THE JOURNAL

OF THE

Board of Arts and Manufactures

FOR UPPER CANADA.

OCTOBER, 1864.

ORNAMENTAL PAINTING AND GILDING ON EARTHENWARE AND PORCELAIN.

This elegant ornamental art was introduced into Canada for the first time by Messrs. Hurd & Leigh, of Yonge street, Toronto, about two years ago.

The exceedingly beautiful wares of the English potteries are so attractive to all who have the least taste, that almost every family regards the possession of a set of beautiful china as among the first requisites of housekeeping. Unfortunately, however, the loss by breakage in transporting this class of goods from England to this country is so great as to raise the price of the finest articles above the convenience of many to purchase. This will be better understood when we bear in mind that one broken article spoils the sale of a whole set, and in many cases two or three sets are required to complete one, on the *whole* of which the duty has been paid. The Messrs. Hurd & Leigh, familiar with the pottery business in all its practical detail, resolved to remedy this state of things by importing their fine porcelain without the ornamental work, and having the artistic embellishment executed here, at their own establishment. They accordingly sent to England for a family of artists who had been educated at a school of design in connection with the potteries, and had long experience in working for some of the best establishments. These came, a furnace was erected, and the business is flourishing under the patronage of both sections of the Province. Besides working for the trade, this firm takes orders from private individuals, such as completing sets, painting and gilding mottos, crests, and designs of any required pattern. The process of embellishment will be all the better understood if preceded by a brief account of the material wrought upon.

The chief ingredients of pottery are alumina and silex, in familiar terms clay and flint, mixed together in various proportions, according to the kind of ware to be produced. The possession of the clay requisite for making the finest porcelain by the Chinese, long gave their manufactures a most envied superiority over those of other countries. The Portuguese had imported porcelain from China since 1503, and as yet, in 1709, all the labour and research, and all the wealth that had been spent in experiments, had failed to produce an imitation of it in Europe. a little before that, a horse's feet sank into a *white soft earth* in Germany, near Schneeberg, when its rider, an iron merchant, travelling on business, was led to examine it, and afterward he determined to sell it for *hair powder*, which was then in fashion. Some of this hair powder fell into the hands of Böttcher, who had long been searching for it, and in 1709 he succeeded in making from it the true translucid porcelain. The exportation of the clay was prohibited, and all in the possession of the secret of making the porcelain were sworn to perpetual secresy, and the penalty of imprisonment for life was attached to its violation.

France had produced an artificial porcelain ever since 1695. In 1755 the much desired material was found in St. Austle and St. Stephen's, Cornwall, and in 1758 fine porcelain was made in England. In connection with this, the name of Josiah Wedgwood will go down to posterity along with those of Luca della Robbia and Bernard Palissy. In France, good porcelain material was found a few years later. The name by which it is customary to particularize fine potter's clay is *kaolin*, the Chinese name, which means a "high ridge," because they obtain it from a high ridge of *granite* rocks, of which the clay is a decomposition.

In Cornwall, it passes through several processes of preparatory treatment, by which all improper substances are removed before sending it away from the "pits" to the potteries. At the pottery it is subjected to the action of appropriate machinery, by which it is cut into small pieces, diffused through water, and forced through a succession of seives till not a particle remains which the potter wishes to exclude. Its proper consistency is determined by weight, one pint weighing 24 ounces. The flint is heated to redness in a kiln, and at this heat thrown into water, which facilitates the next process of grinding it to fine powder. This is worked in water by machinery until a pint weighs 32 ounces, when it is fit to mix with the kaolin solution in the proportion of five of kaolin to one of flint. To this mixture are added, according to the nature of the ware to be produced, broken porcelain ground, powdered bone ash and plaster of Paris. The mixture is now called "slip," and the next thing to be done is evaporation to the consistency of dough in the "slip kiln." Then, in order to increase its toughness and plasticity, and to effect the expulsion of air it undergoes a variety of manipulations, as *beating*, *slapping*, and thorough kneading. Fine porcelain paste is often kept a year or more in a moist state before it is used. It is now formed into the articles required on the potter's wheel, a vertical sort of lathe, or in moulds. The articles so formed are dried in a warm room, and then baked in a kiln; but in order to protect them from the direct action of the fire they are carefully placed in deep boxes made of a kind of clay that will bear a higher degree of heat than the articles they are to contain. These boxes, or "seggars" as they are called, are piled up to the top of the kiln, the bottom of one serving as a lid to the one below. These must be arranged so that the fire shall have access to all alike. The heat is gradually increased to, say 1860° to 1880° Fahrenheit, and the usual time allowed for baking is about 40 to 50 hours; but that is determined by "trials." Now the fire is withdrawn, the ash-pit doors closed, and all is left to cool, when the seggars with their contents are taken out, and the baked ware is "biscuit," called so because it appears like biscuit. It is next to be *glazed*. Litharge, clay, ground flint, white lead, sand, soda, feldspar, common salt, and a variety of articles, enter into the composition of glazes, nearly every potter having his own favourite method, which is his own secret. Potters have always been oppressed with secrets, and sometimes they have not dared to divulge them on pain of death. The glaze is mixed in much the same way as the "slip" was, and to about the consistency of cream. The biscuit articles are dipped into this, and on taking them out enough adheres for the required object. It is now placed again in the seggars, to be fired at a much lower temperature than before, when the glaze fuses and forms an even, glossy, transparent coating. It is in this state and on this vitreous covering that they are to receive the gilding and fine painting. The common blue, and other coloured wares, have their pictorial embellishments transferred to them when they are biscuit, thus: the design is engraved on a copper plate, printed from that on damp tissue paper; the latter, containing the picture, is pressed by rubbing it on to the biscuit, where it remains an hour, and then dipping it into water softens the paper so that it can be peeled off, leaving the picture on the article, the oil in which the colour was ground is dissipated by heat in an oven. Now, when it is dipped into the glaze-tub, that material *will adhere to the painted part of the biscuit* as well as to the other, so that on fusing, the glaze covers and protects the colours.

The finest porcelain made in England has kaolin and granite for its basis, but a much larger proportion of bone-ash. This, composed as it is of carbonate of lime, phosphate of lime, and a little magnesia, makes an excellent flux, the phosphoric acid diffuses itself through all the materials in baking, uniting them into a translucent enamel. This is imported by Hurd & Leigh in white, and embellished by them.

On visiting the art department of Messrs. Hurd and Leigh, we encountered no reserve. On the contrary, even more than we thought of asking was communicated in the most frank and gentlemanly manner. We found the artist seated, work in hand, and his palette before him, treating his subject much as a miniature painter would, with this difference in favour of the latter, that *he* can *see* the effect of his colours as he applies them; the porcelain artist must *know* what his *will be* after they shall have had eight or ten hours firing in the kiln to burn them into the glaze, for they will be entirely changed in appearance. The science of chemistry has furnished the palette of the ceramic artist with all the colours he requires, but being metallic oxides, and having to be submitted to the action of fire for a long time, it is indispensable that he should understand their nature, so as to know the exact proportions in which to combine them for the desired effect. The utmost care is also required in rubbing and preparing them with the proper quantities of volatile oil and flux on the palette.

For the gilding various preparations of gold are employed, but generally in its precipitate, rubbed up with old thickened oil of turpentine, and applied, as the colours are, with a camel's hair pencil. We should state that the artist has by his side a small round rotary table, on which, when it is desired to put a band of gold or colour on the article to be ornamented, the article is placed, and the table turned round whilst the pencil, charged with gold or colour, is held in contact. When the ware thus treated has been freed of the volatile oils by dissipation, they are ready for the kiln, where they are carefully placed on iron shelves, perforated for the equalization of the heat. When the kiln is filled the door is walled up, the fire kindled, a red heat raised, and in from eight to ten hours the colours and gold are properly burnt in. This process requires no seggars. The gilded articles are next taken to the burnisher who rubs the gilding carefully in one direction with a tool of agate or blood stone, with fine sand and whiting as auxiliaries, and the ware is fit for sale.

From the earliest times, and in all countries, the potter's art has been practised. It would be in vain to attempt to trace it to a beginning, as the ancient Egyptians had no knowledge of its origin. It must have been ancient before the commencement of history, for their oldest traditions ascribed the invention of pottery to *Num*, the supreme director of the universe, who moulded the human race on his potter's wheel, out of the dark clay of the Nile. The Assyrians and Babylonians used *terra cotta,* baked earth, *i.e.,* clay, as a material to write on, and entrusted to its faithful keeping their public archives, their historical annals, astronomical computations, religious dedications, title deeds, bills of exchange, and all important transactions. On two of the cylindrical terra cotta books now existing can be read Senacherib's campaign against Judah; on two others is recorded Nebuchadnezzar's dedication of the great temple to the seven planets; and we are also indebted to its being written on this indestructible material for the history of the Assyrian monarchy.

In Greece, the ceramic art was pursued with an intensity of devotion, which requires the fine Greek organization, inspired with the Greek mythology, fully to appreciate. It was at Samos and at the Athenian Ceramicus, where the spirit of abstract form revealed itself to its votaries, and was embodied in those immortal works of Phidias, Myron and others, which have been preserved by the potter's art as types of perfect beauty for all time.

Three thousand years ago, the ancient Etruscans, probably of the same race, and inspired by the same spirit, developed those matchless forms of classic purity which are the models of our English potters.

The most celebrated painters of ancient and modern times have vied with each other in adorning the productions of the potter, and this happy union of sculpture and painting has found patrons wherever it has been known. Kings and queens, philosophers and statesmen, have been found amongst its most enthusiastic promoters and collectors, ever since its reappearance in Europe at the beginning of the fifteenth century. The dukes of Urbino, to establish a kind of pottery in their duchy, made great sacrifices. Henri II. and his consort Catherine de Medicis, were also great patrons of the ceramic art. Every one acquainted with the romantic history of ceramics will feel grateful to the memory of this royal couple for their affectionate protection of Palissy, at the revocation of the edict of Nantz. Bernard Palissy was painter, chemist, sculptor and potter of the noblest type, who died in prison rather than have liberty at the expense of conscience.

Elizabeth, and Catharine II. of Russia, Maria Theresa and Charles III., and a host of others, were zealous patrons of the art as well as collectors of its specimens. The celebrated pottery of Sèvres owes its perfection to the influence of Madame Pompadour over Louis XV. Connisseurs all know the connection of Madame Dubarry's name with that establishment, for it is the name of its most admired colour.

The King of Prussia thought a set of Dresden ware, with battle pieces painted on it, worthy the acceptance of the Duke of Wellington after Waterloo. George IV. was a large collector. The Queen has an extensive collection, and there are numerous rare specimens in Marlborough House. There are also known to be in England over two hundred private collections, besides the public ones at the British Museum, at the Museum of Ornamental Art, and at the Museum of Practical Geology.

LITHOGRAPHY.

Board of Arts and Manufactures Certificate.

The art of lithography has been practised in Canada for several years past, but principally in producing works of but ordinary artistic interest, such as maps, bank checques and notes of hand, commercial labels, &c. A few creditable productions have, however, been issued: such as the chromolithograph of Paul Kane's Indian scenes, by Fuller & Bencke, of Toronto; a diploma for the Toronto Mechanics' Institute, designed and lithographed by Sandford Fleming, and printed at Scobie's lithographic press; a large folio show card for the British America Assurance Company, designed and lithographed by J. Moser, Toronto, and printed at the lithographic press of W. C. Chewett & Co. These, with a few others, are all that have been produced here worthy of being mentioned.

The demand for first class productions has heretofore been so very limited as to have afforded but little encouragement to this class of artists; and, generally speaking, when anything very good has been required, instead of encouraging those amongst us who were striving at the same time to promote a proper taste and secure for themselves a suitable reward for their labours, our citizens have gone to the United States, or to Europe, to obtain what they required and ought to have had executed here. We are glad to be able to write that, in our opinion, this will be no longer necessary, as we have both the artists to design and those to carry out their designs, in this city. We would here instance a certificate just completed for the Board of Arts and Manufactures for U. C., to award to candidates successfully passing the annual examination of the Board.

This certificate is on a centre tinted ground, 14 inches by 10 inches, and was designed expressly for the Board by Mr. R. C. Todd, decorative artist of this city. Near the top of the design is a well executed vignette representing the official seal of the Board, composed of the arms of the

Province of Upper Canada, supported on the right by a male figure representing the industrial arts, and on the left by a female figure representing the fine arts, with the railway locomotive, &c., in the back-ground.

Surrounding the vignette, and beneath it, are the title of the Board and the subject-matter of the certificate, in ornamental lettering. At the base, and extending quite across, is a happily conceived group of figures, with appropriate surroundings, representing several of the most important branches of the fine and industrial arts. Here we have the youth at his studies, sitting in the midst of his books and philosophical apparatus and instruments; the marble-mason, the blacksmith, the joiner and the weaver, all apparently engaged intently upon their several occupations; the painter, with *easel* and *palette*, surrounded with objects of interest in sculpture, music, architecture and the decorative arts; and lastly the printer, not the least important of them all, holding somewhat of an intermediate place between the artist and the mechanic, and in the prosecution of his art advancing the spread of light and knowledge over the earth. In the background of this group are factory buildings and a steamship, representing manufactures and commerce.

Having said this much for the design, we would not do justice to Mr. Fuller of the Lithographic Department of the firm of Messrs. Chewett & Co., of Toronto, did we fail to notice the truthful and admirable manner in which that gentleman has re-produced the design on stone. It is alike creditable to designer and lithographer in all its parts —no matter how perfect the work of the former may be, if the labours of the latter are not equally well performed, the designer's skill has been exercised in vain.

A copy of this work is being exhibited by Messrs. W. C. Chewett & Co. at the Provincial Exhibition, now being held in the City of Hamilton, and we recommend to all persons requiring productions of a similar character, to examine it before sending any more orders to foreign countries.

NOTICE.

Duties requiring our attendance at the Provincial Exhibition in the City of Hamilton, during the last week of September, necessitates going to press with the present number a little earlier than usual. We must therefore defer any notice of the Exhibition for the November number of the Journal, when we hope to be able to give a pretty full notice of he Arts and Manufactures Department.

Useful Receipts.

Axle Grease.

1. The popular axle grease of the celebrated Mr. Booth is made as follows:—Dissolve ½ lb. common soda in 1 gallon of water, add 3 lbs. of tallow and 6 lbs. of palm oil [or 10 lbs. of palm oil only]. Heat them together at 200° or 210° Fah.; mix, and keep the mixture constantly stirred till the composition is cooled down to 60° or 70°.

2. Another and thinner composition is made with ½ lb. of soda, 1 gallon of water, 1 gallon of rape oil, and ¼ lb. of tallow, or palm oil.

3. The French compound, called Liard, is thus made:—Into 50 parts of finest rape oil put 1 part of caoutchouc, cut small. Apply heat until it is nearly all dissolved.

4. Mankettrick's lubricating compound consists of 4 lbs. of caoutchouc [dissolved in spirits of turpentine], 10 lbs. of common soda, 1 lb. of glue, 10 gallons of oil, and 10 gallons of water. Dissolve the soda and glue in the water by heat, then add the oil, and lastly the caoutchouc, stirring them until perfectly incorporated.

5. The following is the ordinary kind of axle-grease in common use:—1 part of fine black lead, ground perfectly smooth, with 4 parts of lard. Some recipes add a little camphor.

Black Lacquer for Boots and Shoes, Harness, &c.

Mix four ounces of shellac and half an ounce of the finest lamp black in a stone bottle, with twenty ounces of alcohol of the strength of eighty degrees, and close the mouth of the bottle with a damp bladder. Add nothing more to the mixture for twenty-four hours, but shake it often in that time. Then pierce a hole in the bladder with a needle, place the bottle in hot water, and let it stand in it half an hour, taking it out often to shake it. Unfasten the bladder skin, pour one ounce of Venetian turpentine into the bottle, close up the mouth again, and place it once more in warm water. The bottle should be kept always corked, and it requires to be shaken before using the contents.—*Shoe and Leather Reporter.*

The Ant Trap.

