enormous quantity of goods manufactured, and with all the facilities at their command, Messrs. Moon & Co. are unable to supply orders fast enough. The demand is always in advance of their powers of production, although new adaptations of machinery are constantly offering greater facilities for the supply of the goods which they manufacture.

We may mention, in order to show the facilities effected by machinery, that a boy can mortice 100 four-panel doors daily, at a cost for wages of 3s. 4d. and that this work, if performed by hand-labor, would cost about £10. That is, perhaps, an extreme instance, but the difference in the cost of making mouldings, &c., if not quite so great, is sufficiently remarkable. Most persons not acquainted with the facts are under the impression when seeing packages of doors and sashes being taken into the interior from Sydney that they are imported American goods. This used to be the case, but it is not so at present. We are assured that very few sashes and doors have been imported during the past two years, and that they cannot now be introduced for less than about 50 per cent. over Sydney manufacturers' prices.

Photography.

PHOTOSCULPTURE.

BY A. CLAUDET, F.R.S.

Read before the British Association for the Advancement of Science.

If in our time opinions are divided as to whether photography is finally to exercise a beneficial influence upon the fine arts, or the contrary, there is no question that its innumerable useful applications are a boon to the community.

After having been habituated to photography, we can scarcely suppose it possible to do without photography, as we might say of railways or of the electric telegraph.

Photography may have been the enemy of all that was inferior in the arts of painting and engraving, but is that to be regretted?

Instead of the dabblers in portraiture who were satisfying a morbid taste, we have a great army of photographers capable of representing the human form and features in the utmost perfection. Printing itself, that universal and powerful aid of civilization, was only established by superseding a class of artists who had, at least, the merit of spreading by their work knowledge and literature during many centuries. They indeed produced *true works of art*, which, though no longer repeated, are to be admired in the museums where they are preserved.

As to the art of painting, instead of being injured, it is served by photography, which enables artists to be more perfect in their design, and to study the beauty of forms yielded by the photographic mirror.

Photography, in multiplying marvellous representations of the beauties of nature, tends to inculcate the taste for artistic productions. There will be fewer bad painters because there will be less and less demand for inferior paintings. Fine works only will be esteemed, and the taste for art will increase in proportion to the value of its productions.

Is it not the same in literature? Who can deny that the more refined and pure it is, the more it educates and disposes the mind to reject whatever has not the stamp of genius?

In an enlightened age inferior literature cannot exist. So the fine arts will be improved by photography. Notwithstanding the alarm of narrow minds incapable of appreciating progress, the discoveries which are based upon science will ultimately produce good, and benefit society. To the painter, photography affords the means of being absolutely correct in design. Reference to photographs in painting portraits, representing draperies, &c., saves immense trouble, and obviates the necessity of long and repeated sittings.

But how can it be said that photography prevents the artist from imparting to his work the impress of genius? Photography is for him only a useful auxiliary.

Nothing, however, can arrest the strides of photography; it extends every day its applications, and gradually invades every art.

Who would have expected that photography was to be the means of sculpture?

Yet, however extraordinary such a prognostication might appear, however difficult at first thought it may be to understand the possible connexion between flat representation of objects and their solid form, it has been proved that from flat photographs a bust, a statue, or other object of three dimensions can be made by a mechanical process without the necessity of the sculptor's copying the original, or even seeing it at all. Yet the result is a perfect fac-simile of the original! Moreover, the work is executed in one-tenth of the time required for modelling by hand.

This beautiful application of photography is called *Photosculpture*, and is the invention of Mr. Willème, an eminent French sculptor.

Before explaining how Mr. Willème was led to this discovery, let me remind you that photography itself was invented by painters of talent, by *artists*, who, while using the camera obscura for studying the subject of their intended pictures, were struck with the beauty of those natural representations. In contemplating them they naturally desired that the pictures could be permanently fixed. Considering that these pictures were formed by the light reflected by the objects, they essayed to fix them by availing themselves of the known scientific fact that light had the property of blackening certain chemical compounds.

The flash of that idea was enough; their genius and perseverance solved the problem, and they created that art which they desired so much—Photography!

A similar and no less instructive story may be told of photosculpture. Mr. Willème was in the habit, whenever he could procure photographs of his sitters, of endeavouring to communicate to the model the correctness of those unerring types. But how was he to raise the outlines of flat pictures into a solid form?

Yet these *single* photographs, such as they were, would serve him to measure exactly profile outlines. He could indeed, by means of one of the points of a pantograph, follow the outline of the photograph, while with the other point directed on the model he ascertained and corrected any error which had been communicated to his work during the modelling. What he could do with one view, or one single photograph of the sitter, he might do also with several other views if he had them. This was sufficient to open the inquiry of an ingenious mind. He saw at once that if he had photographs of many other profiles of the sitter, taken at the same moment, by a number of cameras obscuras placed around, he might alternately and consecutively correct his model by comparing the profile outline of each photograph with the corresponding outline of the model. Such was the origin of a marvellous and splendid discovery. But it soon naturally occurred to him that instead of correcting his model when nearly completed, he had better work at once with the pantograph upon the rough block of clay, and cut it out gradually all round in following one after the other the outline of each of the photographs.

Now supposing that he had 24 photographs, representing the sitter in as many points of view (all taken at once), he had but to turn the block of clay, after every operation, $\frac{1}{24}$th of the base upon which it is fixed, and to cut out the next profile, until the block had completed its entire revolution, and then the clay was transformed into a perfect solid figure of the 24 photographs—the statue or bust was made!

When this is once explained, every one must be struck with admiration at the excellence of the process. It is so sure and so simple, that we are surprised it had not been thought of before. But so it is with the most valuable inventions. They wait until some genius grasps the idea, and conceives how to make them practical.

