THE JOURNAL

OF THE

Board of Arts and Manufactures

FOR UPPER CANADA.

MAY, 1864.

MALLEABLE CAST IRON.

(From the *Engineer.*)

Among a large majority of those engaged in the arts, malleable cast iron has always been a metallurgical mystery. The mode of its production is generally a secret in the few foundries where it is made, and the very ignorance of its true character has prevented its use to anything like the extent it deserves. M. Brüll not long since communicated to the French Society of Civil Engineers a very complete account of the history, mode of production, and properties of malleable cast iron, which deserves to become widely known. It appears that Réaumur, as early as 1722, read as many as six *memories* before the Academy upon the "art of softening cast iron," and, to quote literally, "de faire des ouvrages de fer fondu aussi finis que cieux de fer forgé." According to Réaumur, this art was a secret which, even before the eighteenth century, had been lost and recovered several times. Indeed, the art was then practised in Paris, but as a secret which not even Réaumur was allowed to penetrate. He made experiments for himself, however, and to an extent accomplished what was desired by enclosing ordinary iron castings in crucibles filled with a mixture of chalk and coal, or bone lime and coal, the crucibles being then exposed to a high and continued heat.

In 1804 Samuel Lucas, of Sheffield, patented a mode of producing malleable cast iron, and his specification clearly indicated the theory of conversion. It was that, simply, of partial decarbonization by exposing the castings to a high heat, when surrounded, in close vessels, with powdered iron ore, or other metallic oxides capable of abstracting a portion of the carbon in the iron. For the most complete results, the weight of oxide was to be from one-half to two-thirds that of the castings treated, and the heat was to be kept up for five or six days. Lucas's specification contains, indeed, nearly all that is essential to the production of good malleable castings, and his process is, substantially, that which has been followed for the purpose ever since the time of his description.

Taking Mr. Brüll's account of the converting process as now praticed, the castings should be of charcoal iron from Ulverstone — a locality which Mr. Brüll, by the way fixes "en Ecosse." The white iron is preferred for the larger class of castings and the gray for the smaller pieces. The iron, M. Brüll states, is to be melted in crucibles, heated over a steel converter's fire, the weight in each crucible being about 66 lb. The fusion is to be continued from an hour to an hour and a half. The articles to be cast are moulded either in green or dry sand as may be preferred, and are to be poured in the ordinary manner. The castings are very brittle, and unless well proportioned and very carefully handled they are apt to crack. They are then ready for treatment in the converting furnace. This is rectangular in form, and opens only at a small door for charging and discharging. The furnace, or more properly speaking, oven, has narrow fire grates beneath extending along its whole length. The castings to be treated are packed, in iron cylinders, in alternate layers of red hematite ore finely powdered. These cylinders are placed in the oven, which is closely sealed, so as to completely exclude the air, and then gradually heated until the contents are brought to a bright red. The time occupied in raising the heat is about twenty-four hours, and this heat is to be continued three, four, or five days afterwards, according to the size of the castings under treatment. At the end of this period the heat is to be gradually let down, another twenty-four hours being properly allotted to this. The annealing operation is one of great delicacy. If any air penetrates to the interior of the oven, or if the heat is raised too high, or if the oxide (hematite ore) employed is not properly mixed with a quantity which has already served before, the castings are certain to be burnt. If the heat is too low, or unequal, the annealing is insufficient, and the castings are liable to break. Care, too, or rather a considerable degree of experience, is requisite to prevent the fusion of lumps of the ore upon the surfaces of the casting. An American mode of rendering iron castings malleable consists in heating them in layers of oxide of zinc, which never forms lumps upon their surfaces. Care, too, is required in packing the castings in the powdered ore. If the thickness is not nearly equal, the castings are considerably warped. It is no wonder, with so many contingencies, that the price of malleable iron castings in Paris is from 7½d. to 10d. the pound.

M. Brüll states that the density of malleable castings is hardly greater than that of ordinary cast iron. Three samples of the former, selected at random, had a specific gravity of 7·10, 7·25 and

7·35 respectively. The colour, both external and that of the fractured specimens, approaches that of steel. The "malleableised" metal takes readily a very fine polish, which is not very easily destroyed upon exposure to moisture. Its resistance under cutting tools, or when exposed to friction, is not, however, great. The metal is very porous, as is proved by the gradual diffusion of oil over a considerable surface where only a portion was placed in a reservoir of that liquid. The Ulverstone white iron is very sonorous, and good clock bells are cast from it. The treatment for malleable castings diminishes this property of communicating sound, but of two objects of the same form, that in malleable cast iron can be distinguished from that in wrought iron by the superior note given off on striking it. On breaking a malleable casting the converting process appears to have penetrated only to the depth of 1-8th and 1-6th inch, and instead of gradual transition from one condition to another, there is a well-defined line of demarcation. Yet the core, originally brittle, is found to have become soft and easily workable. Worked under cutting tools the outside of a malleable casting gives long and elastic shavings, while, as the tool enters beneath the surface, the chips, towards the centre of the casting, become more and more brittle. Under twisting and other strains the interior crack, while the exterior presents its customary appearance of toughness. Malleable cast iron is easily stamped, drawn, and hammered without heating. It can also be worked well under the hammer at a low heat, and at this stage hammering appears to improve the grain. At a higher heat it breaks into fragments. Very small sections may be, now and then, welded, but, on the whole, malleable cast iron is not weldable. It is, however, readily brazed with copper. It melts only under a very high heat, and, indeed, it stands fire so well that it is employed for foundry ladles, crucibles for the precious metals, and for the tubes of some descriptions of boilers. Malleable cast iron may be case hardened more readily and to a greater depth than wrought iron. The castings are not blistered, sealed, or warped in the process, and the case hardening may be effected either with bones, hoops, or leather in the ordinary manner, or with prussiate of potash.

MM. Morin and Tresca have made an extensive series of experiments upon the resistance to rupture, limit of elasticity, &c., of malleable cast iron, all of which are recorded in the "Annales du Conservatoire des Arts et Metiers." The strength, per unit of section was found to diminish greatly as the dimensions of the pieces submitted to experiment were increased. The direct resistance rupture was found, in some of the experiments, to be about 50,000 lb. per square inch, or exactly 35 killogrammes per square millemètre. As to the general results of these experiments M. Brüll observes that they indicate a general resistance, a co-efficient of elasticity, and a limit of elasticity as great in malleable cast iron as in good wrought iron. This was, indeed, to have been expected from the ordinary practical acquaintance which we have of the first named material. M. Brüll touches upon the prices at which malleable cast iron is produced in various countries. In Switzerland, for example, it costs upwards of a shilling a pound, while at Liége the cost of castings in this material is not much greater than that of English cast iron. The whole question of the employment of malleable cast iron turns really upon that of its cost. If it can be cheaply produced, and we have no doubt that, with simple improvements it may be, it may be readily substituted in place of many applications of wrought iron. A Glasgow firm has already done something in this direction, but the subject should be more generally pursued by others.

RIVETTED JOINTS IN WROUGHT IRON.

One of the most important operations in engineering is the making of joints in wrought iron, or joining two or more pieces of wrought iron together. It is equally important to have a good and proper joint in a wrought iron girder as in a wrought iron steam boiler. Many lives and valuable property may depend upon the quality of the joint in either case.

In a wrought iron girder whose length is too great to have the plates, bars, or angle irons in one piece, extending from end to end, except by welding, which is generally too expensive, and not always safe until each weld has been tested, it is necessary to connect the two or more pieces of metal in such a manner that the whole of any strain on any one plate or bar shall be taken through, or conducted to the next plate or bar, with as much safety as if the two pieces of metal were one. This conduction of strain from one bar to another ought always to be done with the least possible amount of metal in the joint, for self-evident reasons. Any excess of metal in the joints of course adds to the weight of the girder, and not only adds the excess in the joints, but also increases the sectional area of the girder throughout, so that the girder must be calculated to carry that excess of dead weight, and is therefore so much heavier.

The quantity of wrought iron now used in various constructions which are "built up" of separate plates and bars of wrought iron is so great that, with a good and proper arrangement of joints, a large amount of metal would be saved. It can easily be imagined that any excess of metal in the construction of a girder must diminish the span that it would otherwise carry itself over with safety.

In wrought iron construction the joints should be as few as possible. The plates and bars should be made of the greatest possible length, but not to exceed such a size and weight as to increase the cost of rolling them. The joints can be made by placing the various parts so that one piece shall lap over another and the two be rivetted together. In this case the rivets will be in "single shear," that is, in pulling the two pieces of iron apart, each rivet will be sheared, or cut through, only once, whilst, if the pieces of metal butt against each other and have a joint plate or bar on each side and rivetted, the rivets will be in "double shear," that is, each rivet must be sheared, or cut through, in two places before the joint will break. Therefore, this kind of joint requires only half the number of rivets that there in the lap joint. It is this butt joint which is generally made in girder work, for the very evident reason that, although two joint strips or plates are required — one on each side of the abutting plates—only half the number of rivets are necessary to make an equally strong joint as the "lap joint." Where several plates or bars have to be joined at the same place, as is sometimes the case in the flanges of girders when composed of several thicknesses, where they all butt in the same plane, the joint plates of necessity extend some distance on either side of the joints, so as to have room for the proper number of rivets. In this case, the rivets should be placed as near to each other as possible without injuring the strength of the plates. Otherwise, if they are too far apart, the first row of rivets will have a much greater strain than the second row, the second row a greater strain than the third, and so on to the last row, which will have the least amount of strain. In fact, this will be the case no matter how near each row is to the other, but the difference will not be so great. It is the elasticity of the metal which causes this difference of strain on the rivets. A joint plate might be so long that the first row of rivets would actually be sheared before the last row had any strain upon them worth speaking of. Therefore, for two reasons the joint plates should be as short as possible—first, to get as nearly as possible an equal strain on all the rivets, and, secondly, to have the least amount of weight in them.

The rivets should in all cases be so arranged that the holes, if drilled, would not decrease the strength of the bars, or useful sectional area, more than by one hole. And the sectional area of the shearing parts of the rivets on each side of the joint should never be less than the sectional area, *minus* the rivet holes, of the bar or plate to be joined. It has been proved by experiment that the ultimate resistance to shearing is proportional to the sectional area of the bar torn asunder, and that the ultimate resistance of any bar to a shearing strain is very nearly the same as the ultimate resistance of the same bar to a tensile strain. Therefore, if the sectional area of the shearing parts of the rivets on each side of the joint is equal to to the useful sectional area of each bar to be joined, there will be the same strength in the rivets as in the joined plates or bars. In most cases it is advisable to have some excess in the sectional area of the rivets, to allow for bad workmanship. Sometimes the rivet holes in several pieces of metal are not fair with each other, and when the rivet is driven in hot, it accomodates itself to the irregular hole, and forms a bad rivet, having lost a portion of its shearing area. A still greater excess should be allowed in the case of rivets that pass through a greater number of pieces, for the holes are more likely to be irregular. The excess to be allowed depends very much upon the quality of the workmanship in the construction. If the holes are carefully drilled the excess to be allowed may be much less than when the holes are punched.

In addition to the shearing strength of the rivets, some strength may be calculated upon from the friction that is produced by the rivetting and cooling of the rivets; this additional strength can only be calculated upon, as an addition, when it is quite certain that the rivet holes are completely filled by the rivets.

Experiments shew that a three-quarter inch rivet properly rivetted in three plates or bars, the centre one having a slotted hole, will take five tons to overcome the friction of the heads of the rivet and make the centre plate slip between the other two, and the friction given by a ⅞-inch rivet will not be overcome with less than 7 tons. This extra force from friction is no addition to the shearing strength of the rivets, unless the rivet holes are well filled up. There is no doubt this friction adds much to the rigidity of built wrought iron girders, and has something to do with the deflection being no more than if all the joints were welded. Good rivetting will bring all the plates into close contact, and besides adding to the stiffness of the work by friction, it prevents anything more than a superficial coating of oxide between the faces rivetted together.

No doubt machine rivetting is the best for giving the greatest friction, and filling the rivet holes most perfectly; and it certainly injures the rivets less than the succession of blows given by hand rivetting. In hand rivetting many of the blows are given when the rivet is comparatively cold, and have, therefore, a tendency to destroy the quality of the iron in the head; and, again, hand blows cannot force the metal into the body of the rivet hole in any way to be compared to machine rivetting. A machine rivetted boiler is generally tighter under pressure than a hand rivetted boiler, showing the plates are in closer contact, and better able to resist corrosion by being rivetted with machinery. —*Mechanics' Magazine.*

WELDING METALS.

Of all the proporties of iron, it need scarcely be said that the comparative ease with which two similar parts are welded together, or *soudés*, as the French say, is the most valuable. We believe that no other metal exists so readily to be united by means of a high temperature of the points of contact, and the impact of blows or sudden pressure. A mere sight of the operation, conducted by a skilful smith, is always interesting, even when of daily-life occurence. In welding two round bars together for instance, the ends are upset or made thicker; and each end is bevelled of in a plane diagonally to the axis of the bar. The two ends are then raised to a welding heat—the temperature of which, by the bye, is as yet quite undetermined—and some grains of sand are thrown on the ends, in order to unite with the oxide necessarily formed on the heated scarfs, and to help the contact of two metallic surfaces. A good portion of the impurities is got rid of by striking the bars across the anvil; the surfaces are then brought together, united by a couple of heavy blows from the smith, when the work is finished by a rapid succession of blows from the "striker," or smith's assistant. The whole *rationale* of welding may be said to possess a peculiar interest at the present time, as there is practically much difficulty and extra uncertainty in getting sound welds in the steel which is now coming so extensively into use. Not very long ago a series of experiments were made at the Woolwich yard on a number of 1½ in. chains, made of various kinds of puddled steel and cast steel. The links broke at the weld, and with a lower stress than good cable bar iron. It thus becomes of the greatest importance to, if possible, get at some reasonable explanation of the process of welding. In the account we gave about a fortnight ago of Messrs. Hawksworth and Harding's steel tube manufacture, we noticed the very interesting fact that they welded steel to iron by "cold pressure" merely, and upon the same principle as the old system of plating—by making silver adhere to copper by passing both through a flatting mill. Two clean surfaces of lead can be thus brought together. The same is the case with india-rubber, and this principle may be almost said to form the basis of the india-rubber manufacture. Steel bearings have deen found welded to their iron journals when run under too great a weight. A whitesmith or fitter often notices similar appearances when at work. He is generally very careful to oil fresh surfaces, even when he brings them only temporarily into contact. The famous patent case of Betts *v.* Menzies, that fat oyster-bank for the lawyers during so many years, is based upon an invention which consists in forming a kind of thin foil by the "cold welding," under pressure, of a sheet of tin and one of lead. Dr. Percy states that "copper in a fine state of division, as when precipitated, will cohere and form a solid mass under great pressure; and copper medals have been struck by Ozann on this principle. Gold and silver, in the state of fine powder, may be converted into a compact metallic mass in the same way. The powder of silver produced by decomposing chlorido of silver with zinc, &c., is gently heated, then compressed, hammered and re-heated alternately, the temperature always being sensibly below the melting point of silver. Fournet obtained bars by this means which might be wrought like bars resulting from fusion. He also made damaskeened bars by using gold and silver powder in alternate layers. Fournet regards this as true welding, *i. e.*, union at a temperature below fusion; and he considers that the firm union effected between two freshly cut surfaces of lead by simply pressing them together is welding." The interesting paper, by Mons. Fournet, here cited, was published in our valuable foreign contemporary, the *Annales de Chimie et de Physique* for 1840. There are numberless other instances, in nature, and in other arts besides that of metallurgy, in which solids are formed by the cohesion under pressure of one or more simple substances in a minute state of subdivision, or of even larger parts in a more or less complete state of separation. Sand is thus formed into bricks by means of great pressure, and brick-making machines on this principle are largely used in America. The packing of sand in the ballistic pendulum used for ascertaining the velocity of cannon, is sometimes found converted into sandstone by the impact of the projectiles. Sawdust has been reconverted into a kind of hard wood by means of hydraulic pressure. *Papier mâché* trays are made by subjecting paper pulp to pressure. It would be an interesting inquiry whether the range of pressure that thus forms a body out of (say) similar but smaller component parts, is the exact measure of the range and pressure—the coefficient of rupture—required to destroy the cohesion? Or, is a new force—a kind of attraction—superinduced when the atoms are once brought into sufficiently close contact to the range of the force of cohesion? In an interesting paper which we gave some time last March, Mr. Z. Colburn would explain the phenomenon of welding by stating that:—"In all welding we first employ a degree of heat sufficient to overcome so much of the cohesive force between the atoms of the iron as to allow sufficient motion among themselves to bring all, or most of the atoms forming one surface, within cohesive range of those forming the opposite surface." According to this, heat in welding would appear to have a double function; that of cleaning the surfaces, and that of rendering less pressure necessary. But does this explanation meet the thermal and chemical influences at work in the operation of welding iron? Why is it so difficult to weld "burnt" iron? Why is it so difficult to weld steel? Why is pure iron—the iron of the chemist and the laboratory—and not that of commerce, so difficult to weld? These amongst many other similar questions are yet very far from solution, and they will probably remain so for many years. As was recently very well remarked:—"The navigator plied, and still plies, his oar, ignorant of the manner in which, by its aid, he is enabled to propel his craft with the force of his arms; or he unfurls his sails without insight into the causes whence spring the welcome breeze or the furious wind; or he puts on the steam, uninformed of the cause which produces the expansion of vapours and gases, and thence the motion of his ship. He follows the needle as his guide, heedless of the mystery by which it is made to point with sympathy towards the north."

It is, however, somewhat strange that more of the obvious qualities of iron are not definitely known. There would not seem to be much mystery in the simple question, whether a welded joint is stronger or weaker than the other portions of a bar; but we nevertheless sometimes hear it asserted that the bar is even stronger at the weld—an opinion often very justly controverted by some practical men.

As the ultimate strength of a structure, or of any of its details, must be determined by its weakest part, it is evidently of the utmost importance to know whether the strength of a bar is diminished or not by a welded joint, the workmanship being, of course, supposed to be of the average order. A practical man need scarcely be told that, even with very good workmanship, the results are always somewhat uncertain. There is a peculiarity about all bad welds which is sometimes overlooked. Thus the proof stress, which is generally made one-half the ultimate strength for a steady load, may sometimes fail to detect a bad weld, as one-half or a little more of the sectional area of the iron may stand the test uninjured, and the defect would thus pass undetected. We do not know any recorded set of careful experiments made to ascertain the relative strength of welded joints, besides those made by Mr. Kirkaldy. The value for general purposes of these experiments may be pretty well determined by stating that eighteen separate welds were tested for wrought iron, and two for steel. The brands of the bars were:—Glasgow, B. Best; Farnley; Govan, B. Best; and Govan, Ex. B. Best. The pieces were cut through, scarfed, and welded in the ordinary way—a few were welded by a chain maker, necessarily a welding smith *par excellence*. The results showed remarkable variations. "Fourteen, as operated on by the smith, show a loss, compared with the original whole bar, from 4·1 to 43·8 per cent., the mean loss being 20·8 per cent.; four, by the chain-maker, from 2·6 to 37·4, *mean* 15·1 *per cent.* Of the former, four broke solid away from the weld; eight partly through solid portion and partly at the weld; two separated at the weld. Of the latter, two broke solid; one broke partly solid and partly at the weld; and one gave way at the weld." Of two ¾ in. steel bars, welded by the makers, one showed a loss of 45·0 per cent., and the second of no less than 59·6 per cent. It may be mentioned that, in order to prepare his specimens for testing, Mr. Kirkaldy formed heads to the ends of his wrought-iron specimens by welding on rings. The sizes of the bars varied from ¾ in. to 1¼ in. in diameter. We have just now alluded to some Admiralty experiments on steel chains, and some other results made by Mr. Kirkaldy would seem to point to a similar conclusion with regard to the difficulty of welding steel. He made several attempts to weld rings on the steel bars, but in the greater number the rings failed at the trial, either at the weld, or the steel was found to be burnt. The end had thus to be staved down. One of the most truly scientific examinations into different questions connected with the working of wrought iron was instituted some years ago by the American Government, on the occasion of the bursting of a wrought iron gun on board the "Princeton." The results of a very elaborate series of experiments showed "that the original strength of the iron was considerably impaired by the process of welding it into so large a mass as that which formed the gun, the strength before and after welding being about as 6 to 5." This is a somewhat similar result to that obtained by Mr. Kirkaldy for his 1 in. bars. *Mechanics' Magazine.*

STEAM CARRIAGES ON STREET RAILWAYS.

