THE JOURNAL

OF THE

Board of Arts and Manufactures

FOR UPPER CANADA.

FEBRUARY, 1865.

BRANTFORD ENGINE WORKS.—GANSON, WATEROUS & CO.

The favourable accounts which we have from time to time received of the reputation of this establishment, together with the recollection of the saw mill in successful operation, which this company sent to the late Provincial Exhibition at Hamilton, have induced us to visit Brantford for the purpose of looking through their manufactory. We now proceed to give our readers a short account of the impression made on us while pursuing our object.

Unfortunately our visit was made at that unseasonable time when the workmen, having scarcely recovered their work-a-day habits after the holidays, were, not blameworthily, tempted to "make another day of it," to see their volunteer "companions in arms" off to the Frontier. We were thus deprived of the pleasure which we always feel on seeing good machinery in motion; and, in the presence of those powerful engines, capable of accomplishing such great results—if need were—without any rest, seeing them in a state of quiescence, we felt the stillness almost oppressive. Practically, however, the absence of motion was less inconvenient than it would have been to those entirely unacquainted with such matters.

All the tools here are of the best kind, and well adapted to the work required of them. If it were otherwise, indeed, the measure of success which the concern has achieved would have been impossible.

The number of hands in constant employment at this establishment is about sixty, many of whom represent families. The principal articles manufactured are the heavier agricultural implements, as mowers, reapers, threshing machines, clover mills, chopping mills, and Sutton & Gibson's patent grain dryer, also steam grist mills; lath, shingle, and gumming machines; portable steam saw mills; upright, horizontal, stationary, and portable steam engines; mill gearing, &c. The annual value of the products of this establishment is about $100,000. It has been stated that "probably there is no other establishment in Canada which has within the last eight or ten years turned out so large a number of mowers, reapers and thrashing machines."*

Our attention was directed to the shingle machine which they manufacture, and which they state to be capable of making, from the log, 13,000 shingles in ten hours, requiring the attendance of three men, and ten horse power to drive it. The work guaranteed is 10,000 a day. This machine is an American idea, made little of until perfected by this firm. The lath machine, we are told, will turn out from 12,000 to 14,000 laths a day, requiring three men and five or six horse power.

The iron "champion chopping mill," which they have patented, is undoubtedly a very effective machine for general crushing, grinding and pulverizing purposes, for corn meal, corn cob and shuck, all kinds of feed, spices, malt, coal and bones. It is claimed for this mill that it possesses some new and very important features, amongst others, that its diamond shaped teeth are so constructed and arranged as to render it independent of its centrifugal force for discharging the substances ground, each tooth from its form and working direction forcing it a stage onwards towards the periphey and discharging edges. That part of the machine which crushes the substances presented is separated from the grinding plates, the former breaking up and preparing the material for the latter. In the crushing process it is forced into the mill proper, and ground to any degree of fineness which may be desired. The crusher operates twice in each revolution, producing a full supply to the grinding plates. The mill will work equally well in either direction, and we think it very desirable that it should do so, as whatever wear of the teeth there may be in working one way will be in favour of the teeth when the motion is reversed.

To farmers who have any kind of power, we should think this a very desirable mill for chopping feed, grinding meal, &c., saving time and toll in going to mill; and we would suggest also that millers would find it much more economical for chopping coarse grain, than keeping mill stones in order for that purpose; also where any kind of hard, coarse, substances are required to be crushed, parties concerned would do well to enquire into its capabilities. It is a small, compact, very strongly built, little affair, occupying little more space than a large cheese. We have seen it in operation, crushing and grinding whatever was thrown in, oats, corn, cobs, and blocks of wood. We learn also that persons using it testify that it is very durable, and will grind ten bushels of corn

* *Brant Expositor.*

meal, or chop from twenty to thirty bushels of corn and cob, per hour. The price of it is $40.

If we are correctly informed, this company have achieved a most enviable reputation for their steam grist and saw mills, of which we have seen very flattering testimonials from good authority. The opinion entertained by the company is that their steam mills are cheaper than the average of water mills. We share with them and many others the belief that the steam engine is destined to supersede the water wheel; and from what we have seen, we are constrained to do Messrs. G.W. & Co. the justice to record our belief, that their improvements have greatly reduced the difference in point of economy heretofore existing between the two motive powers in question, especially in the application of steam power to the manufacture of flour and lumber. If, as they say, they can apply all their improvements wherever steam is used as a motive power, the manufacturing industry of the country must be benefited in proportion as they are introduced. If they shall succeed in convincing capitalists that they can make good their promise to construct effective and durable steam mills, which would be better investments than the average of water mills, no one will hesitate between water and steam, for it is understood that water power is becoming less and less certain from clearings at its sources; besides which, the advantages in favour of steam power in the choice of a site are so manifest that, other things being equal, every sane person would pronounce for it.

These gentlemen have put forth a statement to the public, to the effect that their steam mills can be, and are, worked with less cost for fuel than the ordinary water mills cost, say for extra interest on first investment in water privilege, and keeping up dam, &c.

Speaking in reference to steam grist mills, they state positively that there is not one in Canada or North America capable of grinding one hundred barrels of flour with six cords of wood; but if they could do so, that at $2 50 per cord, not reckoning expense of labour in firing, it would cost, running 275 days a year, $4,125, or simple interest on $68,750. Whereas they undertake to build a steam grist mill, which they will guarantee to grind one hundred barrels of flour for every one and a half cords of wood, say $3 75, or $1,031 25 for a working year of 275 days, making a difference in their favour of $3,093 75.

If these statements are correct, then has this establishment contributed largely to the interests of the country. If they can be impugned, let it be so; and our columns will be as open to the refutation of error, as they are to accord the meed of praise where it is due.

Mr. R. Vansickle, Leyden P. O., who runs Gartson, Waterous & Co.'s saw and grist mills, and who raised objections to the smallness of the boiler (less than the old one, which was not large enough), found it amply sufficient to drive his mill of muley saw, 4 feet circular, edging, stabbing and lath saws, and gristing mill of two runs of 44 in. stones, at the same time, frequently grinding 200 bushels or more a day. In answer to a question as to fuel, he says, "I cannot tell you what amount of fuel we consume; but when our circular saw alone is running, with the grist mill in full operation, grinding 16 or 18 bushels an hour, we burn no more than the saw dust, leaving the slabs for future use." The circular saw, he says, will cut 2,010 feet of lumber in 45 minutes, with the grist mill in full operation.

Mr. J. C. Geddes, manager of the Bank of British North America, proprietor of the steam flouring mills of Burford, states, in reference to certain improvements made for him in those mills, that they have accomplished more than was promised, and believes they will grind three times the quantity with the same quantity of fuel.

Mr. D. D. Hay, of Listowell, C.W., had an engine that was hardly capable of driving one run of 30 in. stones, and now has a new engine from the above works, which, with the old boiler, can drive two run of stones and a five feet circular saw, quadrupling the work with the same quantity of fuel.

Of the patent direct action circular saw, similar to the one exhibited at Hamilton, Mr. Potter, of Brantford, who has had great experience in saw mills and lumber, says it is the best he has any knowledge of in any country, for quantity and quality of work.

If these statements are correct, and the names given are highly respectable, then the requirements of theory, which are that three fourths less fuel should accomplish the work commonly done, are very nearly approximated. So close indeed is this approximation, that if it is true, that "physical conditions of perfection cannot be secured under any circumstances," new data may be furnished by the results here arrived at for further theoretical investigation. We have been told that "Every question 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;" but if it shall be proved that we have fulfilled the conditions indicated by theory. and physical perfection being impossible, may we not require that science should go on exploring the way in advance of actual practice?

The comparatively great power of the small Brantford engine, is due to the practical application of certain laws and conditions which have been too frequently overlooked or neglected. Every engine is built with special reference to the nature as well as to the amount of its work. Steam is used expansively, with the cut off and double valve. Every provision is made for securing perfectly dry, superheated, and, as Mr. Waterous calls it, "vital" steam, to enter the cylinder under such conditions as are most favourable to the conversion of all its force, which the laws governing it render possible, into work. The quantity of steam admitted is comparatively small. The stroke of the piston is short and rapid—conditions which they have long observed, and which are admitted to be indispensable to economy. The small quantity of steam required, enables the engineers to use boilers very much smaller than those we have been accustomed to, besides which they impart to them greater efficiency by their conformation and mode of heating.

We know there are many excellent machinists and engine builders in this country, and some of them may have improvements not sufficiently known, if so, we offer our columns freely for discussing their merits. The great object of this journal is to disseminate that kind of knowledge which is most conducive to the best interests of the country, taking care to keep our readers well posted in all improvements at home and abroad.

At this juncture, more than at any former period of our history, it behoves every man to contribute whatever of intellectual or material he may possess to the general good.

To contribute, however, does not always mean to give something for nothing; but let him bring his knowledge or his skill practically before the country; and if it be suitable, and required, the laws of supply and demand will take care of his interests.

NEWSPAPERS FOR READING ROOMS.

The Directors of the Toronto Mechanics' Institute are desirous of disposing of a number of the newspapers taken for their Reading Room, as they are exchanged for the current numbers. Thus, the New York World of Monday arrives in Toronto on Tuesday, and is removed on Wednesday to make room for Tuesday's paper—the Monday's number may be immediately sent away to any party subscribing for it. This we conceive to be an excellent plan, inasmuch as it will afford many parties an opportunity of purchasing expensive papers at a greatly reduced price. Particularly will it assist Mechanics' Institutes in the country to do so. On reference to our advertising columns a list of the papers, with the prices at which they are offered, will be found.

MR. LUKE'S SPIRIT OF TURPENTINE.

In drawing attention to the various specimens of spirits of turpentine shown at the last Provincial Exhibition, in the city of Hamilton, we remarked in reference to that submitted by Mr. Luke, of Angus, that "we were assured that it answers the purpose of the painter very well for common work." Mr. Luke has handed us a certificate, of which the following is a copy, and which we cheerfully publish:

"Hamilton, October 3rd, 1864."

"I hereby certify that the sample of turpentine offered to me for trial by Mr. M. C. Luke is a good article. I have experimented with it in Messrs. H. G. Cooper and Co's (Carriage) Manufactory of this city, in a variety of ways, and it operates to my satisfaction in every respect.

(Signed) "Christopher F. Donovan,
"*Carriage Painter.*"

The above was also endorsed by Mr. C. Cooper, Carriage Painter. If it has thus been proved suitable for carriage work, it will no doubt be equally so for any other good work.

With respect to the peculiar odour of this turpentine, Mr. Luke thinks it is owing to the kind of wood it is obtained from, and not to the mode of distillation, as previously suggested. The other samples are obtained from white pine, Mr. Luke's is from the red pine, some specimens of which—completely saturated with the gum—are now in our rooms.

We would suggest to parties using spirits of turpentine in considerable quantities, that they should give the *home made* article a trial. As a people we will never be really prosperous, until we learn to manufacture for ourselves, and to use such manufactures in preference to the imported article, wherever it will answer our purpose to do so.

Samples, and information in reference thereto, from any manufacturers other than those already referred to, will be gladly received, and publicity given to them.

TO SUBSCRIBERS.

We again beg to remind subscribers who are in arrear, and whose accounts were furnished in the December number of the Journal, that we need the amount due. Subscribers for 1865 are also respectfully requested to remit the amount of their subscriptions, in postage stamps or otherwise, as soon as convenient.

Board of Arts and Manufactures
FOR UPPER CANADA.

MEETING OF THE COMMITTEE.

The Executive Committee of the Board held its last Meeting for the year on Tuesday, January 17. The members present were the President, the Vice President, H. Langley, W. H. Sheppard, J. Shier, Professor Buckland, and H. E. Clarke.

The Minutes of former meeting were read and approved of, and sundry accounts ordered for payment.

The special Committee appointed to prepare a plan, and estimates of cost, of a school of Arts in connection with the Board, submitted their report, which was adopted. (See report embodied in annual report to the Board.)

The special Committee also appointed at last meeting to

"Consider and report as to any improvement that may be desirable in the system of awarding prizes in the Arts and Manufactures department of the Provincial Exhibition; and also as to the reception and classification of goods, and admission of the public during the time the judges are engaged in the important duty of making their awards."

Presented their report, which was adopted. (See report embodied in annual report to the Board.)

Resolved—on motion of Mr. Langley, seconded by Professor Buckland—"That the Committee desires to record its appreciation of the successful labours of the Secretary, in editing the Journal for the past year, and sincerely hope that their successors in office may be able to secure his services upon the same for the succeeding year; and also that they may be able to afford some substantial acknowledgment of his labours.

A draft of annual report to the Board was submitted and discussed, and finally adopted, with Treasurer's analysed statement of receipts and expenditure for the year appended thereto.

The Committee then adjourned.

ANNUAL MEETING OF THE BOARD.

Toronto, 18th January, 1865.

The annual meeting of the Board was held this day, in the Board Room, Mechanics' Institute, at two o'clock, p.m.

The members present were the President, Dr. Beatty, Delegate, Cobourg Mechanics' Institute; the Vice-President, Professor Hincks, University College, Toronto; J. Shier, Delegate Whitby Mechanics' Institute; Professor Buckland, University College, Toronto; Thomas Sheldrick, President Dundas Mechanics' Institute; F. W. Coate, President, and Messrs. W. H. Sheppard, H. E. Clarke, H. Langley, B. Walton, Daniel Spry and W. Edwards, Delegates, Toronto Mechanics' Institute.

Certificates, duly attested, were submitted of the appointment of Delegates by several Mechanics' Institutes, namely:—Cobourg, Dr. Beatty and E. A. McNaughton; Dundas by its President, T. Sheldrick; Guelph, James Gow, Thomas Mair and Robert Melvin; Hamilton, James Cummings, Thomas B. Harris, H. M. Melville, C. W. Meakins, Samuel Sharpe, Archibald McCallum and Anthony Copp; Toronto, F. W. Coate (President) W. Edwards, W. H. Sheppard, H. E. Clarke, H. Langley, George Carroll, Daniel Spry, Benjamin Walton and C. W. Bunting; Whitby, John Shier, John Bengough and M. Thwaite; the Toronto Board of Trade by Samuel Spreull.

The Minutes of last meeting of the Board were read and approved of as correct.

The report of the Committee for the past year was read, with Treasurer's balance sheet and analysed statement of Receipts and Expenditure.

On motion of Mr. Shier, seconded by Professor Buckland, the report was received and adopted.

The President, Vice-President, and Secretary-Treasurer, were respectively proposed for re-election, and as no other nominations were made, they were accordingly elected by acclamation, namely:—

President:—J. Beatty, Esq., M.D., Cobourg.
Vice-President:—Rev. Professor Hincks.
Secretary-Treasurer:—Mr. Wm. Edwards.

The ballot was then taken for the *Committee*, which resulted in the election of the following gentlemen:—

W. H. Sheppard, H. Langley, John Shier, Professor Buckland, F. W. Coate, E. A. McNaughton, H. E. Clarke, Thos Sheldrick and B. Walton.

On motion of Mr Sheppard, seconded by Mr. Shier, it was *Resolved*—"That the Board recommend the Committee to continue to urge upon the Legislature the necessity of making such alterations in the Patent Laws of this Province, as are suggested in the report of the Committee; also the desirability of amending the act under which this Board is constituted."

On motion of Mr. Sheppard, seconded by Mr. Shier, it was *Resolved*—"That Mr. R. J. Griffith and Mr. Daniel Spry be requested to act as auditors of the accounts for the past year."

On motion of Mr. Langley seconded by Mr. Shier, it was *Resolved*—"That the thanks of this Board be accorded the President, Dr. Beatty, for the efficiency and zeal with which he has performed the duties of his office for the past year."

On motion of Mr. Sheppard, seconded by Mr. Sheldrick, a vote of thanks similar to the above was unanimously accorded to the Vice-President, Rev. Professor Hincks.

The Board then adjourned.

W. EDWARDS, *Secretary.*

ANNUAL REPORT OF SUB COMMITTEE.

The Sub-Committee beg to submit to the Board the Eighth Annual Report—being an abstract of proceedings during their period of office, and of the present position and future prospects of the Board.

During the year, the following Mechanics' Institutes have been represented on the Board: Cobourg Institute, by two delegates; Dundas, by its president; Hamilton, by its president and seven delegates; London, by its president and two delegates; Toronto, by its president and eight delegates; Whitby, by its president and one delegate. The Toronto Board of Trade has also been represented by one delegate; and the Toronto University College by the Rev. W. Hincks, F.L.S., Professor of Natural History, and George Buckland, Esq., Professor of Agriculture.