It will, perhaps, be argued as a defect of photosculpture, that, being the result of a mechanical process, it leaves no opportunity for the display of artistic taste or feeling, and that its productions must therefore be only vulgar and matter of fact. This would be a mistake; because the sculptor, who has to direct the last operation, will exercise his skill in communicating to the model all the refinement with which, as a sculptor merely, he could have endowed it. For supposing the photographs to have been deficient in attitude or expression, in giving the last touches to the model, the sculptor can correct those imperfections. The pantograph of photosculpture will communicate to the clay the true character and the proportions of the object, with all the correctness of the photographs; it will produce a perfect likeness, and it will be necessary to give to this first draught the softness and finish of a work of art. These of course cannot be imparted except by the skilful hand and the intellectual feeling of a true artist. In short, as the model must be touched by a sculptor, it is clear that the sculptor so engaged should be such as will not spoil the work of the unerring machine, but, on the contrary, improve it in many particulars, and even add to it the sentiment of art. Therefore the process of photosculpture is to put into the hands of a skilful sculptor a model perfect in its proportions, correct in design, full of character, including draperies of the most elegant outlines, such as only are represented by photographs; and this model, so prepared for him, would have required a tedious labour with the disadvantage of much uncertainty.

As photography has been the means of improving the art of painting, so photosculpture is destined to improve sculpture, and to spread in all classes the taste for this noblest branch of the fine arts. It may be said that sculpture is understood only by a very limited number of educated minds. It is seen only in palaces, in the public galleries, and in the mansions of the rich. Good sculpture is very expensive, and for this reason it is not customary for the middle classes to employ sculptors to execute busts or statuettes of relatives or friends. Besides the question of price, there are very few artists capable of producing such a work as shall be an inducement to the possession of this kind of similitude. Photosculpture, therefore, opens a new era by the advantages of its procedure. The work is done with greater accuracy, in a very short time, and consequently at a moderate price. The original has only to sit once for the photograph, and then in a few days, without further trouble, or the necessity of appearing repeatedly before the sculptor, a bust or statuette is produced. Such facilities cannot fail to make the demand very general, and this must cause the employment of a great number of artists. The "ateliers" of photosculpture are indeed *to be the best school of sculpture*, from which will issue a succession of skilful artists, who, having practised the mechanical process, will be able, when photographers cannot be obtained, to model by hand. Therefore the art of sculpture must in every way benefit from the practice of photosculpture, which, undoubtedly, we shall see honoured in the dwellings of thousands, not only as regards portraiture in general, but also as to the resemblances of those who by their genius and virtues have deserved our admiration and esteem.

Again, photosculpture will be the easy and inexpensive means of reproducing in various sizes, and with unerring faithfulness, the beautiful remains of antique sculpture, whether statues, vases, or other objects which can only be seen in museums and galleries, and thus the public can possess, at a small cost, copies or rather facsimiles of the great creations of past ages. The only copies existing of those works cannot often be repeated, for they must be made at some risk of injuring the original, the only process hitherto known being that of taken casts; hence they are expensive and rare. To obtain a certain number of photographs of these precious relics is all that will be needed for their re-production by the photosculpture process.

Photography has already been the means of copying the paintings of celebrated masters existing in public and private galleries. By these photographs every one is enabled to possess copies of the noblest works in the art of painting. These copies contain composition, design, and everything capable of conveying the feeling of the artist; but they are deficient in one essential—colour!

It is otherwise as regards the representation of statuary, which leaves to the mind to imagine colour. Photosculpture has then the advantage of reproducing works in sculpture without depriving us of any of the attributes which have made them famous.

Photosculpture will further be applied to the representations of animals, showing them in true and natural attitudes; by this means faithful models will be introduced in the manufacture of porcelain, clocks, furniture, and much that contributes to the embellishment of our dwellings.

In a word, photosculpture is calculated to spread the taste for the beautiful in form; it opens a new era, which will be remarkable in the history of the fine arts.

I have thought that I could not give to the meeting a better illustration of the process of photosculpture than by executing the bust of our illustrious president, Sir Charles Lyell. I invited Sir Charles for this purpose, and he was kind enough to sit for his photographs on the 16th August.

The machine has done the work, the sculptor has given the finishing-touch to the model, and here is the bust completed, Sir Charles not having seen it before I brought it to the meeting!

In so short a time I have also been able to obtain of the same bust a model in bronze, and I leave to the meeting to form some opinion of photosculpture by this and other examples now near me.

At the conclusion of the lecture, Mr. Claudet illustrated, by means of a model, the mode of working in photosculpture, and also exhibited a number of busts and statuettes produced by the process, which were examined with much interest.

PHOTOGRAPHY.

THE WOTHLY IMPROVEMENTS.

From the *Reader* we learn that "A new discovery is reported to have been made by Herr Wothly, a German photographer, by means of which it is asserted that photographic impressions, hitherto more or less subject to change and decay, will be rendered permanent and imperishable. The process by which this improvement upon the present method of preparing photographic paper is said to be secured, consists in the substitution of a double salt of uranium for nitrate of silver, and of collodion for albumen, which have hitherto been used in the preparation of photographic paper. The ordinary method of preparing sensitive paper is to size it with albumen, the surface of which is then submitted to the silver preparation, which is sensitive to light and fitted to retain the printed image. But this process has been long felt to be defective; the impressions obtained under these conditions is not only less perfect than the reversed image upon the glass, known as the "negative," from which it is printed, but the production of any number of impressions of unvarying excellence is well-nigh impossible. We know also that all these impressions are liable to change, and in many cases to disappear. There can be little doubt that the film of collodion—which, under Wothly's process, is rendered sensitive, not by nitrate of silver, but by being combined with the salt of uranium—would yield a far better surface to the action of the light; and the impressions fixed upon it would be free from all those blots and inequalities which mark more or less all photographic impressions hitherto produced. This alone is a great gain. The other advantages claimed by the inventor—of absolute permanence and simple and easy manipulation—are not so clearly established; but there seems great reason to think that an important step in advance has been made. Time alone can be accepted as the true test of all claims for permanence; but the impressions obtained by the new process are said to have been exposed to the action of sun and rain for weeks together without betraying any sign of change."