A Mr. Fisher advocates a new grading of the city of New York the paving of the streets with plates of iron, the prohibition of the use of horses, and the substitution of steam carriages in their place, arguing that with level streets there would be a large saving of the traction power required in removing merchandise from one part of the city to another, and that with iron pavements and without horses the streets would be cleaner and freer from dust, and the sidewalks would be more agreeable for pedestrians.

Board of Arts and Manufactures FOR UPPER CANADA.

DEATH OF PATRICK FREELAND, ESQ.

It is our painful duty to record the death of Patrick Freeland, Esq., Barrister, of this city, on the 6th instant. Mr. Freeland was a member of this Board from the time of its first organization, in 1857, and an active member of its executive committee during the whole period, with the exception of the year 1861. He at all times co-operated with its other members in rendering the Board as efficient for the promotion of the mechanical arts, and the advancement of the industrial classes, as they were enabled to do with the very limited means placed at their disposal. He had also for many years been connected with the Mechanics' Institute of this city, as a lecturer—Director—Corresponding Secretary and President, and contributed no little by his energy to its prosperity; he was also a member of the Council of the Canadian Institute, and for a few years past held the honourable post of Secretary of that institute. He was fond of scientific studies; and his well appointed work-shop at his private residence, with its very superior lathe and the beautiful specimens of his handy-work, shows how interested he was in the study and practice of mechanical subjects. His usefulness was felt and appreciated in other directions, which is not in our province to dwell upon in the pages of this Journal.

Our sympathies are with his bereaved partner and young and interesting family.

PROVINCIAL EXHIBITION.

Manufacturers and others interested in the forthcoming Provincial Exhibition, are recommended to give their careful attention to the Rules and Regulations, published in this number of the *Journal*. This is more particularly necessary as some few important changes have been made therein, since last year's Exhibition.

We would again urge upon mechanics and manufacturers to commence early in preparing their articles for exhibition, so as to have them *well* prepared, and delivered at the Exhibition grounds in good time.

CIRCULATING LIBRARY.

At a meeting of the Executive Committee of this Board, held on the 28th ultimo, the *Book Committee* was instructed "to establish a Library of Books for circulation of such a character as shall be useful for Mechanics, Engineers, Decorators and Artists, so soon as in their opinion it shall be practicable to do so; a sufficient and approved guarantee being left with the Secretary for any books so taken out."

This Library is intended to be entirely distinct from the valuable *Free Library of Reference* now open to the public in the Board Rooms, and will be composed more generally of treatises, or reading books, upon the several subjects indicated, such as Bourne on "The Steam Engine;" C. Wye Williams on "Heat in its relation to Water and Steam;" Wiesbach on "Mechanics of Machinery and Engineering;" Jamaison's "Mechanics for Practical Men;" Fairbairn on "Mills and Mill Work;" Tyndall on "Heat considered as a Mode of Motion;" Mosely's "Mechanical Principles of Engineering and Architecture;" Griffith's "Marine and Naval Architecture;" Howard on "Colour as a Means of Art," &c. &c.

The circulation of these works is not proposed to be limited to this city and neighborhood, but to be extended to any part of the Province, on the necessary guarantee for their safety being given. It is not intended that this Library shall interfere with the circulation of works from the Libraries of Mechanics' Institutes; for owing to the very low fees charged by these Institutions, they cannot afford to purchase for circulation works of the class here proposed, which vary in price, generally, from $3 to $12 per volume; and which are also too expensive for working men, with few exceptions, to purchase for their private Libraries, but who would for the use of such works cheerfully pay a fee of, say, from two to four per cent. per week, on their first cost.

The financial difficulty is the only one likely to delay the organization of this Library, but we expect to be able to announce its commencement—though small it may be—in the next number of the *Journal;* and we trust that many of the classes for which it is intended will fully avail themselves of its advantages.

TO SUBSCRIBERS.

Subscribers who have not already paid, are urgently requested to forward the amounts due for the present year, as well as all arrears, to the undersigned, either in postage stamps or otherwise. All Subscribers, except those residing in Toronto, Montreal, Cobourg, Hamilton and Whitby, who are in arrears with their subscriptions, will receive an account of the same enclosed in the present No. of the Journal. Where no account is so enclosed, it will be understood the only amount due is for the present year, 75 cents.

Members of Mechanics' Institutes and Agricultural Societies, paying directly to their respective Secretaries, without having to be waited upon for payment, are only charged at the rate of 50 cents per annum.

As the subscription to the Journal is small, and the loss sustained by the Board in publishing it is large, it is hoped that Subscribers will at once attend to this notice.

W. Edwards *Secretary.*

BOOKS ADDED TO THE FREE LIBRARY OF REFERENCE.

F 56	—Canada Directory, 1 vol., 8vo., 1864.	*Mitchell.*
I 78	—British North American Almanac and Annual Record, for the year 1864: a Handbook of Statistical and General Information. 1 vol., 8vo.	*J. Lovell.*
T S	—Proceedings of Institution of Mechanical Engineers for 1862. 1 vol., 12 mo.	*Institution.*
G 57	—Canadian Agriculturist for 1863	*Board of Agricul.*
T S	—Transactions of Board of Agriculture, State of Maine, 1862	"
P P	—United States Reports on Patents for 1862, Arts and Manufactures, 2 vols.	*Commissioner.*
"	" " " Agriculture, 1 vol.	"
T S	—Annual Report of Regents of Smithsonian Institution for 1863. 1 vol., 8vo.	*Smiths'n Institute*
P P	—Statutes and other Parliamentary Publications for 1863, several vols.	*Canadian Gov't.*

RECENT BRITISH PUBLICATIONS.

Adams (W. H. D.) Steady Aim; a Book of Examples, &c., fcap. 8vo	0	3	6	*Hogg.*
Albert (H.R.H. Prince) Principal Speeches and Addresses, cheap ed., fcap. 8vo.	0	1	0	*Murray.*
Aristotle; a Chapter from the History of Science, by G. H. Lewes, 8vo	0	15	0	*Smith & Elder.*
Athletic Sports and Manly Exercises, by "Stonehenge" and J. G. Wood, 18mo.	0	2	6	*Routledge.*
Baily (Francis) Doctrine of Life Annuities, &c., edited by H. Filipowski, 8vo.	2	2	0	*Howell.*
Bayley (W. H.) Handbook of the "Double" Slide Rule, roy. 12mo	0	2	6	*Bell & Daldy.*
Binns (W.S.) Course of Geom. Drawing, rev. ed., Pt. 1, cr. 8vo. 4s.; Pt. 2, 6s.; cmplt.	0	9	6	*Weale.*
Bohn's Scientific Lib. Chess Congress of 1862, edit. by J. Löwenthal, post 8vo.	0	7	0	*Bohn.*
Brodie (Rev. James) Remarks on Antiquity and Nature of Man, fcap. 8vo	0	2	8	*Hamilton.*
Craik (Geo. L.) Outlines of the Hist. of Eng. Language, 5th ed. rev., sm. post 8vo.	0	2	6	*Chapman & Hall.*

RECENT BRITISH PUBLICATIONS—*Continued.*

Erichsen (John E.) Science and Art of Surgery, 4th edit., enlarged, 8vo........	1	10	0	*Walton.*
Herzberg (Dr.) Sewing Machine . its History, &c., translated by U. Green, 8vo....	0	7	6	*Spon.*
Jeffreys (John Gwyn) British Conchology, Vol. 2, Marine Shells, post 8vo.	0	12	0	*Van Voorst.*
Kemp (Edward) How to Lay out a Garden, 3rd edit., greatly enlarged, 8vo..........	0	18	0	*Bradbury.*
Manly (Henry) Principles of Bookkeeping by Double Entry, 8vo.	0	4	6	*Stanford.*
Percy (John) Metallurgy, Vol. 2, Iron and Steel, 8vo.	2	2	4	*Murray.*
Vaux (Calvert) Villas and Cottages, new edit., roy. 8vo.	0	15	0	*Low.*
Watts (Henry) Dictionary of Chemistry, vol. 2, 8vo.	1	6	0	*Longman.*
Weatherley (Henry) Art of Boiling Sugar, Lozenge Making, &c. &c., 8vo............	0	2	6	*Author.*

NINETEENTH EXHIBITION.

OF THE

PROVINCIAL AGRICULTURAL EXHIBITION.

To be held at the City of Hamilton, on Monday, Tuesday, Wednesday, Thursday, and Friday, September 26, 27, 28, 29 *and* 30, 1864.

RULES AND REGULATIONS.

Membership.

1. The members of the Agricultural Societies of the several Townships within the County or Electoral Division, or United Counties, wherein the Annual Exhibition may be held, and the members of the County or Electoral Division Society, shall be also members of the Association for that year, and have members' tickets accordingly; provided the Agricultural Societies of the said Townships, or the Society of the said County or Electoral Division or United Counties, shall devote their whole funds for the year, including the Government Grant, in aid of the Association, and shall pay over the same, accompanied with a list of the members of each such Society, to the Treasurer of the Association, two weeks previous to the Exhibition, and provided also that the sum so paid over shall not be less than one dollar for each member of any such Society.

2. The members of the Board of Agriculture, and of the Board of Arts and Manufactures, the Presidents and Vice-Presidents of all lawfully organized County Agricultural Societies, and of all Horticultural Societies, are members of the Association for Upper Canada, *ex-officio*. The payment of $1 and upwards constitutes a person a member of the Association for one year; and $10 for life, when given for that specific object, and not as a contribution to the local funds.

3. Members can enter articles for competition in every department of the Exhibition, at any time previous to the dates below mentioned, and all who become members previous to or on the Saturday preceding the show week, will be furnished with tickets admitting them to the grounds during the whole time of the show, without additional charge.

Entries.

4. No one but a member shall be allowed to compete for prizes except in class 46; sections 11 to 16, of class 49; and class 56.

5. All entries must be made on printed forms, which may be obtained of the Secretaries of Agricultural Societies, or of Mechanics' Institutes throughout the Province, free of charge. These forms are to be filled up and signed by the exhibitor, enclosing a dollar for membership, and sent to the Secretary of the Board of Agriculture, Toronto, previous to, or on the following named dates:—

6. *Horses, Cattle, Sheep, Swine, Poultry.*—Entries in these classes must be made by forwarding the entry form, as above mentioned, filled up, and member's subscription enclosed, on or before Saturday, August 20th, five weeks preceding the show.

7. In all classes of Blood Horses and pure bred cattle, full pedigrees, properly certified, must accompany the entry. No animals will be allowed to compete as pure bred, unless they possess regular Stud or Herd Book pedigrees, or satisfactory evidence be produced that they are directly descended from such stock. In the class of Durham cattle particularly, no animal will be entered for competition unless the pedigree of the same be first inserted in the English or American Herd Book, or in the Upper Canada Stock Register, kept at the office of the Board of Agriculture.

8. *Grain, Field Roots, and other Farm Products, Agricultural Implements, Machinery, and manufactures generally,* must be entered previous to or on Saturday, September 3rd, three weeks preceding the show.

9. *Horticultural Products, Ladies' Work, the Fine Arts, &c.,* may be entered up to Saturday, September 18th, one clear week preceding the show.

10. *Exhibitors are particularly requested to take notice that it is absolutely requisite that the entries be made at the dates above mentioned, in order to afford sufficient time to examine the entry papers, and to correspond with parties, where necessary, for the correction of errors and omissions.*

11. In the live stock classes, the entry must in every instance be made in the name of the *bonâ fide* owner; and unless this rule be observed, no premium will be awarded, or if awarded will be withheld.

12. In all the other classes, entries must be made in the names of the producers or manufacturers only. If any person shall enter an article for exhibition as produced or manufactured by himself, when it has not really been so, he shall forfeit the premium which may be awarded the article, and be precluded from exhibiting in future.

13. In the Agricultural and Horticultural department, the competition is open to exhibitors from any part of the world, with the exception of some classes of fruit.

14. In the Arts and Manufactures department, no article can be entered for competition unless it be the growth, product or manufacture of Canada;

and no money premium will be awarded except in accordance with this rule; articles of foreign manufacture, however, may be entered for exhibition only, and will be reported upon by the judges, according to their merits, or certificates awarded them, if deserving. Manufacturers are requested to furnish with their articles exhibited, the quantity they can produce, or supply, and the price, for the information of the judges, whose decision will be based on the combination of quality, style, and price, and the adaptation of the article to the purpose or purposes for which it is intended.

15. No person shall be allowed to enter for exhibition more than one specimen in any section of a class, unless the additional article be of a distinct named variety, or pattern, from the first. This rule not to apply to animals, but to apply to all kinds of grain, vegetable products, fruit, manufactured articles, &c., in which each additional specimen would necessarily be precisely similar to the first.

Extra Entries.

16. Every article must be entered under some one of the headings in the regular list when possible, but if any article is of a distinct character from anything specified in the list, it may then be entered in the extra section of that class with which it most nearly corresponds. No article, however, will be allowed to be entered as an extra for want of sufficient quantity or number, or any other similar defect, when of the same kind or variety as anything named in the list; in such a case the article cannot be exhibited.

17. Articles manufactured previous to the last Exhibition shall not be entered in competition for the prizes named in the prize list for this year, but shall be awarded diplomas if in the opinion of the judges such articles are superior to any others exhibited, and are deemed worthy of the same.

18. On the entry of each animal or article, a card will be furnished the exhibitor specifying the class, the section, the number of the entry, and the name and residence of the exhibitor, which card must remain attached to such animal or article during the Exhibition.

Trial of Mowing and Reaping Machines.

19. A public trial of the Mowing and Reaping Machines entered for exhibition will take place in the field during haying and harvest time. For this reason, therefore, it will be necessary that the entries of these machines should be made on or before 1st July. Due notice of the time and place of the trial will be given.

Transport of Articles, placing them on Exhibition, and Charge of them while there.

20. All articles for exhibition must be on the grounds on Monday, September 26th, except live stock, which must be there not later than Tuesday, 27th, at noon. Exhibitors of machinery and other heavy articles, are requested to have them on the grounds as far as possible during the week preceding the show.

21. Exhibitors must provide for the delivery of their articles upon the show ground. The Association cannot, in any case, make provision for their transportation, or be subjected to any expense therefor, either in their delivery at, or return from the grounds; all the expenses connected therewith must be provided for by the exhibitors themselves.

22. Articles not accompanied by their owners may be addressed to the care of the superintendent of the exhibition, who will receive them on their being delivered at the grounds, but in no case will such articles be brought on the grounds and placed on exhibition, except by and at the expense of the owners or their authorised agents.

23. Exhibitors, on arriving with their articles, will apply to the superintendent of the grounds, who will be stationed within the entry gate, and will inform them where the articles are to be placed.

24. Exhibitors will, at all times, give the necessary personal attention to whatever they may have on exhibition, and at the close of the show take entire charge of the same.

25. No articles or stock exhibited will be allowed to be removed from the grounds, till the close of the exhibition, upon the delivery of the President's address, on Friday afternoon, under the penalty of losing the premiums.

26. While the Directors will take every possible precaution, under the circumstances, to ensure the safety of articles sent to the exhibition, yet they wish it to be distinctly understood that the owners themselves must take the risk of exhibiting them; and that should any article be accidentally injured, lost, or stolen, the Directors will give all the assistance in their power towards the recovery of the same, but will not make any payment for the value thereof.

Steamboats, Railroads, Customs.

27. The Association will make arrangements with Steamboat and Railroad proprietors for carrying articles and passengers at reduced rates.

28. Arrangements will be made with the Customs department for the free entry of articles for competition.

Admission to the Grounds.

29. Tickets from the Secretary's Office will be furnished each person becoming a member previous to or on Saturday, September 24th, which will admit himself only, free to every department of the exhibition, during the Show. Life members admitted free throughout the Exhibition.

30. No members tickets will be issued after the above mentioned last Saturday evening, but those issued up to that time will be good till the close of the show.

31. Necessary attendants upon stock and articles belonging to exhibitors, will be furnished with admission tickets with their names written upon them, which ticket will be good at the *Exhibitor's Gate only*, during the show.

32. Tickets of admission, to those who are not members, will be issued on and after Tuesday morning, at 25 cents each—such ticket to be given up at the gates each time of admission, on Tuesday, Wednesday, Thursday, and Friday. Children under fourteen years of age, half price. Carriages to pay one dollar each admission; each occupant, except the driver, to be also provided with the usual admission ticket. Horsemen half-a-dollar.

Judges and their Duties.

33. The judges will be appointed by the council of the Association previous to the Exhibition, and will receive a circular informing them of the fact and inviting them to act.

34. The judges are invited to report themselves at the Secretary's office, presenting their circular of appointment, immediately on their arrival at the grounds.

35. The judges will meet, at the committee room on the grounds, on Tuesday, September 22nd, at 10 o'clock, a.m., to make arrangements for entering upon their duties, and will then be furnished with the committee books containing the numbers of the entries in each class.

36. No person shall act as a judge in any class in which he may be an exhibitor.

37. In addition to the stated premiums offered for articles enumerated in the list, the judges will have the power to award discretionary premiums for such articles, not enumerated, as they may consider worthy, and the Directors will determine the amount of premium.

38. In the Fine Arts and Mechanical Department, Diplomas will be awarded—in addition to the money prizes—to any specimen evincing great skill in its production, or deemed otherwise worthy of such a distinction, on its being recommended by the Judges and approved of by the Committee to whom all such matters shall be referred.

39. *In the absence of competition in any of the Classes, or if the Stock or articles exhibited be of inferior quality, the Judges are instructed to award only such premiums as they think the articles deserving of.* They will exercise their discretion as to whether they will award the first, second, third or *any* premium.

40. Each award must be written in a plain, careful manner, on the blank page opposite the number of the entry; and the reasons for the award should be stated when convenient.

41. No person will be allowed to interfere with the Judges while in the discharge of their duties. *Exhibitors so interfering will forfeit their rights to any premium to which they might otherwise be entitled.*

Extracts from By-Law.

42. "The Judges shall, in the execution of their duties, be careful to act with the most rigid impartiality; shall make their entries in a clear and conspicuous manner, in all cases of doubt or difficulty referring freely to the Secretary, to any member of the Council, or to the Superintendent; and when they have completed their reports shall sign and deliver their books to the Secretary of the Department to which they belong."