Housewives and others who are troubled with ants may probably use the following trap to advantage:—Procure a large sponge, wash it well, and press it dry, which would leave the cells quite open: then sprinkle over it some fine white sugar, and place it near where the ants are troublesome. They will soon collect upon the sponge and take up their abode in the cells. It is only necessary to dip the sponge in scalding water, which will wash them out dead by the tens of thousands. Put on more sugar, and set the trap for a new haul. This process will soon clear the house of every ant.

Quick Antidotes.

If any poison is swallowed, drink instantly half a glass of cool water with a heaping teaspoonful each of common salt and ground mustard stirred into it. This vomits as soon as it reaches the stomach; but for fear some of the poison may still remain, swallow the white of one or two raw eggs, or drink a cup of strong coffee, these two being antidotes for a greater number of poisons than any dozen other articles known, with the advantage of their being always at hand; and if not, a half-pint of sweet oil, or lamp oil, or "drippings," or melted butter or lard, are good substitutes. Dr. J. Edmonds, a prominent English physician, writes as follows to the London *Times*:—"I inclose a simple, safe, and accessible prescription for the whole range of acid and corrosive poisons, which, if promptly used, will almost invariably save life. Mix two ounces of powdered chalk or magnesia, or one ounce of washing soda, with a pint of milk, and swallow at one draught; then tickle the back of the throat with a feather or finger, so as to produce vomiting. Afterward drink freely of hot milk and water, and repeat the vomiting, so as to thoroughly wash out the stomach. Any quantity of chalk or magnesia may be taken with safety, but soda in large quantities is injurious. I may add that, the narcotics being excepted, milk alone is an antidote for almost all the poisons, and especially if followed by vomiting."

To Imitate Mahogany.

Use beech, box, or any other close grained wood: plane it level, and smooth it with fine glass-paper. Then stain it by any of the following modes: 1. Rub the surface with nitrous acid, and afterwards brush on two or three coats of the following mixture: Dragon's blood, 4½ oz., soda, 1 oz., rectified spirits, 3 pints; mix and apply. When dull it may be revived by using cold drawn linseed oil as a polish.

2. Aloes, 2 parts, dragon's blood, 1 part, spirit, 20 parts; dissolve and apply. Finish with oil and wax, coloured with alkanet.

A New Form of Gunpowder.

Messrs. Hall & Wells, of Worcester, England, propose a new gunpowder, to consist of 47 parts of chlorate of potash, 38 parts of ferro-cyanid of potassium, and 5 parts of sulphur. The ingredients, after being first pulverized, are mixed into a paste with water; when dry, about 10 parts of caoutchouc are added, and the compound is complete. One of its peculiar features is that it may be so moulded that the entire charge shall constitute a solid mass, thus greatly facilitating the manufacture of cartridges.

Nutritive Fluid.

Take 1 pint of new milk, 2 pints of soft water, 2 tablespoonfuls of parched flour, 1 teaspoonful of of salt, 2 teaspoonfuls of white sugar, 1 teaspoonful salæratus, and 2 teaspoonfuls of lump magnesia. Bring the milk and water to a boil, add the flour previously wet with a part of the water, boil just 5 minutes, and pour on to the sugar and salt in an earthen vessel; stir it occasionally, and when nearly cool add the salæratus and magnesia. Take 1 tumblerful or ⅔ full every hour. This is excellent for persons suffering with weak stomachs or diarrhœa.—*Boston Cultivator.*

To Preserve Metal from Corrosion.

Dip the article in a very dilute solution of nitric acid, and afterwards immerse in linseed oil, allowing it to drain thoroughly.

Coloured Glass.

According to some, we have lost the secret of the ancient glass dyes, but this is a mistake. Gold is as willing as of old to stain glass ruby red, and so is the humbler copper, which can also tincture it green. Silver secures a yellow or an orange, and iron gives the same. Cobalt provides for blue, copper and chromium for green, manganese for purple, and uranium for a topaz-like canary yellow. Tin makes a white glass milky and opaque, such as we see in the dials of watches, and a black enamel is secured by the darker oxydes of manganese, iron, and cobalt.

Solders.

For Lead.—Melt one part of block tin, and, when in a state of fusion, add two parts of lead. Resin should be used with this solder.

For Tin.—Pewter, 4 parts; tin, 1; bismuth, 1. Melt them together and run them into slips. Resin is also used with this solder.

For Gold.—Pure gold, 12 parts; silver, 2; copper, 4.

For Brass.—Brass, 2 parts; zinc, 1.

For Iron.—Good tough brass, with a small quantity of borax.

For Pewter.—Bismuth, 2 parts; lead, 1; tin, 2.

For Copper.—Copper, 2 parts; zinc, 1.

For Silver.—Silver, 5 parts; brass, 6; zinc, 2.

Hard Solder.—Copper, 2 parts; zinc, 1.

Soft Solder.—Tin, 2 parts; lead, 1 part.

Selected Articles.

PROCEEDINGS OF THE SOCIETY OF ARTS.

CANTOR LECTURES.

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

LECTURE III.

Delivered on Tuesday Evening, April 14th, 1864.

Leather.—The art of the currier. Morocco, Russia, and patent leathers. The art of tawing skins. Chamois and glove skins. Parchment. *Hair*, its composition and dyeing. *Wool*, its washing, scouring, bleaching, and dyeing. *Silk*, its adulterations and conditioning.

I shall have to crave the indulgence and patience of my audience during this lecture, as it will chiefly consist of descriptions of processes for the most part well known to manufacturers and others engaged in the leather trade. Thus, the art of currying, which is applied principally to such leathers as are intended for the upper parts of shoes, for harness, &c., is carried on at the present day nearly as it was fifty years ago, and still is but little known to the public.

Currying.—The objects in view in currying leather are several: to give it elasticity—to render it nearly impermeable—to impart to it a black or other colour, and, lastly, to reduce it to a uniform thickness. These qualities are imparted by the following processes: After the leather obtained from hides or the thicker qualities of skins has been damped, it is placed on a stone surface and energetically rubbed, first with a stone, then with a special kind of knife called a slicker, and lastly with a hard brush. The leather is then ready to be stuffed or dubbed, which consists in covering it on the fleshy side with tallow, and hanging it in a moderately warm room; and as the water contained in the leather evaporates, the fatty matter penetrates into the substance of the leather and replaces it. The dubbing process is then repeated on the other side of the leather, which is now ready to be softened and rendered flexible, and this is effected by rubbing it with a tool called a pummel. The leather then undergoes the last mechanical operation, which reduces it to uniformity of thickness by shaving off the inequalities of its surface by means of a peculiarly shaped knife called a slicker. The greatest part of the curried leather is blackened on the grain side by rubbing it with grease and lamp black, and lastly brushing it over with a mixture of grease and glue. I believe that some kinds of curried leather are dyed by a purely chemical process, that of rubbing the tanned skin, first with iron liquor, and then with a solution of gall nuts or other tanning substances. The most tedious of the foregoing processes is that of dubbing, which has been greatly improved of late years by the Americans. The scoured skins are placed in a large revolving drum, of ten or twelve feet diameter, and lined inside with wooden pegs. A certain quantity of tallow is then introduced and the whole set in motion, and whilst the hides are thus tossed about, a current of warm air is passed through the drums which carries of the moisture and allows the grease to penetrate the hide. By this means thick hide leather can be stuffed in four or five days.

Split Leather.—A large branch of trade has sprung up within a few years owing to the invention of machinery for splitting hides, skins, and kips, by which the quantity of leather has been considerably increased, though I am afraid this has been done at the expense of its quality.

Fancy Leathers.—Allow me to give you a slight insight into the methods of preparing various fancy leathers, such as Morocco, Russia enamelled, tawed, or kid leather, used for soldier's belts, gloves, &c., and lastly, oiled leathers, used for washleather, gloves, &c. Until the middle of the eighteenth century, Morocco leather was wholly imported from that country, for it was in 1735 that the first Morocco works were established in Paris, and similar manufacturies were soon set up in various parts of the Continent and in this country. The process by which Morocco leather is prepared is as follows:—The goat and sheep skins, which are especially used for this branch of manufacture, are softened, fleshed, unhaired, and raised or swelled by methods similar to those already described, but one essential element of success in this kind of leather lies in the perfect removal of all lime from the skins, which is effected by plunging the well-washed skins in a bath of bran or rye flour, which has been allowed to enter into a state of fermentation. The result is, that the lactic and acetic acids generated by fermentation of the amylaceous substances combine with the lime and remove it from the skins. The other essential point is the mode of tanning the skins. Each skin is sewn so as to form a bag, and filled, through a small opening, with a strong decoction of sumac, and after the aperture has been closed the skins are thrown into a large vat containing also a decoction of the same material. After several hours they are taken out, emptied, and the operation is repeated. To render these skins ready for commerce it is necessary to wash, clean, and dye them. The last operation was formerly tedious, and required great skill, but since the introduction of tar colours, the affinity of which for animal matters is so great, it has become comparatively easy. The skins after they have been dyed, are oiled, slightly curried, and the peculiar grain, characteristic of Morocco leather, is imparted to them by means of grooved balls or rollers. There are two inferior kinds of Morocco leather manufactured, viz., those called *roan*, prepared in a similar way to Morocco, but not grained, and *skivers*, also prepared in the same manner, but from split sheep skins. I owe to the kindness of Mr. Warren De la Rue, the beautiful specimens of leather before me, which will enable you to appreciate the various qualities of these interesting productions.

Russia Leather.—The great esteem in which this leather is held is owing to its extreme softness and strength, its impermeability, and resistance to mildew, which latter property is imparted to it by the use of a peculiar oil in its currying, that is birch-tree oil, the odour of which is well known as a distinguishing feature of Russia leather. As to its preparation, I will merely state that it is very similar that of Morocco, with these differences, that hot solutions of willow bark are used instead of sumac; that it is generally dyed with sandal wood and a decoction of alum; and, lastly, as already stated, the birch-tree oil is used in currying it.

Enamel Leather.—This class of leather is usually prepared with calf and sheep skins tanned in the ordinary manner. They are dyed black by rubbing them over with a decoction of logwood, and then with iron liquor or acetate of iron. The leather is softened with a little oil, and is ready to receive a little varnish, which is applied by means of a brush. The varnish is composed of bitumen of Judea, copal varnish, oil varnish, turpentine, and boiled oil.

Tawed or Kid Leathers.—The manufacture of this class of leathers differs entirely from that of those already described, as their preservative qualities are imparted by quite different substances from those used with other leathers, the preservative action of the tanning being substituted by that of a mixture of alum and common salt. Let us examine together a few points connected with the production of this class of leather. One of the most interesting characteristics is the method of unhairing sheep, lamb, and kid skins, after they have been well washed and fleshed on the beam. The old process of unhairing by smearing on the fleshy side with a milk of lime, was improved by mixing with the lime a certain amount of orpiment, or sulphuret of arsenic; but Mr. Robert Warrington having ascertained that the rapid removal of hair in this case was not due to the arsenic, but to the formation of sulphuret of calcium, proposed, with great foresight, the following mixture as a substitute for the dangerous and poisonous substance called orpiment, viz.: Three parts of polysulphuret of sodium, 10 parts of slacked lime, and 10 parts of starch. The polysulphuret of sodium may be advantageously replaced by the polysulphuret of calcium. The skins unhaired by any of these processes, are now ready to be placed in a bran or rye bath, as with Morocco leather, or in a weak solution of vitriol, to remove, as already stated, the lime. After the lime has been thoroughly removed from the skins, they are dipped in what is called the white bath, which is composed for 100 skins of 13 to 20 lbs. of alum and 4 to 5 lbs. of chloride of sodium or common salt, and the skins are either worked slowly in this bath or introduced into a revolving cylinder to facilitate the penetration of the preservative agent, which, according to Berzelius, is chloride of aluminium resulting from the action of the chloride of sodium on the alum. When the manufacturer judges that the skins have been sufficiently impregnated with the above mixture, he introduces them into a bath composed of alum and salt in the same proportions, but to which are added 20lbs. of rye flour and fifty eggs for 100 skins. After remaining a few hours they are removed, and allowed to dry about fifteen days, and are then softened by working them with a peculiar iron tool, the white surface which characterises that class of leather being communicated to them by stretching them on a frame and rubbing them with pumice stone. A large quantity of tawed leathers are also preserved, retaining their hair, which is done by simply suppressing the unhairing and rubbing processes.

Chamois, Wash, or Oiled Leather.—These classes of leather are named from the fact that formerly they were exclusively produced from the skin of the chamois, but at the present day sheep, calf, and deer skins, and even split thin hides, are manufactured into this kind of leather. I should also state that the employment of this kind of leather has greatly decreased of late years, owing to the general substitution of woollen fabrics in articles of clothing. You will see by the following description that the preparation of this class of leather differs entirely from those previously detailed; the conversion of skins into leather, or from a substance subject to putrefaction to one free from that liability, being no longer effected by tannin, as in the case of hides, and Morocco and Russia leathers, or by the use of mineral salts, as in the case of tawed leathers, but by that of fatty matters, especially animal oils, such as sperm. The skins are prepared in the same manner as for tawed leathers, and then submitted to what is called the prizing operation, which consists in rubbing the hair side of the skin with pumice stone and a blunt tool or knife, until the whole of the rough appearance is removed, and the skin has acquired a uniform thickness. They are then worked on the peg until the great excess of moisture has been wrung out, and plunged into the trough of a fulling mill, to the action of the wooden hammers of which they are subjected until nearly dry. They are then placed on a table and oiled, and several of them, after being rolled together, are replaced in the trough of the fulling mill. When the oil has been thus worked into the substance of the skins, they are removed, exposed to the amosphere, again oiled, and once more subjected to the fulling mill; after which they are placed in a moderately heated room for a day or two, the object of which is twofold, viz., to facilitate the evaporation of the water and the penetration of the oil, and to create a slight fermentation, by which the composition of certain of the organic substances have undergone such modification as to enable them to combine in a permanent manner with the fatty matters. These processes are repeated until the manufacturer deems the leather sufficiently prepared to be fit to undergo the following operations, viz., to be immersed for several hours in a caustic lye bath, to remove the excess of oily matter, washed, and pegged. It is only necessary to stretch the leather on a table, then on a horse, and lastly between rollers, after which it is ready for the market. The ordinary buff colour of these leathers is communicated by dipping them, previously to the finishing processes, into a weak solution of sumac. Before speaking of the further processes necessary to fit these leathers for the glove manufacturer, allow me to have the pleasure of describing that of Mr. C. A. Preller, whose mode of preparing leather is very interesting, owing to the rapidity with which he converts hides into leather, and also the remarkable toughness which his leather possesses. To attain these desirable ends Mr. Preller proceeds as follows:—The hides are washed, slightly limed, unhaired, fleshed, and partially dried; they are then smeared with a mixture made of fatty matters and rye flour, which having been prepared a few days previously has entered into fermentation, a process which has so modified the fatty matters as to render them more susceptible of immediate absorption by the hide. I think that this feature of Mr. Preller's plan deserves the serious notice of all engaged in the manufacture of oiled leathers, as it appears to prove that fatty acids (or modified fatty matters) are better suited for combination with skins than neutral fats. The hides, with additional fatty matters, are then introduced into the large American drums, previously noticed in speaking of currying, and after four days they are removed, washed in an alkaline fluid, worked with a pummel and slicker, and after being dried they are ready for market.