At a recent meeting of the London Photographic Society, a letter was read from Mr. Tunny, the well-known photographer of Edinburgh. He says: "I have been all out of breath, so to speak, in anxiously waiting the disclosure of the 'Wothlytype,' but I suppose we are destined to remain somewhat longer in suspense. In the meantime I have not been idle; I have been endeavouring, if possible, to ascertain what can be made of uranium, as that is the hinted-at salt, in combination with other metallic compounds. I have, in the first place, got very vigorous prints by the nitrate of uranium and chloride of gold—also good results with the uranium and silver; perhaps as good as any have been the result of the ammonia phosphate of silver; all these, and many others that will suggest themselves, give very vigorous prints, simply combined with collodion; but there is the drawback of want of sensitiveness, taking nearly double the ordinary time to print; however the weather has been very bad for conducting my experiments.

"I cannot, as yet, give the definite formulæ for the above, as I have used them in every conceivable proportion; but if any of your readers will take, firstly, half an ounce of spirit of wine, add nitrate of uranium (as much as it will dissolve by long and continual shaking) now add half an ounce of ether, three grains chloride of gold, and six grains of gun-cotton, they will have a collodion that will print by its being simply poured over a sheet of paper laid upon a piece of glass. The prints are fixed by being placed for a few minutes in a bath of water slightly acidulated with nitric or oxalic acid.

"Secondly: The phosphate of silver being dissolved with the smallest quantity of ammonia, just sufficient being added to redissolve it, added to ordinary plain collodion, in the proportion of six grains to the ounce, makes a very sensitive printing collodion.

"Thirdly: Nitrate of silver three grains, dissolved in a drop or two of distilled water, added to the first or uraniumized collodion, *without the gold*, also makes a good printing collodion.

The *Scientific American* says:—"Until the patent is granted here all our photographers are at liberty to make use of the process, and for their convenience we subjoin the following directions, extracted from the British specification:

To one pound of plain collodion add from 1½ to 3 ounces of nitrate of uranium and from 20 to 60 grains of nitrate of silver.

The paper is prepared for printing by simply pouring the above sensitized collodion upon its surface, and hanging the sheets to dry in the dark.

The printing is accomplished by exposing the paper to light under the negative in the usual manner, and for about the usual time required for silvered paper; print until the desired depth is reached. It is not necessary, as in the ordinary process, to print the positive to a greater intensity of color than the fixed picture is intended to have.

After printing immerse the picture in a bath of acetic acid for about ten minutes, or until that portion of the salts not acted upon by the light has been dissolved. The picture is now fixed and finished by thorough washing or rubbing with a sponge or brush, or by rinsing in pure water; then dry. Changes in the tone of the picture to suit the taste may be made before drying, by using a bath of chloride of gold, or of hyposulphite of soda.

Such, in brief. is the new Wothlytype process. We have given it a few trials, with the most gratifying success. We presume that it will ere long be recognized among photographers as an established and excellent method of printing. It is not claimed that it surpasses the silver printing, but the superior convenience of the Wothlytype process will be a very strong reason for its employment, if the pictures it produces prove equal, or nearly equal, in durability or other qualities, to those resulting from the old method of printing.

The uranium sensitized paper, it is stated, can be preserved for an indefinite time in properly-prepared receptacles, from which light is excluded. This is another important advantage, as the common silvered paper loses its value soon after preparation.

The uranium prints, made as above described, have a smooth and glossy appearance. When an unglazed surface is desired the sensitive salts are dissolved in alcohol and water, adding some saccharine substance. The paper is then coated with the mixture

The best results of the Wothlytype process ensue when a well-sized, fine and very hard-rolled paper is employed. It is recommended to coat the surface of the paper with a sizing of starch, arrowroot or gum tragacanth."

PHOTOGRAPHIC SOCIETY OF SCOTLAND.

New Method of Photographic Printing.

Mr. Thomas Fox, of Alloa, read the following communication:—

"I beg to submit to your notice a process of printing without nitrate of silver; it is very simple, very rapid, and the ingredients required are of the cheapest, and at the same time it produces pictures very distinct, the shades of an intense black, equal if not darker than any known process, and which will not fade from ordinary exposure, from the known chemical combination of the materials used. It is the exact counterpart from printing with nitrate of silver, and whitens the paper where exposed to light, the shaded parts becoming black, and yielding very fine and soft gradations of tone when treated with the following simple process.

The process consists of bringing the bichromate of potass in direct contact with logwood; and the plan I adopt is to sensitize the paper with a solution of the bichromate of potass and sulphate of copper, mixed in the proportions of one part of the former to two of the latter, and to either float or steep the paper for a few minutes, then dry it by the fire in the dark (this paper will retain its sensitiveness for some days, if carefully preserved from light); you then place your copy to the sensitive side, if a glass transparency, with the printed side down, and with a paper print, either with the printed side down or the plain. With the printed side down you get a reversed picture, but which suits admirably for transferring. The time of exposure is much the same as in printing with nitrate of silver: in sunshine from one to three minutes is amply sufficient from glass, and for a paper print or piece of printing it will be rather longer, according to the thickness of the paper; the thinner it is the better. Of course, in dull weather it is proportionably longer; at the same time I would say, paper thus prepared is much more sensitive than the silvered, and will print considerably quicker.