43. "Upon the discovery of any fraud, deception, or dishonest practice, either in the preparation, ownership, or of any representation concerning any article exhibited which may have affected or have been intended to affect the decision of the Judges, the Council shall have power to withhold the payment of any prize awarded, and may prohibit any such party or parties from exhibiting in any class for one or more years, and may also publish the names of such persons, or not, as may be deemed most expedient."

Delegates, the Annual Meeting, &c.

44. Delegates and members of the Press are requested and expected to report themselves at the Secretary's office immediately on their arrival.

45. The Annual Meeting of the Directors of the Association will take place on the grounds on Friday morning, Sept. 30th, at 10 o'clock.

46. Delegates from County Societies desiring to obtain a portion of the Canada Company Prize Wheat for their Counties, will please apply to the Secretary for it before leaving the exhibition, and take it with them from thence.

The General Superintendent.

47. The General Superintendent will have the entire supervision of the grounds and the arrangements of the exhibition. He will have an office upon the ground, where all persons having inquiries to make in relation to the arrangements will apply.

Paying the Premiums.

48. The Treasurer will be prepared to commence paying the premiums on Saturday, October 1st, at 9 A. M., and parties who shall have prizes awarded them are particularly requested to apply for them before leaving Hamilton, or leave a written order with some person to receive them, stating the articles for which prizes are claimed.

49. Persons entitled to cash premiums must apply for them at the Secretary's office, who will give *Orders on the Treasurer* for the amount.

50. These orders must be endorsed, as they will be payable to *order*, not to *bearer*, and on presentation to the Treasurer, properly endorsed, will be paid either in cash or by cheque on the Bank.

51. Orders for premiums not applied for on Saturday as above will be given by the Secretary, and the amount forwarded by the Treasurer, on receipt of proper instructions.

Miscellaneous.

52. Provender will be provided by the Association for live stock at cost price. For information Exhibitors will apply to the Superintendent of the grain and fodder department at his office.

53. Auctioneers will be on the ground after the premiums are announced, for the purpose of selling any animal or article which the owner may wish to dispose of, and every facility will be afforded for the transaction of business.

54. In case the Directors shall require any particular information in reference to animals or articles taking first prizes, the owners will be expected to transmit it when requested to do so.

PROGRAMME FOR THE WEEK.

1 Monday, Sept. 26, will be devoted to the final receiving of articles for exhibition, and their proper arrangement. None but officers and members of the Asssociation, judges, exhibitors, and necessary attendants will be admitted.

2. TUESDAY, 27th. — The judges will meet in the Committee Room at 10 A. M., and will commence their duties as soon as possible afterwards. As soon as they have made their awards, they will report to the Secretary of their respective Department, and will then be furnished with the prize tickets, which they are requested to place on the proper articles before dispersing. Non-members admitted this day on payment of 25 cents each time. The ploughing match will take place this day within as convenient a distance of the exhibition grounds as possible.

3. WEDNESDAY, 28th. — The judges of the various classes will complete their awards, and will

place all the prize tickets if possible. Admission this day same as yesterday.

4. Thursday, 29th.—All the remaining prize tickets not yet distributed by the judges will be placed upon the proper articles this morning, before 9 o'clock, if possible. Admission the same as yesterday.

5. Friday, 30th.—The annual meeting of the Directors of the Association will take place at 10 A. M., in the Committee Room. The President will deliver the Annual Address at 2 P. M., after which the Exhibition will be considered officially closed, and exhibitors may commence to take away their property. Admission to-day the same as yesterday.

6. Saturday, Oct. 1st—The Treasurer will commence paying the premiums at 9 A.M. Exhibitors will remove all their property from the grounds and buildings. The gates will be kept closed as long as necessary, and none will be admitted except those who can show that they have business to attend to.

Correspondence.

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

Sir,—I notice on the last page of your *Journal* for the last month an article on "Ventilation of Ships," in which it appears that a Mr. Edmonds has ventilated the *Royal Sovereign*, and in his remarks describes the "exhaustion principle," patented by me, both in Canada and the United States, sixteen years ago. In my patent in the United States, part of my specification runs thus: "In building a new steamer, or other vessel, the space between the lining and the vessel's plank might with great ease be converted into an escape passage for the foul air. In applying the system to an old one, the foul air might be made to pass under or behind the seats by which the cabins are usually surrounded, and taken out at proper intervals by wooden pipes or chimnies. The floor, however, ought to be perforated, (in order to let the *external* air down, so as to keep the vacuum caused by the draught of the foul air pipes or chimnies supplied), in order that the body of foul air and carbonic acid gas, which is there constantly generating, may be constantly *drawn* off."

The writer of that article must have made a mistake in describing "deep air channels" as "acting immediately below the deck," in order to increase or "perfect the ventilation," as that course would evidently bring the foul air *upward* and past the breathing zone. The rest of this article I fully approve of.

In a lecture delivered here before the Mechanics' Institute, printed and widely distributed in England, as well as this Province, after alluding to the awful effects of miasm in ancient Egypt from the then modern mode of sepulture, and the effects of the cholera here in 1832 and 1834, I find the following:—"And we may expect a repetition of these evils until shipowners shall be *obliged* to properly ventilate their ships. The carrying out of our present sanitary regulations only lead to the sacrifice of life, time and money. I have the utmost confidence in my assertion when I say that if I were allowed to ventilate an emigrant ship, not a single person on board would die of an infectious disease (contracted on board) in crossing the Atlantic."

If British sailors and soldiers generally, to say nothing of emigrants, could once experience the advantages of ventilated ships over the ordinary miasmatic holes in which they are obliged to sleep, and the extra cost would be comparatively nothing, what an enormous saving in a national point of view would be the result. But so long as the "*red tape*" system governs, and no man except "*the proper officer*" *can* be consulted upon these matters, so long will the millions which our men costs us be squandered away, and our army and navy "in want of men."

Henry Ruttan.

Cobourg, C. W., 13th April, 1864.

Proceedings of Societies.

TORONTO MECHANICS' INSTITUTE.

The Annual Meeting of this Society was held in its Lecture Room, on the evening of Thursday the 9th instant. The President, Mr. Wm. Edwards, in the chair.

From the Report of the Directors, as read by the Secretary, we make the following extracts:—

The Membership.

"Though there has been a slight decline in the entire numerical strength of the Institute during the past year, there has been an increase in the membership proper, as will be seen from the following statement:

The number of members at the date of the last Annual Report, was	698
Honorary Members	18
Life Members	81
Subscribers	264
Total	1061
From which deduct by deaths, removals and withdrawals	526
Leaving	535
New Members admitted during the year	197
New Subscribers	270
Leaving a total of	1002

Classified thus—

Members	704	
Subscribers	199	
Life Members	81	
Honorary Members	18	
		1002

The Finances.

"The Treasurer's account, an analyzed statement of which will be found in Appendix A to this Report, shows the total receipts for the year to be $12,647 99; total payments $12,548 16; leaving a balance in hand of $99 83.

"The amount of liabilities at this date, as per Appendix B, (not including the building de bt) is $1,445 24, and the available assets $328 83; excess of liabilities over assets $1,116 41. The liabilities in excess of assets at the date of last Annual Report amounted to $1,629 37, showing a reduction during the past year in excess of liabilities over assets of $512 96.

"In the above-mentioned liabilities is included the sum of $170 99, being the net proceeds of the first series of ten Re-Unions, held during the past season, and credited to the fund instituted for the purchase of a concert grand piano, for the Music Hall. The net proceeds of the subsequent six special Re-Unions, amounting to $135 01; and of Mr. Vandenhoff's seven readings, to $228 85—together, $363 86—have been credited to the Institute general account, and will be found in detail in Appendix A.

"Appendix C shows the total expenditure on behalf of the Classes, $443; total receipts, $369; balance against the Classes, $74. The Report of the Auditors for the year is contained in Appendix D.

The Library.

"This very important department of the Institute has been considerably improved during the year by the addition of numerous new publications, besides several of the older and more valuable works. From year to year the library is becoming more and more attractive, as is evident from the greater number of readers. This gratifying result may be attributed in a great measure to the increased facilities for access which the members have to the more popular volumes. So great has the demand become that not only duplicate copies, but in several instances as many as four, six, eight and twelve copies of the works of the popular authors have been procured.

The number of books in the Library at the date of last Annual Report, was		5554
Added during the year	528	
Bound up from Reading Room	76	
Presented	40	
		644
Total		6198
Lost and worn out during the year		98
Leaving now in the Libaary		6100

Reading Room.

"The Reading Room has also been improved, several of the more important English and American Commercial Publications, besides various Periodicals and Magazines, have been ordered since last Report. The addition of the Commercial Publications has rendered the Reading Room still better adapted to the requirements of the Mercantile Community."

[Here follows a list of 68 British, American and Canadian Newspapers and Periodicals paid for by the Institute; and a list of 42 others furnished gratuitously by their respective publishers, and by private individuals, and which are thankfully acknowledged by the Directors.]

The Classes.

"The Classes in connection with, and under the immediate control of the Institute, for tuition in the various branches of useful knowledge, which were established in the fall of 1862, were continued during the past season, and have succeeded as well as could possibly be expected. These Classes, though well adapted for all, were more espically designed for young artizans, clerks, and those whose avocations rendered study impossible during the earlier hours of the day. There were in all five of these classes in successful operation, namely:—An English Grammar and Composition Class, numbering 21 pupils, under the charge of Mr. Samuel McAlister; a Book-keeping and Penmanship Class, numbering 58, under the charge of Mr. W. R. Orr; an Ornamental, Architectural and Mechanical Drawing Class, numbering 20, under the charge of M. Berger; a Mathematical Class, numbering 6, under the charge of Mr. Huggard; and a French Class, numbering 10, under the charge of M Pernet. The pupils composing these classes numbered in the aggregate 115; among them there were several who attended during the preceding season, who, it is hoped, will again present themselves. It is much to be regretted that the attendance was not greater—that so few comparatively of the working classes have taken advantage of the privileges thus afforded them, and this is the more surprising as the terms were so very moderate as to be within the reach of the whole community. In the course of a few seasons, young men might through the agency of these classes attain such a knowledge of the rudiments of the various branches of a thorough English education, as would eminently fit them for such a course of study as would ultimately render them thoroughly competent to discharge creditably such duties as may hereafter devolve upon them in almost any position in life.

"The Directors of the Northern Railway of Canada have again very liberally subscribed the munificent sum of one hundred dollars to the support of the classes, which sum was appropriated by the Board to the purchase of suitable prizes, to be awarded at the end of the term to such of the pupils as should pass the most creditable examinations in their respective classes. In accordance with this design, first and second class prizes of books were purchased, of the value of $10 and $6 respectively. The services of several efficient examiners were procured, and the final competitive examinations resulted as follows:—

John Nimmo	1st	prize	Book-keeping.
Robert Mills	2nd	"	"
William Bartlett	1st	"	Penmanship.
John E. Brent	2nd	"	"
Richard Woodsworth	1st	"	English.
John D. Nasmith	2nd	"	"
Miss Wilson	1st	"	Ornamental Draw.
Chas. Bell	2nd	"	" "
Wm. Miller	1st	"	Architectural "
Alex. Greenlees	2nd	"	"
R. Palin	1st	"	French Class.

"In consideration of the liberality of the Northern Railway Company, the Directors of the Institute have given to all the apprentices in the Railway Works the privileges of the Institute and its Classes gratis.

"The Directors desire to acknowledge the zeal and efficiency with which the teachers have discharged their duties, for they feel that to them in a great measure may be attributed the very gratifying success which has attended their united labors.

The Re-Unions.

"The Re-Union enterprise, originated and successfully carried on during the preceding year, was again entered upon early in the season just closed, and the Directors are pleased to be in a position to state that the entertainments this year have been successful even beyond their anticipations. It was considered advisable to commence the season with a series of ten Re-Unions. So popular did these soon become, that crowds thronged the Music Hall on each occasion, and at the termination of the course, a further series of six special Re-Unions was announced. These proved as popular and in every respect as successful as those which preceded them. The Re-Unions of the past season, the Directors believe, have been a source of much amusement and instruction to the members generally, if not to the citizens at large, for they have excited an emulation among the numerous amateurs who have taken part in them, and have besides been the means of directing the attention of several young persons to the study and practice of music and elocution. As before stated, sixteen Re-Unions in all have been held, and they were conducted so economically that the rates of admission were placed so low as to bring them within the reach of the whole community."

The Secretary.

"The Directors gladly acknowledge the zeal and assiduity with which Mr. Longman, the Secretary, has discharged his varied duties during the past year. The books and accounts are neatly and accurately kept, and the affairs of the Institute attended to punctually and well."

The Report being unanimously adopted, the balloting for office-bearers for the ensuing year took place, which resulted in the election of the following gentlemen :—

President—F. W. Coate.
First Vice-President—Henry Langley.
Second Vice-President—Richard Lewis.
Treasurer—William Edwards.

Directors—C. W. Connon, LL.D., George Carroll, Daniel Spry, H. E. Clarke, John J. Withrow, John H. Richey, Samuel Rogers, Wm. Hamilton, Jr., James Rollo, Wm. Halley, John McGee, W. P. Marston.

The following resolutions were then severally put, and unanimously adopted:

Resolved—That two gentlemen be appointed to thoroughly canvas the city for new members, and thus increase the funds of the Institute.

Resolved—That the members of this Institute, deeply deploring the loss they have sustained in the death of Patrick Freeland, Esq., a late President of the Institute, desire to convey to his family the sincere expression of their sympathy under their present great bereavement.

Resolved—That the thanks of the members of the Institute are due and are hereby most heartily tendered to the amateurs who so kindly contributed to the success of the Re-Unions.

Resolved—That we have heard with feelings of deep regret the contemplated departure from the city of our much esteemed friend, C. W. Bunting, Esq., whose unflagging energy and great zeal in the discharge of the onerous duties which devolved upon him as first Vice-President of this Institute, merits our highest approbation. We wish him every success and many friends in his new field of labor.

Resolved—That the Board of Directors be instructed to increase the salary of Mr. James Woodsworth, the Assistant Libarian, $50 per annum.

The President elect urged upon the members, that each one should endeavour during the ensuing year, to prevail upon at least one other person, to join the Institute ; by which means the membership would be doubled, and the Finances at once relieved from any further difficulties.

The meeting then adjourned.

USEFUL RECEIPTS.

Charcoal Crayons.

Saw pieces of charcoal to the required shape ; let them macerate for 30 minutes in Melted Wax ; then dry them on blotting paper. Drawings of this, warmed at the back, become indelible.

Collins' Disinfecting Powder.

1. Dry Chloride of lime 2 parts, burnt alum 1 part. Used with or without water, to purify rooms, Cesspools, &c.

2. Anhydrous sulphate of Alumina 1 part, chloride of lime 2 parts. Mix.

Colours for Confectionary, &c.

These should always be harmless. Liquid Cochineal serves for reds, while sap green, Prussian blue, yellow saffron, &c afford innocent means of colouring sweatmeats, jellies, and liquors.

Colours, Vehicles for.

Boiled Linseed oil, with dryers, serves best for oil paints. Water-Colours may be used with gum water, solution of gelatine, or a solution of shellac and borax.

Copper, Nitrate of.

Saturate nitric acid with copper ; evaporate until the acid flies off; re-dissolve with fresh acid ; filter, evaporate, and crystallise. Used in electrotyping, and in making show colours.

Pickled Pork equal to Fresh.

Let the meat cool thoroughly: cut into pieces four to six inches wide: weigh them, and pack as tight as possible in the barrel, salting very lightly. Cover the meat with brine made as strong as possible. Pour off a gallon of the brine, and mix with it one tablespoonful of saltpetre for every hundred pounds of meat, and return it to the barrel. Let it stand one month ; then take out the meat ; let it drain twelve hours. Put the brine in an iron kettle, add one quart of molasses or two pounds of sugar, and boil until perfectly clear. When it is cold, return the meat to the barrel, and pour on the brine. Weigh it down, and keep it covered close, and you will have the sweetest meat that you ever tasted.

White Beeswax.

Have a hard-wood board made in the shape of a shingle, then put the wax in a pot of hot water over the stove. While the wax is melting soak the board in warm water to prevent the wax sticking to it, then dip the board into the pot of water and wax as you would dip candles, and you will have a thin sheet of wax on the board. This you can loosen with a knife so it will slide off. Then dip as before, and so on until you have dipped all the wax off. Take these thin sheets of wax and spread them on a white cloth in the hot sun until they are white, afterwards melt and cake.

To restore Faded Photographs.

The prints should be unmounted by soaking in water for a time, and then immersed in a saturated solution of bichloride of mercury, in which they may be left for two or three minutes, and afterwards thoroughly washed. The change takes place directly they are in the bichloride solution.

Best Time to paint Houses.

Experiments have indicated that paint on surfaces exposed to the sun will be much more durable if applied in autumn or spring, than if put on during hot weather. In cold weather it dries slowly, forms a hard, glossy coat, tough like glass; while if applied in warm weather, the oil strikes into the wood, leaving the paint so dry that it is rapidly beaten off by rains.

The Best Lime for the Calcium Light.

Lime made from Italian marble is the most satisfactory. It does not crack, gives a good light and is easily prepared. Small pieces of white marble are put into a clear fire, in a stove or open grate. After remaining at a red heat for twenty to thirty minutes it is, after cooling, easily cut into any desired shape.

To make Lard Candles

To every eight pounds of lard add one ounce of nitric acid, and the manner of making it as follows:—Having carefully weighed your lard, place it over a slow fire, or at least merely melt it; then add the acid, and mold the same as tallow, and you have a clear beautiful candle. A small proportion of beeswax makes them harder.

Cheap Paints.

The essential part of all good paints, properly so called, is linseed oil. Oil, if well boiled, may be applied alone, and affords an excellent protection to hard wood and implements, and upon floors. Sundry substances ground very fine are used to mix with the oil, and in proportion as they thicken the oil and form an opaque coating, they are said to possess "body." A pretty good cheap paint for outside work is made by mixing plaster of Paris with white lead, or zinc white, and grinding them together in a paint mill with oil. Plaster alone may be used, and it is said to form a durable and cheap paint. Of course any color may be given which is desired.

Iron Cement.

To make an iron cement suitable for making rust joints, mix thorougly 112 lbs. of clean cast-iron borings or turnings, with 8 ounces of sal-ammoniac, and 1 ounce of flour of sulphur, and add sufficient water. Keep wet when not to be immediately used, or it will heat and be spoiled.

Sulphur in Asthma.

Dr. Duclos of Tours recommends washed sulphur in doses from ¾ to 1½ grains three times a day for several months. And the Boston Medical Journal mentions three very bad cases of asthma which it says were completely cured by this treatment. It is simple, and may be readily tried.

Sugar-making from Sorghum or Imphee.

Take the most thorough granulated sirup on hand, and place on a strong linen cloth, suspended by the corners at a slight swag; prepare a vessel underneath to catch the drips, then introduce pure cold water in falling drops on the grained sirup in the cloth, stirring at the same time thoroughly, so as to cause the water to come in contact with every particle of grain; continue the process of washing in this way until the waxy or gummy tendency is destroyed considerably, then apply a press to hasten the expulsion of the liquid part, leaving the grain in the cloth, which may be put into a vessel, and will soon dry and crumble ready for market by stirring."

Selected Articles.

INDUSTRIAL MUSEUMS IN THEIR RELATION TO COMMERCIAL ENTERPRISE.

BY THE LATE PROFESSOR GEORGE WILSON.