Your Committee cannot but express their regret that so few of the Institutions intended to be benefited by the operations of the Board, should see it to be their duty to take part in its management. They fear, however, that no great improvement can be looked for in this respect, until the legislative grants to these Institutions are resumed, either on the former basis, or on that of the proposed amended act, providing for the payment of such grants through the instrumentality of this Board, in the same manner and on similar conditions as the payments of the Agricultural grants are made through the Board of Agriculture; or until such an increased annual grant is secured to this Board as shall make it more especially to the interest of the several Institutions to connect themselves with it.

For some four years successively has this Board, in conjunction with the Board for Lower Canada, sought for important amendments to that portion of the statute under which they are incorporated. These amendments have been concurred in by the respective governments and legislatures to which they have been submitted; but owing to their being connected with and forming a part of the same act constituting the Board of Agriculture and Agricultural Association and Societies, in regard to which important differences of opinion have so far existed, have failed to obtain the amendments sought for.

Patent Laws.

Your Committee have to regret that no amendments have as yet been made to the Provincial Patent Laws. Owing to their prohibitory character as regards subjects of other countries, our inventors are still prevented from participating in the benefits arising from the liberal provisions of the United States laws, under which patent rights are granted to subjects of foreign reciprocating countries on the same conditions as to its own subjects. The only conditions upon which a Canadian citizen can now obtain the benefit of the United States market for his invention, is by paying the sum of $500 for such right, under the American law as it existed prior to March, 1861.

The Hon. L. Letellier, late Minister of Agriculture, in concluding some lengthy remarks upon this subject in his report for the year 1863, says—

I deem it unnecessary to dwell any further upon the necessity of following, in the matter of patents for inventions, the example of liberality and of reciprocity afforded us in this respect by older countries, more advanced than ourselves in the development of the various branches of manufacturing industry, a course the adoption of which, it would seem, they have never had reason to regret.

Should these liberal views prevail with our present legislature, and the confederation of the Provinces be also carried out, our inventors will then be in a position to secure as a market for their inventions nearly the whole of the continent of North America.

The Journal.

The most serious drain upon the funds of the Board for the past four years has been on account of the Journal, upon which the average annual loss has been nearly $700. While your Committee look upon this as a larger sum than would have been required for the purpose had the Journal been properly patronized, and much larger than the funds of the Board could afford, in justice to its many other important objects; yet, in view of its advantages as a medium for disseminating the best of practical information amongst the industrial classes, they cannot for a moment think of recommending its discontinuance.

During the past year, the Secretary has undertaken the whole duty of editing and superintending its publication, without any additional remuneration, by which means the loss was much less on the last than on former years; and by means of other changes already introduced, while the efficiency of the Journal will be fully sustained, it is anticipated the loss on its publication for 1865 will be reduced to a minimum amount.

Your Committee desire to record their appreciation of the successful labours of the Secretary, Mr. W. Edwards, in connection with the Journal; and sincerely hope that their successors in office, in securing his services for the ensuing year, may be able to afford some substantial acknowledgment of his labours.

Free Library of Reference.

Owing to other demands on the funds of the Board, but comparatively few additions have been made to the Library during the year. The total number of volumes on the shelves at last report was 1,171; added during the year 102; total number now in Library 1,273; comprising British, American, and Canadian Specifications and Plates of Patents, 584 vols.; Statutes, Journals and other Parliamentary Publications, 167 vols.; Transactions of Societies, 33 vols.; and of the latest Cyclopædias and Standard Works on Architecture, Decoration, Designing, Engineering and Mechanics, Manufactures and Trades, and General Science, 489 vols. Of these your Committee acknowledge donations from the United States Patent Office of 6 vols. (in duplicate); from the Institution of Mechanical Engineers, 1 vol.; from the Smithsonian Institution, 1 vol.; from the Board of Agriculture for Upper Canada, 3 vols.; and from the heads of departments of the Government of this Province, the regular transmission to the Rooms of the Statutes, Journals, Sessional Papers, Blue Books, and other Parliamentary documents.

The library has been regularly kept open to the public from 10 a.m. till 4 p.m. each day; and on Tuesday and Friday evenings from 7 till 10 o'clock, to afford to persons engaged in industrial pursuits the opportunity of consulting the works it contains.

Annual Examinations.

The examination of members of Mechanics' Institutes in certain studies named in the published programme, and awarding to them certificates according to individual merit, as established by the Board in 1862, was comparatively successful during the past year. There were sixteen candidates out of the seventeen whose papers were returned to the Board, that obtained certificates: the number awarded being, of 1st Class, six; of 2nd Class, eleven; and of 3rd Class, nineteen; full particulars of which were published on page 197 of the Journal for the past year. Your Committee consider this result sufficiently encouraging to induce the Board to persevere, trusting that the time may soon arrive when these examinations shall be as popular as they are calculated to be beneficial in the education of the adult working classes.

School of Arts.

A special Committee was recently appointed to report on the practicability of establishing a School of Design in connection with the Board, the report of which Committee appeared in the December No. of the Journal, recommending that, instead of a School of Design merely, it would be more desirable to organize one combining Chemistry and Natural Philosophy with Drawing and Designing; the Special Committee was therefore re-appointed, with instructions to prepare a plan and estimate of cost of such a School of Arts; and at the last meeting of your Committee their report of the following scheme and estimates was presented, and is now submitted and recommended for consideration and adoption by the Board:—

1st. That the School be in three divisions, each distinct from the others, and to be commenced either separately or together as the circumstances may permit.

The first division to be for the study of Natural Philosophy and Chemistry.

The second division for Drawing, Designing, and Modelling.

The third division for Practical Mathematics.

2nd. The course of study to be pursued in the first division should embrace those subjects contained in classes 8, 13, 15 and 16 of the programme of annual examinations of the Board for the present year, namely, "Principles of Mechanics," "Practical Mechanics," "Chemistry and Experimental Philosophy," and "Geology and Mineralogy."

The teacher of this division should be a gentleman engaged by the Board at an annual salary. His duty should be, 1st, to give practical instruction in the classes during their sessions, on four nights per week; and in each week to give one popular lecture on science. 2nd. For one month preceding the fall session, and for one month after the spring session, to travel as a lecturer to those Mechanics' Institutes affiliated with the Board. 3rd. To edit a Chemistry and Experimental Philosophy department of the Journal. With a view to supplementing the salary paid by the Board, he be allowed to practise as an analyst on his own account, when not engaged in his duties in connection with the Board.

3rd. The fall session to commence on the first Monday in October, immediately after the teacher shall have finished his first month of lecturing, and to continue until the Friday preceding Christmas-day. The spring session to commence on the second Monday in January, and continue until the last Friday in May; after which the teacher should travel and lecture during the month of June. During the months of July and August there should be full vacation for the teacher, excepting his duties in connection with the Journal.

4th. During the sessions, two evenings in each week should be occupied in the study of Natural Philosophy, and two evenings in Chemistry; and on one evening in each week a popular lecture on some practical scientific subject should be delivered, the admission to which should be free to the public, with a view not only to impart instruction as widely as possible, but to induce individuals to join the school.

5th. The second division should include instruction in Elementary and Geometrical Drawing, as well as the higher branches of Art; particular attention being given to the drawing and modelling of organic forms, with a view to the attainment of such an accurate knowledge of their structure as shall enable the student to apply them with power and truth to every branch of decorative art or manufacturing industry. Instruction by means of lectures to be given on the fundamental principles of decorative and constructive design.

The Board to provide suitable casts and appliances, to which more attention should be given than to drawing from copy.

To pupils entering in the Geometrical Drawing department, it should be requisite that they have previously passed through a course of instruction in practical Geometry.

6th. The third division should include instruction in classes 6, 7, 11, and 14 of the programme of examination, namely, "Algebra," "Geometry," "Trigonometry," "Mensuration," and "Conic Sections."

7th. The second and third divisions should be under the charge of a separate teacher, or teachers, from the first division; and should each meet for instruction on two evenings per week during the fall and spring sessions of the school, on which evenings only would the services of the teachers in these divisions be required.

8th. Pupils, before entering in either the first or third division, should be required to pass a preliminary examination, in rudimentary studies. At the close of the Spring session in each year, pupils should be eligible to stand for examination and certificates at the annual "Final Examination" of the Board.

9th. The first division would require a Laboratory fitted with apparatus for the illustration of chemistry. The gallery of the Model Room might be made suitable for the purpose. The Model Room, with occasional use of the Library, would afford ample accommodation for general instruction in this division, and for the exercises of the second and third divisions.

10th. The expense of fitting up and furnishing apparatus, is estimated at $600. The annual expense as follows:—

Teacher of first division—Salary	$800 00
" second and third "	400 00
Annual expense of apparatus and chemicals	300 00
Fuel, light, &c., &c	200 00
Contingencies	300 00
Total	$2,000 00

11th. That the school be opened Free to all, of both sexes, who may be able to furnish evidence of worthiness to participate in its benefits, and who continue to manifest diligence and punctual attendance, and obedience to the rules; for although many of those who might enter its classes would be able to pay for the instruction received, others would not be able to do so; and to charge some, while others were admitted free, would be making invidious and unpleasant distinctions in the school.

Your Committee are satisfied that the school as here suggested, could be efficiently established and carried on for the foregoing sum of two thousand dollars per annum; and that for the first year the sum of $600, might be appropriated therefrom, for the necessary apparatus and fitting up; so that by increasing the Annual Legislative grant from $2,000 to $4,000 per annum, the school could be added to the other operations of the Board, and the whole carried on with efficiency and success.

Your Committee deem it highly desirable, and conducive to the interests of the community, that every facility should be afforded the industrial classes, to make themselves more intimately acquainted with the physical, artistic, and mathematical principles they are daily calling into action—thereby enabling them to economize raw material, shorten the processes of production, and produce more elegance of design and accuracy of workmanship, in whatever they execute. Artizans so instructed, both as to the science and practice of their respective arts, would be more likely to establish manufactories amongst us, employing the idle youths of our cities and towns, and adding to the wealth of the country.

Your Committee cannot but remark, that while liberal public provision is made for the education of persons intending to follow the various learned professions, they cannot see that it is less important that the working classes should be provided for.

That these were the views of the Legislature in passing the Act establishing this Board, there can be no doubt, as in one of its clauses (22 Vic., cap. 32, clause 31) it authorizes the Board "to found schools or colleges for mechanics, and to employ competent persons to deliver lectures on subjects connected with mechanical arts and sciences, or with manufactures;" and also to establish "schools of design on the most improved plan, and furnished and supplied in the most complete and appropriate manner that the funds at their disposal may admit of;" but so far, means have not been provided for carrying out these objects.

Your Committee recommend that the Board submit the foregoing scheme and estimates, to the Provincial Government, and pray for such an increase to the annual grant, as shall enable the Board to carry them into effect:—

Arts and Manufactures Exhibitions.

Believing that little interest is manifested by the leading manufacturers of the Province, in many important departments of industry, in securing proper representations of their products at the Annual Exhibitions of Agricultural Associations, your Committee recently appointed a special Committee to

"Consider and report as to any improvement that may be desirable in the system of awarding prizes in the Arts and Manufactures department of the exhibition; and also as to the reception and classification of goods, and admission of the public during the time the judges are engaged in the important duty of making their awards."

The Special Committee report—

"That in considering the matter submitted to them, they found it beset with many difficulties—some incident to a country *young* in manufactures, and others arising from long use of a system defective in so far as it has failed to secure satisfactory results.

It appears that the system of awarding 1st, 2nd, and 3rd prizes, creates in the minds of many really good workmen, a fear that their productions may be placed as second-rate in comparison with others that differ from them only in points involving questions of *taste* in the minds of the judges, and not one of superiority of workmanship. These fears would to a certain extent be obviated, if prizes were awarded for ABSOLUTE, rather than COMPARATIVE merit; for if an article should then be considered *excellent* by the judges, another article of the same description being so little inferior as to almost imply a doubt of its inferiority, would be pronounced excellent also, and it would be a matter of taste with the public as to which they would patronize.

The leading object of Manufacturers in bringing their productions for exhibition, is to *push* their business: the money prizes, even if obtained, are generally so insignificant that in most cases they will not cover the expense connected with the exposition of the article; and when one produces an article which is really excellent, and gains no reward, simply because there may be one or two articles of the same kind a little *more* excellent, it is truly discouraging to the producer.

Your Committee would therefore recommend that it be submitted to the consideration of the Council of the Association, that, instead of offering 1st and 2nd prizes for *best* and *second-best* of any specific article, Manufacturers be invited to send whatever they may produce of interest or worth, and that medals or diplomas attesting absolute merit be awarded, with such money additions as the funds will allow—such money allowances to be made with reference to the labour and expense incurred in bringing the articles forward. This would place all exhibitors in the position of those who now make "Extra Entries," and which are considered inferior to the regular entries; but which are really those that bring out the genius as well as the skill of the producer. It is not so much to produce by means of extraordinary labour and good materials a first-rate specimen of a specified article, as it is to originate the article itself, and bring forth both the *idea* and the workmanship, which is the case with many of the extra entries.

With reference to the reception and classification of goods, there are points which your Committee would desire to see pressed upon the attention of the Council of the Association. No matter what limit may be fixed for the reception of goods entered for prizes, some persons will always be late. We are persuaded that a time ought to be fixed sufficiently early to allow the work of the judges to be performed before the exhibition commences, so that those who are late may *exhibit* their articles, but lose the chance of obtaining prizes. Persons of regular habits will be in time when a rule is given for their guidance, and procrastinators will always be late, however you may make sacrifices for their accommodation. Your Committee therefore recommend that a stringent rule should be adopted upon this subject.

Your Committee are strongly persuaded, from their individual experience, that it is impossible for judges to form a correct judgment on the articles presented, unless they have the place to themselves, so as to have free access to the objects and undisturbed opportunity for consideration; and would therefore recommend that the public be not admitted to the main Exhibition Building during the time the judges are performing their responsible and arduous duties."

Trade Marks and Titles of Designs.

Your Committee are pleased to be able to report that the Assistant Minister of Agriculture, J. C. Tache, Esq., is manifesting great interest in the operations of the Board, and has caused to be forwarded for registry and public inspection, in accordance with the Statute 24 Vic., cap. 21, sec. 25, copies of all "Trade Marks" and "Titles of Designs" registered, and "Patents for Inventions" issued, by the Bureau of Agriculture; and has also given his assurance, with the approbation of the Hon. the Minister of Agriculture, that lists of subsequent issues shall be regularly forwarded to the Board for reference, and for publication in the Journal.

Finances.

The Secretary-Treasurer's detailed statement, herewith submitted, shows total receipts for the year, including cash balance of $847 50 from last year, of $3,170 19; expenditure, $2,338 50; balance in hand, $831 69; assets due on Journal, after deducting for cost of collecting and probable losses, $250; shewing a total balance in favor of the Board of $1,081 69. Total balance Dec. 1863, including assets on Journal, $1,167 50.

The annual Legislative Grant to the Board of $2,000 has heretofore been for the 12 months ending on the 31st of December in each year; but during the last session of Parliament the Government financial year was changed so as to terminate on the 30th of June instead of the 31st of December, as heretofore; so that the present balance in hand, with such subscriptions as may be received on account of the Journal, will be the only available funds for the six months ending 30th June next.

All which is respectfully submitted.

JOHN BEATTY, M.D.,
President.

COMMITTEE-ELECT.

Subsequently to the adjournment of the Board, the Committee *elect* held a meeting and organized the following special Committees:—

Resolved—on motion of Mr. Sheldrick, seconded by Mr. Coate—"That Professor Buckland, W. H. Sheppard and H. Langley, do constitute the Book and Journal Committee."

Resolved—on motion of Mr. Shier, seconded by Mr. Sheppard—"That Professors Hincks and Buckland, and Mr. Langley, do constitute the Committee on 'Final Examinations.'"

Resolved—on motion of Mr. Sheldrick, seconded by Mr. Shier—"That the President and Messrs. Clarke and Walton do constitute a Committee to urge upon the Legislature the amending of the Patent Laws, and the act constituting this Board.

The Committee then adjourned.

W. EDWARDS, *Secretary.*

Canadian Patents.

BUREAU OF AGRICULTURE AND STATISTICS, Patent Office, Quebec.

(For the half year ending June 30th, 1864.)

James Edward Harrison, of the Village of Bridgewater, and George Wolfe, of the same place, Stocking Weaver, "an improved machine for the Extracting of stumps, called the Bridgewater stump machine."—Dated 5th January, 1864.

Richard Clement, of the Township of Stamford, in the County of Welland, Inn keeper, "an improved clothes wringer, called Clement's Clothes wringer."—Dated 8th January, 1864.

John Cameron, of the Township of Pickering, in the County of Ontario, Carpenter and Joiner, "a churn and washing-machine combined, which is applicable to rubbing, sifting, and grating purposes, called Cameron's combined circular churn and washing machine."—Dated 9th January, 1864.

John Harris, of the City of Montreal, Brewer, "a new and useful lever paddle for propelling and steering vessels."—Dated 13th January, 1864.