I have then a strong decoction of logwood ready, and filter such a quantity as will float the print; I add a little hot water to hasten the development, float the sensitized picture from half a minute to a minute, print-side down, and then, holding it by one corner, gradually raise it from the logwood; a perfectly delineated copy is the result. I then dip it in hot water, which carries off the superfluous logwood that may be hanging to the paper, then dip it in hot or cold water, and varnish. This gives a very distinct picture, with the shades of a deep black, and the lights of a rather greyish-yellow tint. In order to obtain a white ground, I use a weak solution of alum, put in hot water.

The same logwood will do a great number of prints. The sensitizing solution retains its power until dried up. There is no danger of baths going wrong, as in the silver baths; and the tedious process of toning, &c., is avoided, not to speak of the great uncertainty and variations in these processes; and it will do all that the carbon process professes to do in transferring, &c. The whole process may be done in a few minutes; the paper being sensitized and dried by the fire at once, may be immediately exposed, developed, and varnished.

For transferring the unvarnished print, I simply pass it under a roller-press, which gives a beautiful impression on albuminized paper, leaving the ground pure white; it also transfers to cotton, linen, glass, stone, wood, and any other material.

I may mention that by varying the strength of the sensitive solution, and the intensity of the logwood, many different shades of colour may be obtained, as you can get blue and purple, and deep black to the lightest shade of black. I see no reason why this process may not also be used in the camera, with an albumen or other transparent medium, using logwood as a developer."

Physiological Effects of Cyanide of Potassium.

M. August Busch, writing in the *Photographic News*, describes the action of cyanide of potassium upon the system as follows:—

If cyanic acid be inhaled pure, unmixed with air, instantaneous death is the consequence.

In the chemical laboratories where prussic acid is manufactured, the assistant who conducts the process must take the greatest care in breathing; if he inhale a little too much of the escaping gas, he feels his eyesight suddenly leave him, and he is in complete darkness; then he has to retreat quickly, or he will fall on the floor.

Electroplaters and gilders, who have to work constantly over strong solutions of cyanide of potassium, feel, after a time, if their working room be not well ventilated, many very bad effects from the poisonous exhalation. Listlessness, weariness in the limbs, dimness of sight, deafness, and loss of memory are some of the effects produced; painful, obstinate ulcers break out on different parts of the body, especially on the hands, when these have been immersed in the fluid.

Strong cyanide of potassium, when applied to an open blood-vessel, is deadly: applied to a broken skin, it produces great pain, and generally a bad ulcer; and if applied to a whole skin for any length of time, it must have the same consequences, especially if that skin be already decomposed by nitrate of silver; for it must be remembered that the elements of cyanide of potassium are so ready to part with each other, that not only the cyanic acts as if it were free, but the potash acts like free caustic potash, viz., dissolves skin, fat, &c., and leaves the deadly poison at liberty to act upon the blood-vessels underneath.

It is, therefore, proper to advise photographers again and again—

1st. To keep their sulphuric, nitric, and muriatic acid bottles far enough from the cyanide of potassium.

2nd. To have their dark rooms always ventilated as perfectly as possible.

3rd. To rather show the stains of honest work, than allow themselves to be rendered unfit for work by employing so dangerous a detergent; but if they *will* apply cyanide to clean their hands, never do so where the skin is broken, nor, if the skin is whole, to continue the operation long, and always to rinse well with water afterwards.

The fact that most of the commercial cyanide is largely adulterated with carbonate of potash does not lessen at all the danger of employing the article; it merely compels the photographer to buy three pounds of cyanide of potassium to do the same amount of work for him that one pound ought to do."

Lea's Cleaning Solution.

The photographic fraternity is under great obligations to Mr. Carey Lea, of Philadelphia, for the knowledge of the following glass-cleaning preparation:— Water, 1 pint; sulphuric acid, ½ ounce bichromate potash, ½ ounce. The glass plates, varnished or otherwise, are left, say 10 to 12 hours, or as much longer as desired, in this solution, and then rinsed in clean water, and wiped or rubbed dry with soft white paper. We have used the solution in our laboratory long enough to be satisfied of its superior excellence for the purpose specified. It quickly removes silver stains from the skin without any of the attendant dangers of the cyanide of potassium. We think that photographers who once give Mr. Lea's preparation a trial will be glad to discard all others.

Practical Memoranda.

Table *of the Weight of Substances of Construction, showing the weight of a cubic inch, and a cubic foot, in ounces and pounds avoirdupois; and also the number of cubic inches in one pound, of the substances most used in construction.*

NAMES OF BODIES.	Weight of a cubic foot in lbs.	Weight of a cubic inch in oz.	Number of cubic inches in a pound.
Copper, cast	549·25	5 086	3·146
Copper, sheet	557·18	5·159	3·103
Brass, cast	524·75	4·852	3·293
Iron, cast	445·43	4·203	3·802
Iron, bar	476 93	4 410	3·623
Lead	709·00	6·456	2·437
Steel, soft	489·56	4·527	3·530
Steel, hard	488·50	4·517	3·537
Zinc, cast	449·37	4·156	3·845
Tin, cast	455·75	4·215	3·790
Bismuth	619·50	5·710	2·789
Gun-metal	549 00	5 0075	3·147
Sand	95·00	.8787	18·190
Coal	78.12	.7225	22·120
Brick	125 00	1.156	13 824
Stone, paving	151·00	1.396	11·443
Slate	167·00	1·544	10·347
Marble	171·37	1·585	10·083
White Lead	197·50	1·826	8·750
Glass	180·00	1·664	9 600
Tallow	59·06	.5462	29·258
Cork	15 00	.138	115·200
Larch	34·00	.315	50·823
Elm	34·75	.321	49·726
Pine, pitch	41·25	.382	41·890
Beech	43·50	.403	39·724
Teak	46·56	.431	37·113
Ash	47·50	.440	36·370
Mahogany	53·25	.493	32 449
Oak	60·61	.561	28·505
Oil of Turpentine	54·37	.503	31·771
Olive Oil	57·18	.529	30·220
Linseed	58·25	.539	29·655
Spirits, proof	57·93	.536	29·288
Water, distilled	60·50	.578	27·648
" sea	64·25	.594	26·894
Tar	63·43	.587	27·242
Vinegar	64·12	.593	26·949
Mercury	848·00	7.851	2·037

Cleaning Oil-stones.