Gloves.—The manufacture of this article is now a most important branch of trade, and is the means of giving employment to large numbers of people in several towns in this country as well as on the Continent. To render the above mentioned oiled leather sufficiently soft and pliable for gloves it is necessary to submit it to the following further operations:—The Chamois, kid, or other skins are rubbed over with a solution composed of 1lb. of soap, dissolved in half a gallon of water, to which is added 1¼lb. of rape seed oil, and 20 yokes of eggs, or what has been recently found to answer better than eggs, a quantity of the brains of animals reduced to pulp. The use of the two latter substances, is extremely interesting in a scientific point of view, for they both contain a peculiar nitrogenated matter called vitalline, and special fatty matters called oleophosphoric and phosphoglyceric acids, which doubtless, by their peculiar composition, communicate to the skins those properties which characterise this class of leather. The skins are then washed and dyed in various colours, after which they are softened, and rubbed with an instrument adapted to slightly raise the surface, and give it that well-known velvetty appearance belonging to glove skins. I shall not take up your time by entering into the details of dyeing these leathers, but describe the following process for bleaching them:—

Bleaching of Skins.—The only process known until recently for imperfectly bleaching chamois and glove skins, was that of submitting them to the influence of the fumes of sulphur in combustion, or sulphurous acid, but latterly two modes of attaining that object have been proposed. The first consists in dipping skins, for two days, in a weak solution of neutral hypochlorite of soda, washing, drying, and rubbing them with soap and and oil. The second mode is to dip glove skins into a solution of permanganate of potash, when they soon assume a brownish colour, due to the liberation of the oxygen of the permanganate of potash, and the fixation of the hydrate of sesquioxide of manganese by the skin. The skins so acted on are washed and then dipped in a solution of sulphurous acid, which becomes converted into sulphuric acid by the action of the oxygen of the sesquioxide of manganese, and the protoxide thus produced unites with the sulphuric acid which is soluble in water. The skins thus bleached when dressed are ready for market.

Gilding of Leather.—The usual mode of ornamenting leather with gold is to apply, in such parts as are desired, a thick solution of albumen, covering those parts with gold leaf, and applying a hot iron, when the albumen is coagulated and fixes the gold. This plan is objectionable when the goods are intended for shipment, and the following method, lately proposed, is far preferable: On the parts required to be gilt, a mixture, composed of five parts of copal and one of mastic, are spread; a gentle heat is applied, and when the resins are melted the gold leaf is spread upon them.

Parchment.—There are two distinct qualities of this valuable material, which has been used from time immemorial as a means of preserving records. The best quality is prepared from young lamb, kid and goat skins, and the second quality from calf, wolf, ass, and sheep skins. To make parchment the following is the process:—The skins are stretched on strong rectangular frames, limed, unhaired, fleshed very carefully, and rubbed with pumice stone, until they have acquired the proper thickness. Then are then dried very carefully in the shade.

Dialysis.—Mr. Thomas Graham, Master of the Mint, has lately drawn the attention of the scientific world to a most remarkable property possessed by organic membranes, of separating when in solution, crystallisable bodies from those which are not so. The former he names crystalloids, and the latter colloids. For instance, if a solution of sugar (crystalloid) is mixed with one of gum (colloid) and placed in the vessel, the bottom of which consists of a septum of animal or vegetable parchment, the crystalloid sugar will pass through the membrane into the surrounding water, whilst the colloid gum will remain in the vessel. Again, if solutions of iodide of potassium and albumen be mixed together, the iodide of potassium will diffuse itself through the membrane, which the albumen will not do. Also if to an alkaline solution of silicate of soda, weak hydrochloric acid be cautiously added, chloride of sodium will be produced and silica will remain in solution, and if such a solution be placed in the dialyser, the chloride of sodium (the crystalloid) will diffuse itself through the membrane, while the silica (the colloid) will remain behind. It is impossible to calculate the immense service which the discovery of these facts by Mr. Graham will render to physiology, toxicology, and to manufactures, as in fact every day new applications of it are being made in these various departments of human research. Thus, to give an example which has special reference to these lectures, I have lately seen it proposed by Mr. A. Whitlaw to place salted meat in large dialysers, when it is stated that the salt only will be removed, leaving all the nutritive properties of the meat undiminished. Mr. Whitlaw also proposes to dialyse the brine in which meat has been salted, and thus to remove the salt, leaving the juice of the meat available for use, while the salt is again in condition to be employed as before.

It will now be my agreeable duty to examine with you a few facts relating to hair and wool. It is interesting to observe that hair, wool, feathers, nails, and claws, may be all considered as prolongations of the epidermis, and present nearly the same chemical composition, as will be seen by the following table:—

	Epidermis of men.	Hide.	Man's nails	Hair.	Quill.	Horse's hoof.	Scale of reptile.
Carbon	50·54	50·89	51·09	50·14	52·43	50·40	53·60
Hydrogen	6·81	6.78	6·12	6·67	7.22	7·00	7.20
Nitrogen	17·22	17 25	16·91	17.94	17·93	16·70	16·30
Oxygen & Sulphur.........	25·63	25·08	25·88	25·25	22 42	25·90	22·90
	100·00	100·00	100·00	100·00	100·00	100 00	100·00

These substances have also this peculiarity, that, notwithstanding their great richness in organic matters they are extremely slow to decompose.

Hair.—The only real point of interest connected with hair appears to me to be the question as to what its various colours are to be ascribed, and I regret that here I can only give conjectures not positive facts. Vauquelin and Fourcroy, who analysed hair most carefully half a century ago, stated that hairs were hollow cylindrical tubes filled with oils of various colours; but Gmelin and others state that the coloration of hair is due to the different proportions of sulphur that they contain.

QUANTITY OF SULPHUR IN HAIR.

Brown	4.98
Black	4.85
Red	5.02
Grey	4.03

Recently Mr. Barreswil has published a paper, in which he states that the coloration of hairs is probably due to the proportion of iron in their composition, and he argues that as iron is the essential element of the colouring matter of blood, it is highly probable that it fulfils the same office with respect to hair. I may state, *en passant*, that great improvements have lately been made in dyeing human hair. Formerly the patient had to undergo most unpleasant treatment, his head being covered with a paste consisting of three parts of lime and one of litharge. An oil cap was then applied and the patient left for twelve hours, when the disagreeable operation of removing the mass and clearing the hair was proceeded with. The black dye communicated to the hair in this process was due to the sulphur of the hair combining with the lead of the litharge, and forming black sulphuret of lead. The present process consists in cleaning the hair thoroughly with a strong alkaline soap, or a little weak alkali, then carefully applying a solution of nitrate of silver, and lastly a solution of monosulphuret of sodium.

Wool differs from hair chiefly by its property of felting, which it owes to its numerous cross lines or serratures, as they are termed; the finer the wool the greater the number of its serratures. Thus, whilst Mr. Goss has found in the finest Saxony wool 2,720 of these serratures, in a single inch in length, he has only found 2,080 in an inch of South Down wool, and 1,850 in Leicester. The wool of sheep can be classed under two heads, that is, into long wool and short wool. Certain classes of sheep will maintain the type or quality of their wool under every circumstance. Such are the original types of South Down, Norfolk, and Dorset, all of which are short wool, and all these sheep feed upon fine and short grass. It has been observed that if they are fed upon coarse grass, their wool will also become coarse. This is also true with Welsh, Scotch, and even Spanish merinos. A further proof that this view appears correct is, that the long-wool sheep, such as those of Leicester, Lincoln and Kent, feed in valleys where grass is long and coarse. In all cases the size of the animal appears also to correspond with their class of food. Another curious fact is the facility with which one type of sheep will merge into another if they change food and climate. Thus many attempts have been made to introduce into France our Leicester breed, the wool of which is so remarkable for its fineness, length, and silvery appearance. Still, after four or five years' residence there, the wool has lost its most valuable qualities. In fact the sheep are no more the Leicester breed. The coarse wool of sheep, however, such as those of Devonshire, does not appear to be so rapidly influenced by any change of climate which the animal may undergo. The aptitude which various kinds of wool have for dyes is also interesting. Thus, the wool of one kind of sheep will not dye with the same facility as that of another; and wool dyes much more uniformly, if the animal has been washed before shearing, than when the washing is performed upon the wool afterwards. Lastly, the wool removed by the liming process before described, will be far inferior in dyeing properties to wool taken from the same kind of animal during life. It may be interesting to some present to know the best method of removing these irregularities. I was engaged during my apprenticeship at the Gobelins in investigating this matter, and I found that the best plan was to steep the wool for 24 hours in lime water, and then to pass it through weak hydrochloric acid. Wool, as it leaves the animal, is not fit for either dyeing or spinning. Thus when wool is washed with water it yields a large quantity and variety of substances, which in France bear the name of *suint*. The most interesting fact connected with this is, that the 15 per cent. yielded by wool does not contain, as shewn by M. Chevreuil, any salts of soda, but a large quantity of salts of potash, the greatest part of which is combined with an acid called sudoric; and what increases the interest of this fact is that Messrs. Maumené and Rogelet displayed at the last exhibition salts of potash which they had obtained commercially from this new source. In fact they have established in several of the large manufacturing centres of France, where considerable quantities of wool are used, factories for the extraction of salts of potash from the *suint*, and they supplied the jury with the following particulars:—That a fleece of wool weighing 8 lbs., yielded on the average about 1¼ lb. of dry suint, or sudorate of potash, and this would further yield about seven ounces of pure potash. If it is now considered that there is annually twenty million pounds of wool washed in Rheim, thirty millions at Elbeuf, and four millions at Fourmies, it would appear from this quantity that if it were all subjected to Messrs. Maumené and Rogelet's treatment, about 2¼ million pounds of pure potash might be recoverable. (For further details on this point see Dr. Hofmann's Report on Chemical Products and Processes in the last Exhibition). Wool which has been simply washed, as above described, is not sufficiently free from extraneous matters to be fit for application in manufactures. It is necessary that it should be scoured, for which purpose, on the continent, it is allowed to remain for some time in putrid urine, or weak ammoniacal liquor, but in this country it is placed in strong alkaline of soap or soft soap, passed through rollers to press out the excess of soap, together with the impurities which it removes, well washed, and dried. In these operations wool loses in weight above 50 per cent. when of good quality, and above 30 per cent. when inferior. But even then the wool still retains a certain amount of fatty matters, which it yields in hot alcohol.

The following table, published by M. Chevreul, will give you an idea of the composition of wool (dried at 212°):—

Earthy matters	27·40
Organic and inorganic salts, soluble in water [*suint*]	32.74
Fatty matters	8·37
Wool	31·49
	100,00

Elementary composition, C. 50 66, H. 7·03, N. 17·74, O. 22.32, S. 2·25.

Before proceeding further, I should like to call your attention to the curious fact that the fatty matters of wool are completely different from the fatty matters of the animal itself; thus, whilst the ordinary suet will be saponified by an alkali, the fat of the wool will not undergo that change, the stearine and elearine being only converted into an emulsion. From experiments I have made I am able to state, that the common opinion that the differences in quality observed in various wools are owing to their fatty matters is erroneous, as the pure wool obtained as above yielded to the dyer colours as brilliant as those presented by wools in which a part of the fatty matter still remained. Another important fact connected with the composition of wool is the quantity of sulphur it contains, which does not appear to be part of the fibre, as the matter containing it can be removed by a weak alkali without destroying the fibrous appearance of the wool, although its tenacity is greatly impaired, and its power of taking dye considerably diminished. Another remarkable fact is that when wool is bleached by sulphurous acid [the only agent known which will effect that purpose], it becomes incapable of taking many colours, especially the new and brilliant coal tar dyes. The long-disputed question amongst chemists—How sulphurous acid operates so as to bleach wool?—has lately been solved by Messrs. Leuchs and Weber, who have proved that sulphurous acid unites with the colouring matter of wool, forming a colourless compound, in proof of which it appears that if the wool is placed in boiling water this colourless compound is dissolved, and the wool regains its susceptibility to dyes, though it is slightly discoloured. A slight amount of alkali added to the boiling water greatly facilitates the removal of this artificial sulphuretted compound. In a paper lately published by Mr. Grothe, he states that 100 parts of wool fix on an average 0·67 of sulphur, or 1·31 of sulphurous acid to bleach it, and practically 100 parts of wool require about five parts of sulphur to be burnt to produce the result. I should also state that wool must always be wet before being submitted to the fumes of sulphur, and it is always advantageous to pass it previously through a soap lye or weak alkali. Wool so bleached should always be well washed in cold water, to remove the excess of sulphurous acid, which otherwise, if the wool were subsequently exposed to moisture, might be converted into sulphuric acid and destroy the fibre of the wool. It may be interesting to ladies to know the process used by a French scourer, named Jolly, to restore Cashmere shawls discoloured by time. It consists in dipping them into a solution of sulphurous acid, which bleaches the wool but does not affect the fast colours with which the fibres composing the patterns of the shawls are dyed. The shawls then only require to be washed and pressed to be restored to their origiual beauty. There is no doubt in my mind that a solution of sulphurous acid might be substituted for the gas in bleaching wool with advantage and economy, owing to the sulphureus acid being in a more condensed form, and in better condition for effecting the bleaching process. A few years ago I took advantage of the fact that wool contains sulphur to produce upon it an artificial lustre. The woollen goods were passed through a weak boiling solution of acetate of lead, washed carefully in pure water, and submitted to the action of high-pressure steam, when the lead combined with the sulphur of the wool, producing galena, which gave the wool a lustre. The action was regulated by generating, under the influence of steam, nascent sulphuretted hydrogen from a polysulphuret of sodium, which facilitated the object in view. Wool is generally dyed either in the fleece, after undergoing the processes of washing and scouring, or it is first spun into yarn or worsted. To describe all the various methods of dyeing wool would far exceed the limits of this lecture. The operations of spinning wool into yarn or worsted are purely mechanical, and it is not therefore within my province to describe them. The same remark applies also to the manufacture of felt and shoddy, now so extensively carried on in Yorkshire, and I shall therefore merely refer to one or two points having reference to chemistry, such for instance as the working up of the wool or the cotton in worn-out fabrics. To recover the wool from such fabrics the process is most simple, consisting merely in immersing them in diluted muriatic acid, and drying them at a temperature of about 220°, by which means the cotton is completely destroyed, the wool remaining unaffected. The material is then submitted to the action of a "devil," which separates and blows away the cotton, leaving the wool ready for being worked up. To remove the vegetable fibre with the view of applying it to the purposes for which it is adapted, as the paper manufacture for instance, the following process has been devised by Mr. F. O. Ward and Captain Wynants. The mixed fabric is submitted to high pressure steam [60 to 80 lbs. to the square inch], and under the influence of this high and moist temperature the vegetable fibre remains unchanged, whilst the animal one is so disorganized that when the rags are removed from the receptacle and dried, and submitted to the action of a beating machine, the cotton fibre remains intact, whilst the animal matter falls to the bottom of the machine in the form of a dark-coloured powder mixed with small lumps of the same substance; this residue has been advantageously applied as a manure, by these gentlemen, under the name of "ulmate of ammonia." I am happy to state that chemical science has discovered several means of distinguishing cotton from wool when employed in the same fabric, and even of determining their respective weights in the same; but the aid of the magnifying powers of the microscope is often required in investigating the mixtures of wool with flax, cotton, jute, &c., which are now so extensively and so ingeniously spun together. The description of these processes, however, would involve so much technicality, and require so much time, that I must not trouble you with their details. The same remarks apply to the means for distinguishing the materials used in mixed fabrics of silk and cotton, or silk, wool, and cotton.