William C. Kendall, of Buckingham, in the County of Ottawa, Mill Wright, "a new and improved water wheel, to be called Kendall's simple Discharge water wheel."—Dated 13th January, 1864.

Edward D. Gingras, of the City of Quebec, Carriage Builder, "a new and improved apparatus for attaching seats to sleighs and other vehicles, either for winter or summer use."—Dated 13th January, 1864

George Matthews, of the City of Montreal, Engraver, assignee of Thomas Sterry Hunt, of the same place, Chemist, "an insoluble and indestructible printing Ink, to be called The Patent Lake Tint."—Dated 13th January, 1864.

Edward Cullen Parkin, of Valcartier, in the County of Quebec, Clerk in Holy orders, "a new and useful material, to be called Lupulane (to be used in Manufacture of Paper)."—Dated 19th January, 1864.

Richard Dover Chatterton, of the Town of Cobourg, in the County of Northumberland, Gentleman, "a new and useful coupling for carriages on Railways and common Roads, called Chatterton's improved safety coupling."—Dated 25th January, 1864.

David Darvill, of the City of London, in the County of Middlesex, Carpenter "an improved Lever-power machine."—Dated 3rd February, 1864.

John Coleman, of the Village of Oshawa, in the County of Ontario, Turner, "a nulling and spiral Guage, called Coleman's nulling and spiral Guage."—Dated 3rd February, 1864.

James O'Hara, of the Village of Brockton, in the Township and County of York, Yeoman, "improved wheels for the propelling of ships and other vessels, called O'Hara's Diagonal Sculling wheels."—Dated 3rd February, 1864.

Donald McKinnon, of the Township of Markham, in the County of York, Yeoman, "an improved Thrashing machine, called McKinnon's Thrashing machine."—Dated 3rd February, 1864.

John Forsyth, of the Town of Dundas, in the County of Wentworth, Machinist, "an improvement on the valves of double action force-pumps, (including the particular kind of pump patented by one Waters)."—Dated 3rd February, 1864.

Samuel Stovel, of the township of Minto, in the County of Wellington, Yeoman, and Ebenezer Stovel, of the same Township, Yeoman, "a self adjusting Snow Gate."—Dated 3rd February, 1864.

John McLim, of the Village of Scotland, in the Township of Oakland, in the County of Brant, Physician, "a screw concave churn-dash."—Dated 3rd February, 1864.

Hugh Cant, of the Town of Galt, in the County of Waterloo, Machinist, "an improved form or description of Steam Engine, called Cant's rotary Engine."—Dated 11th February, 1864.

Joel Smith, of the Township of Haldimand, in the County of Northumberland, Blacksmith, "a machine for shrinking or upsetting the tires of wheels of Waggons and other vehicles, called and known as Smith's tire shrinking machine."—Dated 12th September, 1863.

George Gray, of the City of London, in the County of Middlesex, Blacksmith, "a new and improved mould-board for ploughs, called Gray's mould-board No. 5."—Dated 18th February, 1864.

Edward Lawson, of Melbourne, in the County of Richmond, Engineer, "a new and useful machine for separating and sorting ores and other matter."—Dated, 20th February, 1864.

James Dougall, of the City of Montreal, Mechanical Engineer, "an improved system of drainage."—Dated, 20th February, 1864.

Samuel Lawrence, of the Township of Stanstead, in the County of Stanstead, Gentleman, "a new and improved churn."—Dated, 26th February, 1864.

Norris Conrad Peterson, of the Town of Sarnia, in the County of Lambton, Blacksmith, "a machine for upsetting and fitting tires for wheels and other irons."—Dated, 26th February, 1864.

Gideon Huntington, of Norwichville, in the Township of Norwich, in the County of Oxford, Iron Founder, "an improved machine for upsetting the tires of wheels of carriages, waggons, and other vehicles, called Huntington's improved upsetting machine."—Dated 26th February, 1864.

Ozias Ansley, of the Town of Port-Dover, in the County of Norfolk, Tinsmith, "a ventilating Stove."—Dated 1st March, 1864.

Louis Blanchard, of the Township of Cornwall, in the County of Stormont, Yeoman, "a new description of gate, called Blanchard's improved gate."—Dated 2nd March, 1864.

Edward Payne, of the City of Montreal, Gentleman, "a new and useful apparatus or instrument for ascertaining the gravity of liquids, to be called Payne's Spiritometer."—Dated 8th March, 1864.

James Miller, of the Parish of St. Pie, in the County of Bagot, Tanner, "the discovery of the art of manufacturing from tan-bark a substance for tanning or dyeing purposes, to be called Miller's Extract of Tan Bark."—Dated 12th March, 1864.

Alexander McCarter, of the Village of Walkerton, in the County of Bruce, Blacksmith, "a new and useful improvement in boxing-machines for carriage and waggon wheels."—Dated 16th March, 1864.

Henry Cunningham, of the City of Kingston, in the County of Frontenac, Iron Founder, "a new and useful double top, and return flue heating and smoke consuming stove."—Dated 16th March, 1864.

Robert George Loftus, of the Township of Enniskillen, in the County of Lambton, Oil-Refiner, "a new and useful process by which the sulphuric acid used in refining distilled petroleum coal oil, naptha, and other products of the distillation of petroleum and coal, can be recovered and made equal to the acid in its original state for the refining of the aforesaid articles."—Dated 21st March, 1864.

David Richardson, of the Township of Brantford, in the County of Brant, Yeoman, "an article, called Richardson's Churn."—Dated 21st March, 1864.

Timothy McGinnes, of the Township of Ameliasburgh, in the County of Prince Edward, Machinist, "an improved apparatus for the drawing of water, called McGinnes' Water Drawer."—Dated 30th March, 1864.

Samuel Wilson, of the Village of Norwood, in the County of Peterborough, Tin-Smith, and James H. McGee, of the Town of Port-Hope, in the County of Durham, Carriage Maker, "a new and improved method of constructing Elbows for stove-pipes, the Elbow as improved being called McGee & Wilson's stove-pipe elbow."—Dated 4th April, 1864.

The Honorable Elijah Leonard, of the City of London, in the County of Middlesex, Engineer, "an improved sawing machine for the cross cutting of timber."—Dated 4th April, 1864.

John Angell Cull, of the City of Toronto, in the County of York, Gentleman, "an improvement in the form and arrrangement of the teeth or tines of a certain agricultural instrument, called 'The Forest Cultivator' as also of those of all other cultivators, or harrows, the shanks of which are used in a position either slanting or curved or sloping backwards, after the manner of the teeth or tines of the said 'Forest Cultivator.'"—Dated 4th April, 1864.

Alexander Carpenter, of the City of Hamilton, in the County of Wentworth, Esquire, "a hot water drum, to be attached in the second or third stories of dwelling houses, to cooking and other stoves for the purpose of heating water for bath and other purposes."—Dated 4th April, 1864.

Philip Taylor, of the Village of Oshawa, in the County of Ontario, Watch-Maker, "an article for the heating of cutters and carriages, called Taylor's cutter and carriage heater."—Dated 4th April, 1864.

Alvirus Gleason, of the Township of Wainfleet, in the County of Welland, Yeoman, "certain new and useful improvements in Thrashing machines and Grain separators, the machine as improved, being called Gleason's Fanning mill and Grain separator."—Dated 4th April, 1864.

Joseph Watson, of the Township of Norwich North, in the County of Oxford, Engineer, "a machine for the sowing of all kinds of grain and of plaster &c., broad-cast with or without a harrow or cultivator attached to it; and for sowing all kinds of grain in drills, and for planting corn by means of furrow and covering teeth combined and attached to the axle or box."—Dated 4th April, 1864.

Charles Jones, of the Village of Brant, in the County of Halton, Gentleman, "an improved clothes-dryer and clothes-horse, called The Victoria clothes-dryer and clothes-horse."—Dated 4th April, 1864.

François Xavier Pichette, of the City of Quebec, Carriage Builder, "a new and improved carriage shaft coupling."—Dated 13th April, 1864.

François Nadeau, of the City of Quebec, Carpenter, "a new and improved coal oil street lamp."—Dated 13th April, 1864.

James Ward, of the Township of Bury, in the County of Compton, Yeoman, "a new and useful instrument denominated a butter worker and bread moulder."—Dated 13th April, 1864.

John Williams, of the City of Montreal, Iron-puddler, "an improved cinder cement for lining puddling furnaces."—Dated 13th April, 1864.

David Roy Goudie, of the City of Montreal Chemist, and Druggist, "an improvement in the manufacture of fly and vermin paper, to be called Goudie's fly and vermin annihilator."—Dated 13th April, 1864.

Joseph Paradis, of the City of Montreal, Machinist, "a new and improved escapement hammer."—Dated 22nd April, 1864.

Alexander Dunn, of the City of Montreal, Tin-Smith and Plumber, "a new and improved self-acting water closet."—Dated 22nd April, 1864.

William James Maclea, of the City of Toronto, in the County of York, Tin-Smith, "a new soldering iron, called Maclea's gas-heating soldering iron."—Dated 2nd May, 1864.

Thomas Fogg, of Richmond, in the County of Richmond, Railway Inspector, "an improved chair for preventing bolts or nuts used in bracing and joining together iron rails from becoming loose or insecure."—Dated 2nd May, 1864.

Horace E. Rowe, of the Village of Napanee, in the County of Lenox, one of the United Counties of Frontenac, Lenox and Addington, "a new and useful Coffee-Pot, called The Royal Coffee-Pot."—Dated 2nd May, 1864.

James Clayton, of the Town of Whitby, in the County of Ontario, Machinist, "a new and useful machine for planting seed and distributing manure, called The root seed and plaster distributor."—Dated 2nd May, 1864.

Alexander Anderson, of the City of London, in the County of Middlesex, Machinist, "a new and useful harrow, called The Universal elastic reversible harrow."—Dated 2nd May, 1864.

Demas Otton, of the Township of Sophiasburgh, in the County of Prince Edward, Yeoman, "a new and improved Roller (Iron headed)."—Dated 2nd May, 1864.

J. H Thomas, of the Village of Brooklin, in the County of Ontario, Artist, "a new and useful Bee-hive, called Thomas' combined moveable comb Bee-Palace and Bee-Hive."—Dated 2nd May, 1864.

Jonathan Hilton Haven, of the Town of Guelph, in the County of Wellington, Clerk, "a new and useful chair, called Haven's sewing chair."—Dated 2nd May, 1864.

John Shaw, of the Village of Oshawa, in the County of Ontario, Chemist, "a butter working machine, called Shaw's butter working machine."—Dated 2nd May, 1864.

Samuel Noxon, the younger, of the Village of Ingersoll, in the County of Oxford, Iron-Founder, "a new and useful cultivator, called Noxon's cultivator."—Dated 2nd May, 1864.

James Riley, of the Town of Windsor, in the County of Essex, Ship-Smith, "a machine called Riley's straw, hay, stalk and root cutter."—Dated 2nd May, 1864.

Thomas Fletcher, of the Township of Beverley, in the County of Wentworth, Yeoman, "a new and useful beam and mould-board, respectively, for ploughs."—Dated 5th May, 1864.

RICHARD FULLER, of the City of Hamilton, in the County of Wentworth, Petroleum Dealer, "a new and useful method of impregnating and preserving wood with petroleum or the extracts thereof."—Dated 6th May, 1864.

JAMES STUART, of the City of Hamilton, in the County of Wentworth, Iron-Founder, "an article which he calls a Township Indicator."—Dated 17th May, 1864.

JOHN MOODY, of the Town of Terrebonne, Machinist, "additional new and useful improvements in the machine for breaking and cleaning flax, hemp and other like fibre yielding plants."—Dated 27th May, 1864.

WILLIAM OAKLEY, of the Town of Goderich, in the County of Huron, Cordwainer, "a new and useful Life Preserver, called Oakley's Polyzone Life Preserver."—Dated 30th May, 1864.

GEORGE STOVEL, of the Township of Minto, in the County of Wellington, Yeoman, "a new and useful Hay Elevator."—Dated 31st May, 1864.

GEORGE PERKS, of the Town of Port-Hope, in the County of Durham, Surgeon, "an improvement in Lamps, which he calls The Fan Blast."—Dated 31st May, 1864.

SILAS POMEROY HANNUM, of the Town of L'Orignal, in the County of Prescott, Watch-Maker, and WILLIAM HAMILTON, of the same place, Carpenter, "an improved Gold-Washing machine."—Dated 1st June, 1864.

ALANSON HARRIS, of the Village of Beamsville, in the County of Lincoln, Machinist, "a new and useful improvement in land Rollers."—Dated 1st June, 1864.

BENJAMIN KEFFER, of the Township of Vaughan, in the County of York, Carpenter, "a new and useful churn, called The British American Churn."—Dated 1st June, 1864.

SAMUEL COUPLAND, of the Township of Blanchard, in the County of Perth, and JOHN ADAIR, of the Town of St. Mary's, in the same County, Blacksmith, "a new and improved machine, called Coupland and Adair's combined cultivator and seed sower."—Dated 1st June, 1864.

ALEXANDER PATTERSON, of the Village of Gananoque, in the County of Leeds, Mechanic, "a machine called Paterson's Excelsior Mattress Filling Cutter."—Dated 1st June, 1864.

HUGH CLARKE, the younger, of the Village of Orono, in the County of Durham, Blacksmith, "a new cultivator."—Dated 1st June 1864.

HENRY CALCUTT, of the Village of Ashburnham, in the County of Peterborough, Brewer, "a compound liquid cooler and heater for cooling and heating liquids of every description, to be called Calcutt's compound Liquid cooler and heater."—Dated 3rd June 1864.

WILLIAM JAMES, of the Township of South Norwich, in the County of Oxford, Yeoman and Joiner, "a new and improved carriage Jack."—Dated 4th June, 1864.

GEORGE W. BOYCE, of the Village of Addison, in the Township of Elizabethtown, in the County of Leeds, Yeoman, "an improved churn."—Dated 4th June, 1864.

JOHN FREDERICK MOSIMAN, of the City of Toronto, in the County of York, Tinsmith, "an improved hot air stove or furnace."—Dated 9th June, 1864.

JOHN J. BEATY, of the Village of Streetsville, in the County of Peel, Machinist, "an Egg Beater."—Dated 13th June, 1864.

ISRAEL KINNEY, of the Township of Oakland, in the County of Brant, Coach-Builder, "an improved box and axle, called Kinney's anti-friction box and axle."—Dated 14th June, 1864.

ABRAHAM P. MILLER, of the Village of Norwichville, in the County of Oxford, Merchant, "a new, and useful Hydrostatic Engine."—Dated 14th June, 1864.

PHILIP WHITTY, of the City of Quebec, Machinist, "a new and useful Gold mining Pick, called Whitty's solid eye mining pick."—Dated 16th June, 1864.

JAMES CHASE, of the Village of Brooklin, in the County of Ontario, Mechanic, "a new and useful reaper rake attachment."—Dated 17th June, 1864.

JOHN VANDYKE, of Grimsby, in the County of Lincoln, Blacksmith, "a new and useful boring machine."—Dated 17th June, 1864.

WILLIAM H. HENDERSON, of Brockville, in the County of Leeds, Machinist, "an improved roof, called Henderson's non-leaking roof."—Dated 20th June, 1864.

DUNCAN MCKINNON, of the Township of Markham, in the County of York, School-Teacher, "The Double Scribe."—Dated 20th June, 1864.

WILLIAM BENTLEY, of the Village of Mount Forest, in the County of Grey, Machinist, and ISAAC IRELAND, of the same place, Machinist, "a new and useful combined hoop and lath machine."—Dated 21st June, 1864.

MOSES CHAPMAN NICKERSON, of the Town of Port-Dover, in the County of Norfolk, Gentleman, "a new and useful compound chemical soap."—Dated 21st June, 1864.

WILLIAM ORTON, of the Village of Aurora, in the County of York, Yeoman, "a new and useful combined hay-maker and hay-raker."—Dated 21st June, 1864.

Selected Articles.

PROCEEDINGS OF THE SOCIETY OF ARTS.

CANTOR LECTURES.

"ON CHEMISTRY APPLIED TO THE ARTS." BY DR. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE VI.

Delivered on Thursday Evening, April 28, 1864.

Flesh, its chief constituents, boiling and roasting. *Animal black*, its manufacture and applications. Various methods of preserving animal matters. Employment of animal refuse in the manufacture of *prussiate of potash*. A few words on the decay of organic matters, and their fermentation and putrefaction.

It will be easily understood, by those who have done me the honour of attending this course, that this last lecture must touch upon a variety of topics, in order to give an idea of some of the applications which animal matters receive, and which yet remain to be discussed.