A correspondent of the *American Artisan* says: I am indebted to you for your favor; and I now send you a practical recipe for the cleaning of oil-stones and hones, which may be worth publishing in the *American Artisan* for the benefit of those who use edge-tools. Take potash, or pearlash, or saleratus, or borax or any alkali; and put from half an ounce to one ounce in a half-pint bottle, fill with soft water, cork and keep it for use. When wanted, pour as much upon the stone as will spread over the same, and let it stand until the oil is "cut," then wash it off. Try it; you will be able to hone as good as when the stone was new. I have found all oil-stones to become fouled and little or no "grit" after using a while, though the best of oil is used. I think the steel which is cut off by use gives the oil a drying property, hence the stone is fouled, and takes twice the time to set an edge that it would to clean off and renew as the stone becomes dry. Water will not unite with grease, but it often happens that water-stones become fouled with oil from the using. The alkali unites with oil, a soap is the result, and this can only be washed off with clean soft water, and then fresh oil or water can be put on, as the case may require.

Elasticity of Bodies.

	Modulus of Elasticity.
Perfect elasticity	1·
Glass	·94
Hard-baked clay	·89
Ivory	·81
Limestone	·79
Steel (hardened)	·79
Cast iron	·73
Steel (soft)	·67
Bell metal	·67
Cork	·65
Elm-wood, across the fibres	·60
Brass	·41
Lead	·20
Clay, just malleable by the hand	·17

All known solid bodies are *imperfectly* elastic—that is, in all, the force of *restitution* is less than the force of compression; but we have none without some force of restitution, or which are perfectly non-elastic.

The above table of moduli, and the rules for bodies of different hardnesses, are the results of experiments of Mr. Eaton Hodgkinson.

Articles of Silk.

Silk articles should not be kept folded in white paper, as the chloride of lime used in bleaching the paper will impair the color of the silk.

Velocity of Mechanism.

A 60-inch fan running 4,000 revolutions a minute, has a velocity at the periphery of 1,100 feet per second. This is just about the average velocity of cannon balls.

Statistical Information.

BRITISH NORTH AMERICAN PROVINCES.

The Financial Position.

Mr. Galt's speech at Sherbrooke has been published in pamphlet form. Appended to it we find the following interesting statements:—

The Financial Position of the Provinces—1863.

	Debt.	Income.	Outlay.
Nova Scotia	$4,858,547	$1,185,629	$1,072,274
New Brunswick	5,702,991	899,991	884,613
Newfoundland 1862	946,000	480,000	479,420
P. E. Island	240,673	197,384	171,718
M. Provinces	11,748,211	2,763,004	2,608,025
Canada	67,263,944	9,760,316	10,742,807
Totals	79,012,205	12,523,320	13,350.832

Increased Revenues in 1864.

Canada, without the produce of the new taxes		$1,500,000
New Brunswick		100,000
Nova Scotia		100,000
		$1,700,000
Deficit of 1863	$827,512	
Surplus of 1864	872,488	
	$1,700,000	
Total revenues of all the colonies, 1864		14,223,220
Outlay		13,350,832
Estimated surplus		$872,488

The Position of the Confederation, estimated on the basis of 1864.

	Revenue now produced for the General Government.	Local Revenue which would not go into the general chest.	Subsidy to be paid to each Province.
Canada	$11,250,000	$1,297,043	$2,006,121
Nova Scotia	1,800,000	107,000	264,000
New Brunswick	1,000,000	89,000	264,000
P. E. Island	200,000	32,000	153,728
Newfoundland	480,000	5,000	367,000
	$13,260,000	$1,530,043	$3,056,849

Difference available for the purposes of the general government $9,543,108

	Expenditure.	Local Outlay.
Canada	$9,800,000	$2,260,149
Nova Scotia	1,222,355	667,000
New Brunswick	834,518	424,047
Prince Edward Island	171,718	124,016
Newfoundland	479,000	479,000
	$12,507,591	$3,954,212

Difference payable by the general government $8,553,379

Surplus at the disposal of the Government, $1,089,729.

Average of the Present Tariffs.

Canada	20 per cent.
Nova Scotia	10 "
New Brunswick	15½ "
Newfoundland	11 "
Prince Edward Island	10 "

Future Position of the Provinces.

	Local Revenues.	Estimated Outlay for 1864, under present Government.	Estimated Local Outlay under the Union.
Nova Scotia	$107,000	$667,000	$371,000
New Brunswick	89,000	404,047	353,000
P. E. Island	32,000	171,718	124,015
Newfoundland	5,000	479,000	250,000
	$233,000	$1,721,765	$1,198,015
Canada	1,297,043	*2,021,979 † 288,170	‡
	$1,530,043	$3,981,914	‡

* Average of the last four years.
† Interest on excess of debt.
‡ Not estimated by Mr. Galt, for reasons given in the speech.