The industrial museums of the country have not risen in obedience to any sudden romantic impulse of educational enthusiasts or hypothetical philosophers, but have slowly grown into a visible reality, and forced themselves on the notice of the practical intellects of the country. How this has been, a few words will explain.

The long peace which followed Waterloo gave us leisure to neglect war; to apply the sciences to the useful arts; and to interchange with our brethren of mankind on all sides, the important discoveries and inventions which they and we had severally achieved. When the French Revolution awoke Europe from its perilous slumber, it awoke the philosopher as well as the soldier and statesman, and Watt's steam engines and Davy's voltaic batteries were fruits of the same energy which dethroned the Bourbons, and won Waterloo. When peace at length came, discovery followed discovery, and invention invention, with a rapidity such as the world never witnessed before. Four of those, partly discoveries, partly inventions — namely, steamships, railroads, locomotives, and electric telegraphs—the beginnings of which were long before the peace, but their practical evolution not till long after it, were of themselves sufficient to have necessitated industrial museums, by their effect in abridging space and time. Keats, the poet, in his Eve of St. Agnes, imagines with exquisite fancy the possibility of a full-blown rose becoming "a bud again." We have seen something of the kind happen. The great globe has seemed before our eyes to contract into smaller dimensions, and all the cities on its surface to come closer together, and almost to look in at each other's windows. When such things have occurred as the simultaneous announcement to every capital of Europe that Czar Nicholas was dead, who has not felt as if the cities of the globe were visibly separated by no other barrier than the almost imperceptible wire-fence of the electric telegraph?

The feeling of increased neighbourhood with the whole earth, which has thus been startlingly brought before us, grows familiar and even pleasant with every excursion we make. What a strange difference has come over the meaning of the words, "a day's journey," as signifying so much space traversed! Think of the difference between even the shortest "Sabbath day's journey," as measured across the Egyptian desert from the back of a camel, and the platform of a locomotive engine; or across the Atlantic from the deck of a packet, and the paddle-box of an ocean steamer. We scarcely seem seated in our express trains, for what by miles is a long journey, when we are called on to surrender our tickets; and before we have time to forget the song to which the sailors hove the anchor on one side of the world, the outlook gazing on the other is heard shouting, "Land in sight."

Our children may tire of swift progression, and cut the telegraph wires and cables, that they may meditate in peace, and undisturbed by news, realise the poet's "lodge in some vast wilderness." But for us in our present eager mood, express trains are but lagging steeds, and the failure of the Atlantic cable a bitter calamity. The seven league boots, the shoes of swiftness, and Fortunatus' wishing cap, which, under the names of steam-engine and telegraph, modern science has bestowed upon practical art, must, although they had been but solitary gifts, have altered all our commercial relations. The entire globe is now an open market-place and bazaar for every nation, and trading must proceed in a very different fashion from before. The great races of men will, doubtless, continue to work at different rates and in different ways, and we shall always probably be able to say of them, what Shakspere's Rosalind says of individuals, "I'll tell you who time ambles withal, who time trots withal, who time gallops withal, and who he stands still withal." But steam-engines and telegraphs are plainly persuading the whole world to keep in all senses the same time o'day, though what that time shall be is still uncertain. I may be allowed, in passing, to indulge the hope that our people will be content to go at the approved national pace of the trot. We have not as yet learned to amble gracefully, and we cannot often afford to indulge, as we have recently been doing, in the expensive luxury of a headlong gallop. But this by the way. What I am earnest to urge as foremost in importance is, that the world opened up so widely to us, and our long separated brethren brought before us, face to face, could not but affect us strangely, although all that world were an African desert, and all its inhabitants wild men practising rude aboriginal arts. But that world contains many a people, as wise at least as ourselves, and their industry, as well as ours, has been quickened by discoveries and inventions not less marvellous than those which are embodied in the steam-engine and electric telegraph. Within the period which divides us from Waterloo, including, however, as organically connected with it, all the years of this century, each of the older sciences has known a new birth, and on every side infant sciences of giant blood have grown before our eyes into a stately adolescence, which, but that we anticipate for them a protracted old age, we should style a grave maturity. Since 1800, great chemists have arisen in France, Germany, Italy, Scandinavia, England, America, who have shown us, to the wondrous extent He has permitted them to show, how God has weighed the mountains in scales, and the hills in a balance; and how we, as His children, reading His laws impressed upon every thing He has made, may transmute air, earth, and sea, into all that the body needs, or the senses, the intellect, and the fancy require. Within the century great mechanicians have wrought with a faith in God's laws which has enabled them to remove mountains, to make hills valleys, and crooked places straight; and though they themselves perhaps did not always care for that, many have in consequence run to and fro, and knowledge has increased. Within the century, great geologists have opened up for us, and deciphered the pages of that most ancient of books, in which in primæval lithography is written, ages before Job announced it—"Surely there is a vein for silver, and a place for gold where they fine it. Iron is taken out of the earth, and brass is molten out of the stone." Within the century, great naturalists, patiently gazing with the eyes of genius when there was light sufficient for illumination; and, when all was dark, feeling about with sensitive fingers, have caught the clues which lead into some of the innermost recesses of living nature, and have brought us through what seemed hopeless labyrinths, face to face with the mysteries of organic life, and shown us how to make practical application of the open secret.

I name no other class of philosophers. Those named may stand for all. Throughout this century each of the physical sciences, moving exultingly forward, has acted on all the other sciences, and been re-acted on by them; and together they have conspired to give industralists of every class a command over material nature, such as the most sanguine of our forefathers did not hope to see attained, even after the lapse of centuries.

Side by side with all this, the moral earnestness of the community has increasingly deepened. The slave has been set free. The liberties of the people have been enlarged. The rights of conscience have been day by day more respected. Feelings of mutual respect and sympathy have been fostered among the different ranks of the nation, and among the different nations of the world; and the breasts of all thoughtful men have brimmed with gratefulness to God that he has so long heard and answered their prayer—"Give peace in our time, O Lord!"

The culmination of the star of peace, under which this progress was made, marked the close of the half-century, In 1851 the monarch of Modern Babylon wrote as did Nebuchadnezzar of old from his great city beside the Euphrates:—"Victoria, the Queen, unto all people, nations, and languages, that dwell in all the earth, peace be multiplied unto you." And, at her august bidding, the nations gathered together within that wondrous Crystal Palace, which seen across the drifting thunder clouds and bloody horizon that have too largely blotted out the clear sky since, appears rather a Midsummer Night's Dream woven by fairies, than a temple built by hands, on which with waking eyes we gazed. The Great Exhibition of 1851 was one of those cyclical blossomings of the mighty banyan tree of the nations which occur only at immense intervals. Acccording to the older botanists, the aloe or agave flowers but once in a hundred years. Their successors think that they made the cycle too long; for my purpose it is too short; but take it either way, 1851 marked one of the aloe-flowerings of the human race, and of the fruits which followed that flowering, the Industrial Museum is one. I do not mean by this that but for the Great Exhibition we should not have had industrial museums. On the other hand, it would, I believe, have been born to us at any rate, only at a later period, and as the fruit of a lesser tree. In actual fact, however, it came to us through the outburst of peaceful energy, which built and filled the Palace of 1851; and whilst we are indebted to a very few individuals for its local development, we must refer its birth, as well as that of the Crystal Palace itself, to a conviction, slowly reached and lying deep in the hearts of men, that industrial museums were a want of the age.

In truth, to recall the former comparison, as the flowering of the aloe at the close of the hundred years (if that is its cycle) implies that the ninety-nine preceding ones have been spent in patiently amassing and elaborating materials for the crown of flowers which it wears on its hundredth birthday; so we must look upon the Palace of 1851, not as a Jonah's gourd which rose in a night and withered in a night, but as the quickly expanded flower of a trunk, strong and enduring, like that of a cedar of Lebanon centuries old. The mere summoning of the nations to Hyde Park in 1851, would have been of none effect had the summons not been met half way by a counterpart longing for such a call. Natural philosophers are familiar with the phenomenon of still water, more than ice-cold remaining liquid and uncongealed, till it is shaken or disturbed, when it shoots in an instant into a forest of crystals. The crystalline forces were all the time struggling to assert themselves, and the slightest motion turned the balance in their favour. The long peace had calmed the world into a similar quiescence; but the latent activities were longing for action, and the Prince Consort had scarcely spoken the words of invitation, before the glass and iron crystallised into a palace, and the nations, as if they had been intently waiting for the call, rose like one man, and piled their works under its graceful dome.

It is in this ready acceptance of the invitation to London, and in the subsequent crowdings to the exhibitions of New York, Dublin, Paris, and Manchester, that I find the strongest arguments in favour of industrial museums. In support of this argument, I would also, but with qualification refer to the erection of the Sydenham Palace, which, though eminently deserving encouragement on many grounds, cares only in part for the Industrial Arts. It is further strengthened by a consideration of the circumstances which preceded the birth of those older, yet withal recent, museums in or near London; that at Jermyn street, which originated in the fact of important minerals accumulating in the hands of the geological surveyors; and that of Kew, which originated in the accumulation of equally important vegetable products in the hands of the Curator of Kew Gardens. Unless the authorities had thrown away the one class of objects and burned the other, they could not well have done otherwise than give them house-room. No sooner, however, had they done so than every one saw that these collections which had, as it were, come together of themselves, were of the greatest interest and value. Out of a similar conjuncture of circumstances, arose the Museum of Irish Industry in Dublin. I might name other institutions, but these may suffice to prove the truth of the statement with which I commenced, that the other industrial museums of the country created themselves; in other words, they were not the result of *a priori* views on the part of speculative founders, or sudden creations of government. You will not for a moment suppose that I mean to say that the museums referred to suddenly came into existence without human help. On the other hand, each of them owes its development to the labours of many energetic men, who found these labours no light task. But it is most remarkable that alike Sir Henry de la Beeche, in describing the origin of the Industrial Geological Museum in Jermyn street, London; Sir William Hooker, in describing the origin of the Industrial Botanical Museum at Kew; and Sir Robert Kane, in describing the origin of the Industrial Museum at Dublin, state explicitly, that it was because materials accumulated around them, not because they looked about for materials that their respective museums came into being. In no case, moreover, did government come to their assistance, till it was placed beyond doubt that, in possession or near prospect, specimens were largely available for each of these museums; and in conformity with this, when government resolved to establish an Industrial Museum in Scotland, it made the collection of specimens the first thing, the building of a permanent museum the second. I dwell upon those points, because they are scarcely known to the general public whom you represent, and because I cannot but think that the independent origin of the three non-Scottish industrial museums affords a powerful threefold argument in favour of the value of such institutions, as things for which the time was ripe, and by neglecting which we shall certainly suffer.

In no part of the empire has the value of museums, as important aids in practical education, been longer or more fully recognised than in Edinburgh, so that I may say that, with one consent, and having the interests of all Scotland in view, the whole of our public bodies have come forward to encourage the industrial museums.

The Industrial Museum, like the College, the Court of Session, or the House of Commons, is at once a walled-in space, and an embodied idea or cluster of ideas. The walled-in space takes its character from the idea which it embodies, and that idea is fourfold. It includes the conception of—

1. An ample exhibitional gallery, where the raw

or workable and other materials of industrial art, the tools and machines employed to modify these, and the finished products resulting from their modifications, shall be displayed.

2. A laboratory and workshop, where the qualities of industrial materials and products, and the effectiveness of industrial apparatus and machines, may be investigated.

3. A library, where the special literature of industrial art may be consulted.

4. Systematic Lectures on the contents of the galleries, the investigations of the laboratory and workshop, and the records of the library, as illustrating the nature of Technology or industrial science.

Let me suppose the industrial museum of the future already existent and realising to the full the idea just referred to.

When that museum shall be erected, I will ask its architect to sculpture on its front an emblematical device, namely, a circle, to imply that the museum represents the industry of the whole world; within the circle an equilateral triangle, the respective sides of which shall denote the mineral, vegetable, and animal kingdoms, from which industrial art gathers its materials; within the triangle an open hand, as the symbol of the transforming forces which change those materials; and in the palm of that hand an eye, selecting the materials which shall be transformed. Gazing through that eye, let us see what the industrial museum can do for commercial enterprise.

I. The commerce of the world deals, in the first place, very largely with mineral, vegetable, and animal substances, as related to industrial art, in three ways. 1. Many of them we style raw materials. The term is a very expressive one, as implying that they need to be cooked, and that they admit of being cooked. Originally applied to food, the meaning is not felt to be forced as used in relation to coal, to metallic ores, to sugar, to skins, or to other bodies, which can be changed, especially by chemical processes, from useless into useful substances. 2. Whilst, however, we are all willing to regard coal as a raw material from which gas and naphtha are prepared, and skins as a raw material from which glue is elaborated, we should scarcely call marble the raw material of a statue, or linen the raw material of paper. The term *genetic* I feel to be too pedantic for general use, and the equivalent word *parent* is too vague. Let us say *workable* material, and we can include in a second division all those substances, such as wood, stone, gutta percha, which are convertible, chiefly by mechanical treatment, into articles of higher utilitarian value. Take as examples the difference between sheep's wool and Yorkshire broadcloth, or between the silkworm's cocoon and imperial velvet.

There is a third large class of substances, which are neither raw nor workable materials, but rather serve to modify both—such, for example, as the iodine and bromine which the photographer uses, the chlorine and alkalies applied by the bleacher, the colours used by the dyer, the oils employed by the leather-dresser.

Now one-half at least of all the ships and waggons of the world are continually occupied in transporting from point to point over the earth's surface the raw, workable, and modifying materials of mineral, vegetable, and animal origin, on and with which our manufacturers exercise their skill. One great service accordingly which an industrial museum may render, is to enable those whom it concerns to detect and distinguish from each other, the various important raw, workable, and modifying materials with which industrial art works. A collection, therefore, of all the more prominent characteristic or typical utilitarian materials, so arranged that the public might readily understand their nature, could not but be of signal service. Consider how the case stands at present. No systematic effort is made by our merchants to search the earth for its liberal treasures. The noblest, as men speak, and the vilest of things, gold and guano, are stumbled on by chance, and gathered at haphazard; and this whether they occur at our own door, or at our antipodes. With a kind of mad patience we go submissively year after year to the same cotton land, and sugar land, or tea land. If it shall please Providence to make cotton, sugar, and tea plants grow elsewhere than in those lands, we of course shall go to the new regions, but we must wait till these are revealed. We are reckless and daring enough in unceasingly scouring strange lands and seas, but of what avail is all this if we only guess at the value of the strange objects which we encounter! Charles Dickens has, however undesignedly, profoundly satirised this folly of ours in his account of Captain Cuttle's endeavour to keep the shop of his friend the philosophical-instrument maker. All went well till a customer inquired for a particular instrument. Whether it was one of the many strange pieces of apparatus consigned to his care, the captain did not know. And as his customer, on being asked if he would know what he wanted if he saw it, replied in the negative, the transaction came to an end. We are like the captain's customer. We go forth in hundreds every year, as pilgrims over the earth, *to seek* as we say, *our fortune*, as if all the seeking were on our side, and we should certainly know our fortune if we saw it. And all the while it may be our fortune, like a lost bride, is seeking us, and too often, like Gabriel and Evangeline in Longfellow's sad story, we pass each other in the dark, and all unconscious of the fact, bid farewell for ever.

How many of the young men who visit foreign countries or the colonies, bent on commercial enterprise, could tell gold from mica or pyrites, or diamonds from rock crystal, or platina ore from iron sand? How many of them, if shown a white shining stone, would be able to say whether it was quartz, limestone, alabaster, cryolite, felspar, or apatite? The first they might afterwards discover was of no pecuniary value; the second might be wrought as marble; the third might carve into sculptures, and would at least burn into stucco; the fourth is the choicest ore of the strange metal aluminium; the fifth is to the potter, enamel-maker, and other industrialists, of the greatest value; the sixth, mineral phosphate of lime, is at present the object of universal search among agriculturalists. How many of the youths in question could tell whether the exudation from a tree was gum, a sugar, a manna, a resin, a gum-resin, a camphor, a caoutchouc, or gutta-percha? How many could tell whether the white crust or hoar-frost like efflorescence on the soil was carbonate of soda, nitrate of potash, borax, or common salt, substances of immensely different money-values? How many could say whether the coloured juice or infusion of a particular plant or tree was a fugitive or permanent dye? Whether a particular seed would yield oil or would not? Whether the fibres of a plant were suitable or not for textile fabrics, for ropes, and for paper-making? Whether a particular wood was soft or hard, lasting or destructible? Whether a particular rock would yield a good building stone or not? Whether the district they had travelled over was a limestone, granite, or sandstone formation? Whether coal was likely to be found in it? Whether it possessed any metals or metallic ores, or other precious minerals? Whether water was likely to be plentiful all the year round? and so on. Now, were it proposed to teach any single youth to distinguish with certainty, wherever he found them on the earth's surface, the various objects which have been referred to, you might well pronounce the endeavour madness. It is not necessary, however, that he should attempt this.

The naturalists who accompany our exploring expeditions, are not trained to identify on the spot every remarkable mineral, vegetable, and animal they encounter. In truth, seeing that it is strange objects which they are specially sent to discover, it is impossible that they should be forewarned of these novelties. It is counted enough that they are amply qualified to detect and preserve all the rare things which come in their way. Of some of these they recognize the full significance at the time, but the majority they send or take home for careful investigation by themselves or others. Besides those purely scientific agents, a large class of travellers of all professions aid natural history solely by sending home the objects with which it is concerned. So important are the services of this class of naturalists to the cause of science, that under the auspices of Sir John Herschell, prompted by the Admiralty, a manual was drawn up some years ago by some of the ablest writers of the country, suitable for the guidance of all intelligent voyagers who may feel desirous to gather materials for our natural history museums whilst wandering in distant lands. In this volume instructions are given as to the objects worth collecting, and the observations worth making, by those amateurs for whom the work is intended. But natural history includes a much wider range of subjects than industrial art, and it should be as easy to instruct travellers how to serve the latter as the former: that it is even more easy, I think will appear from the following considerations.

The raw (and other) materials of industrial art are not after all very numerous. Food, clothing, fuel, building-stones, mortars, timber, clays, metallic ores, and some other minerals, drugs, vegetable extracts, dye-stuffs, manures, oils, acids, and alkalies, form the chief material pabulum of intelligent industry. Now even, if we suppose a young man sent with a roving commission to search for *all* of those materials throughout the world, it would not be difficult to teach him how to recognise each one, at least to the extent of ascertaining to what class it belonged. It would of course be still more easy to equip him intellectually for a search for some of them. He could only learn by actually looking at, tasting, touching, and otherwise handling the typical representatives of the objects which he sought to gather; but if he laid a foundation in this practical experience, he could afterwards in distant lands widely enlarge it, and be enabled by a guide-book or manual, both to refresh his memory and to extend his knowledge. Thus, in the matter of food, it can be shown; M. Soyer and all the other culinary authorities concurring; that the nutritious value of every edible vegetable, root, fruit seed, or stem, can be ascertained sufficiently well for all great practical purposes, by resolving it, as it always can be resolved, into one class of substances represented by starch, gum, sugar; and into another represented by the curd-like body called albumen or fibrin, which gives to wetted flour or dough its stickiness. Had this simple test been trusted and applied, Ireland would not have been decimated by the potato famine; nor, were it believed in at home, would unwise mothers tantalise hungry infants with meagre arrowroot, or unwise farmers, attracted by its cheapness, diet their horses upon sago; neither would mysterious noblemen advertise their restoration to health through assimilation of costly packets of Revalenta Arabica.