Flesh.—M. Chevreul, in 1835, and Baron Liebig, in 1845, examined the changes which flesh undergoes when placed in contact with hot and cold water, and the following table taken from Liebig's interesting work on the chemistry of food, will give you an idea of the composition of flesh:—

Cold water.		Action of boiling.	
Soluble	66	Coagulated albumen	29·5
		Gelatine	6·0
		In Solution	30·5
Insoluble	164	Fibres and membranes	164·0
Fat	20		
Water	750		
	1000		

Liebig and Chevreul further succeeded in insolating, from the 30 parts soluble in water, some of the following substances :—

Kreatine	$C_8\ H_9\ N_3\ O_4 + 2\ H\ O$
Kreatinine	$C_8\ H_7\ N_7\ O_2$
Sarcosine	$C_6\ H_7\ N_3\ O_4$
Inosinic acid	$C_{10}\ H_9\ N_2\ O_{10}$
Lactic acid	$C_6\ H_5\ O_5 + H\ O$
Guanine (Scherer)	$C_{10}\ H_5\ N_5\ O_2$
Xanthine (Strecker)	$C_{10}\ H_4\ N_4\ O_4$
Glycocalle ,,	$C_4\ H_5\ N_1\ O_4$
Leucine (Cloetta)	$C_{12}\ H_{13} N_1\ O_4$
Osmazone	

The most important mineral salts in flesh are the acid phosphate and lactate of lime, and, according to Fremy, the acid phosphate of potash and chloride of potassium. The above statement shows that flesh is a most complicated substance, and it is easy to conceive that this must be so, when it is remembered that it is derived from blood, of which it contains a large amount ; but a most interesting curious fact is that, whilst blood is rich in salts of soda and poor in salts of potash, in flesh the relative proportion of these salts is directly reversed. Another interesting fact is the small amount of solid matter contained in flesh, and also the small amount of nutritive matter it yields to water under the most favourable circumstances. I repeat the most favourable circumstances," for when meat is placed in boiling water the three per cent. of albumen it contains is coagulated, closing the vessels of the flesh, and preventing all further exit of the fleshy fluids, and such should be the case when meat is intended to be eaten as boiled meat and is properly cooked ; but when the object in view is to extract the whole of the matter soluble in water, as in the preparation of beef tea, then the meat should be cut in small pieces, and brayed in a mortar with water, the whole then thrown into clean linen and pressed. The juice of the flesh so obtained should then be carried just to the boil, again passed through the strainer, and after the addition of a little common salt will be ready for the patient. Beef tea, even prepared by this process, which is certainly the best to my knowledge, contains, as the table above shows, but a small quantity of nutritive matter there being only a little gelatine and a small proportion of the other substances named above. Chevreul attributes the odour of beef tea and meat soups to osmazone, and Liebig to kreatine ; in fact, Liebig considers kreatine to be one of the essential substances characterising the aroma of various kinds of flesh. Liebig during his researches on this substance succeeded in obtaining from—

Fowls' flesh	3·21	of kreatine.
Ox heart	1·37	,,
Pigeon	0·82	,,
Beef	0·69	,,

Further he observed, that the flesh of wild animals contained a much larger proportion of kreatine than that of those which were confined ; for instance, that there was six times as much in the flesh of a wild fox as in that of a tame one. Allow me to say a few words on the properties of this curious substance, which presents itself in the form of moderately large white rectangular prisms, having a pearly lustre, soluble in water, insoluble in alcohol. Although this substance is neutral, it is converted when heated with hydrochloric acid into another solid crystallized substance called kreatinine, which possesses strong alkaline properties. When kreatine, instead of being treated by an acid is acted upon by baryta, it is converted into an acid compound called inosinic acid. Liebig ultimately succeeded in finding these substances, as well as another called sarcosine, in various animal secretions. I shall not take up more of your time by discussing the chemical properties of these substances, but merely state that they enable us to distinguish real soup tablets from spurious ones. For this purpose a solution of the tablet in cold water should be made, when, if genuine, it will give a precipitate with chloride of zinc, whilst the spurious one which contains gelatine but no kreatine, will not do so. Another reaction is, that the pure article will yield 85 per cent. of its weight to alcohol, whilst the imitation will only yield about five.

Preservation of meat and animal substances.—A low temperature is most favourable to the preservation of flesh and other animal substances, and under that condition it will not enter into putrefaction, the best proof of which is that elephants in a perfect state of preservation have been found in Siberia buried in ice, where they have doubtless existed for many thousands of years. It is also well known that the inhabitants of polar regions preserve their meat fresh by burying it in snow, and I mentioned an instance in one of my previous lectures, viz., the preservation and bleaching of sturgeon's bladders on the banks of the Volga. A high state of desiccation or dryness also contributes powerfully to the prevention of decay. Thus in Buenos Ayres and Monte Video meat is cut into thin slices, covered with maize flour, dried in the sun, and it is consumed largely, under the name of tasago or charke, by the inhabitants of the interior, and also by the black population in Brazil and the West Indies. Further, dried meat reduced to powder is used by travellers in Tartary and adjacent countries, and I may add that of late years meat biscuits have been extensively consumed by the emigrants having to travel from the United States to California and the West Coast generally. It is stated that six ounces per diem of this meat biscuit will maintain a man in good health throughout his journey. A remarkable instance of the preservation of animal matter by extreme desiccation is related by Dr. Wefer, who states that in 1787, during a journey in Peru, he found on the borders of the sea many hundreds of corpses slightly buried in the sand, which, though they had evidently remained there for two or three centuries, were perfectly dry and free from putrefaction. Although it is not within the scope of these lectures to describe the preservation of vegetable matters, still I cannot refrain from mentioning the interesting method adopted by MM. Masson and Gannal, by which, as you are doubtless aware, vegetables are preserved in the most perfect manner. Their process is most simple, as it consists in submitting the vegetables for a few minutes to the action of high pressure steam (70 lbs. to the square inch), then drying them by air heated to 100°, when, after compression by hydraulic pressure, they are made into tablets for sale, and when required for use it is only necessary to place the tablets for five hours in cold water, when the vegetable substances swell out to their former size and appearance and are ready for cooking. As the presence of oxygen or air is an essential condition of putrefaction, the consequence is that many methods have been invented to exclude that agent, or rather, as I shall show at the end of this lecture, the sporules or germs of cryptogamic plants or animals, which are the true ferments or microscopic source of fermentation and putrefaction. Permit me to describe concisely some of the methods proposed; and I believe that one of the best processes for excluding air was that invented by Appert, in 1804. It consists in introducing the meat or other animal substance with some water into vessels which are rearly closed, these are then placed in a large boiler with salt (which raises the boiling point of the liquor), and the contents of the vessels are kept boiling for about an hour, so as to exclude all air, and destroy, by the high temperature, all the sporules or germs of putrefaction they may contain, when they are hermetically closed. M. Chevalier Appert has improved this process in placing the prepared vessels in a closed boiler, by which means he raises the temperature (by pressure) to 234°, effecting thus the same purpose more rapidly and economically. To give you an idea of the extent of this trade, I may state that M. Chevalier Appert prepared above 500,000 lbs. of meat for the French Army in the Crimea. I am aware that many modifications have been applied to this process, but I shall only mention that of Mr. G. McAll, who adds to the previous principle of preservation a small quantity of sulphate of soda, well known to be a powerful antiseptic. The beautiful specimens now on the table, which have been kindly lent to me by Messrs. Fortnum and Mason and by Mr. McAll, will satisfy you of the applicability of the above-named methods for the preservation of meat and other animal substances. But before concluding this part of my lecture, I must add that the preservation of animal and vegetable substances by the exclusion of air and cryptogamic sporules is also effected by other methods than those above described; for instance, they are imbedded in oil, or in glycerine, as suggested by Mr. G. Wilson, or in saccharine syrups. I should not forget to mention that several plans have been proposed for protecting animal matter by covering their external surfaces with coatings impermeable to air. Two of the most recent are the following:—M. Pelletier has proposed to cover the animal matter with a layer of gum, then immerse it in acetate of alumina, and lastly in a solution of gelatine, allowing the whole to dry on the surface of the animal matter. The characteristic of this method is the use of acetate of alumina which is not only a powerful antiseptic, but also forms an insoluble compound with gelatine, thus protecting the animal matter from external inqury. Mr. Pagliari has lately introduced a method which is stated to give very good results. It consist in boiling benzoin resin in a solution of alum, immersing the animal matter in the solution, and driving off the excess of moisture by a currrent of hot air, which leaves the above antiseptics on the animal matter. It is scarcely necessary to mention the old method of using smoke arising from the combustion of various kinds of wood, except to state that in this case it is the creosote and pyroligneous acids which are the preservative agents. The preservation of animal matter by a very similar action is effected by the use of carbolic acid, a product obtained from coal tar. It is much to be regretted that this substance, which is the most powerful antiseptic known, cannot be made available for the preservation of food, but there can be no doubt that for the preservation of organic substances intended for use in arts and manufactures, no cheaper or more effective material can be found. For example, I have ascertained that one part of carbolic acid added to five thousand parts of a strong solution of glue will keep it perfectly sweet for at least two years, and probably for an indefinite period. Also, if hides or skins are immersed for twenty-four hours in a solution of one part of carbolic acid to fifty of water, and then dried in the air, they will remain quite sweet. In fact, hides and bones so prepared have been safely imported from Monte Video. From these facts and many others with which I am acquainted I firmly believe that this substance is destined within a few years, to be largely used as an antiseptic and disinfectant. I need hardly speak of the power of chloride of sodium, or common salt, in preserving animal matters, and it is highly probable that the interesting process described to you on the 13th April, by Mr. J. Morgan, for the employment of salt is likely to render great service in preserving animal food from putrefaction. But with regard to the feasibility of its use in Monte Video and Buenos Ayres, I cannot offer an opinion, as it depends upon so many local circumstances which it is impossible to appreciate here. Messrs. Jones and Trevethick displayed at the last exhibition some meat, fowls, and game preserved by the following process, which received the approbation of the jurors. Meat is placed in a tin canister, which is then hermetically closed, with the exception of two small apertures in the lid. It is then plunged into a vessel containing water, and after the air has been exhausted through one aperture by means of an air pump, sulphurous acid gas is admitted through the second aperture, and the alternate action of exhausting the air and replenishing the sulphurous acid gas is kept up until the whole of the air has been removed. The sulphurous acid gas in its turn is exhausted, and nitrogen admitted. The two apertures are then soldered up, and the operation is completed. As I consider the action of carbon on animal matters rather as a case of oxydation than of preservation, I shall refer to that subject further on, and shall, therefore, proceed to consider the employment of certain animal matters not yet alluded to during this course of lectures, such as the flesh of dead animals not used as food, and those other parts of their carcases which have not been applied in any of the processes already described. The greatest part of these refuse matters are used for producing animal black, which differs from bone black, referred to in my first lecture, being used in the state of impalpable powder, whilst bone black or char is composed of small hard grains. The manufacture of animal black is generally carried out by introducing into horizontal retorts connected with a coil or condensor, and with an exit pipe for the gases, some of the animal matters mentioned; on the application of heat decomposition occurs, the oily matters distil and condense in the worm, and constitute what is called oil of dippel, formerly much used in the art of currying certain classes of leather; water also distils, charged with a variety of ammoniacal salts, which are generally converted into sulphate of ammonia for agricultural purposes. As to the gases, they are usually ignited and burn to waste. The carbonaceous mass which remains in the retort is removed, and ground to powder with water in a mill, allowed to settle, and, lastly, dried and sold under the name of animal black. Its chief uses are in the manufacture of blacking and printing ink. Another manufacture which consumes a large quantity of animal refuse, especially the horns, hoofs, &c., of too inferior a quality to be used for the purposes described in my first lecture, is that of the yellow prussiate of potash, a most important salt, for it is extensively used in calico printing, silk and wool dyeing, and in the manufacture of the pigment called prussian blue, for gilding silver, copper, and other inferior metals; and lastly, it is the source from which cyanide of potassium is procured, a substance much employed in the art of photography.

Let me now call your attention to the manufacture of prussiate of potash, the greatest portion of which is still prepared at the present day by the old process devised by Dr. Woodward, F.R.S., in 1724. It consists in introducing into large cast-iron pots American pearlash, melting it, closing the vessel, and then setting the mass in motion by means of a revolving shaft. At this period of the operation, hoofs, horns, and other animal refuse, are introduced in small quantities at a time. Under the influence of heat and of the alkali, the nitrogen of the organic matters splits into two parts, one part combining with the hydrogen to form ammonia, which escapes, whilst, the other portion unites with the carbon, producing cyanogen, which remains combined with the potassium of the potash. After several hours the operation is considered to be completed, and the melted mass is run out into small cast-iron receptacles; when cool, these are placed in large vats with water, and a jet of steam is introduced, and the whole is kept on the boil for several hours, when the cyanide of potassium is partly decomposed, giving rise to carbonate of potash and to cyanide of iron, for not only has a portion of the iron of the melting pots been attacked and combined with the mass, but a certain quantity of iron filings has been used during the operation. However, two parts of the cyanide of potassium combine with one part of cyanide of iron, and the result is that a double cyanide, called ferro-cyanide of potassium, or yellow prussiate of potash, is formed. The liquors are then allowed to clear by standing, and the aqueous solution is evaporated until a pellicle appears on its surface, when it is allowed to cool. and the salt is deposited on strings which have been passed through the crystallising vat, and which facilitate the crystallisation of the prussiate salt. In consequence of the large amount of animal matter used as compared with the quantity of prussiate obtained, this salt has always commanded a good price in the market, and has induced many eminent chemists to try to devise cheaper processes for obtaining it. To attempt here to give merely an outline of these various proposed plans would involve so much technical description as would occupy far too much time for this lecture, but I would recommend those interested in this branch of manufacture, to read the learned account given by Dr. A. W. Hoffman, in his report on "The Chemical Products in the last Exhibition," page 57, where they will find the process of M. Gauthier-Bouchard for obtaining salts of cyanogen from the ammoniacal waters of gas works; those of Mr. R. T. Hughes and Messrs. Bramwell, of Newcastle, for the conversion of nitrogen of the atmosphere into cyanide of potassium; that of M. Kamrodt, for decomposing ammonia by carbon carried to a high temperature; and, lastly, that of MM. Marguerite and De Sourdeval, for producing cyanogen from the nitrogen of the atmosphere and fixing it by means of barium. This latter process seems to be highly commended by the learned reporter to whom I have referred. I must not, however, omit to mention the scientific and interesting process devised by Mr. Gelis, and based on the chemical reaction which ensues when bisulphide of carbon is mixed with sulphide of ammonium. Yellow prussiate crystallises in large crystals belonging to the octohedral system, composed, as before stated, of two parts of cyanide of potassium 2 Cy K, and one of iron, Cy Fe + 3 of water or H O. This salt is freely soluble in water, but is insoluble in alcohol, and when mixed with weak vitrol and heated gives rise to prussic acid, which distils, and may be used either as a violent poison or, in qualified hands, as a most valuable therapeutic agent. When ferro cyanide of potassium is heated with several times its bulk of concentrated sulphuric acid, instead of yielding prussic acid, as above it gives rise to a poisonous gas called oxide of carbon, which burns with a beautiful blue flame, and which we have all seen burning in our fireplaces when the combustible matter has lost all its volatile constituents and nothing remains but a red incandescent mass. When chlorine is passed through a solution of this salt chloride of potassium is formed, and the yellow prussiate is converted into red prussiate or ferricyanide of potassium, composed of $3\ Cy\ K + 3\ Fe_2\ Cy_3$. When heated with peroxide of mercury, potash, peroxide of iron, and cyanide of mercury are produced, the latter being a most violent poison. To produce Prussian blue on silk with this salt, all that is required is to dip the silk in a slightly acidulated liquor containing a persalt of iron, and when the silk is washed and mordaunted, it is dipped in a weak acidulated solution of yellow prussiate of potash, when it assumes a beautiful blue colour due to the formation of Prussian blue. To dye wool it is necessary to pass it through a boiling bath composed of yellow prussiate, muriate of tin, and a small quantity of sulphuric acid. Prussian blue is gradually formed, and fixes itself on the fibre. To produce blue on calicoes, a solution of yellow prussiate of potash is made, to which is added some tartaric acid and muriate of tin. This mixture, after having been properly thickened, is printed on the calico, and then submitted to the action of steam, the Prussian blue so produced being fixed on the cotton fibre by means of the oxide of tin, resulting from the decomposition of the salt employed.