Silk.—This material has always been highly esteemed, owing to its remarkable durability, and to the beauty of the fabrics produced from it. Thus the Chinese have used silk from time immemorial, and the Romans held it in such high estimation that, in the time of the Cæsars, silk was worth its weight in gold. The most interesting fact for us is the date of the introduction of the silkworm into Europe. It is related that in A. D. 555 two monks, returning from the East, concealed some silkworms' eggs in their staves, and having succeeded in rearing the worms, their culture soon spread through Greece and Turkey, and gradually found its way into Italy towards the twelfth century. The silk in use at the present day is chiefly derived from the *Bombyx mori*, but the extensive disease which has during the last eight or ten years destroyed very large numbers of the worms has given rise to great efforts to introduce some new species, two of which, the *Bombyx mylitta*, feeding on the *Palma Christi*, or castor oil tree, and the *Bombyx ailanthi*, feeding on the plant from which it is named, have been to some extent successful. The material forming the silk is secreted in two glands placed on the side of the animal's body, whence it passes into an organ called the spinaret, on each side of which are two other glands, which secrete a gummy substance, and this uniting with the former forms the silk fibre. Permit me to add here a fact which I think will interest you, viz., the extraordinary weight of silk which a small weight of eggs will yield. Thus, four ounces of eggs will yield 87,900 to 117,000 cocoons, and as on an average a pound of silk requires 270 cocoons, the four ounces of eggs will give 422 lbs. of silk, or 100 lbs. of cocoons yield generally 8 lbs. or about 14 per cent. of silk. The production of silk fibre from cocoons is extremely simple. It is effected by placing the cocoons in boiling water, which softens or dissolves the gummy matter which binds the fibres together, and the end of the fibre being detached and placed on a reel, is easily wound. This is the state in which it is usually imported into this country under the name of raw silk. When two or more of these fibres are slightly twisted together they form what is called tram or weft, and when two of the threads are twisted in opposite directions and laid together they form organzine or warp. To render this substance susceptible of dyeing, it is necessary to remove the gum by an operation called boiling off, which consists simply in boiling the silk for some time in a soap lye, and washing and wringing it well afterwards, in which operation it loses about 21 per cent. The following table will shew the chemical composition of silk:—

Gelatine	19·08	Commercial yield 79 per cent. of silk.
Albumen	25·47	
Wax and fatty substances	1·45	
Silk fibre.........	54·00	
	100·00	

FIBROINE.

Carbon, 48·53; hydrogen, 6·50; nitrogen, 17·35; oxygen and sulphur, 27·62.

Conditioning Silk.—This expression implies the ascertaining of the real commercial value of silk, or, in other words, its condition, and the necessity of this has been so fully admitted that a conditioning house has existed for forty or fifty years in Lyons, and its advantages have been so fully appreciated that similar establishments have arisen and are well supported in every town on the continent, where dealings in silk to any amount take place. I may mention, as an instance of the universal adoption of the practice, that even in Crefeld the finest building in the town is the conditioning house. The result is that on the continent the intervention of the conditioning house between buyer and seller has become quite a matter of course, with the happy result of abolishing a class of dishonourable dealing, which is eating like a canker into the silk trade of Great Britain. I cannot understand why the attempts made to introduce this admirable system into our country have hitherto met with so little success, and can only infer that there is an unsoundness in the trade, which places many of the silk manufacturers to a great extent under the control of wealthy merchants, who, it appears, are the chief opponents of conditioning. Otherwise one would suppose that its advantages to all engaged in working up this valuable product are too obvious to require demonstration, for, taking the most moderate view of the matter, the average gain to the manufacture by conditioning will be not less than five per cent., and this loss [if he does not condition] cannot be recovered in any subsequent state, so that his foreign competitor has in this respect alone an advantage over him of at least five per cent. Allow me to conclude this lecture by stating in a few words how conditioning is carried on. Silk being an exceedingly hygrometric substance—its moisture varying constantly with the amount of humidity and the temperature of the atmosphere—the first operation is to ascertain the total amount of water it contains, for which purpose samples, carefully selected from the bale when its reaches the conditioning house, are weighed in delicate scales, dried in hot-air stoves, and re-weighed, the excess of moisture [beyond the 10 per cent. admitted to be the average normal quantity] being then easily calculated. The second operation carried out in the conditioning house is that of boiling off the samples dried as above, and again drying and reweighing, to ascertain the quantity of soap, oil, sugar, acetate of lead, &c., added to give weight, and the result of this operation is to shew a loss of 30, 35, and even 40 per cent., instead of about 21 per cent., which is the average amount of natural gum.

WARMING AND VENTILATION.

Atmospheric Air.

A Pure atmosphere, whether within or without our habitations, we take to be one of the first requisities to the preservation of health and comfort. Therefore most intimately connected with our subject is the air which we breathe, which was one of the elements of the ancient philosophers, which is an absolute essential to the existence of all animated beings, and which encompasses our globe to a height of about forty miles.

Although several of the mechanical properties of the atmosphere was discovered by Galileo, and by Torricelli about the middle of the seventeenth century, its composition was not accurately determined till 1774, when Dr. Priestley first discovered oxygen gas, which he proved to be one of its constituents. He considered this gas as the pure elementary principle of the ancients. Shortly afterwards azotic gas was discovered, and the difference between its properties and those of the other were at once apparent. In oxygen gas, bodies burn more rapidly, with more remarkable splendour, and with the development of a far greater amount of heat, than they do in common air; while in azotic gas they cannot be made to burn at all. In a given quantity of oxygen, animals respire without inconvenience, and live much longer in it, than they do in the same volume of common air; whilst in azotic gas, animals are immediately deprived of existence; when immersed in it, they die of suffocation, precisely as they do when suddenly plunged into water.

Whilst the air was being experimented on in Britain, other philosophers on the European continent were pursuing similar analyses. Thus Scheele, the Swedish chemist, without the knowledge of what had been done in this country, made corresponding results from his experiments, and Lavoisier in France drew similar conclusions. Air in the opinion of these experimentalists, consists essentially of a mixture of oxygen and azote; and the relative volumes of each, according to their conclusions, consists of the following formula:

Oxygen........................	27 volumes
Azote...........................	73 „
	100 „

Since the time of these philosophers however, it has been discovered that they were both wrong in their deductions. In 1782, Mr. Cavendish by a careful analysis of the atmosphere, made in the neighbourhood of London, extended over a whole year, ascertained that the volume of oxygen in atmospherical air, is much smaller than was supposed by both Scheele and Lavoisier. His results were:—

Oxygen...................	20·82 volumes
Azote......................	79·18 „
	100·00

and he found that these proportions never varied throughout the year, although his analysis was made in all seasons and at various periods of the day. Notwithstanding that these experiments were published in *The Philosophical Transactions* of the following year, they seem to have attracted little or no notice, for the determinations of the Swedish and the French chemists, continued to hold their ground in the eye of the philosophical world. At length, in 1802, Berthollet announced that he had frequently experimented upon the air in Egypt, by using a stick of phosphorous to absorb its oxygen and had invariably found it to consist of the following compound:—

Oxygen........................	21 volumes
Azote...........................	79 „
	100 „

This, then, was pretty confirmative of what Mr. Cavendish had discovered about twenty years before, and led to other analyses of the atmosphere in different parts of the globe. Mr. Brande says that these proportions are probably not liable to any appreciable change, dependant on season, mild weather, situation, or height from the surface. "Berthollet," he continues, "found 21 per cent. of oxygen in Cairo and in Paris; Saussure the same in Geneva; De Martyr in Catalonia, and in all winds, weathers, seasons, and states of the barometer. In wet and dry, in inhabited and uninhabited places." Sir Humphrey Davy found the same in Bristol, and in other parts of England and upon the coast; also in air brought from the coast of Guinea. Brande found the same in air from Behring's Straits, and from Otaheite, places very far apart from each other. Berger in the mountains of the Jura as well as in the valleys of Savoy; Configliachi, on the Simplon and Mont Cenis; Gay Lussac and Humboldt in Paris in all seasons and weathers; and Dalton and Selden in England. Air collected at the back of the upper gallery of Covent Garden Theatre, consumed by fire within these few years, gave on a full night, 20 oxygen, and rendered lime water more than usually turpid.

Besides these gases, however, atmospheric air contains a small quantity of carbonic acid gas. To whom the merit of this discovery belongs, we believe is not known, but it was easy to be inferred, after the cause of the difference between mild alkali and caustic was ascertained. Mr. Dalton was the first to reduce the quantity of 1 per cent. supposed to exist, and Thenard again reduced his quantity to about one half. But by far the most complete set of experiments on the volume of carbonic acid gas in the atmosphere, says a writer in an elaborate article in the new series of the *Encyclopedia Brittanica*, was made by M. Saussure. He abstracted the carbonic acid from given volumes of air by means of barytes in muriatic acid, and throwing down the barytes in the state of sulphate from the solution, the sulphate of barytes ignited and weighed, readily supplied the weight of carbonic acid; and this weight, together with the known specific gravity of carbonic acid gas, furnished the data for determining its volume.

Although carbonic acid gas is more variable in relative proportion to the other gases composing the atmosphere, yet is it found in air brought from the most elevated and purest regions. Both Saussure and Beauvais found it on the top of Mont Blanc, and in the same proportion in the streets of Paris. The former found, it varied with the seasons, and it is believed to be affected by the influence of the vegetable kingdom. At sea it has, sometimes, not been discoverable. In low situations, wind has a tendency to increase its quantity, which is accounted for by the commingling of the atmosphere of the mountains with that of the valleys; the difference however, is so small, that it is only by making a long series of observations, that it becomes perceptible. Over plains there is usually a greater quantity to be found during the night, than during the day; and the difference is not nearly so great in winter as in summer. As vegetables have the property of absorbing this gas and applying it to the purposes of their nutrition and growth, this is, no doubt, the reason why, in the superior strata, it exists more abundantly than at the surface of the earth. The immense quantity which is thrown into the atmosphere by the breathing of animals as well as by the combustion of fuel, must find absorption somewhere, and doubtless, the Supreme Being, considering this, in the grand scheme of Creation, has made the forests, the fields and the flowers, its great receptacle. In the flora of some parts of the globe, there are certain kinds of plants denominated *air-plants*, which grow and flourish without a root penetrating the earth. How is it that these have received their name? Simply from the fact of their having been supposed to be nourished exclusively by the atmosphere, whence they derive their nourishment. We are aware that they are usually found in places where they are brought into contact with, at least, microscopic particles of vegetable matter, and that they *may* receive their nourishment from the jucies of the trees and other plants upon which many of them hang to adorn; but we are also aware that some of the bromeliaceous species will live for months together suspended free in the air clinging to a stone balcony, or hanging to a bar of iron.

Besides the various gases we have enumerated, as constituents of the atmosphere, there is a fourth element, which is the most variable of them all. This is the vapour of water, from which it is never altogether free, and the proportion of which, arising from causes which cannot be fully explained, is continually altering. In our climate in summer, and in warm weather, it is more plentiful with a south and west wind, than it is in winter and cold weather, and with an east and a north. It usually fluctuates between 1 and 1·5 per cent.

Thus the atmosphere, so far as analysis has yet been able to carry its operations, is composed of, at least, four different elastic fluids. These comprise three different gases with aqueous vapour. There can be no doubt that many other gaseous bodies, and many vapours, exist in it also, but in too small quantities to be discovered by the most delicate tests that we have it in our power to apply. These different elastic fluids are mixed equally together, and though there be a considerable difference in the specific gravities, that difference has no tendency to cause them to separate. The reason of this equable mixture was first pointed out by Dalton. It depends upon a principle not yet generally recognised, but of the existence of which recent observations leave little doubt. This principle is, that the particles of elastic fluids are not mutually elastic to each other. The particles of oxygen repel the particles of oxygen, and the particles of azotic gas repel the particles of azotic gas; but a particle of oxygen does not repel a particle of azotic gas. Hence, when a gas issues from an orifice into a space filled by another gas, it rushes precisely as if it were flowing into a vacumn."

Thus, then, without any relation to whatever other vapours may exist in the atmosphere, its average ordinary constitution may be stated as follows:

Oxygen..................	21·00	volumes
Azote....................	77·50	,,
Carbonic acid...........	0·08	,,
Aqueous vapour.........	1·42	,,
	100.00	

These, then, are the elements of which the air is composed, and which in the language of Ray, *On the Creation*, "serve us and all animals to breathe in; containing the fuel of that vital flame we speak of, without which it would speedily languish and go out; so necessary it is for us, and other land animals, that without the use of it one could live but very few minutes."

Ventilation.

What has been termed *natural ventilation*, may be considered as the suggestive cause of *artificial ventilation*. It is a law in physics, that the immediate effect of the application of heat to any atmospherical region, is to produce an ascending movement on the upper mass, and to relieve the barometrical pressure which is bearing upon the under. The cooler surrounding region, however, not being so relieved, but, on the contrary, its weight rather increased by the additional current passing over it, is forced in by the different hydrostatic pressures, which are thus brought to bear upon it, and which is the cause of the origin of two distinct winds. Each of these, of course, takes an opposite direction; the one setting *outward*, from the warmer region above, and the other setting *inward*, from the cooler below. Should the heated region be circumscribed in its limits, these winds will move from and towards it as a centre; but if it consists of a lineal tract, or a whole zone of the globe, such as the generally heated intertropical regions, they will become two horizontal streams, flowing inwards on both sides, below, where they will unite. They will then take a vertical course upwards, along the medial line, where, having themselves, in their turn, become heated, they will assume a reversed movement, and stream *outwards*, just as the other currents had done before them. Here, then, is the beautiful law of *natural* ventilation, arising simply from the effects of heat and cold, producing certain degrees of expansion and contraction upon the atmosphere.

The application of any natural law to the improvement of the physical condition of our own species is one of the first duties of the practical philosopher. Accordingly, this law has been recognized, adopted, and applied to the purpose of artificial ventilation, upon which, in fact, every theory upon this subject has been, or ought to have been based. Thus, then, we see it carried out in a vast number of phenomena of which, probably, because they are continually before our eyes, we take little or no heed. We witness it daily in the fire which is lighted in a stove surmounted by a chimney in which the air expands the moment it becomes heated by the combustion of the fire. In such an instance it becomes lighter, bulk for bulk, than the outward atmosphere, and consequently ascends, then escaping at the top, diffuses itself through the new atmosphere into which it has just entered. "This," says the Reverend Dionysius Lardner, "produces what is called a *draught* in the chimney, which means nothing more than the upward current of air produced by this ascent of the heated air confined in the flue. When a stove, &c., becomes cold, and when the fire is lighted, it fails to heat the air in the flue, with sufficient rapidity to produce a current necessary for the draught." With this fact, of course, all are perfectly familiar, and all are, also familiar with the smoke with which they are frequently assailed and half-blinded and choked, when it rebels against the flue and rushes back into the room. To remedy this evil is one of the many objects to which modern ventilators have directed their attention; but to those who have not the means of becoming tenants of such dwellings as are favoured with all the modern improvements of the fire-side, there can be no harm in stating that the draught is frequently quickened by holding burning fuel, for some time, a little up the chimney before putting it into the grate.

By the law which we have already described, it is manifest that nature herself, is constantly keeping up a system of fresh atmospherical supplies, so to speak, in all parts of the globe. She is continually making efforts to purify herself, so that she may present *us*, and all animal creation, with whatever is bright, beautiful and necessary; attractive or repulsive as *our* ever-varying sensations may be impressed by the objects which she has placed within the perception of our sensorial powers, and the reach of our understandings. This, at least, is the light in which we view her operations. Generally speaking, however, in so far as the writer's experience goes, and it has been somewhat wide, both at home and abroad, this is not the aspect in which the scope of her designs is regarded, as exemplary for imitation of mankind. In our larger towns and cities, whatever efforts may have been, and are being made, by thoughtful philanthropists to improve their sanitary conditions, the efforts have been, and are, to a great extent, marred, or entirely neutralized, by the inveterate habits of vast numbers of the inhabitants themselves. Whether it be through ignorance, or from being to the manner born, or from an hereditary depravity of disposition, it is difficult to determine; but the writer has known some, and witnessed housands of men of high mercantile intelligence, possessed of sound understanding, considerable learning, and shrewd common sense, creating an atmosphere for themselves, and practically contradicting all the intentions and laws which Nature would seem to have designed for their sublunary enjoyment. We do not which to "speak it profanely," as Hamlet says, but we have known them to "nightly congregate', and sit for hours in an atmosphere compounded of the fumes of tobacco, gin, wine, brandy, and beer' superadded to all the usual steaming comestibles of a common symposium. This is not written satirically, for the writer himself has occasionally done it; but it is evident that such an atmosphere, when persisting to respire in it nocturnally, must, more or less, be operating perniciously upon the constitution. It has always done so on his, and, without egotism, *his* is not of the weakest mould. The ventilation of the rooms in which these meetings take place, too, are generally—may it not be said almost invariably?—bad; but this is the very last consideration which enters the minds of those who are their habitual frequenters. In such places, atmospherical purity is never thought of, until the air becomes so completely saturated or loaded with pestilential vapours and mephitic gases, that it is, to some, no longer endurable. These, of course, through an involuntary necessity must retire; but others, who, like Mithridates, have become accustomed to their poison, will sit to the last, and never dream of the deleterious effects it has upon them, until they are brought to a conviction of it, by the force of some fatal calamity overtaking them, at a much earlier date than they had ever anticipated. It is from the very antipodes of a desire to promote intemperance, when it is remarked, that the tavern rooms of this country, whilst existing in the multitudinous excess in which they do, should be made as comfortable as possible, and should be ventilated on the most approved principles, in order that those who frequent them may, at least, have the means of breathing, perhaps even then an atmosphere a little less thick than the opaque smoke of a newly fired furnace. It should be recollected, that individuals, however cleanly in their habits, effuse, either from their breaths or their bodies, a greater or a less degree of impurity. This remark may be very humiliating, nay, even offensive, to the immaculate *self*-worshippers of this age, but it is nevertheless true. For example, some exhale almost exclusively by their lungs, while in others, the pulmonary exhalation of moisture is comparatively small to that which is effused from the body. When this is the case with the most pure and beautiful; the most spotless, innocent and engaging Eves of the creation, who use the bath daily, who live in the most strict accordance with such laws as will preserve their loveliness as long as they possibly can, how must it be with those *objects of compassionated filth*, who live in every way entirely opposite? This fact should never be allowed to depart from the mind, namely, that the air acts unceasingly, not only on the blood as it passes through the lungs, but also on the surface of the body; and disease and death may arise from an unwholesome atmosphere in contact with the skin, even when the lungs are supplied with pure air.