Again as to fuel. No doubt it is a nice question, What is coal? and somewhat hard to answer; but there is no difficulty in ascertaining whether a strange body is combustible, and if so, whether it is easily kindled, burns long, burns brightly, gives off much or little smoke, yields a large cinder, and leaves little ash.

As for clothing materials, if they are of vegetable origin, the strength, tenacity, softness, lustre, colour, and durability of the textile fibres can be tested by simple and decisive means; and the hair, wool, or fur of animals is not more difficult to guage, so far as its textile and felting characters are concerned. The essentials of a good building-stone may be counted on the fingers of one hand, and although prolonged trial often reverses summary judgments upon mineral masses, we can always at least distinguish a bad from a very good stone, and appraise with some nicety the blocks from every quarry.

The qualities of timber are not recondite or mysterious. As for the metals, the most valuable are the most easily detected. The softness, yellow lustre, abiding splendour, and insolubility of gold; the quickly tarnished paleness of silver; the liquid silveriness of mercury; the obtrusive density of platina: the magnetic characters of iron ore; the striking colour of ores of copper; the prominent crystals of ores of lead, forbid their escape from keen eyes. Each, indeed, of the great classes of industrial materials have qualities with which any moderately sagacious, and sufficiently patient observer may soon become familiar.

In proof of this, look at the astonishing amount of information concerning the resources of a strange country which a single intelligent traveller can give us. The solitary example of Livingstone is sufficient for my purpose. He had far fewer advantages, before he left this country, as I who was his fellow student know well, than could be placed at the disposal of travellers now-a-days; but he made himself as skilful as he could in the knowledge likely to be serviceable to him in Africa, and he turned it all to excellent account.

Some of our industralists have discovered the importance of systematically employing trained agents abroad, and have profited by the discovery. Foremost among them are the horticulturists and florists of the country, who have long been in the habit of sending skilful practical botanists to distant regions to select and send home their rare useful plants. All whom I address are familiar, I presume, with one or more of the works on China by Mr. Robert Fortune, and know how much he has done to introduce Chinese plants into this country, as well as into India.

Recently, this example has been followed, in even a more interesting way, by the English firm, Price's Candle Company, who have published directions for the use of all visitants of distant lands who care to look out for plants yielding wax, butter, or oil, and desire to form on the spot some notion of their value, as sources of candle and lamp-fuel, and as elements of importance in the soap-factory.

This example has in turn been followed by the energetic scientific officers and civilians in India, in all the Presidencies. One of those gentlemen in particular, Dr. A. Hunter of Madras, has drawn up rules for the selection and treatment of textile fibres from new plants found in the East, which would serve for the guidance of searchers for such in all parts of the world.

Next to the horticulturists, in recognition of the principle under notice, are the metallurgists. The great metal merchants of Birmingham despatch over the world skilful mineralogists to seek for precious ores. One former assistant and friend of mine is at present in Spain on such a search; another, who knows all the mines of Northern Europe, has sailed to Chili on a similar errand.

I may also refer here to the volume of 'Lectures on Gold,' published by the Government School of Mines in London a few years ago, as a guide to the multitudes of our countrymen flocking at that time to the gold fields of Australia. It illustrated the perfect possibility of equipping travellers intellectually for the reaping of that industrial harvest which awaits the sagacious in every land. Contrast with this the vast amount of time, labour, money, and energy, which have been wasted in vain attempts to discover by chance, or through glimpses of half-knowledge, the riches of unknown regions. Bags of iron pyrites have been sent home as gold-dust; lumps of red oxide of iron, as the cinnabar ore of quicksilver; pieces of flattened lead-shot, as grains of platina. Men have exchanged abroad heavy gold-dust for light diamonds, alas! too light! for they proved, on reaching home, to be quartz crystals; and single-witted knaves have felt so confident of the general ignorance, that sham nuggets, manufactured in Birmingham, have been sent out to the gold diggings, where they were scattered on Sunday mornings over exhausted mines about to be offered up for sale: entry immediate.

Let any one, indeed, take a map, and mark upon all of Europe, Asia, Africa, and America, which is still unexplored, and after reflecting upon the immensity of the area thus brought into view, ask himself how its material riches are to be ascertained, and he will not, I imagine, propose to leave them to be stumbled on by such chance visitors as may wander aimlessly and ignorantly through that region.

I have spoken specially of distant lands, but he who does not know valuable objects at a distance, will as little recognise them at his own door; nor need I remind you that around and between the two chief cities of Scotland, lie beds of iron-ore, building-stone, and gas-fuels, besides other minerals whose existence and value have been fully recognised only within the memory of living men, and these in most cases not past their prime.

One great service, then, which an industrial museum may render to commercial enterprise, is the teaching of those about to be scattered over the world, how to recognise the important raw, working, and modifying materials of industrial art. Scotland has always, in virtue of being "Caledonia stern and wild," kept her poets who could live on a little oatmeal at home, and sent her hungry practical men abroad. At the present day, more than of old, from the bosom of almost every family, one or more sons are sent forth over land and sea. Surely, then, we should give them opportunity before they part from us, to make themselves familiar with the typical industrials of all countries, and after singing "Auld Lang Syne" for the last time with them, and before bidding them farewell, should place in their chests, beside the Bible and the volume of national songs, some brief treatise which might help them to know whether it is a fish or a serpent which is offered to their grasp, and to perceive that they are receiving bread, where they thought it was a stone.

II. The Home Industrial Museum, secondly, should be a place where the nature and value of the unknown products of this country and of foreign countries might be ascertained and made public. Investigations into native products calculated to serve the entire nation have been prosecuted in all the practical museums of the country since their establishment. I mention one or two. At the Museum of Economic Geology, London, an elaborate and most valuable series of researches on the steam coals of the navy, was made some years ago by Sir Henry De la Beche, and Dr. Lyon Playfair. An equally important series of analyses of the iron-ores of England has recently been completed under Dr. Percy of the same museum; and Dr. Hoffmann and Mr. Witt, who are also among its officers, have investigated at great length, the question—How far, without prejudice to the public health, the sewage of great towns may be rendered agriculturally useful? Sir Robert Kane, Director of the Museum of Irish Industry, Dublin, has devoted an entire volume to the discussion of the Industrial resources of Ireland. Along with Dr. Sullivan, he has also made a detailed report on the modes in which the too abundant peat of his native country can be rendered useful: and in the laboratory of this museum, the question of cultivating beet-root in Ireland as a source of sugar has been very fully considered. Similar investigations are continually in progress.

As for foreign countries, every day ships bring to our great seaports important raw materials, which, through the ignorance of brokers, are wasted or neglected. Samples of every strange raw material which passes through the Inland Revenue Office, should be sent to one or other, or all, of the industrial museums of the country, to be examined and reported on for the good of the community. It is not intended by this to come in between the importer and his profits, but only to supplement his ignorance or neglect of the value of what he has imported. But whatever may be thought of this proposition, none will probably deny that it would be of signal service to the mercantile public to be assured that whatever raw materials their correspondents or agents sent home would be examined, if desired, by skilled adepts, and their commercial value proximately determined. If you only call to remembrance the immense stimulus which commercial enterprise has received within but twenty years, from the discovery abroad of gutta percha, guano, gold, and nitrate of soda, besides many other bodies less familiar to the general public—you will perceive how essential it is that every possible workable material should be collected abroad, and carefully examined at home.

(To be concluded in our next number.)

ON THE FADING OF PRINTS AND THEIR RESTORATION.

BY MM. DAVANNE AND GIRARD.

(Extract from the "Bulletin" for February, 1864.)

Some fifteen years ago the exhibitions of photographic works displayed a melancholy spectacle; for in the space of a few months, often a few weeks only, the proofs, which originally displayed such freshness and brilliancy of tone, would be found transformed into yellow, faded, and discoloured images. Some few only, the works of more able or more fortunate operators, survived the general disaster and preserved their primitive colour. Matters now, however, are changed in this respect, and such exhibitions present another aspect. The prints, during the months when they remain exposed to the sun's light, suffering scarcely any change; such as they were on the first day, so they remain to the last.

From its very formation the French Photographic Society felt the importance of such fading in positive prints, and the question received the greatest consideration from the Society. Our attention was then directed to the subject by several of the members, and particularly by the President, M. Regnault.

Here was then an interesting study; the changes in photographic prints being among the mysterious phenomena which science had yet to comprehend. Without being discouraged by the difficulty of the task, we undertook it, and have been fortunate enough, since 1855, to determine the principal points of the question.

Already several able photographers had expressed the opinion that hyposulphite of soda must be the cause of the changes in the prints, but no demonstration had yet been given of the fact, and that hypothesis had been abandoned. Other experimenters, profiting by the labours of M. Fizeau, had, by a sort of intuition, proposed the employment of the salts of gold for the toning of prints, but the majority of photographers neglected the use of these salts, as no one had yet shewn them to be effective.

In a memoir presented to the Society on the 19th of October, 1855, and which contains the programme of the long work we have been developing for nearly ten years, we were fortunate enough to specify the causes of the changes in prints, to explain their nature and theory, to indicate a means of rendering them unalterable, and even to make known a certain method of preventing the alteration in proofs badly prepared, and to retain them, at least very nearly, in their original state. It is from the publication of this memoir that may be dated the regular amelioration in the processes of positive printing.

The study of the change in prints is at this moment nearly completed, and we have only to recall to your notice the principal facts in our former work. One theoretical point, however, remains yet in obscurity: we had not, in 1855, been able to state precisely the cause of the yellow discolouration which characterised the faded prints. This was a gap, the importance of which we fully understood, and which a more profound research enables us to fill up to day.

The first point established by us, in 1855, is that all faded prints contain sulphur, the presence and the quantity of which it is easy to detect by ordinary analysis.

When the print is quite faded, and yellow all over, the proportions of sulphur and silver which it contains are very nearly the theoretical quantities demanded in the formula of sulphide of silver Ag S.

It was natural to conclude from this fact that the alteration was owing to sulphurisation. To ascertain if this were really the case, our first care was to submit to the action of sulphurous compounds prints newly fixed, and consequently formed of silver and argento-organic matter. The alkaline sulphides in solution were our first reagents, and we have constantly noticed that, if left for a sufficient time in a solution of this nature, the best fixed prints would change and become yellow. The change, however, is not produced immediately, but is preceded by a transitory phenomenon; in the first moments of immersion the proof takes a black-violet tone, very agreeable to the eye, but not lasting; and whether it be left in the sulphur bath or removed at once, and washed and dried, the effect is still the same; after a short time the print will turn completely yellow.

Sulphuretted hydrogen, which, after the alkaline sulphides, we tried the effect of, should have furnished us with the means of explaining the succession of these different phenomena. In fact, employed in an aqueous solution, this reagent acted upon the fixed prints in the same manner as the alkaline sulphides; they became first black and then yellow; but it was not the same if operated on in a state of absolute dryness.

Thus, a fixed proof, *dried carefully at a temperature of* 110°, and on which is directed a current of sulphuretted hydrogen perfectly dry, takes a violet hue; it tones in fact, and for however long a time the current of gas may act upon it the colour will not change. But the slightest trace of water will be sufficient to change this state of things; if the gas be in the least damp the violet colour will change to yellow. An immersion for a few minutes in hot water, or for an hour or more in cold water, will suffice to change a print thus toned entirely yellow.

The clearness and precision of these experiments leave nothing to be desired; they shew that the changes in positive prints are caused by a simultaneous action of sulphur and water; that sulphuretted hydrogen alone or moisture alone is insufficient alone to cause the fading of a print, but that the combined action of both these agents is indispensable; they enable us to explain why it is that one proof, placed in a portfolio and exposed to damp from a thousand different causes, will change, whilst another, prepared at the same time and in the same manner, may be exposed to light in a dry place without undergoing any change whatever.

The causes which create the liability to such changes are of three kinds:—

1st. The toning baths, composed of hyposulphite of soda, acidulated or charged with salts of silver. These baths have been a long time in favour, but, thanks to the discoveries which we have published since 1855, they are now nearly discarded. We will say no more now on this point but that baths of this kind should be absolutely banished from the studio. To this class of sulphuretted compounds belong also the baths formed of sulphide of sodium or ammonium, which some photographers have had the imprudence to propose, but the use of which, from our own experience, we would forbid most absolutely.

2nd. The imperfect washing after the fixing by hyposulphite of soda. It is in that wherein lies the real danger of change. When the print has been insufficiently washed, and is then kept in a damp place, the hyposulphite remaining in the paper attacks, little by little, the silver with which it is covered, and transforms it slowly into sulphide, and very soon, under the influence of such change, the image loses its fresh and brilliant tone, and takes the yellow and faded hue of an old print. But it is easy to avoid this danger. In a former chapter we have explained carefully, and in detail, the whole practice of fixing, and if the operator does but follow exactly our directions he will have nothing to fear from the hyposulphite of soda. The use of alkaline sulpho-cyanides, as we have also demonstrated, is a still better guarantee against alteration from this cause.

3rd. Sulphuretted hydrogen, which, normally, exists everywhere, and more especially in the neighbourhood of large towns. But this cause of change is of little importance, and should have no more effect upon a photograph than upon a painting in oil or a chalk drawing. And, indeed, as will be understood from what we are about to state, its influence may be regarded as *nil* if the proof be submitted to a vigorous toning by means of the salts of gold.

In a preceding chapter we have gone over carefully all the details of toning, and explained the nature of the baths, which, as it appears to us, should be preferred; and having done so we were desirous of ascertaining the comparative amount of resistance to change which the different toning processes known up to this date affords to the proofs. For this purpose we have taken proofs prepared by the most opposite processes, by ourselves, as well as by other operators, and have placed them where they were exposed to the exhalations of sulphuretted hydrogen, to damp, to rain even, so that their combined action could be exercised upon the silver composing the pictures. With these prints we placed also a portion of one which we had revived by means of a prolonged immersion in chloride of gold. It was well that we had made this addition, as without it the result obtained would have held out but a poor prospect for the duration of photographs, for after a few months the whole of the prints, with the single exception of the fragment, had completely faded, whilst that alone, which owed its tone to the quantity of gold with which it had been restored, had not suffered the slightest change. In watching, too, the progressive alterations of the prints, we perceived clearly that the change to the yellow tint had been more rapid in proportion as the gold toning had been less vigorous.

This experiment establishes the facts that those prints which have been most deeply toned resist the change best, and that if the baths in which they have been toned have contained a considerable quantity of gold they will have nothing to fear from the action of damp sulphuretted hydrogen.

Thus, then, of the three causes of change mentioned above, the first no longer exists, the second may be easily avoided, and the third is of no importance if the print has been strongly toned. Let it be distinctly understood that *prints well washed and vigorously toned will not fade; change is not their normal destiny, but is an accident against which it is always easy to guard them.*

The experiments which we describe possess, then, a great practical importance, and an importance not less from a theoretical point of view, as they show that during the action of changing, it is upon the silver alone and not upon the gold that the sulphides operate.

This settles the question which in 1855 we were unable to solve. If the change is due to the action of the sulphurous compound upon silver, how was it that the prints became yellow, as every one knows that sulphide of silver is of a black-violet? It is only very lately that we have discovered the answer to this; it is owing to the influence upon the sulphide of silver of those organic matters which play so important a part in the different phases of the production of positive prints. In fact, the sulphide of silver prepared by the simple decomposition of a salt of silver bears no resemblance to that produced by decomposition in presence of the organic matters used for sizing the paper. If we take a solution of nitrate of silver and pass into it a current of sulphuretted hydrogen, we obtain the ordinary black-violet precipitate, the sulphide of silver; but add to the solution starch, gelatine, or albumen, and the product formed by the gas will be a sort of lake, due to the combination of the sulphide of silver with organic matter, and this lake, which is slightly soluble, will have precisely the yellow tint which characterises the faded prints.

Thus, when the metallic silver with which the print is covered is submitted to the action of a compound of sulphur, it forms the black-violet sulphide of silver, and a true toning is produced; but little by little, water intervenes, penetrates the sizing, swells it, the sulphide of silver and the organic matter act upon each other, and the lake of sulphide of silver substitutes for the black-violet colour of the sulphide its own yellow tint.

Such are the successive phenomena produced upon the surface of a print if it has been toned in a sulphur bath; if, by imperfect washing, it has been left impregnated with hyposulphite of soda; and, lastly, if it be placed, after insufficient toning, where it may be exposed to the exhalations of sulphuretted hydrogen exceptionally abundant.

Restoration of faded prints. The question of the restoration of prints had, at the time when we first occupied ourselves with it, in 1855, a very great importance. At the present day, however, that importance is much diminished, for we can show that alteration is abnormal, and is owing to imperfections in the preparation which nearly all photographers know how to avoid, and, therefore, the restoration of faded prints possesses but a secondary interest.

Let us now describe rapidly this operation. It consists, simply, in submitting the prints to a new toning. When placed in a solution of gold, a faded print will tone and colour again like a print recently prepared, but more slowly. It will regain here a portion of the brightness which it had lost, but he will be deceived who expects that all its former freshness will be restored. As we have said above, the lake of sulphide of silver and organic matter is slightly soluble, and, consequently, the more delicate half-tones will, after their change to the yellow state, be destroyed by the action of the water, and they cannot be restored. Moreover, there are no faded prints in which some of the lighter portions will not be found tinted with yellow, doubtless in consequence of an alteration in the albumen with which the paper is covered; perhaps, too, owing to the presence of silver which the imperfect washing has failed to remove, and in the restoring bath this yellow tint will not disappear. On the contrary, it will rather increase, and if we, to remove it, submit the restored print to the action of chlorine or chloride of lime, these agents act also as on the thinner portions of the metal forming the image and destroy the half-tones.

However this may be, the use of the salts of gold yields under ordinary circumstances very satisfactory results. It removes the yellow tints of faded prints, substitutes for it the black or violet, and, more than all, prevents further change by replacing the silver surface, highly susceptible to the action of sulphur, by a surface of gold, which offers an almost absolute resistance to it.

The best mode of conducting the above operation is as follows:—The print is removed from the cardboard to which it is attached and immersed in water until saturated, then left for four or five hours in a neutral solution, recently prepared, of double chloride of gold and potassium, the strength of which may vary from $\frac{2}{1000}$ to $\frac{5}{1000}$. The stronger it is the more rapid is its action. When the colour appears to be sufficiently restored the print must be washed in ordinary water, while washing, as well as the immersion in the gold bath, should take place in the dark. When washed the print must be placed in the hyposulphite solution to remove the chloride of silver formed by the double composition, and finally washed again in water in the usual manner.

PHOTOGRAPHS AND MEMORY.

The distinguished Dr. Draper, of the New York University, thus speaks of the impressions made by light:—

"If after the eyelids have been closed for some time, as when we first awake in the morning, we suddenly and steadfastly gaze at a brightly illuminated object, and then quickly close the lids again, a phantom image is perceived in the infinite darkness before us. We may satisfy ourselves that this is not a fiction of the imagination, but a reality; for many details that we had not time to examine in the momentary glance, may be contemplated at our leisure in the phantom. We may thus make out the pattern of such an object as a lace curtain hanging in the window, or the branches of a tree beyond. By degrees the image becomes less and less distinct; in a minute or two it has disappeared. It seems to have a tendency to float away in the vacancy before us. If you attempt to follow it by moving the eye-ball, it suddenly vanishes.