Nothing is more simple than to gild or silver metals by means of ferrocyanide of potassium, or to cover iron and other metals with copper. To obtain a gilding liquor, it is only necessary to take 1,000 parts of water, adding to it 100 parts of yellow prussiate of potash, 10 parts of chloride of gold, and 1 part of caustic potash. Each of these should be added successively, and the whole of the liquor carried to the boil and filtered. It is then ready for gilding silver or brass objects, when properly attached to the pole of a galvanic battery. The silvering liquor is made by substituting for the chloride of gold, in the above process, ferrocyanide of silver, prepared by adding nitrate of silver to a solution of ferrocyanide of potassium, the white precipitate resulting being washed and added to the liquor intended for silvering. For covering zinc or iron with copper it is simply necessary to substitute the ferrocyanide of copper for that of silver. Ferrocyanide of potassium, as above stated, is also employed for the manufacture of Prussian blue, which was accidentally discovered by Diesback, in 1718, by adding alum, containing iron, to the ammoniacal liquors sold to him by Dippel, which were produced, as already stated above, during the distillation of animal refuse. These liquors, being rich in cyanide compounds, yielded with the salt of iron of the alum, Prussian blue. At the present day Prussian blue is manufactured by different processes, but they are all based on the principle of mixing various salts of iron with red or yellow prussiate, when double cyanides of iron (or Prussian blues) are produced.

I shall now examine with you some of the various causes which contribute to the destruction of animal matters, when it arises from slow decay or putrefaction. The first of these to which I shall have the pleasure of calling your attention, is that observed by Dr. Stenhouse, who, in 1854, made the curious discovery that, if the body of an animal be buried in a carbonaceous mass, such as charcoal, after a few months the whole of the animal, excepting the skeleton, would entirely disappear; and, what was still more remarkable, was that, though the experiments were conducted within his laboratory, no unpleasant effluvia were apparent to those who are constantly there. This eminent chemist attributed the rapid and complete destruction of animal tissue in these experiments, to the oxidation of the animal matters by the oxygen of the atmosphere; but to enable you fully to understand how this occurs, I must call your attention to the following facts. Lowitz, many years since, observed that charcoal possesses the property of absorbing and condensing in its pores large quantities of various gases, and Theodore de Saussure made an entensive series of experiments, from which I extract the following data:—

One cubic inch of boxwood charcoal, absorbed of—

Ammonia	90	cubic inches.
Hydrochloric acid	85	" "
Sulphurous acid	65	" "
Sulphuretted Hydrogen	55	" "
Carbonic acid	35	" "
Oxygen	10	" "
Nitrogen	7	" "

Consequently the absorption or condensation of a gas in charcoal appears to be in proportion to the solubility of the gas in water, and although the condensation by a solid and by a liquid may at first appear necessarily due to different causes, and therefore to bear no relation to each other, yet in my opinion these two actions are identical. Seeing that the gas is condensed by the molecular attraction of the solid, I do not see why the same attraction should not be exercised by the molecules of the liquid. The different degrees of solubility of various gases are no doubt owing to their respective physical properties, such as specific gravity, repulsive or expansive forces of their molecules, &c. I may here mention that I am now engaged in a series of experiments, in the hope of throwing some light on this interesting question.

Gay-Lussac, in his researches on the condensation of gases by charcoal, found that one gas may expel and take the place of another gas already condensed in the charcoal; and Dr. Stenhouse, following up this observation, states that the gases, vapours, and sporules generated by the putrefaction of animal substances, are absorbed by charcoal and brought into immediate contact with the oxygen of the atmosphere also contained in the pores of the charcoal, which oxidising or destroying the products of putrefaction converts them into water, carbonic acid, nitric acid, &c. These important scientific observations of Dr. Stenhouse have already received practical application; thus Mr. Haywood has established charcoal filters at the mouths of public drains, thereby arresting the escape and diffusion in the atmosphere of the noxious effluvia given off by the putrefying matters in the sewers. Further, charcoal respirators have become extensively used since Dr. Stenhouse called public attention to the valuable properties of this substance; and, lastly, atmospheric filters, containing charcoal, have been successfully applied in the houses of Parliament to purify the entering air from any noxious gases it may contain before passing into the building. The natural decay or destruction of organic matters is due to two perfectly distinct causes, one of them chemical and the other physiological. The former has been investigated by many of the most eminent chemists of the day, and no doubt can remain that the action of the oxygen of the atmosphere converts the carbon of organic substances into carbonic acid, the hydrogen into water, the sulphur into sulphuric acid, the nitrogen into nitric acid, the phosphorus into phosphoric acid, &c. Much light has recently been thrown upon these phenomena by Mr. Kuhlman, who clearly shows that the oxides of iron play a most important part therein; thus that the sesquioxide of iron yields its oxygen to the elements of the organic matters; that the protoxide of iron thereby formed absorbs oxygen from the air, which reconverts it into sesquioxide, and this again yields its oxygen to a fresh portion of organic matter, so that sesquioxide of iron is a most powerful oxidising agent, it being, in fact, the condenser of oxygen and the medium of its conveyance to and destruction of organic substances. MM. Chevreul and Kuhlmann have also shown that sulphate of lime acts in a similar manner, namely, that it yields its oxygen to the elements of organic substances, and is thus converted into sulphuret of calcium, which having a great affinity for oxygen is again rapidly converted into sulphate of lime, and thus the oxygenation and destruction of the organic matter is effected. Mr. Millon has published an interesting paper on the formation of nitre, or nitrate of potash, through the ammonia generated during the destruction of organic substances being oxidised into nitric acid, which combines with potash, if present, and if not with lime or magnesia, which are present in all soils. Mr. Millon has remarked that this important chemical reaction is effected by an organic substance called humic acid, which acid, or its homologues, exists in large quantities in all earthy loams containing much organic, and more especially vegetable, matters in a state of decomposition. Humic acid absorbs the oxygen of the atmosphere, which oxidises the ammonia into nitric acid and water. The chemical theory of the destruction of organic matters through oxidation and their absorption of plants and re-conversion into the same substances from which they were derived, such as sugar, starch, gum, oil, essences, &c., or albumen, fibrine, gluten, caseine, &c., was greatly in favour a few years since, as it appeared to fulfil all the requirements of nature. It has, however, been greatly shaken by the beautiful researches of M. Pasteur on fermentation, putrefaction, and spontaneous generation, which prove clearly that these physiological actions play a most active part in the destruction of organic substances. This most skilful chemist has demonstrated that there is no such thing as spontaneous generation, and that the notion entertained by some physiologists, that if matter is placed in favourable circumstances as to heat, light, &c., and in a proper medium, it will become spontaneously animated, is undoubtedly erroneous, and that life in all instances proceeds from a germ or egg in which the vital principle is implanted by the Creator. He proves that life, even in the most insignificant of microscopic creatures, always originates thus, and that there is no single instance of matter being animated by purely physical causes. Let me draw your attention to a few among many facts observed by M. Pasteur, proving that life is not a property of matter, like weight, elasticity, compressibility, &c., but is always the result of a germ even in its lowest development.

When arterial blood is carefully introduced from the artery into a clean vessel, and there brought into contact with oxygen, no fermentation or putrefaction of the blood ensues; and if the experiment is repeated, substituting for the chemically prepared oxygen, atmospheric air which has been passed through a tube containing pumice stone and carried to intense heat, in this case also, there is no putrefaction or fermentation; but if ordinary atmospheric air be used in the place of pure oxygen, or heated air, and left in contact with some of the same blood, this vital fluid will rapidly putrefy, which is doubtless owing to the presence in the atmospheric air of the sporules or eggs of mycoderma and vibrios, or organised ferments, which give rise to the various chemical phenomena and changes of organic matters into products which characterise fermentation and putrefaction. The same results are obtained when fresh urine is substituted for blood, an important fact, proving that the germs of fermentation do not exist in the fluids themselves, and that fermentation does not proceed from any molecular or chemical change in the composition or nature of the organic substances contained in blood and urine, but that the ferment from which these phenomena proceed is to be sought for in the atmosphere. I shall substantiate this view by several other interesting observations made by M. Pasteur.

If some asbestos is heated to a red heat and plunged into a liquor susceptible of putrefaction, such as a saccharine liquor, no fermentation ensues, but if atmospheric air is passed through asbestos at natural temperature, and the latter then immersed in a similar solution of sugar, active fermentation soon takes place, proving that the atmospheric air has left on the surface of the asbestos sporules of the mycoderma vini, which being introduced with the asbestos into the saccharine fluid, originated the well-known alcholic fermentation. Another beautiful series of experiments by M. Pasteur is the following:—He introduced into 60 small balloons a small quantity of a highly putrescible fluid, and after boiling the fluid in order to drive out the air remaining in the balloons by the formation of steam, he closed the small apertures, so that on cooling the steam condensed and a vacuum was produced. He then proceeded to open 20 of these balloons at the foot of one of the hills of the Coté d'Or, 20 others at the summit of the same (about 2,000 feet high), and the remaining 20 at a point near Chamounix, and the following results were observed: Of the first 20 balloons the contents of 15 entered into putrefaction within a few days; of the second 20 only 6; and of the third 20 only 2 gave signs of fermentation. These results, as well as some others published by M. Pasteur, prove that the sporules or germs of putrefaction and fermentation exist in all parts of the atmosphere, but more abundantly in the lower strata, which are necessarily in contact with great quantities of organic matter in a state of decay, and that these sporules become scarce in the upper regions of the atmosphere, which are further removed from the source of pollution. Further, he has proved, as I stated in my last lecture, when speaking of the preservation of milk, that fluids extremely liable to fermentation or putrefaction, may be prevented from entering into those conditions by heating them to 250° or 260°, a temperature at which the sporules cannot resist decomposition in the presence of water. M. Pasteur has advanced a step further in this interesting inquiry, for he has demonstrated that there are two distinct phases in putrefaction. In the first there are the vibrios produced in the bulk of the fluid containing animal matters in solution, and that these microscopic animals resolve the organic substances into more simple compounds; in the second phase, there are produced on the surface of the fluid cryptogams, which he calls mycoderms, and which absorb oxygen from the air, and oxidise the products developed by the vibrios. In the case of the fermentation of vegetable substances, such as saccharine matters, there are mycoderms (*mycoderma vini*) which resolve them into, say alcohol and carbonic acid, while other mycoderms (*mycoderma aceti*) are produced, and grow on the surface of the fluid, oxidising the alcohol into water and acetic acid. He therefore concludes that the animal vibrios and vegetable mycoderms exist abundantly in nature, and that they must be and are the most active causes of the destruction of vegetable and animal substances which have fulfilled their vital function on the earth, reducing them into water, carbonic acid, ammonia, sulphuretted hydrogen, &c., which, in their turn, become the foods of a succeeding generation of plants and animals. We may therefore truly say that death is life in the constantly reviving world.

M. Pasteur has observed another most curious fact connected with these microscopic beings—(I say microscopic, because it requires a most powerful instrument and high powers to distinguish them, and to ascertain that vibrios possess a vibratory motion while mycoderms are stationary); this is, that vibrios are the only animals which can live in pure carbonic acid, and which are killed by oxygen even diluted with another gas. Oxygen is essential to the life of mycoderms, and some of them can also exist in carbonic acid. Lastly, M. Pasteur has noticed that if a very small amount of yeast is added to a saccharine fluid, the yeast will not materially increase in quantity, because the new generation which is produced lives on the remains of its parents; but if phosphate of ammonia or of lime and some sal ammoniac is added with the yeast, the latter will rapidly increase and occupy several times its original bulk. It is curious to observe that these microscopic cryptogams require the same kind of food as man. Thus they require nitrogenated food—so do we. They require mineral food, as phosphates—so do we. They require respiratory food—so do we. They produce carbonic acid as part of their vital functions—so do we. I cannot do better than conclude this part of my subject by giving the following table descriptive of the various ferments observed by M. Pasteur:—

FERMENTATION.

Mycoderma vini.	Resolves sugar.	Alcohol. Carbonic acid. Succenic acid. Glycerine.
Mycoderma aceti.	Oxidises Alcohol.	Acetic. Water.

PUTREFACTION.

Infusorial Ferments.

Vibrios resolve animal substances.

Bacterea oxidizes organic matters of an animal origin.

I should mislead you, however, if I did not call your attention to another class of fermentations, which are chemical in their nature and in their action. This, for example, is the case when bitter almonds are crushed and mixed with water. The amygdaline they contain is decomposed into prussic acid, hydruret of benzoil, &c., by the ferment they contain, which is called emulcine. Again, when black mustard is reduced to meal, and placed in contact with water, the myronic acid it contains is decomposed into the essential oil of mustard, a most corrosive fluid, and this is also effected by a special ferment called myrosine. Again, when malt is mashed with water of a temperature of 170°, its starch is converted into sugar by a ferment called diastase. We also know that the starch which we take into our stomachs as food is converted into sugar by animal diastase, which exists in the saliva as well as in the pancreatic juice, and that this conversion is identical with that which takes place in the mashtub. In fact the whole of the changes which our food undergoes to render it fit for assimilation in the digestive organs of the body may be considered as a series of different fermentations. What gives a further interest to these chemical ferments is, that not only are they all nitrogenated, and possess a similar composition, but they present many identical properties, but each has its own peculiar action, that is, it will only cause fermentation in those matters which have been placed by nature in contact with it. Thus diastase will not convert amygdaline into prussic acid, hydruret of benzoil, &c., nor will myrosine convert starch into sugar.

In conclusion, it is certain that our knowledge of these interesting phenomena of putrefaction, fermentation, &c., is yet in its infancy, and there is no doubt that many important discoveries in this intricate branch of knowledge will from time to time be brought before the world, and reward science for its persevering efforts.

MANUFACTURE OF STARCH.

(BY ROBERT MURRAY, F.R S.A.)

Starch, from whatever source, always presents the same chemical properties; its physical characters, however, may slightly vary with the plant which furnishes it, and the processes followed for obtaining it. This composition is to five atoms of vinylate *plus* one atom of carbon $(C + CH_2O)_5$. It occurs in the form of oval or rounded grains, never crystalline, in the cellular tissue of different parts of plants, and in the seeds of wheat, oats, barley, and other grains; in the potato, in the roots of the tapioca and arrowroot, in horse-chesnuts, and in a great variety of different plants. The grains of starch appear to differ considerably in size and somewhat in form in different plants. They all consist of little cells or bags, in which the meal or true starch is contained, of each of which it formed a part, and by which it received its supply of nourishment. It is easy to perceive the slight change by which vinylate, a solution of which in water constitutes the blood of plants, is converted during the ripening of the plant into starch. Thus—

$6\,CH_2O$	$HHO=$	$C+5\,CH_2O$
Vinylate, six atoms.	Water.	Starch, one atom.

In its pure state it is a fine white powder, without taste or smell. It emits a peculiar sound when squeezed between the fingers, and feels slightly crystalline. Starch is not soluble in water, in alcohol, or ether. It forms with boiling water a kind of mucilage, which cools down into a jelly. It is soluble in diluted acids, forming a transparent solution, which undergoes a series of remarkable changes by boiling. The recent solution forms a deep blue, with a watery solution of iodine; but after boiling, iodine does not produce any colour, in consequence of the formation first of dextrine, and then of sugar. Starch forms a transparent gelatinous compound if rubbed in a mortar with a strong solution of potash, which compound is soluble in water and alcohol; and the addition of acids produces a precipitation of the starch. Dried at 212°, starch is found to consist of carbon, 44·44; hydrogen, 6·17; and oxygen, 49·39. At common temperatures, starch is represented by the formula $C_{12}H_{12}O_{12}$, so that by being raised to the temperature of 212° it loses two equivalents of water. The specific gravity of ordinary starch is about 1·5.

In the manufacture of starch by the ordinary processes, wheat is preferred to any other material. Sir H. Day found as much as 76·50 per cent. of starch in a sample of Middlesex wheat, 75 per cent. in Polish wheat, 73 per cent. in North American wheat. Even such wheat as is damaged by exposure or long keeping will serve for making starch, this principle being much less liable to decomposition than the other constituents of wheat.

Wheat Starch.

The simplest method of separating the starch from the gluten and other constituents of wheat is that of washing dough in a linen bag in a gentle stream of water. By this process, however, the starch is not entirely free from gluten; a plan is therefore adopted, founded on the property which dilute acetic acid, or dilute alkaline solution has of dissolving gluten, and not acting on the starch. The alkali (caustic soda) is specially added by the manufacturer in making starch from rice flour; the acetic acid is not added, but generated by the fermentation in the liquor—a decomposition of a portion of the gluten and of the starch. The following takes place when wheat is used for the purpose of manufacture:—The grain is coarsely ground between iron rollers, and digested in a vat with water enough to wet it thoroughly. In three or four days, according to the weather, fermentation sets in, the mixture settles, and is removed to a large fermenting-vat with more water. There it remains for two or three weeks, when the deposit is removed to a stout basket, and washed by a stream of water, and the milky liquor which passes through contains the starch. It is strained through a hair sieve into a square tub or frame. In about twenty-four hours the impure starch subsides; supernatant liquor is drawn off by taking out the plugs situated at different heights in the side of the frame. The deposit consists of an upper layer of thin light matter, called slimes, below which is a white coherent layer of impure starch. The slimes are removed, and the remainder being agitated with fresh water, is thrown upon a finer sieve than that previously used. This process is repeated several times in order that the deposit may become firm. A little smalt or artificial ultramarine is added to to give the blue tint; and any trace of acid must be neutralised by the addition of an alkali. When the starch is sufficiently firm, and while still moist, it is boxed—that is, shovelled into oblong wooden boxes four to five feet long, one foot broad, and about six or seven inches deep, perforated at the bottom, and lined with fine cloth or fine canvas. When tolerably hard, the starch is taken out, cut into pieces five or six inches square, and set to dry on half-burned bricks, which absorb moisture from the starch. When tolerably dry, the pieces are removed to a table, and a slimy crust, which forms on the sides, is scraped with a knife. The remainder, or pure starch, is packed up in papers, in which it is sold, and strongly heated in a stove until it becomes quite dry. In drying it splits up into the prismatic columns which are well known to the consumers of this domestic article.