Considering these things, it must be remarked that it is, perhaps, impossible to adapt a proper degree of ventilation to meet every individual case, as well as to form an accord with the condition of the external air. It must be remembered, that the subject upon which we are treating is one of wide extent, embracing many particulars of a most important kind. It takes within its grasp, the climate in which we live, the tenements which we occupy, the pursuits which we follow, the infinite variety of modes which we adopt, for protection from the vicissitudes of the seasons, and, among other matters, the minute shades in the peculiarities of idiosyncracy with which we are collectively endowed. A science so extensive, and comprehending so much, must, necessarily, be still far from perfect; but in so far as it has advanced, it has been the cause of awakening in the minds of many public men a depth of sympathy which has induced them to seek out the causes of the disease and death which have, from time to time, marked local districts in some of our larger towns and cities. They have looked beyond the mere surface of physical existences, and nobly bestirred themselves, at least, to ameliorate, if they can do nothing more, those conditions whence, it has become evident to them, the evil has had its source. They find, that ignorance of the primary laws of ventilation is among the greatest, and, accordingly, have set themselves about enlightening the public, on this subject, by every means in their power. To a large extent, they have succeeded, but there is still an immeasurable field lying fallow, exhibiting the pale red or the pale yellow shades of colour, which suffuses the faded cheek and unmistakeably intimates the existence of that unseen, but not unfelt, malaria which slowly robs the people of their strength, and finally destroys their vitality. These spectral forms, though really living, are literally dead. They exist and breathe, but their animation is gone—wrested from them by FOUL AIR, which, like ALCOHOL, is one of the greatest and most insidious destroyers of our species.

Returning to the subject of natural ventilation, it is to be observed, that the principal currents to which we have alluded, are subjected to an almost endless variety of modifications. Thus they are influenced by the attraction of the sun and moon, the rotation of the earth, the relative effect of land and water, the continually changing influence of local temperatures, the force of volcanic operations, the evaporation and deposition of moisture, the electric state of both air and earth, and the countless changes which accompany chemical action in the mineral kingdom, as well as those which happen in the organic world. The animal and vegetable kingdoms, says Dr. Reid, not only contribute to the movement of the air, but, are the great causes of the most important changes included in it, and the means of preserving the unity of its composition. The animal kingdom consumes its oxygen and produces carbonic acid, while in the vegetable kingdom, the great tendency is to absorb carbonic acid and replace oxygen. But whenever these great movements are interrupted by local causes, or an undue accumulation of vegetable and animal debris takes place, there the right balance is not sustained. Pestilential effluvia contaminate the air; and were it not for the wind, the rain, and the impetuous storms which from time to time, visit such localities, and the operation of a peculiar diffusive power in consequence of which no gas can accumulate permanently to the exclusion of other gases on the surface of the earth, whatever may be its specific gravity, they would at last become as fatal as the Valley of Death in Java, or the carbonic springs in Bavaria, in the Grotto Del Lano, in Italy, and other places notorious for their destructive atmospheres.

To natural ventilation, then, too much care and circumspection cannot be exercised in selecting a site for the erection of any sort of building whatever destined for habitation, or even for visitation, as an object of general curiosity. If for habitation, a dry gravelly soil, a southern aspect, an elevation to secure a free drainage, and an uninterrupted access of air, with suitable protection from the changes and chances of season, are essential. It should be remote from every kind of local impurity and should command as an agreeable view as the selected spot of ground will admit. All that has a tendency to raise the spirits, exalt the soul, and impress the whole mind with the benificence of the Creator, should, if possible be associated with it. In such a situation, health, without which life is hardly worth having, would then be secured almost to a certainty, and with means sufficient at command to procure the ordinary comforts of life, happiness, as far as it can here be obtained, would surely be in the possession of any rational creature who has an eye to see, a heart to feel, and a soul to venerate and adore.

* * * * * * *

In all ventilation, the primary object is the removal of vitiated so as to give room for the introduction of sweet or fresh air in an imperceptible stream. Investigating the principles of this subject, however, there have been brought to light a number of facts which are not only curious in themselves, but of considerable interest and value to every inquiring mind. For example, in advocating a downward current for the purposes of ventilation, experiment has proved that the exhalations from the human body, especially carbonic acid in excess falls to the ground under ordinary conditions. To prove this, on going to bed, take some fresh lime water and place it in a basin on the floor in your bed room. In the morning the surface of the water will be covered with a slight pellicle, thereby discovering the formation of carbonate of lime. Sometimes the water will have a milky appearance; but this depends pretty much upon the stillness of the atmosphere. This is one mode of showing the downward direction which carbonic acid takes under ordinary circumrtances. But, it has been further ascertained, that it lies in levels or strata like so many separate and invisible sheets at different altitudes in the atmosphere. On the floor, the effect of the acid will be distinctly seen on the surface of the water. If placed midway between the floor and the ceiling, it will be but slightly visible, and if placed near to the ceiling it will not be visible at all. Thus the falling tendency of carbonic is not visionary, but real; it is a fact which this simple experiment proves, and which every one has the power and means within his reach of establishing. In making the experiment, however, care must be taken to prevent all currents, and the fire-place should be enclosed in order that there may be no disturbing influences acting upon the atmosphere.

Sebacic acid, or the acid which is derived from fat, also falls as it is exhaled. Under ordinary circumstances, this fact may also be detected by experiment; but let us ask ourselves by what power is it that a dog *scents* out his master, and will trace him for miles up and down a country in which he himself has never been before? The answer is, by the effluvium from the sebacid glands. This faculty of perception in the dog is a natural, and not a supernatural, power. The effluvium given off by his master falls to a low level, and the dog distinguishes it from that exhaled by any other persons. We are all aware that in hunting, the scent often lies floating over a low line, and the dogs will run with their heads above ground. Then the cry of the hunter is "heads up and tails down." This property of detecting falling exhalations shows in the dog the possession of a far greater superiority in the sense of smell than that with which man is endowed.

Besides these acids, there are other emanations to be considered as being evolved from the human person; but carbonic acid exhaled from the lungs will not fall in a disturbed atmosphere. This, therefore, must be perfectly still to admit of this condition. From this circumstance it would appear that the downward system of ventilation as applied to crowded rooms or halls would be most favourable for the escape of carbonic and sebacic formations, these being naturally heavier, and having a consequent tendency to escape by any aperture from below. But the condition is perfect stillness, one not easily obtained. Blood heat is 98°, and breath when it leaves the lungs is about 92°. At six inches from the mouth its temperature is reduced to 74°; at a foot it is very nearly down to 60°; and in cold weather from 64° to 65°, when the atmosphere is at its mean temperature. Now, the actual weight of the carbonic acid in the breath is about one and a half times heavier than the atmosphere, and this certainly gives it a tendency to fall; there are, however, conditions which counteract this tendency, and these are, unfortunately for the downward theory, much more common than those which are favourable to it. Wherever the air which we are to breathe in a hall or apartment is to come from, its purity cannot be too particularly considered. Dr. Reid says that an elevation of five, ten, or twenty feet often gives a much better atmosphere than can be obtained from a lower level. "In all lofty buildings," he says, "fresh air may be supplied, when requisite, from above, and where local circumstances render it desirable, air is sometimes advantageously introduced by turrets from an altitude of one, two or three hundred feet. When air is pure and dry, cool vaults are available, they are invaluable in cooling it in hot weather. In large towns, such as London and Manchester, where local impurities abound, and particularly where fog and frost are observed at the same time, special means may be adopted for removing those that are most offensive. Filters have been constructed for air on the same principle as for water. Few of the more simple arrangements of this kind that have been sustained for any length of time have been found more serviceable than filtration through any porous texture to exclude suspended blacks (soot). Washing the air also, has in some cases been tried by moistening the filter with a stream of water. Lime-water is preferred, where sulphurious acid, carbonic acid, hydrochloric, or hydrosulphuric are present from manufacturing operations in any notable proportions. Perforated zinc or porous gauze, steeped previously in a solution of hydrochlorate of zinc, have been used largely for the filtration of air."

Whatever may be the situation of the building in which we are, however, the more sudden, violent or frequent the changes in the atmosphere, the wider extended must be the scope of the provisions made for the obtainment of a proper ventilation. On this account all the resources of windows and doors whatever these may be, must in every climate of extreme temperatures, still be inadequate for the purpose of efficiently admitting of the escape of vitiated air. They cannot at all seasons operate as warmers of cold and coolers of hot air, therefore other arrangements should be made to assist these in the certain removal of a bad atmosphere. Without this no systematic species of ventilation can be practically brought into operation. In every case, and to suit the peculiarities of every temperament, it would be an utter impossibility to suggest a perfect form of ventilation without, perhaps, every person agreed to live alone, and never to enter an apartment where half a dozen people had met together. Then some *genius* of a daring energy and originality might attempt something of the kind; but even he, we fear, would fail in accomplishing a feat so various and so vast. Much may be done, however, by the adoption of simple means in making due provision for the necessities of individual dwellings in which the ventilation has been found defective. With a view to this there are certain principles which may, with considerable success, be easily carried out. For example, the first that suggest itself is the necessity of having the means of breaking the impulse of a cold, raw atmosphere, and causing it to diffuse itself throughout the apartment, instead of permitting it to come in, in a well-defined stream. Where it is made to spread over a large space before it comes in contact with the person, there is not the same degree of danger of being affected by it as there is in the other. Equalizing as far as possible, the admission of air, is a great point. In fact, this is so necessary to comfort, that no habitation can be agreeable without it. The air, therefore, should be divided into innumerable small streams, so that none of them may be felt individually, but every one bear with its due proportion upon the person. A writer upon this subject observes, that air ought always to be admitted in this manner, or at such a distance from those on whom it is to act, that its impulse may be greatly moderated before it reaches them. "Wherever a proper supply of air is admitted," says Dr. Reid, "this equalization is essential, more particularly in crowded apartments; and the greater the degree to which it is carried, the more perfect and clear is the result. Nothing is more common than to see apartments ventilated effectually, so far as may be necessary for the removal of foul air, but with a movement that induces a most offensive series of chilling draughts, if means be not taken to warm the supply of air given, and for introducing an effective equalization. In rooms for invalids this subject becomes of great consequence, especially in diseases of the chest. To a great number, unequal currents are as dangerous and offensive as an oppressive atmosphere."

Of all the sources of atmospheric movement, however, a change of the specific gravity of the air, depending on an alteration of temperature, caused by respiration and the general heat of the body, is under all ordinary circumstances, the most favourable source of movement. In common apartments, where there are no other means of facilitating ventilation beyond a couple of openings, these placed at different levels will always give much relief. In such a case, the one usually admits the cold, whilst the other, which should be as high as possible, gives free egression to the hot or vitiated air. Where there is but one opening or aperture in an apartment, it also should be placed as near to the ceiling as possible, as it had to perform the twofold purpose of admitting the cold, whilst allowing the heated air to escape.

The conditions which present the most perfect system of ventilation in Dr. Ried's view, are where a crowded room is freshly aired on every side, with the most gentle movement at a proper temperature, so that the impetus of the atmosphere is not felt; the vitiated air escaping in a central stream, and all products from artificial lights carried away by the same current. In such an instance, he presumes that double glazing is introduced to prevent down-draughts from ice cold glass. "In public buildings where long sittings are held, under every variety of circumstances, in different seasons, with ever-varying numbers, by day and by night, and amidst endless changes of the atmosphere, it is impossible to regulate the ventilation satisfactorily, without a power to move the air, and without appropriate valves. For this purpose, ventilating chimneys, or shafts, worked by fire, fanners, pumps, or screws driven by a steam-engine, or water-wheel, a jet of steam, a stream of air, acting as a blowpipe, a current of electricity, or any other power may be used. The shaft and the fanner are usually preferred, especially the former."—*Sanitary Reporter*.

Quick Work.

The Siberian Telegraph line is working to Queenstown, Ireland, from Irkoustek, Siberia—a distance of 6,500 miles. A dispatch was recently transmitted the whole distance in two hours: a great feat, making a fair allowance for gain in apparent time—*Telegraphic Journal*.

THE FLOW OF WATER THROUGH LONG PIPES.

Water, in its descent through the mains, absorbs by the resistance of the sides a portion of the motive power of the fall. Again, when the water has to be forced through conduit pipes by means of pumps, this resistance requires additional work, which has to be added to that consumed by gravity. And thus, in establishing engines for the water supply of towns, it is of course necessary to take into account this extra power which has to be given to the prime mover. Every foot of pipe will afford more or less of resistance through friction and adhesion to the motion of the water; every change of direction at a knee or bend will increase this resistance, and will cause a loss of head equal to the height due to the velocity multiplied by a known coefficient. One of the reasons of the loss of *vis viva* in the change of direction undergone by a fluid at a knee or curve is to be found in the centrifugal force which tends to separate the water from the inner side of the pipe, and thus to form a contraction. A whirling motion is also produced at the point of cross section of the two diverging centre lines. Any sudden enlargement in the pipe will also cause a diminution of the velocity, and in the same proportion as the area of cross section is increased. When a pipe is narrowed at the inside by the jutting out of a portion, or by a twist, as is often the case with drawn out pipes, and still more with soldered pipes, this narrowing of the channel will also produce a loss of *vis viva*. It has been found by means of a great number of experiments that the frictional resistance is quite independent of the pressure, but that it is directly as the length and inversely as the width of the pipe. It has also been proved that this resistance is greater at higher speeds and smaller at slower speeds, and that it increases very nearly with the square of the speed. Of course, however slow the current may be, all these resistances must make themselves felt to a more or less degree according to the speed, according to the greater or less length of the pipe, according to its smaller or greater diameter. Any accidental circumstance, such as the presence of air, or that of any narrowing of the channel, will also considerably increase this resistance. With the fact before us that, however slow the speed, these losses will at once make themselves felt in a long pipe with a narrow diameter, it seems incredible that the motion of a current of water should be employed to give motion to the indicating plungers of hydraulic presses. The losses are independent of the pressure, and being, as we have seen, liable to be increased at a rather quicker rate than the square of the velocity, fluid friction is thus in a direct contrast to the friction of solids. But though the friction of water in a pipe is not increased by pressure, there is every reason for the belief that, at very slow speeds, and with very high pressures, the contraction of the water itself under pressure would come into play, and, favoured by what Mr. Grove terms "the irrepressible bubble of gas," compression alone would produce some motion in a pipe with an attendant loss of head. A small diameter of pipe would doubly favour this action. The formulæ of different authors differ very considerably with regard to the friction of water in pipes, as well as to other questions in hydraulics. There is more especially one influence on the motion of water in pipes which seems to have been little regarded in England and Germany, at any rate in the books. We allude to the influence of the nature of the surface of the pipe on the motion of the water. The rules generally given suppose that the nature of the surfaces does not influence to any considerable extent the resistance of the sides, and they are based on an expression of this resistance, which contains a factor composed of two proportional terms, the one to the first, the other to the second, power of the average velocity of the water in the pipe. But the engineers of water-works in this country and abroad had long ago noticed that, though the volumes of water delivered by new cast-iron mains for a short time after their erection considerably exceeded the amounts indicated by the formulæ, the case was exactly opposite after the pipes had been in use for some time, and the slightest deposit had formed itself in the pipes. It is for these reasons that Mr. Hawksley has long recommended and used the empirical formula for the number of gallons delivered per hour :$=\sqrt{\frac{(15\ D^5)\ H}{L}}$, in which L is the length of pipe in yards, H the head of water in feet, and D the diameter of pipe in inches. M. d'Aubuisson, well known as the author of a book on hydraulics, and the engineer of the water-works of Toulouse, also proved that the losses of head caused by the friction of water in mains was sometimes double that indicated by the formulæ of De Prony. D'Aubuisson employed, for the calculation of the deliveries of pipes in which the velocity amounted to or exceeded six decimetres, a formula based on the supposition that the resistance was proportional to the square of the speed merely, and this formula gave results rather less, by about a third, than the formulæ of De Prony.