The Auditor's Statement of the Liabilities of Canada.

Debenture debt, direct and indirect		$65,238,649 21
Miscellaneous liabilities		64,426 14
Common School Fund		1,181,958 85
Indian Fund		1,577,802 46
Banking Accounts		3,396,962 81
Seignorial Tenure:		
Capital to Seigniors,	$2,890,711 09	
Chargeable on Municipalities' Fund,	196,719 66	
On acct. of Jesuits' Estates	140,271 87	
Indemnity to the Townships	891,500 00	
		4,118,202 62
		$75,578,022 09
Less—Sinking funds...	$4.883,177 11	
Cash and Book acc'ts.	2,248,891 87	
		7,132,068 98
		$68,445,953 11
From which, for reasons given in his speech, Mr. Galt deducted the Common School Fund		1,181,958 85
Leaving as net liabilities		$67,263,994 27

Imports, Exports, and Tonnage of the Provinces.

	Imports.	Exports.	Sea-going tonnage, inward and outward.
Canada	$45,964,000	$41,841,000	2,133,000
Nova Scotia	10,210,391	8,420,668	1,481,953
New Brunswick	7,764,824	8,964,784	1,386,980
P. E. Island	1,428,028	1,627,540	No returns
Newfoundland	5,242,720	6,002,212	" "
	$70,600,963	$66,846,604	4,952,934
	66,846,604	Lake T'ge	6,907,000
Total trade	$137,447,567	Total tons	11,859,934

EDUCATION IN UPPER CANADA.

(*From the Chief Superintendent's Annual Report for* 1863.)

COMMON SCHOOLS.

Number of School Sections	4,273
" Schools open	4,133
" " free by action of ratepayers	3,228
" School Houses	4,173
" Pupils attending	360,808
" Children not attending any School	44,975
" Teachers, males 3,094, females 1,410*	4,504
Average salary paid male Teachers in cities..	$558
" " " " " towns..	470
" " " " " counties..	261
" " " female " cities..	225
" " " " " towns..	227
" " " " " counties..	172

Receipts from Legislative grant	$166,928	
" Municipal assessments..	919,525	
" Rate bills in Sch. not free	72,680	
" Clergy Reserve fund, &c.	106.467	
" Balance of 1862	167,285	
		$1,432,885

* Episcopalians, 747; Roman Catholics, 504; Presbyterians, 1,316; Methodists, 1,313; other denominations, and not reported, 624.

Exp. for Salaries of Teachers	$987,555	
" Maps, Apparatus, Prizes and Libraries	20,775	
" School houses and sites.	106,637	
" Rents and repairs	34,864	
" School books, stationery and fuel	104,613	
Balances unexpended	178,438	
		$1,482,885

ROMAN CATHOLIC SEPARATE SCHOOLS.

Number of Schools established		120
" Pupils attending		15,859
Appropriated from Legislative grant	$8,178	
Provided from local sources	25,629	
		$33,807

GRAMMAR SCHOOLS.

Number of Schools		95
" Pupils		5,352
" " admitted by Scholarships from Common Schools.		215
Receipts from Leg. grant and fund	$44,724	
" Municipal grants	15,636	
" Fees of pupils	20,462	
" Balances, &c.	8,786	
		$89,608

NORMAL SCHOOL.

Students admitted to be trained as Common School Teachers	291
Had previously been Teachers	147
Admitted from commencement, in 1847	3,981
Had previously been Teachers	2,086

COLLEGES.

Colleges reported in Upper Canada		16
Students attending		1,820
Income from Legislative aid	$150,000	
" " Fees	44,000	
		$194,000

ACADEMIES AND PRIVATE SCHOOLS.

Number reported	340
" of Teachers	497
" of Pupils	6,653
Total Educational institutions in U. Canada	4,588
" Pupils	375,338
" Expenditure for their support	$1,621,805

Consumption of Water.

A man is generally supposed to require about half a gallon of water per day for drinking, cooking, &c., and about four gallons more for washing, bathing, and other purposes; a family of five heads will require about nine gallons per day. In Paris the consumption of this liquid is officially stated to be

4½	gallons	for every man per day.
16½	"	" horse "
9	"	for a two-wheeled carriage per day.
16½	"	" four " " "
92	"	for every sq. yard of garden per annum.
66	"	for a bath per day.
½	"	for every sq. yard of public road per day.

The consumption in Madrid, according to the report of the directors of the Canal de Isabella II. Company, is

5¾	gallons	for every man per diem.
21½	"	" horse "
14½	"	" two-wheeled carriage per diem.
21½	"	" four " "
12	"	" square yard of garden "

The following is the consumption, in gallons, of water, per day and individuals, in the chief towns of Europe and America:

Rome, 243; New York, 125; Marseilles, 103½; Besancon, 54; Dijon, 44; Bordeaux, 37½; Hamburg, 28; Genoa, 26½; Madrid, 26; Glasgow, 25; London, 24½; Gette, 23; Lyons, 19; Manchester, 18½; Brussels, 17½; Monaco, 17; Toulouse, 16½; Geneva, 16¼; Narbonne, 16; Philadelphia, 15½; Paris, 15; Grenoble, 14½; Montpelier, 13; Nantes, 13; Voiron, 12; Clermont, 12; Edinburgh, 11; Havre, 10; Angouleme, 9; Liverpool, 6; Metz, 5½; St. Etienne, 5½; Altona, 5½; Constantinople, 4½; Rio de Janeiro, 2.

This statement only comprises the quantities of water supplied by aqueducts; those yielded by wells and other means are not easy to ascertain.

Miscellaneous.

CHEMISTRY.

BY CAMPBELL MORFIT, M.D., F.C.S.,

Late Professor of Analytical and Applied Chemistry in the University of Maryland.