Although so clean and beautiful an article is thus produced, the process of manufacture is really a very offensive one. The fermentation of the grain produces a foul acid water called sour water, and the putrefaction of the grain produces a very offensive odour. The sour water contains alcohol, acetate of ammonia, phosphate of lime, and gluten. The fermentation which takes place first is vinous, at the expense of the sugar, and a considerable portion of the starch, carbonic acid, and alcohol, are formed; the former is evolved as gas, and the latter remains in the liquor. The decomposition of a portion of the gluten gives rise to ammonia, which unites with some of the acetic acid to form acetate of ammonia. The lactic acid is a secondary product, arising from the fermentative decomposition of a portion of the starch. It probably assists the acetic acid in dissolving the gluten.

The loss of a great portion of the starch, and of all the gluten, and the insalubrity of the volatile products of the fermentation, render the improvement of this process highly desirable. Some of these inconveniences have been overcome by falling back upon the method of washing dough in water, for which purpose a trough is used with an upper false bottom, perforated with numerous small holes; the dough is made with a very small quantity of water, is turned up with a large pestle, while water is poured on from above. A wooden box below the trough receives the water containing the starch, and by continuing the operation long enough, the whole of the starch is separated, and the gluten remains in the trough. The deposit of starch is, however, contaminated with gluten and other impurities; these are separated by fermentation with one or two washings, and the starch is dried as before. This method is said to furnish about 55 per cent. of starch, and about 30 per cent. of gluten, and it is a great object to preserve the gluten. Wheat is also used in the manufacture in an unground state, for which purpose it is sifted clean and soaked in soft water until soft enough to be crushed between the fingers. It is then immersed for a short time in warm water, placed in bags exposed to strong pressure in a wooden chest containing water. In some starch works the swollen grain is ground between edge stones, and the crushed grain repeatedly agitated with water in a large cistern, and thus the starch is separated

Potato Starch.

The potato is largely used in making starch, especially in France. The quantity of starch not only differs in the different varieties of potato, but also in the nature of the soil, mode of culture, and the season of the year. Even the same kind of potato yields different proportions of starch at different seasons. Professor Playfair found that 240 lbs. of the same kind of potato yielded—

In August	23 lbs. to 25 lbs.
,, September	32 ,, ,, 38 ,,
,, October	32 ,, ,, 40 ,,
From November to March ...	38 ,, ,, 45 ,,
In April	38 ,, ,, 28 ,,
,, May	28 ,, ,, 20 ,,

Starch is not distributed equally over the tuber but exists in largest quantities towards the exterior. In large potatoes, the centre is often quite transparent, containing only cellular tissue and water; the tissue just beneath this contains the starch in large quantity, and the proportion gradually decreases towards the centre.

According to Boussingault, the average composition of the tubers of the potato are, viz.:—

	Moist.	Dry.
Water	75·9	—
Albumen	2·3	9·6
Oily matter	0·2	0·8
Fibre	0·0	1·7
Starch	20·0	83·8
Salts	1·0	4·1
	100·0	100·0

As the manufacture of potato starch requires to keep a large quantity of potatoes in store, the best method of preserving them is a point of great importance. Potatoes may be kept for a year or more at the temperature of freezing water, without the loss of starch. It was formerly the practice to keep them in large heaps in underground cellars, but the bruised tubers soon began to ferment, and the heat occasioned thereby led to a general fermentation and loss. Potatoes, are more usually embedded in large shallow ditches, called silos, dug in sandy soil, if that be practicable. They are protected from the air by a thatch, and ventilating apertures made by building trunks of wood in the mass.

In the manufacture of starch from potatoes, the first process is to soak the tubers in water for about six hours, which softens them and assists in its removal. In order to extract the starch the tubers are first freed from adhering earth by a thorough washing, and are then rasped by machinery. The pulp thus obtained is received upon a sieve, and washed continuously by a gentle stream of water—as long as the washings run through milky. This milkness is due to the granules of starch which are held in suspension. When the milky liquor has settled an hour, the starch will be deposited at the bottom of the pan, and the water drawn off, and the deposit is repeatedly washed with fresh water until the washings are no longer coloured. The starch is then suspended in a small portion of water, run through a fine sieve to keep back any portions of sand; and, after having been allowed to settle, is drained in baskets lined with ticking, and the mass is placed upon a porous floor of half-baked tiles, in a current of air, which is at first of the natural temperature; the drying is completed by the application of a moderate artificial heat.

The first liquor that is poured from the starch contains those constituents of the potato that are soluble in cold water, among these is vegetable albumen. Boil the liquor in a glass flask, upon which it will deposit a flocky greyish matter which can be separated by filtration. This is the albumen, a nitrogenised body, which is soluble in cold and in warm water, but is coagulated in boiling water. Albumen occurs abundantly in oily seeds, such as almonds, rapeseed, linseed, &c. If you burn a little of the albumen on a slip of platinum foil it will develop an ammoniacal odour, which indicates the presence of nitrogen, and is thus distinguished from starch.

Colouring Matter in Potatoes.

A fresh cut potato is quite white, but it gradually becomes brown. The expressed juice of the potato, or the first liquor poured from the starch, gradually turns brown. This is the case with many vegetable substances. The seeds of the sweet-pea have a bright-green colour when a pod, not quite ripe, is opened, but after a few hours' exposure to the air and light, they become a dark-brown colour.

This kind of starch is hygrometric, and therefore not well adapted to the stiffening of linen; it generally contains about 1·5th its weight of moisture, but when saturated about 23 per cent. It is often adulterated with gypsum, chalk, and argillaceous matters, which are easily detected by incineration. Potato starch is sold under various names for the purpose of food.

Starch-water, from which the starch potato is deposited, is useful for the purpose of irrigation; it contains an azotised matter, and small particles of pulp. The marc of the pulp is deprived of half its water by expression, and is then used as food for cows and sheep. Starch made from potatoes cannot be used alone to make pastry; but a little of the starch added to wheaten flour is thought to improve the quality of the bread. If the proportion of potato-starch exceed one-fifth the weight of the flour, a peculiar flavour is communicated to the bread, in consequence of the presence of a minute quantity of an oily matter contained in several amylaceous principles, and probably identical with the oil of potato spirit or fousel oil.

It forms the basis of the "nutritive farina," for which purpose the starch is carefully prepared, coloured, and aromatized. "The Prince of Wales' Food," "Soluble Starch," "Patent Corn Flour," "Indian Corn Starch," "English Arrowroot, &c. are all chiefly composed of potato-starch. A variety of tapioca is made by heating moistened potato-starch to nearly 212°: some of the granules of starch burst, and form small, hard, and irregular grains, which resemble true tapioca.

Conversion of Starch into Dextrine.

Prepare starch paste with half-an-ounce of potato-starch and four ounces of water. Bring this paste to the temperature of 150° F., and stir into it about one ounce of the extract of malt containing diastase. Keep this mixture at a temperature until it becomes a transparent and thin fluid. Then raise the heat till the mixture boils, and after a few minutes, strain it through a linen cloth, and put it in a warm place to dry up. The product is dextrine.

Conversion of Starch into Sugar by Diastase.

With the other three ounces of the extract of malt, act upon starch-paste in the same manner, only with the difference that a general heating at from 150° to 160° must be continued for several hours. Dextrine is first formed, but this is converted, by continuance of heat, into sugar. The temperature of 150° is most favourable for the production of sugar. At a boiling heat the action of diastase is destroyed.

Maize or Rice Starch.

The general processes in the manufacture of wheaten-starch have been found inapplicable to maize and rice; on this account, these substances have been for the most part disregarded by manufacturers. Mr. Polson, of the Royal Starch Works. Paisley, however, who has studied the characteristic qualities of the cereals in question, has at length devised a combination of processes, by the employment of which the production of starch from maize and rice is rendered a profitable manufacture, and to whom I am indebted for some valuable papers upon the processes of manufacture.

By means of these processes, a starch of a first-class quality is obtained from maize or Indian corn, the cheapest of all grains, by mechanically separating the starch from the other constituents of the grain, resort being had to chemical agency only for the purpose of dissolving out a small portion of foreign matters which remain after the mechanical treatment. Thus the gluten, which is the most valuable portion of the grain considered as food, and the other constituents, are obtained separately, without any loss of weight or deterioration in quality, and in a state well suited for the purpose of feeding cattle.

In preparing maize or rice starch, according to Mr. Polson's system, the grain, which may be either whole or coarsely ground or bruised, is steeped in water for a few days until it is thoroughly soaked. It may be allowed to ferment thereafter, with the view of thereby facilitating the subsequent processes; but the fermentation is not essential to these operations, and it is preferred to omit it, and proceed at once to bruise or reduce the soaked grain to a pulp by means of a levigating machine. This pulp is mixed with water, and the husks and fibrous matters are separated by means of a sieve or sieves, made of fine silk gauze, or other suitable material. The sieves may be constructed like the bolting machines used in flour mills, or they may be in the form of flat frame-seives, either kind being driven in connection with the general machinery of the establishment. The husks and fibrous matters separated by the sieving process may be passed a second time through the levigating machine and through the sieves, for the purpose of extracting a further quantity of starchy matter. They may then be dried and ground, in which state they are very suitable for feeding cattle, as they retain their natural properties unaltered, not having been subjected to the action of any chemical agent, and consequently their sale for that purpose constitutes a source of considerable economy in the manufacture of starch. The starchy matter separated by the sieving process contains a portion of gluten and other matters, which cannot be effectually separated by the means usually adopted for the manufacture of wheaten-starch. According to the present invention, however, this may be effected by the employment of any of the three following processes:—In the first, the starchy matter, as it leaves the sieving apparatus, is made to flow over a plain surface, which may be either level or slightly inclined; the width of the plain and the amount of the starch-flow being so proportioned as to cause the latter to spread out uniformly in a thin stream, covering the entire surface. The water and gluten, with the other foreign matters, pass off at the further extremity of the depositing plane, leaving the starch deposited over the whole surface. As the deposit of starch does not take place equally at all parts of the depositing plane, but becomes less towards the extremity of which the water and gluten pass off, and as this inequality disturbs the process of deposition and separation, provision is made for securing a uniform inclination during the entire process, by gradually damming up the flow by means of a series of weirs placed across the depositing plane at suitable intervals. These weirs are formed of slips of wood, which are placed one above another from time to time as the deposit increases, and they are made water-tight by means of pieces of cloth of the width of the depositing plane, and fastened down to the plane by one edge, whilst the other edge is folded over the front of the slips of wood forming the weir, and made to stream over the top of them in the direction of the current. The starch thus obtained is washed with water and dried in the usual manner; and though it is not absolutely free from foreign matters, it is strong and of good colour, and is very suitable for some manufacturing purposes. The gluten, and other matters which have passed off with the water at the end of the depositing plane, may be treated by the usual alkali process, and then again passed over the depositing plane for the production of starch in a state of superior purity. According to the third process referred to for the final treatment of the starch, the alkali process is adopted as in the second process; but the foreign matters which remain after the alkali treatment of the starchy matter or starch are separated by mixing it with water in a depositing frame, will be found to descend to the bottom of the mass, and the pure starch may be drawn off by means of a syphon or tap.

The various operations which have been described, or some of them, are applicable to the preparation of starch from other farinaceous substances besides maize and rice, the process being modified to suit the various substances treated by them.

Starch from Peas.

This variety is prepared on a large scale by soaking peas for some days in water till they are quite soft and passing them through a cylinder; the paste is then passed through a linen cloth or rubbed on a sieve. The result will be as with the potatoes: a milky liquor will pass through the cloth, and woolly fibre will remain within it. The liquor, on settling, will deposit starch, and the clear liquor will be found, when boiled, to deposit albumen. The starch must, as before directed, be washed and dried.

Other Sources of Starch.

It may be produced from horse-chesnuts by proceeding in the same manner as with potatoes. It is also produced from sago. The celebrated "Glenfield Patent Starch" is solely manufactured from sago.

The occurrence of starch is not confined to the vegetable kingdom. According to Dr. G. Budd, granules of starch have been found in the brain; in certain cases of scrofulous caries, the liver assumes the peculiar hard, semi-transparent, waxy appearance described by him. Virchow has shown this condition to arise from the deposition of aneloid matter in the gland; and a similar deposit has been found in the kidney in the same cases. The accumulation of small quantities of starch in the animal tissues, even in health, is not uncommon.

Tests for Starch.

Starch produces an intense blue colour when it meets free with iodine. A solution of tannic acid occasions a precipitate in one of starch. Dilute a drop of starch solution, and add to it a little of tincture of iodine. The solution will acquire a deep-blue colour. If the liquor is boiled the colour disappears, but it returns when allowed to cool. If boiled with dilute sulphuric acid, starch quickly looses its viscidity, and is ultimately converted into glucose. If the tincture of iodine is dropped on flour, potatoes, and other amylaceous compounds, it produces this characteristic blue colour.

Useful Receipts.

To take Fac-similes of Signatures.

Write your name on a piece of paper, and while the ink is wet sprinkle over it some finely powdered gum arabic, then make a rim round it, and pour on it some fusible alloy, in a liquid state. Impressions may be taken from the plates formed in this way, by means of printing ink and the copperplate press.

Liquid Glue.

Dissolve 1 lb. of best glue in 1 lb. of water; add gradually 1 ounce of nitric acid of sp. gr. 1·36; and beat the mixture for a short time. This will save the trouble of heating the glue-pot.

To fasten Knife-handles.

The *Chemical Gazette* says: "When knives and forks have come off the handles from being carelessly put into hot water, or otherwise, a cement made as follows will be useful to re-fasten them: Take of shellac two parts, and prepared chalk one part; reduce them to powder and mix thoroughly. Fill the opening in the handle with the mixture, heat the shank of the knife and press it in."

Organic Poison in Rooms.

Dr. Richardson, an English chemist, says that iodine, placed in a small box, with a perforated lid, destroys organic poison in rooms. During the continuance of an epidemic small-pox in London he saw the method used with benefit.

Copying Paper.

Mix lard and lamp-black to a paste, rub this over paper, wipe off the waste with a rag, and dry the paper. A clean sheet placed under this while written on with a lead pencil, &c., receives a copy.

Oiled Paper.

Brush paper with boiled oil and dry the sheets. Used to enclose paste blacking, white lead, &c.

Flexible Paints.

Boil 1½ lb. of yellow soap with 1 gallon of water, and mix while hot with 140 lbs of oil paint. Used to paint on canvass.

Papier Mache.

Paper pulp pressed into various forms with size, glue, white of egg, paste, &c. When painted or japanned they are light elegant ornaments, quite waterproof.

Benzine as an Insecticide.

A mixture of ten parts benzine, five parts soap, and eighty-five water, has been very successfully used by Gille to destroy the parasites which infest dogs. It has also been used with good results in veterinary practice, as an application in certain diseases of the skin; and thus diluted, is found to answer better than when pure.

Gum Paste.

Gum arabic, with a little gum tragacanth, made to a thick solution. Used to attach labels to bottles, book-backs, &c.

Map Colors.

Yellow.—1. Dissolve gamboge in water. 2. Make a decoction of French berries, strain, and add a little gum arabic.

Red.—1. Make a decoction of Brazil dust in vinegar, and add a little gum and alum. 2. Make an infusion of cochineal, and add a little gum.

Blue.—A weak mixture of sulphate of indigo and water, to which add a little gum.

Green.—1. Dissolve crystals of verdigris in water, and add a little gum. 2. Dissolve sap green in water, and add gum.

Furniture Paste.

Wax and turpentine coloured with alkanet. Sometimes soap, liquor potassœ, or pearl-ash is added, at the option of the maker.

Razor Paste.

1. Prepare putty powder, 1 oz.; oxalic acid, ¼ oz.; gum, 20 grains; powder and make into a paste.

2. Emery in finest powder, 2 parts; spermaceti ointment, 1 part; mix.

3. Colcothar and emery made into a paste with lard.

Zeiodite.