* * * * * *

The speed of flow in pipes in which incrustation had but very slightly diminished the diameter was found to be very considerably less than that indicated by the formulæ of De Prony, and only after these pipes were cleaned was there an agreement between De Prony's formulæ and experience. In fact, M. Darcy showed, by a comparison between the values obtained for the numerical coefficients determining the amount of resistance with pipes of the same, or nearly the same, diameter, that the mere nature of the surfaces, besides their more or less polish, exercises a very considerable influence on the intensity of the resistance to the current. He found that, according as the pipes are of wrought iron painted with tar, or of new cast iron, or of cast iron covered with deposit, the co-efficient varied in the ratios of about 1 to 1·5 and to 3. The two last figures in the ratio of 1 to 2 justify, as Morin remarks, the practical rule adopted by M. d'Aubuisson for calculating the dimensions of conduit pipes. According to this formula, he allowed for a force of head double that given by the formula of M. de Prony. This result, which has an important bearing on water supply, "shows that, to be certain of a regular and constant delivery of the mains, it is necessary to suppose them to have got into the state of surfaces covered with deposit, whatever may be the more or less polished substance of which the pipes originally consist." During the first stages in which the pipes are at work, the delivery will be greater than that indicated by the formula employed, but in course of time and usage the delivery will approach it more and more, and the normal delivery will be that which has been thus determined upon beforehand. The smoothness and nature of the surfaces of water mains, and the power required to force the water through them, thus appear to be convertible terms, and if an easy and cheap mode of so forming the surfaces of cast iron pipes that incrustations would be continually cleared off the surface by means of the current itself, the inventor would probably make a fortune, and, what is more, would certainly deserve it.—*Mechanics' Magazine.*

Machinery and Manufactures.

THE MANAGEMENT OF STEEL.

The third edition of a very useful pamphlet on "The Management of Steel," by George Ede, of the Royal Gun Factories Department of Woolwich Arsenal, has just been published by W. Tweedie, London; from which we shall give in this and subsequent number of the Journal some lengthy extracts:

On the Forging of Steel.

"There are tons of the very best steel condemned as bad steel—when at the same time it is the forging of it that has made it bad, through men not having a proper knowledge in the management of it; and those masters who study their own interest will only employ those men for the forging of steel on whom they can most depend. For I have seen plenty of the very best steel destroyed, and have even heard men remark to each other, "Make it well hot—it will work the easier;" and I have felt what a sad thing it was to see men that knew better; yet they would destroy their employer's property. Therefore I say, as justice to the manufacturer and supplier of steel, it behoves masters to put those men only at the forging of steel on whom they can most depend.

"In forging of cast steel the fire must be regulated by the size of the work; and in heating the steel, when the flames begin to break out, beat the coals round the outside of the fire close together with the slice to prevent the heat from escaping. To save fuel, damp the coal, and throw water on the fire if it extend beyond its proper limits. To ascertain the heat of the steel, draw it out of the fire, and that often, for it requires to be well watched to heat the steel properly; and if not hot enough, thrust it quickly in again. Soft coke is even better than coal for the fire. The heat the steel receives is judged of by the eye; and care should be taken not to use a higher degree of heat than is absolutely necessary to effect the desired purpose, and to use as few heats as possible; too frequent and overheating steel abstracts the carbon, gradually reducing it to the state of forged iron again. It is an idea of many men that so long as the steel does not fly to pieces when they strike it with the hammer, it is not too hot; but it is an erroneous idea, and easily proved when it comes to be hardened, and when it comes to be used; still it is an idea that many men will maintain. If cast steel is over-heated it becomes brittle and can never be restored to its original quality. Steel which has been over-heated may be restored in a slight degree by hammering it well at a lowered heat. This will, however, improve burnt steel but little. I can safely say that no man will ever injure the steel by being too careful how he takes his heats. Cast steel may be welded by boiling sixteen parts of borax and one of sal ammoniac together over a slow fire for an hour, and when cold grinding it into a powder. The steel must then be made as hot as it will conveniently bear, and the borax used as sand.

On the Hardening of Steel.

"My object now is to show to the reader some of the chief causes of steel breaking in hardening, and likewise to give a few remedies to prevent these causes; and I am sure, from my own experience, that whoever tries them will find them correct. In the first place, I wish to apprise the reader that all bright steel requires a coating of some description before putting it in the water, more especially when the article runs large; or the sudden action of the water on the outside of the steel in most instances is sure to crack it. As a proof of this, take a piece of steel cut from a bar with the skin on, harden it as often as you please, and you will find it is a very uncommon thing for that either to crack or break, if it is not made too hot; but take the same piece of steel, or another piece from the same bar, file or turn it bright, and it is quite likely to break the first time it is hardened. As a proof that the skin on the steel prevents the water from acting so suddenly on the outside of the steel, in cooling it so much sooner than the middle, common turning tools will always stand better, and keep a finer edge, if the tools are hardened from off the hammer with the skin on, to what they will if they are either filed or ground before hardening; that is, if the heat of the steel is regulated so as not to require tempering after being made hard. For the most useful hardness is produced by that degree of heat which is just sufficient to effect the purpose, the hardness of steel depending upon the intimate combination of its carbon, therefore the heat which effects this is the best. But there are a number of tools used in the turnery that cannot be ground after hardening, therefore these must be fitted up with the file, and the necessary precautions used in hardening them.

Before putting any article in the fire it is necessary to examine its shape, as every article has a particular way in which it should go into the water; therefore, it is requisite to know, before it is put into the fire, which way it is to be put into the water when it is drawn from the fire; likewise the water has to be studied into which the article is put, and likewise the heat on the article before it is put in the water, and the position of it in putting it in the water. Water that is intended for hardening should never be dead cold; and the heat of the article, if the steel is good, should never exceed that of a low red heat; for if the water is dead cold, and the steel a little too hot, there is as much risk of its breaking as there is in pouring boiling water into a glass bottle; for dead cold water acting so suddenly on the outside of the steel, the expansion of the middle is more than the outside can bear, and causes the steel to break; therefore, to avoid such risk, get a quantity of lighted charcoal, or a bar of ignited iron, and put it in the water, just sufficient to take the chill off. In dipping any article in the water, if there is a stout part and a thin part, always let the stoutest part go into the water first, and as near the centre of the water as possible, so that there may be an equal pressure of water surrounding it. Putting the stoutest part in the water foremost causes the article to cool more equally, whereas if the thin part be put in the water foremost it is cold first, and the stout part having to contract after the thin part is cold, the thin part cannot give, consequently it has to break. But this cannot always be done, as there are no means of getting the stoutest part of some articles in the water foremost; for instance, such an article as a feather edge milling cutter, and many other things which have their stoutest part in the centre—these must be put in perpendicularly by putting a piece of strong wire through the hole in the centre, and putting it gently into the water; and instead of moving it backwards and forwards in the water, lift it up and down, so that fresh water may pass through the centre every time it is lifted up and down, and the deeper the tank the better. But in lifting it up it must not be allowed to come above the water, or it will be sure to crack; the outside edges of such articles being much thinner than the middle they are cold sooner, so that the middle is wanted cold as quickly as possible after the outside edges; and were it drawn backwards and forwards in the water, the water being warm in the hole in the centre, it would be longer in cooling.

"I speak from experience that the shape of different articles has to be studied; for instance, take such an article as an eccentric collar, which shall be 1½ inch thick on one side, and ¼ of an inch on the other, having a 2-inch hole in it for the shaft; in hardening this it is most certain to break in the weak side, for one side being so thin, it is cold almost instantly, and the stout side contracting after the other is cold, it pulls it asunder. By taking a little trouble all this risk is avoided. Before such an article as the above be put in the fire, fit a piece of iron round the thin part, so that it is made up to the thickness of the stout part, or a little thicker, and bind it on with a piece of binding wire, and coat it with potash, and I will guarantee that it hardens without breaking, because one part then is cold as soon as the other. There are various things that steel can be coated with, such as soft soap, black lead, or plumbers' size; but in hardening in a common fire, or a furnace, the prussiate of potash is the best. In hardening in lead, soft soap, black lead, or plumbers' size answers exceedingly well. In coating of steel, you first get the article just red, draw it from the fire, having the potash already powdered up fine, and in a box with small holes in the lid; similar to a grater; shake the box till there is a coat all over the articles, put it in the fire again till it gets to the desired heat, and it is then ready to put into the water, except in very large articles, where there is a great body of steel. It is requisite then to draw it from the fire a second time, and give it another sprinkle of potash, so as to give it a thicker coat. By binding a little binding wire about it, it assists to make the potash cling more firmly to it. There are many things that require to be hardened, where the substance of the steel is so great that it is necessary to bore holes about it in different places to make it cool more equally. In very large cutters, some are apt to have the hole where the spindle passes through too small, so that large and small cutters may fit the same spindle; but the larger the cutter the larger the hole should be; or otherwise bore a few holes round the middle hole, so that the substance of the steel is reduced, or it may be reduced by turning it thinner, so as to form a boss each side, thus greatly reducing the risk of its breaking in hardening. But if it happen that any article that has to be hardened has any holes about it near to the very edge, it is then necessary to stop these holes up with a piece of loom, and it will prevent the hole breaking out. Any size cutters, bushes, gauges, rings, or collars, or articles of any description may be hardened without breaking by following the rules I here lay down. Sometimes a steel ring or a cutter is required to have one thin edge; these must not be put in the water too suddenly. In very large round steel it is sometimes necessary to bore a hole through the centre to allow the water to pass through, and even then it will break asunder if it be drawn backwards and forwards in the tank; this should always be lifted up and down in the water to allow fresh water to pass through the hole, unless when it is under the water; if it be turned on to its side, it can then be drawn backwards and forwards with the same result. It sometimes happens that there is a fracture in the steel before it is hardened, this can be detected when the article is in the fire, and at a low heat. This fracture is sometimes found in the steel as it comes from the manufacturer, but is very often caused in the forging by excessive heating, and oftentimes the hardener gets blamed for faults which belong to other men. If there is a crack in the steel when it is just red, it can be detected, but hardening will not mend it. It may be useful to some to know that if a piece of binding wire be bound round any article, and a piece of loom wrapped round the wire, the wire merely to keep the loom from falling off, and the article, after drying the loom, may be put in the fire and heated all over, and when sufficiently hot may be put into the water, and the part that has the loom round it will remain soft, because the water cannot penetrate through the loom quick enough to harden the steel. If the loom be on the middle, the ends only will be hard; but if the loom be on the ends, the middle will be hard, and the ends soft, and the mechanic will find this plan very useful in many cases. The less frequently the water used for the purpose is changed, the better it is for the hardening of steel; therefore, as it wastes, fresh water should be added, and as it is necessary to clean the tank out occasionally, it would be well before using fresh water, to make it hot by putting a bar of ignited iron into it, and let it get cold again before using it; for when quite cold water is used, there is always a risk of the steel cracking.

"By applying aquafortis to the surface of steel previously brightened, it immediately produces a black spot; if applied to iron the metal remains clean, but looks a little dull where the acid touched it. By this test iron may be known from steel, as the smallest vein of either will be distinguished by its peculiar sign. There are many large things broken by taking them out of the water before they are thoroughly cold; and some people are of the opinion that it is the action of the air on the steel which causes it to break. But be this as it may, it is a real fact that if a large body of steel be taken out of the water before it is thoroughly cold, in nine cases out of ten it is sure to break. If a large piece of iron is heated and put in the water, and kept under the water a considerable time, after the outside of the iron is black, and then drawn out of the water, the heat from the middle of the iron will in a few seconds turn the outside to a red heat again. Water acts on steel in a similar manner. When first the article is put into the water, the water begins to act on the outside of the steel, cooling it gradually towards the middle; and if taken from the water before it is quite cold, the heat in the middle begins to act on the outside of the steel in a contrary way to the water, by straining the outside of the steel more than it can bear; and in most instances I have noticed, when I have been trying experiments, that as soon as the water dries on the steel, it cracks, and the larger the steel the greater the risk, so it is important that it should be quite cold before it is taken out of the water, if the article be any way large.

"It is not requisite that the article should lie in the water till the water is dead cold, for in some instances the article is wanted for use as soon as possibly it can be had; in such cases, if the article is not too large to go into a handbowl, put the bowl under the water in the tank, and place the article in the bowl, lift the bowl and the article out together, with the water covering the article in the bowl, and then sink the bowl with the article still in it into another tank of dead cold water, or under a tap, with cold water running on it, and it will in a short time be ready to lift out. But if the article is too large to go into a bowl, put it in a bucket and act as I have stated, and it will then come out safe without a crack, and not crack after it is out. Hundreds of things break, by lifting them out before they are cold.

"In many things where the heat that is on the article is wanted to temper the part that is dipped in the water, such as chisels, drills, and the like articles; these things, when they are dipped to the depth required to harden them, should always be moved quickly about in the water, and it will prevent many a drill screwing off in that particular spot, and prevent many a chisel breaking. I have no doubt that many readers of this little book have noticed when they have been chipping, that their chisels have broken clean off, about an inch from the edge, with a very light blow from the hammer, and the cause of that arises in a great number of instance from the chisel having been held still in the water when hardening it; for the water cooling it across in a straight line causes the hardened part to tear from the other, yet not sufficient to show till it is struck with the hammer, and then it drops off, and if the break be examined it can be seen that the water did it. But these kind of articles having the skin on the steel when they are dipped in the water, it prevents the water from having just the same effect on them as it does on articles previously brightened. I recollect once having a quantity of small drifts to harden, and I was requested to keep the heads soft, so I put a certain number of them in a box, with charcoal dust to heat them, and when sufficiently hot, I shot them into the water with the intention of softening the heads after; but I found upon examining them that I had a number of them very crooked, owing to their being very slight, and going from the box so suddenly into the water; so I adopted another plan. I heated a certain number together, and taking them out separately, dipped them straight and gently into the water, which answered the purpose so far. But it took a little longer to dip them separately; so thinking to save this extra time, I thought I would only dip them in as far as I required them hard, and that would save me the trouble of softening the part that was not required hard. But not caring about going ahead with any quantity of things till I make myself sure that all is going on well, after I had done about two dozen I examined them, and I did not find one of them but what was cracked at the part that was level with the top of the water, so I dipped the remainder all over, and not a crack appeared in one after. I then made some lead red hot and dipped the parts that were required soft into it, and accomplished them very nicely. If the hardener should meet with articles that he considers have too large a centre in them, and that there is a risk of having a crack in them, if he stop the centre up with a piece of loom to keep the water out of it, there is little or no danger of its cracking.