"Now the condition that regulates the vanishing phantom-images on the retina is, that when they have declined in vigor to less than $\frac{1}{64}$th of the intensity they had while in presence of the object that formed them, they cease to disturb the sight. This principle is illustrated when a candle-flame is held opposite to the sun, or any light having more than 64 times its own brillancy. It then ceases to be visible. The most exact of all known methods for measuring light—that by the extinction of shadows—is an application of the same principle.

"But the great fact that concerns us is this:—Such a duration of impressions on the retina of the eye demonstrates that the effect of external influences on nerve vesicles is not necessarily transitory. It may continue for a long time. In this there is a correspondence to the duration, the emergence, the extinction of impressions on photographic preparations. Thus I have seen landscapes and architectural views taken in Mexico, 'developed'—as artists say—months subsequently; the images coming out, after the long voyage, in all their proper forms and in all their contrast of light and shade. The photograph had forgotten nothing. It had equally preserved the contour of the everlasting mountains and the passing smoke of a bandit fire.

"Are there then contained in the brain more permanently, as in the retina more transiently, the vestiges of impressions that have been gathered by the sensory organs? Do these constitute the basis of memory—the mind contemplating such pictures of past things and events as have been committed to her custody. In her silent galleries are there hung micrographs of the living and the dead, of scenes that we have visited, of incidents in which we have borne a part? Are these abiding impressions mere signal-marks, like the letters of a book, which impart ideas to the mind, or are they actual picture-images, inconceivably smaller than those made for us by artists, in which by the aid of a microscope, we can see, in a space not bigger than a pin-hole, a whole family group at a glance?

"The phantom-images of the retina, as I have remarked, are not perceptible in the light of day. Those that exist in the sensorium, in like manner, do not attract our attention so long as the sensory organs are in vigorous operation, and occupied with bringing new impressions in. But when these organs become weary and dull, or when we experience hours of great anxiety, or are in twilight reveries, or asleep, the latent apparitions have their vividness increased by the contrast, and obtrude themselves on the mind. For the same reason they occupy us in the delirium of fevers, and doubtless also in the solemn moments of death. During a third part of our lives we are withdrawn from external influences—hearing, and sight, and the other senses are inactive; but the never sleeping mind—that pensive, that veiled enchantress, in her mysterious retirement, looks over the ambrotypes she has collected—ambrotypes, for they are unfading impressions—and combining them together as they chance to occur, weaves from them a web of dreams. Nature has thus introduced into our very organization a means of imparting to us suggestions on some of the most profound topics with which we can be concerned. It operates equally on the savage and on the civilized man, furnishing to both conceptions of a world in which all is unsubstantial. It marvelously extracts from the vestiges of the impressions of the past overwhelming proofs of the reality of the future, and gathering its power from what might seem a most unlikely source, it insensibly leads us—no matter who or where we may be—to a profound belief in the immortal and imperishable, from phantoms that have scarcely made their appearance before they are ready to vanish away!"

ON BOILING WATER.

BY W. GROVE, ESQ., Q.C., F.R.S., M.R.I.

A paper by M. Donny ("*Mémoires de l'Académie Royale de Bruxelles,*" 1843) makes known the fact that in proportion as water is deprived of air, the character of its ebullition changes, becoming more and more abrupt, and boiling like sulphuric acid with *soubresauts*, and that between each burst of vapour the water reaches a temperature above its boiling point. To effect this, it is necessary that the water be boiled in a tube with a narrow orifice, through which the vapour issues; if it be boiled in an open vessel it continually reabsorbs air and boils in the ordinary way.

In my experiments on the decomposition of water by heat, I found that with the oxy-hydrogen gas given off from ignited platinum plunged into water, there was always a greater or less quantity of nitrogen mixed; this I could never entirely get rid of, and I was thus led into a more careful examination of the phenomenon of boiling water, and set before myself this problem—what will be the effect of heat on water perfectly deprived of air or gas.

Two copper wires were placed parallel to each other through the neck of a Florence flask, so as nearly to touch the bottom; joining the lower ends of these was a fine platinum wire, about an inch and a-half long, and bent horizontally into a curve. Distilled water, which had been well boiled and cooled under the receiver of an air-pump, was poured into this flask, so as to fill about one-fourth of its capacity. It was then placed under the receiver of an air-pump, and one of the copper wires brought in contact with a metallic plate covering the receiver, the other bent backwards over the neck of the flask, and its end made to rest on the pump plate. By this means, when the terminal wires from a voltaic battery were made to touch, the one the upper and the other the lower plate, the platinum wire would be heated, and the boiling continued indefinitely in the vacuum of a very excellent air-pump. The effect was very curious; the water did not boil in the ordinary manner, but at intervals a burst of vapour took place, dashing the water against the sides of the flask, some escaping into the receiver. (There was a projection at the central orifice of the pump-plate to prevent this overflow getting into the exhausting tube.)

After each sudden burst of vapour, the water became perfectly tranquil, without a symptom of ebullition until the next burst took place. These sudden bursts occurred at measured intervals; so nearly equal in time that, had it not been for the escape from the flask, at each burst, of a certain portion of water, the apparatus might have served as a timepiece.

This experiment, though instructive, did not definitely answer the question I had proposed, as I could not of course ascertain whether there was some minute residuum of gas which would form the nucleus of each ebullition; and I proceeded with others. A tube of glass, 5 feet long and $\frac{4}{10}$ths inch internal diameter, was bent into a V-shape; into one end a loop of platinum wire was hermetically sealed with great care, and the portion of it in the interior of the tube was platinised. When the tube had been well washed, distilled water, which had been purged of air as before, was poured into it to the depth of 8 inches, and the rest of the tube filled with olive oil; when the V was inverted the open end of the tube was placed in a vessel of olive oil, so that there would be 8 inches of water resting on the platinum wire, separated from the external air by a column of 4 feet 4 inches of oil. The projecting extremities of the platinum wire were now connected with the terminals of a voltaic battery, and the water heated; some air was freed and ascended to the level of the tube—this was made to escape by carefully inverting the tube so as not to let the oil mix with the water—and the experiment continued. After a certain time the boiling assumed a uniform character, not by such sudden bursts as in the Florence flask experiment, but with larger and more distinct bursts of ebullition than in its first boiling.

The object of platinising the wire was to prevent more points for the ebullition, and to present *soubresants* as much as possible.

The experiment was continued for many hours, and in some repetitions of it for days. After the boiling had assumed a uniform character, the progress of the vapour was carefully watched, and as each burst of vapour condensed in the oil, which was kept cool, it left a minute bead of gas, which ascended through the oil to the bend of the tube: a bubble was formed here which did not seem at all absorbed by the oil. This was analysed by a eudiometer, which I will presently describe, and proved to be nitrogen. The beads of gas, when viewed through a lens and micrometer scale at the same height in the tube, appeared as nearly as may be of the same size. No bubble of vapour was condensed completely, or without leaving this residual bubble. The experiment was frequently repeated, and continued until the water was so nearly boiled away that the oil, when disturbed by the boiling, nearly touched the platinum wire; here it was necessarily stopped.

To avoid any question about the boiling being by electrical means, similar experiments were made with a tube, without a platinum wire, closed at its extremity, and the boiling was produced by a spirit lamp. The effects were the same, but the experiment was more difficult and imperfect, as the bursts of vapour were more sudden, and the duration of the intervals more irregular.

The beads of gas were extremely minute, just visible to the naked eye, but were made visible to the audience by means of the electric lamp.

In these experiments there was no pure boiling of water—*i.e.*, no rupture of cohesion of the molecules of water itself, but the water was boiled, to use M. Donny's expression, by evaporation against a surface of gas.

It is hardly conceivable that air could penetrate through such a column of oil, the more so as the oil did not perceptibly absorb the nitrogen freed by the boiling water and resting in the bend of the tube; but to meet this conjectural difficulty, the following experiment was made:—A tube, 1 foot long and $\frac{2}{10}$ths inch internal diameter, bent into a slight angle, had a bulb of $\frac{3}{4}$-inch diameter blown on it at the angle; this angle was about three inches from one end and 9 from the other; a loop of platinum wire was sealed into the shorter leg, and the whole tube and bulb filled with and immersed in mercury; water distilled and purged of air as before, was allowed to fill the short leg, and by carefully adjusting the inclination, the water could be boiled so as to allow bubbles to ascend into the bulb and displace the mercury. The effect was the same as with the oil experiment, no ebullition without leaving a bead of gas; the gas collected in the bulb, and was cut off by what may be termed a valve of mercury, from the boiling water, then allowed to escape, and so on; the experiment was continued for many days, and the bubbles analysed from time to time; they proved, as before, to be nitrogen; and, as before, continued indefinitely.

A similar experiment was made without the platinum wire, and though, from the greater difficulties, the experiment was not so satisfactory, the result was the same.

As the mercury of the common barometer will keep air out of its vacuum for years, if not for centuries, there could be no absorbtion here from the external atmosphere, and I think I am fairly entitled to conclude from the above experiments—which I believe went far beyond any that have been recorded—that no one has yet seen the phenomenon of pure water boiling—*i.e.*, of the disruption of the liquid particles of the oxy-hydrogen compound so as to produce vapour which will, when condensed, become water, leaving no permanent gas. Possibly, in my experiment of the decomposition of water by ignited platinum, it may be that the sudden application of intense heat, and in some quantity, so forces asunder the molecules that, not having sufficient nitrogen dissolved to supply them with a nucleus for evaporation, the integral molecules are severed, and decompositisn takes place. If this be so, and it seems to me by no means a far-fetched theory, there is probably no such thing as boiling, properly so called, and the effect of heat on liquids in which there is no dissolved gas may be to decompose them.

Considerations such as these led me to try the effect of boiling on an elementary liquid; and bromine occurred as the most promising one to work upon; as bromine could not be boiled in contact with water, oil, or mercury, the following plan was ultimately devised:—A tube, 4 feet long and $\frac{4}{10}$ths inch diameter, had a platinum loop sealed into one closed extremity; bromine was poured into the tube to the height of four inches; the open end of the tube was then drawn out to a fine point by the blow-pipe, leaving a small orifice; the bromine was then heated by a spirit-lamp; and when all the air was expelled, and a jet of bromine vapour issued from the point of the tube, it was sealed by the blow-pipe. There was then, when the bromine vapour had condensed, a vacuum in the tube above the bromine. The platinum loop was now heated by a voltaic battery, and the bromine boiled: this was continued for some time, care being taken that the boiling should not be too violent. At the end of a certain period—from half an hour to an hour—the platinum gave way, being corroded by the bromine; the quantity of this had slightly decreased. On breaking off, under water, the point of the tube, the water mounted, and showed a notable quantity of permanent gas, which on analysis proved to be pure oxygen. As much as a quarter of a cubic inch was collected at one experiment. The platinum wire, which had severed at the middle, was covered with a slight black crust, which, suspecting to be carbon, I ignited by a voltaic spark in oxygen in a small tube over lime-water; it seemed to give a slight opalescence to the liquid, but the quantity was so small that the experiment was not to be relied on. No definite change was perceptible in the bromine; it seemed to be a little darker in colour, and had a few black specks floating in it, which I judged to be minute portions of the same crust which had formed on the platinum wire, and which had become detached.

The experiment was repeated with chloride of iodine, and with the same result, except that the quantity of oxygen was greater: I collected as much as half a cubic inch in some experiments, from an equal quantity of chloride of iodine, the platinum wire, however, was more quickly acted on than with the bromine, and the glass of the tube around it to some extent.

Melted phosphorus was exposed to the heat of the voltaic disruptive discharge by taking this between platinum points in a tube of phosphorus, similarly to an experiment of Davy's, but with better means of experimenting; a considerable quantity of phosphuretted hydrogen was given off, amounting in several experiments to more than a cubic inch.

A similar experiment was made with melted sulphur, and sulphuretted hydrogen was given off, but not in such quantities as the phosphuretted hydrogen. I tried in vain to carry on these experiments beyond a certain point; the substance became pasty, mixed with platinum from the arc, and from the difficulty of working with the same freedom as when they were fresh, the glass tubes were always broken after a certain time. Had I time for working on the subject now, I should use the discharge from the Ruhmkorf coil, which had not been invented at the period of these experiments. At a subsequent period, when this discharge was taken in the vacuous receiver of an air-pump from a metallic point to a metallic capsule containing phosphorus, a considerable yellow deposit lined the receiver, which, on testing, turned out to be allotropic phosphorus. No gas is, however, given off. I had an air-pump (described "Phil. Trans.," 1852, p. 101) which enabled me to detect very small quantities of gas, but I could get none. It was in making these experiments that I first detected the striæ in the electric discharge, which have since become a subject of such interesting observations, which are seen, perhaps, more beautifully in this phosphorus vapour than in any other medium, and which cease, or become very feeble, where the allotropic phosphorus is not produced.

I tried also phosphorus highly heated by a burning glass in an atmosphere of nitrogen, but could eliminate no perceptible quantity of gas, though the phosphorus was changed into the allotropic form.

It is not difficult to understand why gas is not perceptibly eliminated in the last two experiments; the effect is probably similar to that described in my paper on the "*Decomposition of Water by Heat,*" where when the arc or electric spark is taken in aqueous vapour, a minute bubble of oxyhydrogen gas is freed and disseminated through the vapour, recombination being probably prevented by this dilution; but, however long the experiment may be continued, no increased quantity of the gas is obtained, all beyond this minute quantity being recombined. If, however, the bubble of gas be collected, by allowing the vapour to cool, and then expelled, a fresh portion is decomposed, and so on.

So with the phosphorus in the experiments in the air-pump and with the burning-glass; if any gas is liberated it is probably immediately recombined with the phosphorus; possibly a minute residuum might escape recombination, but the circumstances of the experiment did not admit of this being collected, as the gas was with the aqueous vapour.

When, on the other hand, the gas freed is immediately cut off from the source of heat, as when the spark is taken in liquids, an indefinite quantity can be obtained.

Decomposition and the elimination of gas may thus take place by the application of intense heat to a point in a liquid, or also in gas or vapours; but in the latter case it is more likely to be masked by the quantity of gas or vapour through which it is disseminated.

I believe there are very few gases in which some alteration does not take place by the application of the intense heat of the voltaic arc or electric spark. If the arc be taken between platinum points in dry oxygen-gas over mercury, the gas diminishes indefinitely, until the mercury rises, and by reaching the point where the arc takes place, puts an end to the experiment. I have caused as much as a cubic inch of oxygen to disappear by this means. I at one time thought this was due to the oxidation of the platinum; but the high heat renders this improbable, and the deposit formed on the interior of the glass tube in which the experiment is made has all the properties of platinum-black; so if the spark from a Ruhmkorf coil be taken in the vapour of water for several days, a portion of gas is freed which is pure hydrogen, the oxygen freed being probably changed into ozone, and dissolved by the water in this case, while in the former it combined with the mercury.

I have alluded to the eudiometer by which I analysed the gases obtained in these experiments; it was formed simply of a tube of glass, frequently not above 2½ millimetres in diameter, with a loop of wire hermetically sealed into one end, the other having an open bell mouth. By a platinum wire a small bubble of the gas to be examined could be got up through water or mercury into the closed end of the tube, and by the addition of a bubble of oxygen or hydrogen gas, a very accurate analysis of very minute quantities of gas could be made: I have analysed by this means quantities no larger than a partridge-shot.

I need hardly allude to results on the compound liquids, such as oils and hydrocarbons, as the fact that permanent gas is given off in boiling such liquids would not be unexpected; but the above experiments seem to show that boiling is by no means necessarily the phenomenon that has generally been supposed, viz., a separation of cohesion in the molecules of a liquid from distension by heat. I believe, from the close investigation I made into the subject that (except with the metals, on which there is no evidence) no one has seen the phenomenon of pure boiling without permanent gas being freed, and that what is ordinarily termed boiling arises from the extrication of a bubble of permanent gas either by chemical decomposition of the liquid, or by the separation of some gas associated in minute quantity with the liquid, and from which human means have hitherto failed to purge it; this bubble once extricated, the vapour of the liquid expands it, or to use the appropriate phrase of M. Donny, the liquid evaporates against the surface of the gas.

My experiments are, in a certain sense, the complement of his. He showed that the temperature of the boiling point was raised in some proportion as water was deprived of air, and that under such circumstances the boiling took place by *soubresauts*. I have, I trust, shown that when the vapour liberated by boiling is allowed to condense, it does not altogether collapse into a liquid, but leaves a residual bubble of permanent gas, and that at a certain point this evolution becomes uniform.

Boiling, then, is not the result of merely raising a liquid to a given temperature, it is something much more complex.

One might suppose that with a compound liquid the initial bubble by which evaporation is enabled to take place might, if all foreign gas were or could be extracted, be formed by decomposition of the liquid: but this could not be the case with an elementary liquid; whence the oxygen from bromine or the hydrogen from phosphorus and sulphur? As with the nitrogen in water, it may be that a minute portion of oxygen, hydrogen, or of water is inseparable from these substances, and that if boiled away to absolute dryness, a minute portion of gas would be left for each ebullition.

With water there seems a point at which the temperature of ebullition and the quantity of nitrogen yielded become uniform, though the latter is excessively minute.

The circumstances of the experiments with bromine, phosphorus, and sulphur did not permit me to push the experiment so far as was done with water, but as far as it went the result was similar.

When an intense heat, such as that from the electric spark or voltaic arc, is applied to permanent gas, there are, in the greater number of cases, signs either of chemical decomposition or of molecular change; thus compound gases, such as hydrocarbons, ammonia, the oxides of nitrogen, and many others are decomposed. Phosphorus in vapour is changed to allotropic phosphorus, oxygen to ozone, which, according to present experience, may be viewed as allotropic oxygen. There may be many cases where, as with aqueous vapour, a small portion only is decomposed, and this may be so masked by the volume of undecomposed gas as to escape detection. If, for instance, the vapour of water were incondensable, the fact that a portion of it is decomposed by the electric spark or ignited platinum would not have been observed.

All these facts show that the effect of intense heat applied to liquids and gases is much less simple, and presents greater interest to the chemist, than has generally been supposed. In far the greater number of cases, possibly in all, it is not mere expansion into vapour which is produced by intense heat, but there is a chemical or molecular change. Had circumstances permitted, I should have carried these experiments further, and endeavoured to find an *experimentum crucis* on the subject. There are difficulties with such substances as bromine, phosphorus, &c., arising from their action on the substances used to contain and heat them, which are not easy to vanquish, and those who may feel inclined to repeat my experiments will find these difficulties greater than they appear in narration; but I do not think they are insuperable, and hope that, in the hands of those who are fortunate enough to have time at their disposal, they may be overcome.

To completely isolate a substance from the surrounding air, and yet be able to experiment on it. is far more difficult than is generally supposed, The air-pump is but a rude mode for such experiments as are here detailed.

Caoutchouc joints are out of the question. Even platinum wires carefully sealed into glass, though, as far as I have been able to observe, forming a joint which will not allow gas to pass, yet it is one through which liquids will effect a passage, at all events, when the wires are repeatedly heated.