In all the advances of either Civilisation or the Arts, and whether pertaining to those which minister to the wants, the industry, or to the protection of man, Chemistry has been a prevailing good, and has left marks of its usefulness. It is, indeed, the *Alma Mater* of the sciences; a great store-house filled with knowledge suited to the wants of all; its boundaries being co-extensive with Nature itself.

Chemistry is the only true socialist; for while it furnishes benefits to every community, it is upon fixed rules which neither policy, persuasion, nor legislation can change. She is immutable in her ways: acting as naturally as astronomy, with nicer precision than mathematics, greater certainty than human jurisprudence, and more industry than art or handicraft, for her operations never cease. It acts, too, with as much beneficence to mankind as all the theories of faith; because in her work she manifests, by unvarying attributes, and by her fruitfulness of universal blessings, the unmistakeable existence of a Great First Cause—a *Providence.*

Chemistry, in its theoretical signification, is that science which teaches us the internal properties of bodies and the mutual action of their elements. Its grand practical division is into—1. Inorganic or mineral chemistry; 2. The chemistry of organised bodies, which we so term because, though now dead, they have had their origin in a vital principle; and 3. Organic chemistry, comprehending those substances which have a present vital existence.

Analytical chemistry devises methods for detecting the various elements of a compound, and estimating their proportions. Synthetic chemistry enables us to form homogeneous compounds of dissimilar substances, and is used to verify the results of analysis. Arraying or docimacy is the dry method of analysis.

Practical or applied chemistry comprises the application of chemical principles to the arts; for example, to the making and fixing of colours for paints and dyes; to the processes of tanning, distilling, and brewing; to the manufacture of glass, porcelain, and artificial stones; and to domestic and culinary purposes. It is more elegantly termed technological chemistry, and to this branch belongs also metallurgy, or the art of separating metals from their ores.

Pharmaceutical chemistry relates to the preparation of remedies employed in medicine.

Medical chemistry is allied to physiology, and treats of the application of chemical principles in the theory and practice of medicine.

Toxicological chemistry refers to poisons, their special action upon the system, and the means of detecting them.

The subdivisions of the science are still increasing, and the varied uses to which it is now applied are so great, that even subordinate branches are growing or taking place out of those that had previously existed.

It was said of Mercury, in the days of mythology, that he plundered Neptune of his trident, Venus of her girdle, Mars of his sword, Vulcan of his implements, and Jupiter of his sceptre. This is but an allegory referring to Chemistry, of which Mercury was the patron, and through the means of which he collected so much knowledge from unseen as well as visible sources; and now, Justice, acting upon her principle of retribution as to matters of this world, makes him return, with interest, to us, the prizes pillaged from the elements and the gods.

No one can tell to what extent the investigations in Chemistry may go; no one can define its limit. It enabled Daguerre to seize the fleeting shadows of the air and fix them immutable upon metal; and hereafter its discoveries may transfix the very sounds of human voices, and hold them quivering in the hand as echoes to the wind. Even thought itself may be reached, and the very breath that gives it silent aspiration be made to stand out upon tablets like recorded words of utterance.

It is a searching agent, which exposes the errors of those who blunder in the studies of Nature—a confirmer of truths—a spirit that dives into the deep bosom of the earth and reveals her riches, that soars into the high region of the heavens and brings away its lightning—that, like light, penetrates everywhere, and, like light, clears away all obscurities.

It is true that Sir Francis Bacon was the first to teach us how to follow the genius of Nature through her many mansions. He began at the beginning in this particular; and yet wonderful as was his learning then, and as it still is, he had only reached the threshold of the great temple of science which succeeding generations have only partly built up. It is still an unfinished edifice; not because it is labouring under the ban of a supernatural power, but because it is a structure to be made of mind, not matter—whose materials are to be drawn from the profoundest intellects, the tests of whose strength must be submitted to ages upon ages—whose increasing lights are beacons to guide its builders, and whose completion will be perfection.

How to Act when the Clothes take Fire.

Three persons out of four would rush right up to the burning individual, and begin to paw with their hands without any definite aim. It is useless to tell the victim to do this or that, or call for water. In fact, it is generally best to say not a word, but seize a blanket from a bed, or a cloak, or any woollen fabric—if none is at hand, take any woollen material—hold the corners as far apart as you can, stretch them out higher than your head, and, running boldly to the person, make a motion of clasping in the arms, most about the shoulders. This instantly smothers the fire and saves the face. The next instant throw the unfortunate person on the floor. This is an additional safety to the face and breath, and any remnant of flame can be put out more leisurely. The next instant, immerse the burnt part in cold water, and all pain will cease with the rapidity of lightning. Next, get some common flour, remove from the water, and cover the burnt parts with an inch thickness of flour, if possible; put the patient to bed, and do all that is possible to soothe until the physician arrives. Let the flour remain until it falls off itself, when a beautiful new skin will be found. Unless the burns are deep, no other application is needed. The dry flour for burns is the most admirable remedy ever proposed, and the information ought to be imparted to all. The principle of its action is that, like the water, it causes instant and perfect relief from pain, by totally excluding the air from the injured parts. Spanish whiting and cold water, of a mushy consistency, are preferred by some. Dredge on the flour until no more will stick, and cover with cotton batting.

Water Supply of London.