In hardening a number of articles at one time, it is best to put them all into a box together with some charcoal dust, let them lie till they have acquired the low red heat called cherry-red, and then empty the contents of the box into the water; they will then be very clean, without scales, and beautifully hard. It is a very good plan for all small taps; and as it is usual to temper these things to a colour after they are hardened, it is necessary to know that they are all hard before beginning to temper them, for it will sometimes happen that there will be some among them that are scarcely hard. If the box has been taken from the fire before it has been properly heated through, then the middle articles in the box will prove not hot enough; so, to make sure of good work, always try them with a smooth file to prove them, for in some instances one bad article would get all the others condemned, even if all the others were right. But the use of the file can be dispensed with if they are brightened on a buff or a stone, which are the proper things for the purpose; for the persons that brighten them will find, if they are properly hard, plenty of brisk lively sparks will fly from them when they are held on the buff; and if they are not hard enough there will be very little fire in them; therefore, with a very little attention, those that are soft can be detected and put aside, and heated again with the next batch. Dies may be put in a box, and hardened after the same manner. I have found red-hot lead to be a convenient thing to heat many things in; but to be constantly employed at it, I believe to be very injurious to health. I have been employed at it for weeks together, and have felt very bad effects from it, and I always avoid using it except in cases of necessity. Still, there are many things that can be accomplished better by heating them in lead than in any other way; such things as long fluted rimers, and various other things that are a great length, for they will always keep straighter by heating them in lead to what they will if they are heated in a common furnace. If the article be very long, it must not be put into the lead too suddenly, or it will be sure to go crooked, for plunging a cold piece of steel too suddenly into red-hot lead causes it to go crooked, the same as if plunged too suddenly into cold water. They should be gradually put into the lead, and gradually into the water, with a little salt in the water to keep it from bubbling, for it is not everything that can be straightened again after it is hard without damaging it, or softening it. Care must always be taken never to have the lead too hot, or the articles will be spoiled, for they will be found to be full of little holes, if closely examined. Before putting the articles in the lead it is necessary to rub them over with a little soft soap, or mix a little black lead with water, and brush them over with it, or plumbers' size, and they will come out of the water clean, without the lead sticking to them. If the black lead is used, they must be dried before they are put in the lead, for the hot lead is likely to fly if they are put in damp. Soap does not require to be dried.

"Any quantity of articles, such as drills, bitts, &c., may be expeditiously hardened by dipping their points in the lead, and cooling them in water; a pair of tongs with long jaws is very convenient for holding a quantity at one time; if the articles are of an unequal thickness, and one jaw of the tongs be made hollow and one flat, a piece of soft wood may be put in the hollow jaw, the tongs will then grip them all; any quantity may be hardened as expeditiously as a single article, if there be sufficient lead. Another thing to be observed is, that the surface of melted lead becomes quickly covered with a skin, which is the effect of the air on the surface, and it wastes the lead so fast that it becomes an object of importance to those who use much to check its formation, or to convert it when formed into the metallic state again. Charcoal converts the dross into metal again; but if a covering of charcoal or cinders be kept on the lead, the dross will not form, for, if it is allowed to form, the lead is not only wasted, but it is a great obstruction in putting the articles in, and likewise in taking them out; lead is an excellent thing in which to heat any long plate of steel that requires hardening only on one edge; for it need not be heated any farther than where it is wanted hard, and it will then keep straight in hardening. But if it is heated all over in a furnace and put in the water all over, it will be warped all shapes and cause a deal of trouble in setting straight, especially to those who are unacquainted with the setting of hardened steel. If it is heated all over, and one edge only dipped in the water, the edge that goes in the water will be rounding, and the edge that does not go in the water will be hollow; this is owing to the steel expanding in hardening, for the steel expanding in hardening causes the edge that goes into the water to get longer, and the other edge being kept out of the water, and still hot, the hardened edge expanding lower pushes the other part of the steel round, causing the edge that is out of the water to be hollow. But if it is heated in red-hot lead, and the edge only that is required hard put in the lead, the other part will be quite cold; and when it is put in the water all over, the hot part will not have sufficient strength in it to alter the cold part, consequently the cold part keeps the hardened part true. The colder the water the more effectually it hardens the steel. Brinish liquids produce rather more hardness than common water, but in most cases common water answers the purpose. Water holding soap in solution prevents the steel from hardening, but as there are many things used in machinery that require to possess the greatest possible degree of hardness, it is necessary with such things to use a saline liquid. Gauges, burnishers, and certain kinds of dies, require to be very hard, also, a file requires a nice, hard tooth. When steel is required to be extremely hard it may be quenched in mercury. But this can only be done on a small scale."

The Corrosion of Boilers.

Nearly all of the large number of boiler explosions, the causes of which are annually investigated by the engineers of the Manchester and Midland Boiler Associations, are clearly found to have occured in consequence of either internal or external corrosion. In the case of locomotive boilers—and they are now exploding sufficiently often to cause considerable anxiety—" furrowing" along a seam of rivets, or rather under the line of an overlap, is found to be the usual malady. In many boilers, especially on those lines where the hydraulic test is regularly applied, "furrows" are discovered in time to prevent explosion. In other instances the plates become "pitted" on their inner surfaces as with small-pox. We have a photograph kindly sent us by Mr. Longridge, of a small portion of the inner surface of one of the plates of a boiler which exploded, with great loss of life, some time ago at Aberaman, South Wales. To compare the pits therein shown with the lunar seas disclosed in Mr. De la Rue's photographs of the moon would not do justice to the former. The iron is eaten away almost everywhere, not uniformly over the whole surface, but in numberless holes. Wherever very pure water is used, or peat water, or water containing sulphur, there is the same corrosion always going on, while, as for furrowing, there appears to be no effective precaution against it. So far as furrowing and other forms of corrosion are concerned, there can be no doubt that wrought-iron is the worst material that can be employed for a boiler. Whether steel better resists corrosion under the same circumstances has not been conclusively ascertained, but in other respects the attempts to employ steel as a material for boilers cannot be said to have satisfied the hopes with which it was originally introduced for this purpose. Copper is now wholly out of the question, nor were it abundant and cheap would its strength be reckoned sufficient. No material applicable to boilers is less liable to corrosion than cast-iron. Wherever great heat has to be borne, its resisting powers make it second only to platinum among the metals. For heating stoves for blast furnaces, and indeed for domestic stoves, wrought-iron is entirely unfit. For gas retorts it is of course worthless, while cast-iron, until the introduction of the most refractory clay retorts, was considered to serve a very good purpose. For superheaters it is quite superior to wrought-iron in any form. The Peninsular and Oriental Company have, indeed, long since abandoned wrought-iron for copper superheaters, but equally good, if not better, results are obtained by Messrs. Richardson & Sons from Mr. Jaffrey's cast-iron superheaters. The motive for the use of cast-iron in heating stoves, gas retorts, and superheaters, is economy; but in the case of steam-boilers, where the principal source of danger has been found to be in corrosion, the use of cast-iron (with a large margin of strength to resist bursting) appears to be essential to safety. The highest required tensile strength is now given to cast-iron boilers—their bursting pressure being from 1,500 lbs. to 2,000 lbs. per square inch, while it appears reasonable to consider them as entirely secure from the common danger of corrosion.—*London Engineer.*

Parchment.

Parchment is made of skins of sheep and lambs, though that kind which is used for the head of drums is said to be made of goat-skins. Vellum is a finer, smoother, white kind of parchment, made of the skin of young calves. The mode of preparation is first to take off the hair or wool, then to steep the skin in lime, and afterwards to stretch it very firmly on a wooden frame. When thus fixed, it is scraped with a blunt iron tool, and wetted and rubbed with chalk and pumice-stone till it is fit for use.

Prevention of Rust in Iron.

Many a valuable hint is to be obtained from an intelligent practical laboring man, which may lead the philosopher into a train of ideas that may, perhaps, result in discoveries or inventions of great importance. When bricklayers leave off work for a day or two, as from Saturday to Monday, they push their trowel in and out of the moist mortar, so that the bright steel may be smeared all over with a film of it, and find this plan an effectual remedy against rust. In Wren's "Parentalia" there is a passage bearing upon this subject:—"In taking out iron cramps and ties from stone-work, at least 400 years old, which were so bedded in mortar that all air was perfectly excluded, the iron appeared as fresh as from the forge." Oxygen, which is the main cause of rust, is abundant in the composition of both water and the atmosphere; and that quicklime has an astonishing affinity for it is evinced in the homely practice of preserving polished steel or iron goods, such as fire-irons, fenders, and the fronts of "bright stoves," when not in use, by shaking a little powdered lime on them out of a muslin bag, which is found sufficient to prevent their rusting. Another instance, very different and far more delicate, bearing upon the same principles; the manufacturers of needles, watch-springs, cutlery, etc., generally introduce a small packet of quicklime into the same box or parcel with polished steel goods, as security from rust, before sending it to a distant customer, or stowing it away for future use. These cases are extremely curious, because, as a general rule, bright steel or iron has a most powerful affinity for oxygen; consequently it is very readily acted upon by damp, and is rusted in a short time, either by decomposing the water and obtaining oxygen from that source, or direct from the atmosphere. It is not absolutely essential that the quicklime should be in actual contact with the metal, but if somewhere near, as in the case of the parcel of lime packed up with the needles or watch-springs, the bright metal will remain a long while without the least alteration in its appearance; the lime (which is already an oxyd of calcium) either receiving an additional dose of oxygen or being converted into a carbonate of lime.—*Builder.*

A Miniature Steam Engine.

We recently had the pleasure of seeing a miniature working model of a pair of Penn's patent trunk engines, made by Mr. Thomas Smith, modeller, of 20, Walnut-tree Walk, Lambeth. These engines are facsimiles of those in H.M.S. "Warrior." The model engines, however, are intended to work at high pressure, whereas the "Warrior's" are condensing engines.

The weight of the pair of model engines is two grains less than that of a silver three-penny piece; and they stand on less space than a silver three-penny piece would cover. The cylinders are 2-32nd of an in. in diameter. Length of stroke 1-16th of an in. The throw of the eccenric is 1-60th of an in. The engines are constructed with the link-motion reversing gear. The hexagon-headed bolts used for fastening on the cylinder covers are 1-100th of an in. in diameter. The engines can be worked at from 20 revolutions per minute up to 20,000 revolutions per minute.—*Mechanic's Magazine.*

Increasing Application of Steel.

The *Practical Mechanic's Journal* says one cannot but notice the great change which the introduction of steel in the place of iron in many parts of mining machinery is likely to effect, as well in cheapening its cost as in rendering it more powerful and more enduring. Although the price of cast and hammered steel is double the price of iron of the same weight, yet the superior strength and endurance of the former enables the engineer to reduce the weight of his casting so considerably as to render the actual cost of steel machinery but little more than that of iron, whilst it is well known that it will last ten times as long and may be more implicitly trusted.

Oil-Lamp Furnace for fusing Metals at a White Heat.

Mr. Chas. Griffin, of London, proposes to fuse metals by means of a furnace heated by mineral oil. The combustion of a quart of this (which only costs 9d.) gives a heat sufficient to fuse 5 lbs. of cast-iron. The furnace being cold when an operation is commenced, it will melt 1 lb. of cast-iron in 25 minutes; 1½ lbs. in 30 minutes; 4 lbs. in 45 minutes; and 5 lbs. in an hour. This furnace is said to possess this advantage, that platinum crucibles remain uninjured, as the rock-oil does not give off sulphurous vapors.

Practical Memoranda.

Table of Properties of Liquids.

Names.	Specific grav. water, 1000	Weight of an imp. gallon in lbs.
Acid, sulphuric	1850	18·5
" nitric	1271	12·7
" muriatic	1200	12·0
" flouric	1060	10·6
" citric	1034	10·3
" acetic	1062	10·6
Water from the Baltic	1015	10·2
Water from the Dead Sea	1240	12·4
Water from the Mediterranean	1029	10·3
Water, distilled	1000	10·0
Oils, expressed:		
linseed	940	9·4
sweet almond	932	9·3
whale	923	9·2
hempseed	926	9·3
olive	915	9·2
Oils, essential:		
cinnamon	1043	10·4
lavender	894	8·9
turpentine	870	8·7
amber	868	8·7
Alcohol	825	8·2
Ether, nitric	908	9·1
Proof spirit	922	9·2
Vinegar	1009	10·1

Relative Strength of Metals to resist Torsion.

Cast iron	=1·	Swedish bar iron	=1.05
Copper	= ·48	English do	=1.12
Yellow Brass	= ·511	Shear steel	=1·96
Gun-metal	= ·55	Cast do	=2·1

Effects of Heat on

Linear Expansion of Metals from 32° *to* 212°.—Faraday.

Zinc,	1 part in... 322	Gold,	1 part in... 682
Lead,	" ... 351	Bismuth,	" ... 719
Tin, pure,	" ... 403	Iron,	" ... 812
Tin, impure,	" ... 500	Antimony,	" ... 923
Silver,	" ... 524	Palladium,	" ...1000
Copper,	" ... 581	Platinum,	" ...1100
Brass,	" ... 584	Flint Glass,	" ...1248

Face Protection from Cold.

An ordinary fine wire-gauze mask, as is sometimes used at masquerades, will keep the face comfortable, even if a fierce wind is blowing, while the thermometer is below zero; a thin vail or a silk handkerchief is a good substitute.

Statistical Information.

Lunatics in Canada.

The number of inmates of our Asylums is very considerable. On the 31st December, 1863, there remained in the Toronto Asylum, 380 patients; in the University Branch, 78; in the Orillia Asylum, 132; in the Malden Asylum, 226; total, in the Upper Canada Asylums, 816. In Beauport Asylum there were 502 patients; in the St. John's Asylum, 62; total, in the Lower Canada Asylums, 564. In Rockwood Asylum there were 98 criminal lunatics. The total number, therefore, of inmates of our asylums at the close of last year, was 1,478. To these we have to add 101 in the gaols of Upper Canada, and 84 in the gaols of Lower Canada, making a grand total of 1,663. Of the 816 patients in the Upper Canada Asylums, 373 were males, and 443 females. Of the 564 patients in the Lower Canada Asylums, 254 were males, and 310 females. It is singular that in both cases, the number of females largely exceeds the number of males. On the other hand, we learn that since the first opening of the Toronto Asylum in 1841, there have been admitted to that institution, in all 1,580 men and 1,398 women—the number of males thus considerably exceeding the number of female lunatics. It would appear, therefore, that the evidence furnished by our Canadian statistics as to whether insanity is more incident to the male or to the female sex, is somewhat conflicting. So it is also with the evidence furnished by the figures, as to whether the married or the single are more liable to lunacy. Of the 1,580 male patients admitted since 1841 into the Toronto Asylum, 702 were married and 878 single—the inference being that single men are more liable to lunacy than the married. But, on the other hand, of the 1,398 women admitted, 899 were married and 499 single—the inference being that women are more liable in the married than in the single state, to fall victims to insanity.—*Globe.*

Facts Concerning Ivory.

England consumes 1,000,000 pounds of ivory annually, or the products of 3,333 elephants. About 4,000 men are annually killed in the elephant hunts. A tusk weighing 70 lbs. is considered a first-class one. A short time ago an American firm cut up a tusk which was not less than 9 feet in length and 9 inches in diameter, and weighed 800 lbs. In 1851 the same house sent over to the London Exhibition the largest piece of sawed ivory ever seen; it was 11 feet in length and 1 foot broad. The dearest ivory is that which is used for billiard balls. Since the conquest of Algeria by France, the ivory trade has considerably increased in the north of Africa. The hippopotamus also yields ivory, which is much harder and less elastic than that of the elephant, besides being of small dimensions.

Old World Libraries.