In some experiments with the ignited platinum wire hermetically sealed into a tube of glass, the end of the tube containing the platinum wire was placed in a larger tube of oil, to lessen the risk of cracking the glass. After some days' experimenting, though the sealing remained perfect, a slight portion of carbon was found in the interior liquid. This does not affect the results of my experiments, as I repeated them with glass tubes closed at the end and without platinum wires, and also without the oil bath; but it shows how difficult it is to exclude sources of error. When water has been deprived of air to the greatest practicable extent it becomes very avid for air. The following experiment is an instance of this:—A single pair of the gas battery, the liquid in which was cut off from the external air by a greased glass stopper, having one tube filled with water, the other with hydrogen; the platinised platinum plates in each of these tubes were connected with a galvanometer, and a deflection took place from the reaction of the hydrogen on the air dissolved in the water. After a time the deflection abated, and the needle returned to zero, all the oxygen of the air having become combined with the hydrogen. If now the stopper were taken out, a deflection of the galvanometric needle immediately took place, showing that the air rapidly enters the water as water would a sponge. Absolute chemical purity in the ingredients is a matter, for refined experiments, almost unattainable. The more delicate the test the more some minute residual product is detected. It would seem (to put the proposition in a somewhat exaggerated form) that in nature everything is to be found in anything if we carefully look for it.

I have indicated the above sources of error to show the close pursuit that is necessary when looking for these minute residual phenomena. Enough has, I trust, been shown in the above experiments to lead to the conclusion that hitherto simple boiling in the sense of a liquid being expanded by heat into its vapour without being decomposed or having permanent gas eliminated from it, is a thing unknown. Whether such boiling *can* take place may be regarded as an open question, though I incline to think it cannot; that if water, for instance, could be absolutely deprived of nitrogen, it would not boil until some portion of it was decomposed; that the physical severance of the molecules by heat is also a chemical severance. If there be anything in this theoretic view, there is great promise of important results on elementary liquids, if the difficulties to which I have alluded can be got over.

The constant appearance of nitrogen in water, when boiled off out of contact with the air almost to the last drop, is a matter well worthy of investigation. I will not speculate on what possible chemical connection there may be between air and water. The preponderance of these two substances on the surface of our planet, and the probability that nitrogen is not the inert diluent in respiration that is generally supposed, might give rise to not irrational conjectures on some unknown bond between air and water. But it would be rash to announce any new theory on such a subject; better to test any guess one may make by experiment than to mislead by theory without sufficient data, or to lessen the value of facts by connecting them with erroneous hypotheses.

OILS AND FATS.

BY CAMPBELL MORFIT.

Although some fatty bodies are very different from others in their chemical nature, and all of them differ from the essential oils, yet being often used in the same branch of manufacture indiscriminately, they may be embraced together as a class under the term *Oleics.*

By far the larger proportion of oils and fats agree in being composed of a fat acid, united to a base called glycerine. The three principal acids are stearic, margaric, and oleic; when stearate or margarate of glycerine predominate (the compound being called stearin or margarin), the fat is more solid, as tallow, suet, &c.; when oleate of glycerine (called also olein) is in sufficient quantity, the fat is fluid or oily, as olive oil. The chemical connection between margaric acid, which is a solid crystalline fat, and vinegar or acetic acid, and the connection between acetic acid and common alcohol, are pointed out in an essay published in the 'Journal of the Franklin Institute,' 1848. Now since formic, acetic, and valeric acids can be shown to be derived from wood-spirit, common alcohol, and fusel oil, which are their respective alcohols, we may infer that the higher fat acids have also their alcohols. The investigations of Brodie in wax seems to point out such alcohols and their acids. The general formula for this fat acid series, the most extended series yet developed in organic chemistry, is $C_n H_n O_4$, *n* being an even number. No well-defined connection has yet been established between other fat acids not belonging to this group.

According to Georgey ('Ann der Chem. und Pharm.' lxvi.), the butter of cocoa contains the following acids:

Caproic	$C_{12}H_{12}O_4$
Capryllic	$C_{16}H_{16}O_4$
Capric	$C_{20}H_{20}O_4$
Pichuric (lauric, laurostearic).....	$C_{24}H_{24}O_4$
Myristic (probably)..................	$C_{28}H_{28}O_4$
Palmitic	$C_{32}H_{32}O_4$

The *cocinic* acid of St. Evre is a mixture of capric and pichuric acids.

Gerhardt and Laurent have endeavoured to prove ('Comptes Rendus,' 1859) that the formula for stearic acid is $C_{34}H_{34}O_4$; that margaric acid is an isomeric modification of it, and should be called metastearic acid.

The train-oil of the Beaked Whale (*belæna rostrata*) has recently been examined by Scharling ('Journ. of Prac. Chem.' xliii.), who gives it the formula $C_{62}H_{60}O_4$. It consists principally of a liquid fat, free from glycerine, a minute portion of spermaceti, and traces of other fats. Its specific gravity is ·8807 at 52°. It burns with a bright flame, and its illuminating power is in the ratio of 1.57 : 1 of common whale oil. It also burns slower and emits less smoke than the latter oil.

Mr. C. Watt, Sr. (Newton's Journ.' 1848, 'Ch. Gaz.' vi.), uses the following method for bleaching dark oils or tallow. To every half ton of oil, take ten pounds of bichromate of potassa. Powder the salt, dissolve it in four pints of hot water, stir, and carefully add fifteen pounds of sulphuric acid, and continue the stirring until complete solution. This mixture is then thoroughly incorporated with the melted fat, previously separated from foreign matters by repose and decantation. The containing vessels should be of wood, and the temperature about 130° F. When, after much agitation, the liquid fat assumes a light green colour, the bleaching is completed, four buckets of boiling water are then to be added, the whole stirred for five minutes and left to repose for several hours, when it will be white and ready for use.

Mr. Watts, Jr., proposes to recover the chromic acid *ad infinitum*, and thus render the process very economical, in manner as follows. Transfer the green chrome liquor, after the separation of the fat, to a tub, dilute it with water, and then add thick milk of lime until the sulphuric acid is nearly saturated; leave to repose, decant the liquor from the sulphate of lime, and carefully add to it another portion of the cream of lime, until the precipitation of all the green oxide and the supernatant liquor is clear and colourless. Drain off this liquor, add fresh water, and, after settling, again decant. Repeat this washing, then transfer the precipitate to a red-hot iron slab, and keep it constantly stirred until it changes to a yellow powder. The chromate of lime thus formed, if decomposed by sulphuric acid in slight excess, yields chromic acid as well suited for bleaching purposes as that from bichromate of potassa.

A good oil-filter is said to be made of fine sand, charcoal, and gypsum; the sand to retain substances suspended in it, charcoal to decolorize it, and plaster to remove water. ('Journ. de Chem Med.' 1846.)

To decolourize raw linseed oil, a solution of two pounds of copperas in two and a half pounds of water is poured into a flask containg two pounds of linseed oil, and exposed to the sun for several weeks, during which it is frequently shaken. The oil is said to be rendered limpid and colourless, and may be drawn off by a siphon, or stoppered funnel.

Many substitutes have been proposed for the more costly oil for lubricating machinery, but hitherto with only partial success. Munkittrick's ('Lond. Journ.' xxxvi. 98) consists mainly in the addition of caoutchouc to common grease, the former being softened by spirit of turpentine; but he also uses other ingredients. For example: ten gallons of water being heated, one pound of glue and ten pounds of carbonate of soda are stirred in; ten gallons of oil or grease are next added, whereby a quasi-soap is formed; and lastly, four pounds of caoutchouc, softened by turpentine, are incorporated.

Boudet ('Jour. de Pharm. & Lond. Pharm. Journ.' 1850), gives the following as the process by which the French *liard*, or lubricating fluid is made. Add one pint of finely minced caoutchouc to fifty pints of rape oil, and heat until the mixture is complete. A very unctuous oil is thus formed, which remains fluid at freezing temperature, and does not clog the machines, but facilitates the motion of their parts.

Heydenreich proposes ('Journ. de Connais. Utiles,' 1849) to distinguish fat oils from each other by their odour when warmed, their colour by contact with oil of vitriol, and their specific gravities. By the first process the oil is heated in a porcelain capsule over a spirit-lamp, when the peculiar volatile odour of fish, linseed, and other oils may be detected, especially if compared in the same way with the unadulterated oils. For the acid test, from ten to fifteen drops of oil are dropped upon a piece of glass, underlaid by white paper, and a drop of oil of vitriol is brought in contact with it by a glass rod. If it be rape-oil, a greenishblue circle is formed around and at a short dstance from the drop, while light yellowish-brown striæ form towards the centre. The same takes place with oil of black mustard, but from twenty-five to thirty-drops of the oil are required. With whale oil, the colour is reddish, after twelve to fifteen minutes violet on the edge, and in two hours violet throughout. Olive oil gives a pale-yellow, passing into greenish-yellow. Linseed oil is at first dark reddish brown, and then black.

The more solid fat, stearin, is separated from the more fluid olein by pressure, to make stearin-candles, or, the fats being decomposed, the more solid stearic acid is separated from buttery or fluid acids, to make stearic acid lights. Under this head we may embrace spermaceti and wax. There is but little novelty offered on any of these points.

To separate the solid from the more fluid fat in palm oil, lard &c., the fats are granulated and pressed cold in bags by a powerful hydraulic press, the olein which flows out being used for soap. The contents of the bags being again granulated, and pressed between warm plates of iron, the balance of the olein, with some margarin and stearin, is then removed. To remove colour from the stearin thus obtained, it is fused with a very little nitric acid. To remove still further all the olein, Morfit proposed mixing it with a little oil of turpentine, and then pressing. See Morfit's 'Chemistry Applied to the Manufacture of Soap and Candles.' According to Heintz (Ber. d. Berl. Acad.), stearin from mutton suet becomes transparent at 124° to 126°, but does not fuse before 144°.

A process is described in the 'Rep. Pat. Inv.' Oct. 1850, for mixing some twenty to thirty per cent. of rosin with fatty bodies in the melted state, by adding sulphuric acid gradually, heating it from twelve to eighteen hours, so as to evolve sulphurous acid, and then submitting the dark-brown crystalline solid to distillation by heated steam. The solid and oily portions are then separated by pressure.

To test for the presence of stearic acid, Geith pours over two drachms of wax, one ounce of lime-water, diluted with one ounce of water. If the acid be present, the liquid loses its alkalinity, and remains clear. Buchner proposes fusibility and specific gravity as an approximate test of the presence of stearic acid, or tallow. Tallow fuses at 108°, yellow wax at 142°. ('Buchner's Rep.' xliv.)

Our knowledge of the composition and alliances of the waxes has been much enlarged by Brodie's investigations of common beeswax and Chinese wax. He found common wax to consist of *cerotic acid* (formerly *cerin*), soluble in hot alcohol, of the composition $C_{54}H_{54}O_4$, therefore of the fat acid series $C_n H_n O_4$; and of *palmitate of meliss-ether* (formerly *myricin.*) By saponifying myricin he obtained palmitic acid and melissin, which last has the formula $C_{60}H_{62}O_2$ ($=C_n H_{n} \times 2 O_2$), or that of an alcohol. By the action of lime and potassa on melissin, he obtained the corresponding acid, melissic acid, $C_{60}H_{60}O_4$. Upon examining Chinese wax, he found it consist chiefly of cerotate of cerote-ether, $=C_{54}H_{55}O, C_{54}H_{53}O_3$, for by saponification he obtained cerotic acid, $C_{54}H_{54}O_4$, and cerotin (the alcohol) $C_{54}H_{56}O_2$ ($C\ H_n \times 2 O_3$).—('Phil. Mag.' Sept. 1848, '*Amer. Journ.*' (2) vii. 427.)

UTILISATION OF BRINE—A PRACTICAL APPLICATION OF DIALYSIS.

Mr Whitelaw, of Glasgow, has recently described the result of a patent process of his own for utilising the brine of salted meat. When fresh meat, he said, had been sprinkled with salt for a few days, it was found swimming in brine. Fresh meat contained more than three fourths of its weight of water, which was retained in it as in a sponge. But flesh had not the power to retain brine to that extent, and in similar circumstances it absorbed only about half as much saturated brine as of water, so that under the action of salt flesh allowed a portion of its water to flow out. This expelled water, as might naturally be expected, was saturated with the soluble nutritive ingredients of the flesh—it was, in fact, juice of flesh—soup—with all its valuable and restorative properties. In the large curing establishments of this city very considerable quantities of this brine were produced, and thrown away as useless. This was the material to which Mr. Whitelaw has applied the process of dialysis, and he thought with success, for the removal of the salts of the brine, and for the production at a cheap rate of pure fresh extract of meat. His process he stated as follows:—The brine, after being filtered to free it from any particles of flesh or mechanical impurities it might contain, was then subjected to the operation of dialysis. The vessels or bags in which he conducted the operations might be made of various materials and of many shapes, but whatever might be their material or shape he called them "dialysers." Such an apparatus as the following would be found to answer the purpose:—A square vat made of a framework of iron filled up with sheets of skin or parchment paper in such a way as to be water-tight, and strengthened if necessary by stays or straps of metal. The sides, ends, and bottom being composed of this soft, dialysing material, exposed a great surface to the action of the water contained in an outer vat, in which the dialyser was placed. He found a series of ox bladders fitted with stop-cocks, or gutta percha mouth tubes, and plugs, and hung on rods stretching across and into vats of water, a very cheap and effective arrangement. He could also employ skins of animals, either as open bags or closed, and fitted with stop-cocks, or bags of double cloth, with a layer of soft gelatine between them. Other arrangements would readily suggest themselves, and might be adopted according to circumstances. But supposing the bladder arrangement was taken, which, he thought, would be found practically the best, being cheap, easily managed, and exposing a great surface to the dialytic action. The bladders were filled with the filtered brine by means of fillers, and hung in rows on poles across, and suspended into vats of water. The water in those vats was renewed once a day, or oftener if required, and he found that actually at the end of the third or fourth day, according to the size of the bladders employed, almost all the common salt and nitre of the brine had been removed, and that the liquid contained in the bladders was pure juice of flesh in a fresh and wholesome condition. The juice as obtained from the "dialysers," might now be employed in making rich soups without any further preparation, or it might be concentrated by evaporation to the state of solid extract of meat. The liquid from the dialysers might be treated in several ways. It might be evaporated in an enamelled vessel to a more or less concentrated state, or to dryness, and in these various conditions packed in tins or jars for sale. It might be concentrated at a temperature of 120°, by means of a vacuum-pan or other suitable contrivance, so as to retain the albumen and other matters in a soluble form. Again, the more or less concentrated liquid might be used along with flour used in the manufacture of meat biscuits. The products he had named were all highly nutritive, portable, and admirably adapted for the use of hospitals, for an army in the field, and for ships' stores. The dialysis of brine might be conducted in salt water, so as to remove the greater portion of its salt, and the process completed in a small quantity of fresh rain or other water. In this way ships at sea might economise their brine, and so restore to the meat in a great measure the nutritive power that it had lost in the process of salting. Thus, then, Mr. Whitelaw obtained an extract of flesh at a cheap rate, from a hitherto waste material. Two gallons of brine yielded one pound of solid extract, containing the coagulated albumen and colouring matter. For the production of the same directly from meat, something like twenty pounds of lean beef would be required. The quantity of brine annually wasted was very great. He believed he was considerably under the truth when he said that in Glasgow alone 60,000 gallons were thrown away yearly. If they estimated one gallon as equal to seven pounds of meat in soup-producing power, then this was equal to a yearly waste of 187 tons of meat without bone. Estimating the meat as worth sixpence per pound, this amounted to a loss of 10,472*l*. In this way the waste over the country must be very great. In the great American curing establishments the brine wasted must be something enormous, as he found that in eight of the Federal States 4,000,000 pigs were slaughtered and cured last season. Mr. Whitelaw concluded by quoting from Gregory and Liebig as to the value and efficacy of extract of meat.

THE PRODUCTION OF SULPHUR IN ITALY.

BY M. P. BIANCHI.

The sulphur at present produced in Italy amounts to no less than 300,000 tons a year, the value of which in the rough state is 30,000,000 francs. This yield, which has increased tenfold since 1830, is furnished in great part by Sicily. The quantity produced in Romagna, formerly but small, has since increased to 8,000 tons per annum.

During the last ten years great improvements have been introduced in the method of extracting sulphur from its calcareous ganque. It is always obtained by liquefaction by burning a portion of the ore; but this operation, formerly performed in small, open, cylindrical furnaces (*calcarelle*), is now effected by simply heaping the stones and covering them with earth as in charcoal burning. These heaps, called *calcaroni*, are of considerable size, often four hundred times larger than the old furnaces. This new mode of operating has the advantage of diminishing the losses occasioned by the production of sulphurous acid, so that the yield of sulphur is increased by one-fifth; besides sulphur can be burnt in this way near houses and gardens, which with the old method was out of the question. Formerly it was burnt only at certain periods of the year, now it can be burnt at any time, so that it is no longer necessary to accumulate large quantities of ore. Finally, the operation, which used to be very frequently fatal to the workmen, is now almost harmless.

Sulphur of Romagna and the Marshes.

At Bologna there is a society called "Sociéte des Mines de Soufre des Romagnes," which possesses eight mines, five in the province of Forli (Romagna) called Firmignano, Luzzena, Fosco, Busea, and Montemamro. The other three, forming part of the province of Urbino and Pesaro, are those of Perticara, Marazzana, and Montecchio.

Most of the sulphur from these workings is refined at Rimini, whence it is carried to the places where it is most in demand, such as Venice, Trieste, Ancona, Lombardy, Tuscany.

This refined sulphur is chiefly used for making sulphuric acid, and lately for the treatment of the vine. Its price, which varies considerably, is, in cakes, from 213fr. 10c. per English ton of 1·015 kilogrammes, and in sticks from 254fr. 35c., put on board vessels in the ports of Rimini and Cesenatico, and delivered at the stations of Rimini and Cesana.

Sulphur from the Neapolitan Provinces.

Sulphur is found here in several places, but in small quantities. It is thus found in the volcanic region of Solfatares, where it exists mixed with clay and other matters, from which it is separated by sublimation, but the yield is insignificant. Small deposits of it are found scattered in the district of Majella, one of which is worked at Santa-Liberata. It has recently been announced that there has been discovered at Civita-Nova a bearing of calcaire impregnated with sulphur, but nothing has been said as to its richness and extent. No more is known of another bearing at Santa-Regina, two miles east of Ariano.

Sulphur of Sicily.

Sulphur exists here in a gypseous bed, layers of which extend over a small portion of the island, from Mount Etna to near Trapani. This formation belongs to a geological epoch which has not yet been positively determined. Here, as in Romagna, it contains, besides gypsum, calcaires and clays, more or less marl. In the first place, the sulphur exists in a state of mixture, sometimes uniformly, sometimes irregularly, sometimes in small parallel veins, and more rarely in the form of crystals; in the latter case it is not unusual to find it associated with *cœlestine*, or sulphate of strontium. In clay, on the contrary, it is found in globular masses, which is also the case in similar bearings in Continental Italy.

There are about fifty mines in Sicily, employing 20,000 workmen. The most productive mines are in the provinces of Caltanisetta and Girgenti; ranging next in importance are those of the provinces of Catana, Palermo, and Trapani. The sulphur is extracted in the manner above described by means of *calcaroni;* the loss during the operation amounts to one-third of the ore. Most of the sulphur is exported in the crude state, but little being refined in the island. In this state it is divided into three qualities, the second and third being subdivided into three other qualities. The yield in 1861 was estimated at about 250,000 tons of commercial sulphur, of which about half was produced by the province of Caltanisetta, a third by Girgenti, 25,000 by Catana, and 20,000 by Palermo; the quantity produced by the province of Trapani is very inconsiderable. Most of the sulphur is exported to France and England.