This substance says the American *Druggists' Circular*, is made by mixing twenty to thirty parts of roll sulphur with twenty-four parts of powdered glue or pumice, which forms a mass as hard as stone that resists the action of water and the strongest acids. Prof. R. Boettger recommends it for making water-tight and air-tight cells for galvanic batteries.

Machinery and Manufactures.

A Masterpiece of Chronometric Mechanism.

Mr. Collins, silversmith, of Gloucester, England, has recently constructed a most ingenious piece of mechanism—an eight-day clock with "dead beat" escapement maintaining power, which chimes the quarters and plays 16 tunes—one (or more if required) every fourth hour. The hands go around as follows: one, once a minute; one, once an hour; one, once a week; one, once a month; one, once a year. It shows the moon's age, the time of rising and setting of the sun; the time of high and low water, half ebb and half flood; and by a beautiful contrivance, there is a part which represents the water, which rises, lifting the ships at high water tide as if it were in motion, and as it recedes leave those little automaton ships dry on the sands. It also shows the twelve signs of the zodiac; it strikes or not, chimes or not, just as you wish it, it likewise has an equation table, showing the difference of the clock and sun every day in the year. The whole of the mechanism of the clock is of beautiful workmanship, and performs most accurately the many different objects which are called into action by the ingenious inventor.

A Remarkable Steam Boiler.

A remarkable steam boiler has been patented by Mr. Edward N. Dickerson, of New York. One of these boilers has exhibited such results as to astonish the practical men who witnessed the trial. The *Providence Journal* says:—The boilers stand on the dock without any chimney whatever, so that the only draught was that which was produced inside of the boilers themselves, which usually would not serve to make steam in less than two or three hours of firing. In these boilers, however, steam was produced in seventeen minutes from the time the fire was lighted; and in half an hour the pressure was about seventy pounds to the inch. The safety-valve was then opened and the steam blown off at a pressure varying from seventy to thirty pounds to the inch. At the pressure of thirty pounds the safety-valve was blocked open, but the steam could not be blown down below that point, although the safety-valve is about twice as large in proportion to the grate surface as is usual, and the fire was made of ordinary cord-wood burning without any chimney. Instead of blowing off water from the open valve, as boilers usually do, nothing but pure steam could be seen, thus showing that no heat is lost by working water; and the products of combustion as they pass from the boiler tubes are so cooled that persons were walking on the perforated plate through which the hot gases were escaping without burning shoes or clothing, and the hand could be held at the aperture of the tube without any inconvenience whatever. Before the boilers were fired up they were subjected to a cold water pressure of more than a hundred pounds to the inch which they endured without complaining. The boilers are less than half the usual size and yet they make pure steam without any "steam chimney" in less than a quarter of the time usually required, and in far greater quantites, from the same weight of fuel, than any other boiler ever constructed can do.

The Prevention of Boiler Explosions.

It is now generally understood that nearly every explosion of a steam boiler is the result of its own weakness. This may be either owing to originally defective material or construction, or to its original strength having been impaired by corrosion or overheating of some of its parts; but the most prolific of all causes of explosion is corrosion. The best preventives are therefore a thorough examination and test of the boiler when new, a frequent and thorough periodical inspection after it has been in operation, and a searching investigation into and published report on the cause of every explosion which occurs.

There are two systems under which such examination and inspection can be carried out with respect to boilers owned by private individuals or firms, and by manufacturing companies, viz. :—one, of course, compulsory, by officers appointed by the state or municipal government, under suitable legislative enactment; and another, voluntary, by an association of the parties interested in a city or district, appointing its own examiners and inspectors, aided in case of explosion by an investigating board composed of competent members of the association.

While we would on no account dispense with the compulsory system above referred to, knowing the impossibility of associating all the parties who ought to interest themselves in any subject, we strongly favor the voluntary system, as we believe that by it the desired end can be attained in a more beneficial and satisfactory manner. Every member of the association must feel personally interested in its success, and greater efficiency in the inspectors and other officers appointed to carry out its requirements is therefore likely to be secured, and any delinquency or negligence of the duty on the part of its officers is less likely to occur.

There has been for some years in Manchester (England), which may be considered as the principal seat of manufacture in Great Britain, an association of the character we have spoken of. This association holds regular monthly meetings, at which its chief engineer presents a report of all examinations, inspections, and investigations which have taken place during the month previous to its date, and this report is published, with any discussion which may have taken place upon it. The world is much indebted to this publication, for it has tended in a great measure to dispel the false notions about suddenly developed mysterious agencies which were a few years ago current on the subject of boiler explosions, and to show that they proceed from causes which may be within human control.—*American Artizan.*

How to Burn Spent Tan Bark.

A recent letter to the *Shoe and Leather Reporter* conveys the following information as in operation in the oak-tanning districts of the West:—

"Our boiler is 24 feet long, and 42 inches in diameter. We set the boiler the height we want it from the ground, excavate a pit beginning two feet under the front end of the boiler, 20 feet long, 8 feet wide, and ten feet deep from the bottom of the boiler.

"The oven in which the tan is burned is then commenced by building a wall of good brick, commencing 18 inches under the front end of the boiler, making that wall 18 inches thick, so the inside of the wall will be flush with the end; the other walls may be 13 inches—the thicker the better. Size of the oven to outside of the walls, of thickness named, is 8 feet wide, 10 feet long from the end of the boiler. The wall is carried up two feet all around, leaving an opening of 2 feet wide in front, for taking out ashes, and ventilating under the grate-bars which are of the size ordinarily used for coal; then put on bearing bars from grate bars, one at each end and one in the center of the oven, two lengths of bars being required, the center bearing bar should be very heavy to prevent sagging with the weight when hot. The walls are then carried up 2 feet as before, excepting the inside course and must be of the best quality of fire-brick put in with fire-clay, requiring 1,500 to 1,800 for an oven. Set in front of the oven, over the space left open below the grates, is an iron door frame 2 feet square. This frame should be well anchored in the wall. At the end under boiler, a space 33 inches wide immediately under the boiler is left. After building some three or four courses above the grate bars in the center of this space a column of 13 inches and 30 inches high is built, forming two holes 10 by 30 inches which must be securely arched over at the top—the sides of these holes, as every other part exposed to the fire, must be lined with fire-brick. Through these holes the heat enters the furnace around the boilers. When the oven is two feet above grates, then an arch two feet deep is turned over the top with fire-brick, leaving two round holes 15 inches in diameter, equal distance from each end, and apart in the top of the arch for feeding the spent tan. The outside walls are carried up 18 inches, or 2 feet above the top of the arch, with common brick. The feeding holes, being walled up the same distance with fire-brick till on the top of the arch—with any kind of soil or sand to the top of the walls, and pave with hard brick. The fire-holes are covered with iron covers, the same as cistern-tops or coal-holes in pavements.

"The wall under the end of the boiler, is carried up and around the boiler, holding it up and forming the end of the furnace around the boiler, which is built the same as any ordinary furnace, excepting at the front end where fire and heat enters from the oven it should be slanted back from the bottom of the fire-holes some 5 feet to within 10 or 12 inches of the boiler, and paved with fire-brick. Two or three small iron doors should be put in the side of the furnace for the convenience of cleaning out the loose ashes from under the boiler, which accumulate rapidly—a breech and smoke-stack, the same as any other furnace. It being understood that a good draught is necessary, the balance of the excavation wall should be as high as is necessary for the ash-pit.

"For larger boilers or more than one boiler, two arches and from four to six holes for feeding the tan would be required. Persons building ovens should get mechanics that have had experience, or get drawings and specifications before commencing; although quite simple it is necessary to be accurate, or trouble may follow. We burn the tan wet, as it comes from the leeches, using wood only to start the fires after cleaning the boiler; requiring about a cord a week. The wood is put in at the front door, from the ash-pit. Tan is fed through the holes described, from the top. We can keep, with attention, a stronger and better heat with the wet tan than with wood. Besides the economy in labor, we get clear of a large portion of the tan that otherwise would be expensive to move. With the boiler and furnace as described, we do the work and heating required for a business of 20,000 sides per annum of heavy leather.

"Messrs. Lang & Warner, Dunlop street, Cincinnati, are using similar furnaces for heating their extensive shops with hot air, with success."

Definitions of Gears.

Cog wheels, as they are familiarly called, are of different classes and titles. The several varieties are here explained:—

A spur wheel has its teeth placed straight across the face of the wheel in line with the shaft, like the prongs of a spur.

A beveled wheel has the face inclined on one side at an angle of 45° with the shaft.

A worm wheel has its face hollowed to receive a screw, and the teeth are inclined to suit the spiral of the screw thread.

A ratchet wheel has its teeth all leading one way, like a circular saw.

Spiral wheels have teeth inclined at various angles with the side of the rim. Sometimes the teeth form a V across the face, or they may be of any shape to suit the whim of the designer.

Staggered gears, as they are sometimes called, have square teeth set diagonally across the face; the second row of teeth are not placed in line with the first but "staggered" or set opposite the space in the first row. These are often used for planing machines, or where motion in one direction is to be suddenly changed to an opposite direction. They are supposed to prevent lost motion, but are not efficient for this purpose except when new.

Backlash of gears is the rattling noise caused by one wheel moving at a greater velocity than the other, and being suddenly overtaken by it. The face of one tooth therefore strikes against the back of the other. Gears set too deep, or so that the teeth bottom will also make a heavy rumbling sound. Staggered gears do not prevent backlash except when new. The tooth, or teeth that take the heaviest strain, or backlash, will soon wear so as to lose it, and in time the system will accommodate itself to the work, so that no benefit will be realized from them or it.

Spur gears for communicating direct motion, are as good as any toothed wheel. They are cheap to make, run well when properly made, and with but little jar. It is a great fault to make small gears with large pitches. It is akin to making small bolts with coarse threads. The coarse teeth have to be deeper, so that they are sooner broken and make more noise. Respecting the form of the teeth there is much diversity of opinion. It seems to be a favorite plan for general work to make them of the same shape that they naturally wear to, but very many mechanics make the teeth the frustrum of a cone, or a regular taper from bottom to top. Gears with wooden teeth driven by wheels wholly of iron are coming more into use for large heavy sizes. The best wooden wheels have the teeth made of young hickory, or lignum-vitæ boiled in linseed oil, and set with the grain end on, in the direction of motion. The body of the wheel is iron, and recesses are cast in the face, in which the wooden teeth are set and fastened by wooden keys. When well made they run a long time. Tallow and blacklead are employed to lubricate them. Beveled wheels are also thus made.

A sprocket wheel, as the English artisans call it, is our rag wheel. The wheels on chain pumps are sprocket wheels, and are used to carry machinery driven by chains. The teeth are placed a certain distance apart, so that the wheels are sometimes eight sided, or six sided, the chain links are of course a certain length; this is called by some a clip wheel.

It is not necessary that gear wheels should be perfectly round; they work well when made elliptic or oval. Of course two wheels running together must be both of the same class, round or oval. When oval the longest diameter of one wheel gears into the shortest diameter of the other. Sometimes staggered gears are made by taking several spur wheels and keying them on the shaft so that the tooth of one comes opposite the space of the other.—*Scientific American.*

Gilding on Glass and China, Enamelling.

A correspondent of the *Scientific American* writes: "The tools required for this business are as follows:—Gilder's cushion, gilding knife, camel hair gilder's tip—cotton wool is best—camel hair pencils; also, a tin dipper, containing water, two parts, new rum one part, and two grains of isinglass dissolved by heat in the liquid. Use this solution cold.

Clean the glass both sides, make a design on the glass with soap sharpened to a point, place the design face downward, on clean paper, having cut the gold leaf to the design roughly and wet the glass over the design with camel hair pencil; lift the gold with the lip brush, and place it on the wetted gloss; over the design continue the process till the design is covered. Then place the glass aside to dry; in about two hours afterward, with the camel hair pencil, coat the gilding once over with the same liquid, and again dry it. When dry smooth the gilding gently with fine cotton wool, free from rough particles. Then re-gild as before, and finish in like manner. Transfer the design on the gold side by any mode that will be free from grease. Then remove the superfluous gold; with a boxwood point make the edges perfect, and keep the point sharp and clean. Take white paint in oil, or weak gilder's whiting, and coat the design all over, one coating after another, until the surface is rendered opaque. Each coat should be dry before the other is applied. The reverse side will appear, by reason of the transparency of the glass, to have a high polish. If gilder's size or whiting is used it should be weak, as that will increase its whiteness; by using oil paint the work done will be water-proof.

Gilding on china is done as above (no paint or soap used) and is rendered water-proof by coating the surface with white shellac varnish. Two coats may be applied, but while it is moist the work must be subjected to about 90° of heat or the varnish will become milky, and the design obscure. This is pleasant work for ladies."

Animal Manures.

In the *Journal d' Agriculture Pratique*, M. Barral gives some interesting details on the subject of the manfacture of animal manure at Aubervilliers. This manufactory consumes every year 8,000 horses, 200 donkeys, 300 cows, 300 pigs, 9,000 cats and dogs, 6,000 kilogrammes of meat unfit for food, 500,000 kilogrammes of offal from the Parisian abattoirs, and 600,000 kilogrammes of other refuse animal matters, such as skins, horns, &c. The raw material is first cut up and boiled to extract the grease. The flesh is then separated from the bones, pressed, and dried. It is afterwards ground and sifted, and the dried bones, which are also submitted to the same process, mixed with it, forming a manure containing 35 per cent. of nitrogen and 55 per cent. of phosphate of lime. The blood is collected separately, and also made into manure. The soup obtained in the boiling is strained, and the solid matter thus collected is added to the rest. The offal is piled in alternate layers with other organic matter, such as wool and parings of horn and hoofs, with which is mixed a certain amount of mineral phosphates. The heap is well moistened with the strained soup, fermentation is set up, and the whole is gradually transformed into excellent manure. During this process the phosphate of lime breaks up into phosphoric compounds, more or less soluble, and various salts of ammonia are formed. This is really a much better use to put dead horses to than making them into *saucissons de Lyon* or *filets de bœuf* for the cheap *restaurateurs.*

Greened Pickles.

The following is a capital and simple expedient to detect the copper in greened pickles. It may be conducted thus:—Cut a greened pickle into small pieces, and put them into a glass of rain water, adding ten or fifteen drops of sulphuric acid; put the bright blade of a knife, or any bright steel surface, in the liquid for twenty-four hours, and if the pickle contain copper it will be found upon the steel blade, as though it had been coated by the galvanic process. All pickles greened in brass or copper kettles shows this result. The green color comes from verdigris, which is deadly poison; the quantity usually taken with the pickles does not often kill, but it produces disease. Why are they colored?—only to please the eye, and make them represent cucumbers. A poisonous pickle may be eaten upon a full stomach: it should never be eaten upon an empty one. They should never be allowed among sanitary stores.

Hermetic Barrels.

A correspondent of the *Scientific American* writes:—"There is a description of a hermetic barrel on page 288, current volume of the *Scientific American*. There is also a reference to said barrel on page 292. Barrels intended to contain refined oil and spirits, are invariably glued on the inside. and, in most cases, painted on the outside. This is a hermétical package, but owing to shrinkage of the wood the glue cracks at the joints, and leakage is the consequence. I have known for some time that a perfect hermetical barrel is possible. The impermeability of the wood is accomplished by having the annular layers concentric in the package as they are in the tree. Our present mode of getting out staves is radial with the trunk of the tree, thus cutting the annular rings in lengths equal to the thickness of the staves, thereby exposing the cellulose portion of the wood to the percolation of fluids, that not only pass through the open pores, but dissolve the mucilaginous matters contained in those that are closed. By getting out the staves trangential to the circles of annular growth, the thickness of the staves would admit of quite a number of layers, the capillaries of which could be filled with water and the ends sealed up, thus preventing shrinkage, preventing percolation. and producing, beyond a doubt, an hermetically sealed package. This mode of getting out staves has another advantage. It is well known that old barrels are tighter than new ones, arising from the fact that the gummy matters having been dissolved, the cellular layers collapse under pressure of the hoops, bringing the ligneous layers closer. But what the barrel has gained in "seasoning" it has lost in durability. The wood being saturated with oil becomes as brittle as if it was dazed. By preventing the absorption of oil, the wood will retain its fibrous toughness; and if it be true that the lower ligneous layer must be pressed against the upper ligneous layer, to act as a fulcrum to break it on, we will be less troubled with broken staves, with their leakage and loss."

Boiler Explosions.

It may be well (says the *Mechanics' Magazine,*) to place the following paragraph on record. Negligence is too often the cause of boiler explosions:—"One of the enginemen engaged at Gospel Oak Colliery, Tipton, was sent to prison on Friday, for placing in jeopardy the lives of about sixty miners. He had neglected to examine the boiler as he ought to have done, and early on Friday morning, when about sixty miners were waiting to go down the pit, the boiler plates were seen to be red hot, and it was, as it is described, almost a miracle that no explosion took place."