At the beginning of the present century the water mains of the City of London were wooden—the trunks of trees bored out—and in no case of more than one foot in diameter. How the metropolitan giant must have grown, the size of his present iron arteries is a proof. The mains of the eight water companies not only supply London proper, but push out far into the country, invading even the agriculturaldistricts, and supplying its farms. They distribute in the aggregate upward of 100,000,000 gallons daily, through 3,000 and odd miles of main, and supply 375,000 houses and factories, through capillary pipes upward of 7,000 miles in length. If all the water daily used in this great city were collected in one great reservoir it would cover seventy acres in extent and six feet in depth. As the spectator watched this great expanse of water he would see it hour by hour draining to the bottom by the collective millions in the metropolis as calmly and noiselessly as a cup is drained by a dusty roadside traveller. The collective iron heart, the steam engines which propel this flood, possesses a force of not less than 9,000 horses.

Overwork.

Unwise above many is the man who considers every hour lost which is not spent in reading, writing or in study, and not more rational is she who thinks every moment of her time lost which does not find her sewing. We once heard a great man advise that a book of some kind be carried in the pocket, to be used in case of an unoccupied moment, such was his practice. He died early and fatuitous. There are women who, after a hard day's work, will sit and sew by candle or gas light until their eyes are almost blinded, or until certain pains about the shoulders come on, which are almost insupportable, and are only driven to bed by physical incapacity to work any longer. The sleep of the overworked, like that of those who do not work at all, is unsatisfying and unrefreshing, and both alike wake up in weariness, sadness and langour, with an inevitable result, both dying prematurely. Let no one work in pain or weariness. When a man is tired he ought to lie down until he is fully rested, when, with renovated strength, the work will be better done, done the sooner, and done with a self sustained alacrity The time taken from seven or eight hours' sleep out of each twenty-four, is time not gained, but time much more than lost; we can cheat ourselves, but we cannot cheat nature. A certain amount of food is necessary to a healthy body, and if less than that amount be furnished, decay commences the very hour. It is the same with sleep, and any one who persists in allowing himself less than nature requires, will only haste his arrival at the mad-house or the grave. This is especially true of brain work.—*Scientific American.*

Reflectors for Street Lamps.

The *American Artisan* suggests that reflectors over the street lamps would send down the light that now goes towards the fixed stars. In the absence of such reflectors one-third of the gas used is wasted. This suggestion is worthy the consideration of municipal rulers, anxious to economise their finances and keep down taxes.

A Remarkable Iron Mountain in Canada.

The existence of an immense iron mountain, almost on the shores of Lake Superior, outrivaling the famous iron mountains of Marquette, seems too marvelous for belief, yet the fact is even so. It is surprising that such a wonderful mineral deposit should remain undiscovered until a recent date. This mountain is six hundred feet above the level of the plain, and nine hundred feet above the level of the lake, being about twice as high as the iron mountains of Marquette. The first examination was made in July this year, by Professor Duffield, of Detroit, who, from the general features, concluded that the range was identical with that of Marquette, and to satisfy himself he visited Marquette to get the range, by which his theory was sustained. A company was formed, which obtained a patent from the Canadian government for 3,200 acres, which comprises the mineral tract in question. Four weeks ago, some of the representatives of the company, with a few scientific gentlemen, set out for the district upon a tour of exploration. The party returned a day or two since, and report that the most sanguine expectations concerning the extent and richness have been more than realized. The ore is of the finest quality, and extending several miles, in deposits many feet in thickness. It is so plentiful that by no human agency can the supply be exhausted for hundreds of years! A quantity taken from the depth of only fifteen feet from the surface, and smelted in a common blast furnace, realized 60 per cent. of pure iron. As 30 per cent. is a good working average, the richness of the newly discovered ore will be apparent. At a greater depth its purity will be on a corresponding scale, in accordance with a well-known mineralogical law.—*Detroit Tribune.*

Limes and Mortar.

On the subject of slaking lime for a considerable time before use, a writer in the *Builder* says: "My experience, after many trials and careful attention, convince me that for all rich, fat, or very meagre limes, this is the best plan; but it is, of course, necessary to keep the lime from contact with the air, by submersion or otherwise. With limes that are moderately or even slightly hydraulic, I hold such a process injurious, as, when once these limes have begun to set, they could not be disturbed, as the setting properties cannot again be restored except by a second calcination, to drive off the chemically combined matter."

Dispensing with the Steeping of Flax.

It appears from the *Society of Arts Journal* that a French manufacturer named Bertin has invented what is reported to be a successful method of dispensing with the steeping of flax. After the fibres have been crushed in the ordinary way, M. Bertin submits them to a new process, that of friction between two channelled tables, which have a sideway as well as to-and-fro motion; in fact, the action is similar to that of rubbing the fibres between the palms of the hands, but under considerable pressure and with great rapidity. The fibre is afterwards beaten in water, which carries off every particle of woody matter, and leaves the flax completely unbroken and in parallel masses. The principle of friction tables has been applied by M. Bertin in other cases, and is said to furnish an economical, rapid, and perfect mechanical action. The same gentleman has adopted a new system of chemical steeping to get rid of the resinous and other matter which attaches the fibres together, which is said to produce the required effect in less than two hours, at a cost of about 1s. 8d. per cwt., leaving the flax nearly white; but the particulars are not given. By M. Bertin's system it is affirmed that the yield of flax is raised from 12 or 15 to 20 or 22 per cent. of the gross material. Lastly, M. Bertin collects the refuse beneath his crushing machines, burns it in his boiler furnaces, and uses the ashes and the water in which the flax is steeped as manure, giving back, as he affirms, the whole of the mineral salts and azotised matter contained in the crop, and the cost of so much artificial manure saved to the cultivator.

Mantel Ornament.

An acorn suspended by a piece of thread within half an inch of the surface of water in a hyacinth glass, will, in a few months, burst and throw a root down into the water, and shoot upwards its straight and tapering stem, with beautiful little green leaves. A young oak tree, growing in this way on the mantel-shelf of a room, is a very elegant and interesting object.