The price of this product has risen during the last few years; in 1860 it sold in the crude state for from 15 to 20 frs. the ton.—*Moniteur Scientifique*, v. 799. 63.

THE WILD RICE OF NORTH AMERICA (*ZIZANIA AQUATICA*).

The water-oats, or wild Indian rice, common in many parts of the North American continent, and we believe also in Russia, is a wholesome, nourishing article of diet, which deserves to be better known than it is at present.

The flower-stem comes up sheathed in a delicate green, membranous leaf, and displays the elegant awned flowers; from these the anthers depend, of a delicate straw colour and purple, which have a most graceful effect waving in the wind. The upper or spiked part is the one that bears the seed. The green grassy leaves fall back from the stem, and float upon the surface when they are no lonper needed to protect the seed. The plant grows in vast beds, in still waters, in a depth of from three to eight feet, where there is a great deposit of mud and sand. In many places, where there is little current, these beds increase so as materially to fill up the shallow lakes, and impede the progress of boats on their surface.

The plant is usually six feet high or more, and has a panicle with male flowers above and female below. It has been found growing wild in the North West Territory, in the lakes and streams all over the country. In Minnesota, Illinois, and many other American States, as well as Canada, it is common..

When the rice begins to show the tender green blade above the water, the lakes seem to be studded with low verdant islands. It comes into flower in July and August. The leaves attain a great length, some have been measured of the great length of 11 to 13 feet. In the month of September, in Canada, in the North Western States, rather earlier, the grains are fully ripe and withered. It is so loosely enclosed between the bearded husks as to fall out at the slightest puff of wind, hence the harvest can only be continued for a few days after the maturity of the crop. The stalk and the branches or ears that have the seed, are described as resembling oats, both in appearance and manner of growing, the stalks being full of joints, and rising from two to four feet above the level of the water.

The squaws collect the seed by paddling through the rice beds, and with a stick in one hand, and a and a sort of sharp-edged curved paddle in the other, striking the ripe heads down into the canoe, the ripe grain falling to the bottom. Many bushels are thus collected. An Indian squaw will gather from five to ten bushels per day. Very great quantities grow on all the lakes in the Minnesota territory. The outlets and bays are filled with it. It is the main reliance of the Indians, during the winter months, for their subsistence. The green rice is dried in the following manner in Canada. The Indians make an enclosure on a square area of dry ground, by sticking branches of pine or cedar close together, to form a sort of hedge. In the centre of this place they drive in forked sticks, in a square of several feet, across which they lay others, and on this rude frame they extend mats of bass or cedar, for the manufacture of which the Indian women are renowned. They light a fire beneath this frame, and when reduced to hot glowing embers, the rice is spread on the mats above the fire; the rice is kept stirred and turned with a wooden shovel or paddle, and after it is dried, the husk is winnowed from it in large open baskets shaken in the wind.

Professor Randall, of Cincinnati, and General Verplanck, late Commissioner to the Chippewa Indians, consider it to be superior in taste, and far more nutritious than Southern rice. It is long, narrow, and of an olive-green colour outside. The kernels are larger, and its flavour is better; for when boiled and stewed, and left to cool, it forms a consistent mass, like good wheat bread. Boiled like ordinary rice it is very palatable. The appearance, however, is not inviting, as the outer skin is dark-coloured, though the inside is white as the Carolina kind. This may be owing to some difficulty in preserving it, and probably, if more completely hulled, the objection would disappear.

The parched Indian rice is heated in pots over a slow fire, till it bursts and shows the white floury part within the dark skin. This sort is eaten by the Indians in their soups and stews, which are chiefly made of game, venison, and wild fowl; and often also dry by handfuls, when on journeys, as the parched corn of the Israelites. The wild rice is sold in the stores of Canada at 10s. a bushel. The Indians sew it up in mats or coarse birch baskets to keep it.

The gathering of wild rice is rarely practised by the settlers, whose time can be more profitably employed on their farms; but we have thought the description of harvesting it might not be devoid of interest, since in men, who have gone exploring or "lumbering" on the shores of lonely lakes and rivers, far from the haunts of civilised man, have sometimes been reduced to worse shifts than gathering wild rice to supply their wants.—*Technologist*.

PETROLEUM AS A STEAM FUEL.

Our readers are aware that a series of experiments, on the use of petroleum or rock oil as a substitute for coal on board steam ships, have been conducted recently in America by a Government commission: some further information on this important subject has recently come to hand. A process for adapting the oil for steam fuel was patented by Shaw and Linton, of Philadelphia, and it was upon the article as manufactured by them that the examination was made. The commission consisted of three persons, including the chief engineer of the United States' Navy, and their investigation extended over five months. They were instructed to report "the relative evaporative powers of the oil as compared with anthracite coal, the practicability of its use, if unattended with danger, and to set forth its advantages if any." As regards evaporation the reply was that it is 103 per cent. superior in power to anthracite coal, while the time required for generating steam to 20 lb. pressure was only 28 minutes against 60. The Commissioners acccordingly recommended the Secretary of the Navy to introduce the oil on board one of the Government steamers, to determine practically its economical efficiency. The advocates for its introduction contend that in a vessel like the Cunard steamer "Persia" the saving, taking into account the smaller space required and all other advantages, would amount to £2,400 each trip. Experiments on a large scale, it is added, will speedily be made with an ocean steamer by a company to whom the present patentees are about to transfer their rights. In addition to the discovery of extensive deposits of the oil in Southern Russia, large quantities are alleged to have been found on the Pacific, in California. The calculations as to economy, however, seem to have been based on the assumption that the price would remain as now after the increase of demand, and also upon the cost of coal in America, and not in England. Should the results, it is added, "equal what may be fairly anticipated, steam navigation will be revolutionized. A war steamer with oil fuel could hold the sea thrice as long as now, and lines of commercial communication, now too far apart, from the difficulty of carrying sufficient coal, would then be formed with ease. Direct lines from New York to Australia and between California and China would be of easy accomplishment."

It is erroneous to imagine that experimental inquiry in this path of science is confined to America. Very recently a locomotive was being fitted, on the St. Helen's Railway, to burn coal oil, on a system proposed by Mr. W. B. Adams; the results have not yet transpired. Our neighbours in France, too, labour in the same field. A letter from Paris says:—"We have heard much lately of a plan for substituting petroleum oil for coal on board steamers. By experiments made here it has been proved that the oil will generate as much steam-power in 28 minutes as coal in an hour. Then there is the great saving of stowage, and an economy of expense by which it is asserted that 77,000 frs. would be saved in one voyage across the Atlantic." All this promises well, and, if the supply hold out, great things may yet be accomplished by the new fuel.

SUPPLY OF CANADIAN PETROLEUM.

The *Oil Springs Chronicle* of the 28th ultimo, on the yield of crude oil says;—

The present yield of crude oil in this place, as near as we can judge, is not over one hundred and fifty barrels per day.— This includes surface oil, about one hundred barrels of which is about the daily yield. The above fact is significant, and taken in connection with the fact that there is but very little oil of any kind in the markets of Canada, we are bound to suppose that oil must advance very materially in value within the next sixty days. We have plenty of oil here—in the earth—but it will not be pumped out until there is a very material advance in price. Oil producers are tired of working without pay, and have made up their minds to let the oil remain in the ground until a remunerative price is offered for it. After this, people who want oil for consumption or speculation will have to pay for it.—The ten cent per barrel oil has "played out," and the sooner the people outside learn this fact the better. Oil in Pennsylvania is selling at the wells for seven dollars per barrel; and now if the oil dealers in Canada choose to go there and pay that price, import it into this country, pay freights and duties, &c., instead of paying a fair price for our oil, they are at liberty to do so; but they cannot force oil producers here to sink wells, pump oil, and sell it for a song. That game wont work any longer. Oil has got to come up or it will not be produced.

Miscellaneous.

The Standard Bushel.

By chaper 53 of the Consolidated Statutes of Canada, the following are the Standard Weight which in all cases are to be held equal to a Winchester Bushel of the Grains, Seeds, or other Articles opposite to which they are set:—

	lbs.		lbs
Wheat	60	Carrots	60
Indian corn	56	Parsnips	60
Rye	56	Beets	60
Peas	60	Onions	60
Barley	48	Flax Seed	50
Oats	34	Hemp Seed	44
Beans	60	Blue grass Seed	14
Clover Seed	60	Caster Beans	40
Timothy Seed	48	Salt	56
Buckwheat	48	Dried Apples	22
Potatoes	60	Dried Peaches	33
Turnips	60	Malt	36

The *cwt* is 100 lbs.
The *ton* is 2000 lbs.

The foregoing standard of Weights is obligatory upon all, unless otherwise agreed upon by both buyer and seller; but a bill is now before the Legislature to render it obligatory in all cases.

In the first session of the Legislature for 1863, an act was passed (cap. 3.) providing for the inspection of "Wheat and other Grain, in which the standard weight of the Winchester Bushel of *Extra Spring Wheat* is fixed at 61 lbs.; *No.* 1 *Spring Wheat* 59 lbs.; and *No.* 2 *Spring Wheat* at 57 lbs.

Economy of Fuel in Steam Boilers.

A correspondent of the *Scientific American*, on "Economy of Fuel," writes:—"I noticed in a late number of the *Scientific American* a few remarks of yours on the waste of fuel. I am satisfied, from my own experience, that this waste is the fault, generally, of proprietors—not of the engineer or fireman. If there is plenty of boiler, so that the fire will not need to be forced, the coal will be consumed thoroughly, for the simple reason that it is easier to do so than to punch it through the bars when half burned. I have lately put in two boilers, making double the capacity of the one formerly used, and find a saving in fuel, as well as a great saving of labor for the engineer. Again, as to the economy of using steam expansively. When we had only one boiler we could manage to run by careful firing with the cut off at half stroke, but could not make steam enough to run at the same speed, using the steam at full stroke. We have lately increased our piston speed fifty per cent., and reduced the amount of steam in same proportion, and are, so far satisfied with the result. As to oiling the cylinder, we find that when the engine lags, from low steam, an application of oil through the steam chest is equal to several pounds pressure by the gage; but as to which is the cheapest—oil or fuel—we have never 'ciphered out.'" J. L. H.

Cincinnati, Ohio, April 4th, 1864.

[Our correspondent's views are correct and to the point. It is a very common error to make boilers too small for their duty; we always advise 15 feet of heating surface to the horse power, and in many cases even 20 is better than the quantity usually given, which is ten. It is cheaper in every respect to have ten horse-power surplus in the boiler than just enough to keep the engine running. Coal will not burn when it is continually raked up, "poked," "sliced," &c., and it is only by slowly roasting away upon the grates that the greatest economic effect is obtained. Lubricating the cylinder has the effect spoken of by our correspondent, but the question of economy is not between fuel and oil, but between repairs and fuel caused by the injurious action of the oil or fat. Engines working moist steam generally require little lubrication of the valves and cylinders; but with vapor of a high temperature the case is different.—Eds. *Scientific American.*]

Marine Boiler Furnaces.

A correspondent of the *Mechanic's Magazine* says:—Although smoke from steam ships is such a recognised nuisance, I see few, if any, means taken to effectually prevent it; and although fuel is an expensive article I still find the apparati for consuming it generally in a very imperfect condition. Always, in going below, a handsome, well-kept pair of engines presents itself to your gaze, but look at the boilers, and the furnace fronts are most likely cracked, the doors in bad repair, and the fire bars more or less out of order, and this when the furnace is an apparatus for consuming fuel every year to nearly half the value of the machinery, and should be kept up in repair as carefully as the slides of the engines themselves. I have lately seen the calorific value of Welsh and Newcastle coal raised nearly 14 per cent., and the power of the boiler producing steam raised to the same extent by the following simple alterations, viz.:—

Reducing the length of the bars so as to increase the proportion of heating surface to about 33 square feet per square foot of grate surface, and securing an efficient combustion chamber, and by adopting a furnace door with the baffle plate alone perforated with as many 7-16th holes as practicable, the door intact, the air coming up through the bottom space only between the door and the baffle plate. Any simple shutter for this bottom space will give the means of regulating the quantity of air going through, which, however, does not seem to be greatly wanted. In a furnace so constructed the most bituminous steam coal may be burned with the greatest economy, almost entirely without smoke by the most careless stoker, and the boiler made to produce the greatest possible amount of steam in a given time.

Singular Detection of Poison.

Paris has recently been much excited by a supposed case of poisoning, and singular discovery of evidence of the crime. A woman died under the care of a homœopathic physician—Dr. Courty de Lapommerais. The Judge of Instruction—the officer charged with the investigations preliminary to the public trial—went to the house of the deceased woman to inspect the room in which she died, but with no fixed idea as to whether he should discover anything at all. He perceived some faint spots on the floor, and found, on inquiry that they were made by the dejections of the sick woman. He ordered the floor to be scraped at the places stained, he carefully collected the scrapings and submitted them to the examination of competent chemists, and these scrapings are going to condemn the prisoner. They contained *digitaline*, the active principle of the *digitalis purpurea*, or purple fox-glove, one of the most deadly poisons of the "Materia Medica," and which acts by diminishing the heart's action. To shew the wonderful power of this medicament, the *digitaline*, as prepared by Homolle and Quevenne, the preparation now principally in use at Paris, is given in doses of one or two milligrammes, or say of one grain, for fifteen days' use.

The chemists commenced by giving small quantities of the scrapings to animals, all of which died in a way to suggest poisoning by *digitaline*. They then selected the frog for the test experiment, because the heart of this animal, when laid bare, continues to beat normally. The test was made on three animals; the heart of the first one was laid bare, and continued its contractions and dilatations as if nothing had occurred; on the naked heart of the second one a minim of a solution of *digitaline* was dropped; the heart commenced to beat slower and slower; presently its pulsations ceased entirely, and the animal was dead. On the heart of the third frog they placed a small quantity of the avenging scrapings from the floor, and they produced exactly the same effect as the drop of *digitaline*; the heart's pulsations slackened by degrees, and presently the animal was dead.

These interesting experiments were made before the Judge of Instruction, and will be repeated before the jury at the trial. Until they were made the prisoner was indifferent and even joyous; he knew that there was no chemical test for the poison he used; he had taken care to nurse the condemned woman himself, and to conceal all the probable sources of discovery; but he had not counted on the spots on the floor, nor on the peculiar properties of the heart of the batrachian tribe. Nevertheless he had occupied himself a great deal with toxicology, and still maintains that he can prove his innocence.

High Atmospheric Pressure.

A report was read a few days ago at a sitting of the Société Médicale d'Emulation, on a curious paper by Dr. Foley, in which he recommends a high atmospheric pressure as a cure for various diseases. He remarks that fish can bear the greatest possible barometical variations by means of their air-bladder, which by swelling up, can moderate, and even momentarily suspend, the circulation of the blood. The permanence of viscero-muscular pressure in fish prevents the shock of the formation of a vacuum; the air-bladder presses upon the vena cava and the aorta, and thus prevents the shock of the vital fluid on its return. In birds there are air-bladders all around the viscera, and nearly resembling the lungs. The higher a bird can soar, the larger are the reservoirs for air covered with contractile organs. The very bones and feathers are pierced for air, and in the more powerful species air bags are provided under the skin. The ostrich, the casoar, and other swift runners, have their largest air-bags under the muscles of the thigh; the condor, swallow, and others whose powers of flight is great, have these bags under the muscles of the wings. By this organization all these creatures can bear any amount of atmospheric pressure or rarefaction within reasonable limits, for the immense depths of the ocean, measuring thousands of fathoms, for instance, are unfit for animal life, and fish that, by way of experiment, have been let down to such depths have been brought up again dead. The effects of the pressure of the atmosphere, though tolerably well known before, have been quite recently tested in England, where it has been found that bottles filled with liquids, and then well corked, but so as to leave a small empty space between the liquid and the cork, would, if kept for an hour under the pressure of a column of water 2,000 fathoms high (which may be done by hydraulic press), have their corks pressed down to the liquid. An empty bottle had its cork driven in, and was brought up again filled with water. Applying all these facts to therapeutics, Dr. Foley remarks that mountaineers are obliged to breath more quickly than men inhabiting the plains, because the air is more rarefied on the mountains than in the plains, and therefore affords less oxygen at a breath than in the denser air. Conversely, therefore, if a patient be in want of more oxygen than he can get under the ordinary pressure, let him be exposed to an atmosphere rendered artificially denser. This can be done by constructing a small chamber, communicating with an air-guage and a safety valve. A patient confined in such a chamber may be subjected without inconvenience to the pressure of about two atmospheres and a half. By this treatment catarrh, asthma, and other complaints of the respiratory organs may be removed; in croup the compressed air will further arterialize the blood and increase the vital power of the patient.

New Mode of Illumination.

M. Soubra, a Professor of Mathematics, has invented a new method of illumination, or rather a method of inverting a flame, by the adoption of which several advantages are expected to be realised. The apparatus consists of a syphon of glass, the open ends of which are turned upwards; a burner is placed just within the shorter branch. Before lighting the lamp, the longer branch of the syphon is heated, and a current of air established, which carries with it any flame placed at the open end of the shorter branch, the flame, consequently, becoming inverted. As soon as the current is established, and the burner kindled, the heating of the longer leg may be discontinued, the current, once established, being sutained by the heat from the inverted flame. The advantages of this new arrangement are as follows:—The supports of the globes or lamp-glasses are placed above the flame, and do not intercept the light; the reflectors, also, are in no danger of becoming blackened by smoke, and they collect rays that otherwise would be lost in the air. The flame has a more elevated temperature on account of the heat being concentrated by the syphon, and the carbon consequently more incandescent. The products of combustion are collected in the syphon, and may be conveyed away, instead of vitiating the air of the apartment. It is proposed to employ these reversed flames as footlights for theatres, the advantages, such as safety, &c., being obvious.

New Voltaic Pile.

M. Maistre Fils has proposed a new voltaic pile. The peculiarity consists in the employment of iron instead of zinc for the oxidable metal, and in the arrangement of the charcoal or copper discs; these, which are circular, are all placed on a spindle which can be made to revolve; the discs dip into the liquid in the cups to such an extent that about one-third of their surface is covered; the exciting liquid employed is water containing a hundredth part of its volume of nitric acid. Iron is considered better than zinc, because there is no danger of its forming a deposit on the discs, the revolution of which prevents their becoming coated with hydrogen, and so rendered inactive,

A Burglar Proof Vault.

A burglar-proof vault has been invented, in which a space between two of the plates is filled with iron balls about one inch in diameter, perfectly loose. The plates cannot be drilled through, as a drill must strike one of those balls, which would rotate with the tool, instead of submitting to the perforating process. One of these vaults has been put up in Chicago Custom-house.

The First Striking Clock.

In the time of Alfred the Great, the Persians imported into Europe a machine which presented the first rudiments of a striking clock. It was brought as a present to Charlemagne from Abdallah, king of Persia, by two monks of Jerusalem, in the year 800. Among other presents, says Eginhart, was a horologe of brass, wonderfully constructed by some mechanical artifice, in which the course of the twelve hours *ad clepsydram vertebatur*, with as many little brass balls, which, at the close of each hour, dropped down on a sort of bell beneath, and sounded the end of the hour. There were also twelve figures of horsemen, who, when the twelve hours were completed, issued out of twelve windows, which till then stood open, and returning again, shut the windows after them. It is to be remembered that Eginhart was an eye-witness of what is here described; and that he was an abbot, a skilful architect, and learned in the sciences.