Petroleum as Fuel.

In a recent number of this Journal (Nov. 1864) we inserted an article from the grocer, on Richard son's invention for using Petroleum instead of coal as fuel for raising steam. More recently an elementary course of experiments was commenced in the factory department of Woolwich dockyard, with a view of testing the capacity of petroleum to supersede coal and other fuel on ship board, and also in propelling steam machinery in the factories. The method adopted is the patented invention of Mr. C. J. Richardson, an engineer residing at Kensington. The plan under trial is simply to burn the petroleum through a porous material, which is placed in an iron chamber, dipped into a water vessel also of iron. The oil admitted into the chamber soddens the porous material, and rises by a sort of capillary attraction. The surface then catches fire and burns rapidly, as long as the oil is supplied. The effect of the flame is so great that with the small apparatus, which is only two feet superficial area, and affixed to a boiler, the oil on Saturday was utilised so as to be equal for steam purposes to five tons of coals. A third advantage is obtained by the employment of the petroleum—namely, that no stokers are needed, and the boilers can be supplied with several fires one above another. The small grate used in the experiments was placed under a boiler of 17-horse power, and in two hours it raised the steam to 10lb. pressure. The only objection seems to be the fear of explosive qualities, but these Mr. Richardson states he is prepared to guard against effectually.

A New Match.

A lucifer match is now in the market that differs from anything hitherto in existence. Upon the side of each box is a chemically-prepared piece of friction-paper. When struck upon this, the match instantly ignites; when struck upon anything else whatever, it obstinately refuses to flame. You may lay it upon a red-hot stove, and the wood of the match will calcine before the end of it ignites. Friction upon anything else than this prepared pasteboard has no effect upon it. The invention is an English one, and, by special act of Parliament, the use of any other matches than these is not permitted in any public buildings. The discovery is a curious one. There is not a particle of sulphur in the composition of the lucifers in question.

Practical Memoranda.

Comparative Strength of Liquors.

Dr. Jones, physican of St. George's Hospital, London, in a recent lecture, stated that the different fermented liquids which he had examined might, in regard to their strength or stimulating power, be thus arranged:—

Cider	100	Champagne	241
Porter	109	Maderia	325
Stout	133	Marsala	341
Ale	141	Port	358
Moselle	158	Sherry	358
Claret	166	Geneva	811
Burgundy	191	Brandy	986
Hock	191	Rum	1243

Thus ten glasses of porter, six glasses of claret, five of Burgundy, four of Champagne, three of sherry, are equivalent to one glass of brandy, or three-quarters of a glass of rum. The reader must always bear in mind, however, that of the large amount of brandy, so-called, sold in liquor shops, but very little is pure brandy.

Conducting Power of Materials used in the Construction of Houses.

As observed by Mr. Hutchinson.

Slate	100	Oak wood	33·66
Keene's cement	19·01	Asphalt	45·19
Plaster and sand,	18·70	Chalk (soft)	56·38
Plaster of Paris	20·26	Stock brick	60·14
Roman cement	20·80	Bathstone	61·C8
Beech wood	22·44	Fire brick	61·70
Lath and plaster,	25·55	Lead	521·34
Fir wood	27·60		

Air and gases are very imperfect conductors. Heat appears to be propagated through them almost entirely by conveyance, the heated portions of air becoming lighter, and diffusing the heat through the mass in their ascent as in liquids. Hence, in heating a room with hot air, the hot air should be introduced at the lowest part. The advantage of double windows for warmth depends, in a great measure, on the sheet of air confined between them through which heat is very slowly transmitted.

Capacity of Bodies for Transmitting Heat.

The capacity which bodies possess of transmitting heat, does not depend upon their transparency; or bodies are not all transparent to heat in the same proportion that they are transparent to light. The following plates of an equal thickness of ·1031 inches allowed very different proportions of heat to pass through them.

Of 100 rays transmitted from an Argand oil lamp they were:

Rock salt	92	Emerald	29
Mirror glass	62	Gypsum	20
Rock crystal	62	Fluor spar	15
Iceland spar	62	Citric acid	15
Rock crystal, smoky and brown	57	Rochelle salt	12
Carbonate of lead	52	Alum	12
Sulphate of barytes,	33	Sulphate of copper,	0

Statistical Information.

The Cunard Line.

Since the year 1824, the date of the constitution of the company, 134 steamers have been built or are now building for the line, of an aggregate burthen of 117,291 tons, and 33,132 horse power; of these, six vessels are not yet ready. The first vessel built was the *Fingal*, of 296 tons, constructed in 1824, just 40 years since. In 1840 the *Britannia* of 1,154 tons was built. In 1850 the *Asia* was built, of upwards of 2,000 tons; while the *Persia*, of upwards 3,000 tons was built in the year 1856. The vessels now building range from 670 tons to 2,700 tons.

Exports of Steam Engines and Machinery from England.

The value of the steam engines exported to September 30th this year, was $5,651,705; and of other machinery $11,163,560; total $16,815,265. In the latter branch there has been a decided advance over the last and previous years.

RAILWAY ITEMS.

United Kingdom.

The total working expenses of the railways of England and Wales for 1863 was $63,298,090; of the railways in Scotland $8,036,020; and of the Irish railways $3,752,060. The length of lines at the end of the year 1863 was 12,322 miles showing an increase since the close of 1862 of 771 miles.

The gross receipts of all these railways for the carriage of Coal, Coke, and minerals, amounted in 1863 to $27,098,335; being for England and Wales $22,522,170; Scotland $4,425,400; Ireland $150,765. There are now in the British Islands three hundred and seventy-five district railways companies, who own eleven thousand five hundred miles of road. They carry above eighty million passengers yearly, and above thirty million tons of merchandise and minerals. They give employment to probably not less than two hundred thousand persons.

Locomotives.—The number of locomotives owned by the railway companies of the United Kingdom at the close of 1863 was 6,643. At the close of 1862, the corresponding number was 6,398.

India.

There are at present ten railways in India either opened for a portion of their whole distance or in process of construction, and some of these have branch lines. Two lines, the Scinde (114 miles) and the Eastern Bengal (115 miles), are finished their whole length. The total length of line now opened for traffic is 2,687¾ miles, and 2,100 mills yet remain to be constructed before the system, as far as sanctioned, will be completed.

Italy.

The lines of the new South Italian Railway Company are fourteen in number, their combined length being 853½ miles.

Accidents.

According to the Board of Trade returns, the number of persons who lost their lives by railway travelling in the United Kingdom, during the year 1863, was 35.—21 of these were attributable to their own misconduct or want of caution, and 14 from causes beyond their own control. The 14 killed was one out of every 14,615,362 carried upon the railways, exclusive of 64,391 season ticket-holders. The injured from causes beyond their own control were one in 511,487—a large number of those being only slightly injured.

From the report of the Registrar-General, we ascertain the proportion accidental deaths from other causes bear to those on railways in the United Kingdom—

Drowning	122 in 1 million.		
Suffocation	61 "	1	"
Poison	13 "	1	"

The number of persons killed on the streets of London, by vehicles alone, was, for 21 days ending October 1st, 25 persons, or at the rate of 433 per annum—a number several times larger than the whole number killed by railway accidents in the United Kingdom.

A writer in a recent number of the *Revue des*

Deux Mondes computes the average yearly loss of life on railway journeys as 1 in 7,000,000 travelers, whereas 70,000 in 30,000,000 travelers would be no more than the fair proportion to the annual loss of life in former days among travelers by land and sea.

The Reciprocity Treaty.

The Reciprocity Treaty came into operation in Canada in October, 1854; but in the States not till the spring of '55, in consequence of the absence of legislative authority. The following table is a statement of the whole trade between the two countries for the ten years, during the continuance of the treaty, from 1854 to 1863 inclusive, showing the excess of imports and exports, the total of free goods, including those under the Reciprocity Treaty as well as under former treaties, and the amount of value under Reciprocity alone:

THE WHOLE TRADE.		Exports to United States.	Imports from United States.	Excess of Imports over Exports.	Total free goods Imported.	Imports under the Recip. Treaty.
1854	$24,182,099	$8,649,002	$15,533,097	$6,884,095	$2,083,756	$681,643
1855	37,565,952	16,737,276	20,828,676	4,091,400	9,379,204	7,725,572
1856	40,684,262	17,979,753	22,704,509	4,724,756	9,983,586	8,080,820
1857	33,431,087	13,206,136	20,224,651	7,018,215	10,258,220	8,640,044
1858	27,565,659	11,930,094	15,635,565	3,705,471	7,161,958	5,564,615
1859	31,515,230	13,922,314	17,592,916	3,670,602	8,556,545	7,106,116
1860	35,750,988	18,427,968	17,273,020	Increase	8,740,485	7,069,098
1861	35,455,815	14,386,427	21,069,388	6,682,961	11,859,447	9,980,987
1862	40,236,887	15,063,730	25,173,137	10,109,427	16,514,077	14,430,626
1863	43,159,794	20,050,482	23,109,362	3,058,930	19,134,966	12,339,367
	$349,497,773	$150,358,432	$199,144,341	$49,945,857	$103,622,244	$18,620,838

The whole trade between the United States and Canada, for the ten years, amounted to three hundred and forty-nine millions, to which there is to be added sundry small exports along the borders of both countries which, paying no duty, are not recognized, and remain unrecorded—an amount which no doubt would swell the total to over four hundred millions, or a yearly average of forty millions.—*Quebec Chronicle.*

Miscellaneous.

Death in the Laboratory.

At a time like the present, when chemistry occupies largely the attention of professional men and amateurs, and enters not only into the fields of art and science, but the arena of popular amusement, it is essential to caution inexperienced chemical operators against the practical dangers to which they expose themselves and others by inattention to scientific rules and natural laws, and by the use of imperfect apparatuses. It is quite certain that no amount of advice, however energetically given, will deter men, in these days of sensation and excitement, from dabbling in matters which they do not understand, or from risking their lives with a view to putting money into their pockets. The public will have novelties and stimulants, and they care little about the risks run by caterers to their unhealthy appetites. If we cannot cure the public, we may warn their servants. Only last week two sudden and violent deaths occurred in Manchester through the explosion of a gas retort placed on the fire in a kitchen, forming an improvised laboratory. A photographer named Crowther, was engaged in the production of oxygen gas, when the apparatus burst, and blew himself and his infant child into eternity. His wife narrowly escaped the same fate; and it is not very long since two young women at Leeds, who had been left by a *pseudo* chemist to watch a similar process, were killed on the spot by a like catastrophe. These, it will be admitted, are exemplifications of the perils to which chemical manipulators expose themselves and their assistants.

The use of oxygen gas was never more prevalent than at present. In the exhibition of the patent ghost of Messrs. Pepper and Dircks, it is an indispensible adjunct, and it has become a substitute, in almost all cases, for the coloured fires so long used for the production of supernatural "effects" at our theatres. Again, the oxy-hydrogen light, which depends for its extreme brilliancy upon oxygen, is extensively employed in the illustration of scientific lectures and for the purposes of popular amusement. The coloured lights, it need not be said, are produced by the transmission of the rays of oxygen in combustion through heated lime and stained glass, and were first used by Professor Ansell, at the Panopticon, some years since. By the introduction of these and similar scientific improvements, oxygen has become almost a necessity, although its expansive and explosive properties make it as dangerous to deal with as high pressure steam or gunpowder, that is, in the hands of the tyro in chemistry.

The accidents of Saturday night last arose principally from the palpable ignorance or want of observation of the unfortunate photographer. In the elimination of oxygen it is of the greatest importance that the closest attention should be paid to the evolvement of the gas, and, when ebullition ceases, that the heat which causes it should also cease to play upon the retort. These points poor Crowther appears to have neglected entirely; hence, the super-heating and consequent expansion of the gas to the bursting strain. The oxygen most extensively used for the purposes named is eliminated from mixtures of chlorate of potassa and manganese, and all chemists are aware that the operation goes on with great rapidity. They accordingly provide apparatuses of sufficient strength to resist sudden pressure, and they are especially careful in apportioning the material correctly. If two much manganese be employed rapid fusion ensues, and the fused mass, driven by the evolving gas, quickly chokes the conducting tube, shuts up the safety valve as it were, and an explosion necessarily follows, as it would in a steam boiler under parallel circumstances. The proper proportions in which chlorate of potassa and manganese should be mixed are, a quarter of a pound of the former to a quarter of ounce of the latter. The manganese really undergoes scarcely any chemical change, but acts principally by catalysis. This combination, if heated slowly over a gas flame, which, from the power we have of regulating its volume, is by far the best medium for effecting elimination, evolves oxygen gas, at first slowly, but soon with much rapidity; finally, the mass ignites, or rather glows into a red heat, and the oxygen is then given off with violence. These facts assuredly lead to the conclusion that under no circumstances should an ordinary fire be used for the elimination, or manufacture, as it is sometimes absurdly termed, of oxygen gas, from chlorate of potassa and manganese. It is safer to use glass vessels than those of any other material, because, if an explosion unfortunately happens in spite of all precautions, the damage done to life and limb will then inevitably be comparatively small.

For eliminating oxygen on a small scale, a Florence oil-flask will answer as a retort exceedingly well, but, for extensive operations, an iron bottle, and the employment of black oxide of manganese as a catalysis, will be found advantageous and safe.

Of course, it would be better that chemical operations should be conducted exclusively by chemists, wherever danger may ensue from carelessness; but as this is not likely to be the case, we can only put unskilled operators on their guard, for the safety of others as well as that of themselves, and teach them that it is absurd to place a stopped-up gas retort on a kitchen fire, as it would be to place a charged powder flask on the parlour stove, during a Christmas revel, for the purpose of creating a sensation.—*Mechanic's Magazine.*

Melting Wrought Iron by Electricity.

By invitation of Professor Ogden Doremus, a few days ago, we (*Scientific American*) went into the Free Academy to see the great galvanic battery which he uses to illustrate his lectures on electricity. The cups hold one gallon each, and at the time of our visit 360 were filled and in operation. Standing in close rows, they nearly covered the floor of a long room. This enormous battery enables Professor Doremus to exhibit the various effects of galvanism to his classes on the greatest scale. The light produced by the carbon points is far in excess of that resulting from the heating of lime by the oxyhydrogen blowpipe. This is demonstrated by employing the two in the solar microscope. By this electric light crystals of uric acid not larger than the head of a small pin are magnified to the size of ten feet, with perfect definition of outlines and structure.

Among the effects of the battery which Professor Doremus exhibited was the decomposition of potash by the current. To direct the current into the cup of potash the pole was terminated by a wrought iron rod about the size of a lead pencil, and in the course of a few seconds the end of this rod was melted, a drop slowly gathering and finally dropping off, when it is scattered in a hundred sparks. A common class experiment with this battery is the volatilization of gold. A quarter of eagle gold piece is placed on a carbon support and the current directed upon it, when the gold rises like a yellow vapour. If a silver cup is held over it, the cup is gilded by the deposit of the golden fumes.

A New Brunswick built ship.

The connoisseurs in nautical matters have during the last week or two, says the *Liverpool Mercury*, been greatly interested in the "Portlaw," a new vessel just arrived from St. John's N.B., and which is considered to be the handsomest vessel ever built on the "Merrimac," while many competent judges declare that she is one of the finest wooden vessels, which have yet appeared in the Mersey. She has been built by Mr. Eben Manson, of Newburyport, for Mr. John Malcomson, of Liverpool, and is commanded by Captain John Curtis. She is intended for the Bombay trade, and has been built specially with that view, to replace the ship "Windsor Forest." Without going into unnecessary details we may safely declare that we never saw a vessel in which so many ingenious mechanical contrivances were adopted—and these, for the most part, suggested or carried out by the captain—to secure the rapid and handy working of the ship, the safety of the cargo, and the comfort of those on board, not forgetting the sailors. The "Portlaw" is a vessel of 1,183 tons, and made the passage from St. John's, N.B., to Liverpool in eighteen days, and on the voyage her sea and sailing qualities were fully and satisfactorily tested.

A Fire Extinguisher.

An apothecary of Nantes has just discovered by the merest accident that ammonia will put out fires. He happened to have about 70 litres of benzine in his cellar, and his boy, in going down carelessly with a light, had set fire to it. Assistance was speedily at hand, and pail after pail of water was being poured into the cellar without producing any effect, when the apothecary himself took up a pail which was standing neglected in a corner, and emptied the contents into the cellar. To his astonishment the flames were quenched as if by magic, and upon examination he found that the pail, which belonged to his laboratory, had contained a quantity of liquid ammonia. The result is easy to explain on scientific principles—for ammonia, which consists of 82 parts of nitrogen and 18 of hydrogen, is easily decomposed by heat, and the nitrogen, thus set free in the midst of a conflagration, must infallibly put out the flames. A large supply of liquid ammonia properly administered would be the promptest fire extinguisher ever imagined.