At present the collection in the British Museum number 40,000 MSS. 600.000 printed volumes, and 200,000 pamphlets. The superb Bibliotheque Imperiale of Paris, the largest in the world, contained in 1861 1,000,000 printed volumes, and 150,000 MSS., 300,000, maps, 300,000 pamphlets, 130,000 engravings, and 150,000 numismatic specimens. It must be conceded, however, that it contains many duplicates. The Library of St. Genevieve at Paris with 200,000 volumes; the Royal Library of Berlin with its 600,000 volumes, and a magnificent collection of Oriental MSS.; the Royal Library of Copenhagen with 450,000 volumes; the Imperial Library of St. Petersburg, which, in little over a century, has accumulated 500,000 volumes; the Royal Library of Munich with 500,000 volumes; the Imperial Library of Vienna containing over 425,000 volumes; the Library of the Vatican possessing on the shelves of its antique alcoves the finest collection of MSS. in the world, among them many inestimable treasures brought thither from Constantinople when it fell in the hands of the Turks; the Laurentian Library of Florence, so scurvily treated by Savonarola.

Specie from San Francisco.

Shipments of specie from San Francisco for the first six months of 1861, 1862, 1863 and 1864:

	To New York.	To England.	To China.	To Other Countries.
1861.	$15,916,290	$1,103,938	$1,343,247	$202,655
1862.	11,290,850	4,216,841	1,007,272	317,652
1863.	5,650,976	16,008,427	1,603,059	495,119
1864.	5,607,940	19,835,269	2,911,733	578,798

The Russian Budget.

The Russian Budget for 1864 shows a deficit of more than 46,000,000 roubles ($27,000,000) The extraordinary military expenses caused by the insurrection in Poland amount to a sum altogether inferior to that deficiency, which they do not alone suffice to explain, and which may be still further increased by diminutions in the receipts, or by additional, supplementary, or extraordinary credits.

Library of the British Museum.

The expenses of the British Museum for the past year were £99,012, being £502 less than during the previous year. 34,589 new books have been added to the library, of which 23,097 were purchased, and the rest secured by copyright. Valuable additions have also been made to the collections of ancient statuary and of manuscripts. Among the latter there are over a hundred letters of William Cowper, including the autograph copies of "John Gilpin," "Alexander Selkirk," and "The Loss of the Royal George."

Miscellaneous.

The Science of Chemistry.

This science is not only of advantage to agriculture, physics, mineralogy, and medicine, but its phenomena are interesting to all men. The applications of this science are so numerous that there are few circumstances of life in which the chemist does not enjoy the pleasure of seeing its principles exemplified. Most of those facts which habit has led us to view with indifference are interesting phenomena in the eyes of the chemist. Everything instructs and amuses him; nothing is indifferent to him, because nothing is foreign to his pursuits; and nature, no less beautiful in her most minute details than sublime in the disposition of her general laws, appears to display the whole of her magnificence only to the eyes of the chemical philosopher. All material bodies are the subjects of chemical research. The solid and fluid matter composing the terraqueous globe which we inhabit, also air, light, and heat, are subjects proper for the examination of the chemist. The arts of dyeing, bleaching, tanning, glass-making, printing, working metals, etc., are purely chemical. The vegetation of plants and some of the most important functions of animals have been explained upon the principles of chemistry. By means of this science agriculture and gardening have been greatly improved in Britain and other countries. Chemistry directs the labors of the husbandman and the rural economist. In the dairy, milk cannot be kept sweet and fresh, and butter and cheese cannot be made without skill, founded on chemical principles. Cookery and the art of curing and preserving beef, bacon, hams, and all animal and vegetable substances, are entirely chemical. The art of brewing, distilling, and making all sorts of fermented liquors depends upon the principles of chemistry. In medicine and pharmacy great benefits have been derived from the discoveries of chemical philosophers. The chemist resolves bodies into their elementary principles, and he examines their nature and properties when in a detached or simple state. He thus discovers their mutual relation to one and other, and can recombine them in proportions different from those in which they were originally united. Hence new and useful compounds may be formed which nature does not produce. But chemistry is not only valuable as an art which supplies many of the wants, comforts, and luxuries of life. Its objects are sublime and beautiful in other senses; for it is intimately connected with most of the phenomena of nature, as clouds, rain, snow, dew, wind, earthquakes, etc.—*Richmond County (New York) Gazette.*

Wallachian Petroleum.

Petroleum has taken so prominent a place of late among our national staples, that it is important for us to keep watch upon the general Petroleum development of the world. A late number of the "Polytechnisches Journal" informs us of a new outlet of earth oil in the rich and remote province or principality of Wallachia, to which we have already alluded. The German journal, after warning commerce to remember that the oil wells of Pennsylvania and Canada have a way of suddenly going out, "thanks, in a great measure, to the indiscriminate way in which rich mother Earth is so bored and tapped, as to make it easy for the gas to escape, by which the Petroleum would else be forced up; or else for water to get in and flood or choke up the springs," goes on as follows:

But there are other Petroleums fast coming into the market. Not to speak of the Burmese Rangoon oil, which has long come to England as ballast, and is used in many German refineries, in January of the present year, the first cargo of Wallachian oil reached London. It was of 280 tuns, and the company which brought it have closed a contract to deliver 20,000 tuns in all the year 1864. A second "Wallachian Petroleum Company" has since been formed. Two specimens of the Wallachian oil compare as follows with an average quality of Pennsylvania:

Qualities.	Pennsylvania Oil.	1. Wallach.	2. Wallach.
Color....................	Greenish Brown.	Brown.	Dark brown.
Fluidity (water=1)	0·73	0·68	0·09
Specific gravity	0·813	0·840	0·894
Smell	Moderately strong.	Strong and unpleasant.	Not very strong.

The general result of Dr. Otto Buchner's analysis is, that the Wallachian product is a valuable contribution to commerce and industry, although he does not think it has demonstrated its fitness to compete with the Petroleum of Pennsylvania. Dr. Buchner, however, has not found his experiments confirm the assertion of American analysts, that the lighter Pennsylvania oils of a specific gravity of 0·80, giving 90 per cent. of burning oil. His highest result has been 70 per cent., of which from 15 to 20 per cent. of benzine.

Hints to Workmen and their Employers.

I don't like to see a workman a quarter-of-an-hour or twenty minutes after his time in the morning, and then enter in a jaunty, defiant, independent style. I don't like to see him punctual in going to, but the reverse in coming back from his meals. I don't like to see the same individual uneasy in his mind five minutes before leaving-off time. I don't like to see a man as the clock strikes drop his work as though it burnt his fingers. I don't like to see him, after habitually coming late to his work, unwilling to devote one precious minute of his own time to his employer's service. I don't like to see an apprentice hastily resume work the instant he hears his master's footsteps, nor do I like his nonchalance in coolly turning to his work when accidentally discovered gossiping in the time he has to be paid for. I don't like to see an employer always dissatisfied on principle. I don't like to see an employer doing the work and his man looking on and laughing in his sleeve. I don't like to see a workman enter into an engagement to do his best and never think of carrying it out, except in receiving his remuneration. I don't like to see an employer make familiar companions of his workmen one day and act the tyrant the next. I don't like to see an employer tell the whole of the office his business concerns. I don't like to see a compositor one day "sticking up for his trade," and the next secreting sorts from his companions, or surreptitiously getting a look at the copy so that he may manoeuvre that the fattest portion shall fall to his own share. I don't like to see a man spend a shilling's worth of time rather than cut up a farthing lead, nor do I like to see him mutilate material rather than give himself a little trouble. I don't like to see a man stay away from his work or get intoxicated when there is a rush or pressure of work, and yet always at his post in slack times, when he would serve his employer by losing time. I don't like to hear a man say he works for a mutual advantage but all the time with a mental reservation. I don't like the man who can see his employer defrauded and not have the moral courage to declare it. I don't like to see a man after a full week's work want a loan of money at the beginning of the next. And lastly, I don't like to see a printer use the tail of an old shirt to cover a tympan, to save buying a shilling parchment.—*London Typographic Advertiser.*

A Word to Apprentices.

Apprenticeship is the most important stage of life through which a mechanic is called to pass; it is emphatically the spring season of his days—the time when he is sowing the seed, the fruits of which he has to reap in after-years. If he spare no labor in its proper culture, he is sure of obtaining an abundant harvest; but, if in the culture of the mental soil, he follows the example of many in tilling the earth and carelessly and negligently does his work like them, he will find the seeding-time past and ground only bringing forth weeds and briers. Let the young apprentice bear in mind, when he commences learning any business, that all hope of success in the future is doomed to fade away like the morning mist, unless he improves the golden season. Let him bear in mind that he can become master of his business only through the closest application and the most persevering industry; and that, unless he does master it, he may bid farewell to all the visions of future prospects and success. The apprenticeship is the foundation of the great mechanical edifice; and surely, if the foundation of a structure be not firm, the structure itself crumbles and falls to the earth. Then, young friends, persevere; be studious and attentive; study well at the branches of your business, both practical and theoretical—and when the time shall come for you to take an active part in life, you will not fail to be of use, not only in your own particular business, but in society.—*American Artizan.*

Odd Jobs.

A Canadian correspondent of the *Genesee Farmer* writes:—" Let any farmer or person of moderate means look round his house and make a careful minute of all the odd jobs he will find which require to be done. Let him take paper or a memorandum book and note them down. He will find at least twenty little matters requiring repair or amendment. The plank-way to the well or yard; the fence round the garden; a garden gate that will open easily and close of itself; repairs to the box protecting the well or cistern; mending tools, harness—and in short almost innumerable small matters all wanting to be done, either on wet days or at some leisure time. Every one who is not a natural sloven is fully aware of the necessity of attending to these matters, but the great difficulty is *he has no tools.* His experience goes to show that the last time he tried to do anything of the kind he had to go to a neighbor and borrow some tools to work with. The saw was too close, and very much otherwise than sharp; the chisels were all too large or too small; the bit-stock had lost its spring and would not hold the bits in their place, so that he could not withdraw them, and perhaps broke some and had to buy new ones to replace them. Nothing was fit to use, and hence what he did was wretchedly done.

" There being no proper awl or gimlet, he tried to drive nails without the holes being bored; splits followed just when most of the work was done, and the look of the job was spoiled, and our poor man of odd jobs was heartily discouraged, and excused himself by determining in his own mind that he never was intended for a mechanic, and never having learned the trade could do nothing at it but make a botch, which was almost worse than leaving the job undone.

"His underrating his ability was a mistake. Almost every man has a certain amount of mechanical ability, but the great drawback is *bad tools.* No good workman has bad tools. All the tools of a good workman are clean, free from rust, with good handles, and sharp as a razor. The saw is well set for green or dry wood, or he has one for each kind of work—ripping, cross-cutting or fine work. How then is it possible for an inexperienced person to do work with bad tools, or tools in bad order, when a mechanic, with all his experience, requires tools the best that can be had.

"The first step which any farmer can make towards renovating or repairing his homestead is to get a set of tools—some of each kind for working in iron or wood, not forgetting a soldering-iron for mending kitchen and other tin matters, and small patching. The whole can be got up for forty dollars, and will save their value and cost in one year, besides the satisfaction of feeling independent and of helping yourself, instead of living in a mess or having interminable bills to pay.

"When the tools are got, a convenient, comfortable workshop must be provided, isolated from the farm building and house, as there is always more or less danger from fire. Put up a good solid bench with an iron vice at one end and a wooden one at the other, a block for an anvil, or some substitute for one, and a good grind-stone in one corner, with a foot-crank to turn it with; and then the first wet or stormy day, referring to your memorandum book for the list of jobs that require to be done, select the first that your wife and family require as necessary to lighten their heavy cares and continuous work, and all experience goes to show that the outlay for tools will not be regretted.

"Again. When your sons require employment in bad weather, there is always some little mechanical job to do in which they will soon take the greatest delight. Nothing reconciles a boy or young man more to what he has to do than to be able to do it better than others similarly circumstanced; and if there is any mechanical talent, it will develop itself wonderfully in the amateur workshop. Then in busy times, when plows, harrows or wagons break, the loss of time in going to the tradesman is often much greater than in doing the work.

"We once knew a gentleman who did all this in England for a few years before the family emigrated. On the arrival of the family in the adopted land, there was not one of the sons who could not do any ordinary job, and no part of their education was found more useful and advantageous than the knowledge of the use of tools. Losses took place. Fire destroyed their buildings in more than one instance, but their mechanical knowledge enabled them to build again, when otherwise they must have given up hope, and turned their exertions into a far lower sphere of action."

To those who write for the Press.

It would greatly facilitate the labors of editors and printers, all over the world, if persons who write for the press would observe the following rules.

1. Write with black ink, on white paper, with ruled lines.
2. Make the pages smaller than that of a foolscap sheet.
3. Leave one page of each sheet blank.
4. Give to the written pages an ample margin all round.
5. Number the pages in the order of their succession.
6. Write in a plain, bold hand, with less respect to beauty than legibility.
7. Use no observations which are not to appear in print.
8. Punctuate the manuscript as it should be printed.
9. For italics, underscore one line; for small capitals, two; for capitals, three.
10. Take special pains with every letter in proper names.
11. Review every word, to be sure that none is illegible.
12. Put directions to the printer at the head of the first page.
13. Never write a private letter to the editor on the printer's "copy," but always on a separate sheet.
14. Don't depend upon the editor to correct your manuscript.
15. Don't ask him to return the "copy."
16. Don't press him to tell you why he refused to publish your article.—*American Artizan.*

Richard Arkwright.

Richard Arkwright was not a beautiful man; no romance-hero with haughty eyes, Apollo-lip, and gesture like the herald Mercury; a plain, almost gross, bag-cheeked, pot-bellied Lancashire man, with an air of painful reflection, yet also of copious free digestion; a man stationed by the community to shave certain dusty beards at a half-penny each. His townsfolks rose in a mob round him for threatening to shorten labor—to shorten wages; so that he had to fly with broken wash-pots, scattered household, and seek refuge elsewhere. Nay, his wife too rebelled; burnt his wooden model of his spinning-wheel; resolute that he should stick to razors rather; for which, however, he decisively —as thou wilt rejoice to understand—packed her out of doors. O reader! what a historical phenomenon is that bag-cheeked, pot-bellied, much-enduring, much-inventing barber.—*Carlyle.*

A "Jaw-breaker."

As an instance of the abominable system of terminology at present adopted by chemists it may be mentioned that Mr. M. H. Schiff, in a monograph on some derivatives of ethylidine, states that he has succeeded in obtaining a chloride of *dimercurodiethylidinediphen-ammonium.* If any one out of the laboratory can pronounce this awful term, we shall be very much surprised.—*Mechanics' Magazine.*

The Time for Sleep and Study.

By all means, sleep enough, and give all in your care sleep enough, by requiring them to go to bed at some regular hour, and to get up at the moment of spontaneous waking in the morning. Never waken up any one, especially children, from a sound sleep, unless there is urgent necessity; it is cruel to do so. To prove this, we have only to notice how fretful and unhappy a child is when waked up before its nap is out. If the brain is nourished during sleep, it must have most vigor in the morning; hence the morning is the best time for study—for then the brain has most strength, most activity, and must work more clearly. It is "the midnight lamp" which floods the world with sickly sentimentalities, with false morals, with rickety theology, and with all those harum-scarum dreams of human elevation which abnegate Bible teachings.—*Hall's Journal of Health.*

Early Breakfast.

Breakfast should be eaten in the morning, before leaving the house for exercise or labor of any description. If early breakfast were taken in regions where chill and fever, and fever and ague prevail, and if in addition a brisk fire were kindled in the family room for the hours including sunset and sunrise, those troublesome maladies would diminish in any one year, not tenfold, but a thousand-fold, because the heat of the fire would rarify the miasmatic air instantly, and send it above the breathing point. But it is troublesome to be building fires night and morning all summer, and not one in a thousand who reads this will put the suggestion into practice, it being so "troublesome," requiring an effort to shiver by the hour, daily, for weeks and months together; such is the stupidity of animal man!—*ib.*

The Poetry of the Steam Engine.

There is something awfully grand in the contemplation of a vast steam engine, Stand amid its ponderous beams and bars, wheels and cylinders, and watch their unceasing play; how regular and how powerful! The machinery of a lady's Geneva watch is not more nicely adjusted—the rush of the avalanche is not more awful in its strength. Old Gothic cathedrals are solemn places, preaching solemn things; but to the deep thinker an engine-room may preach a more solemn lesson still. It will tell him of mind—mind wielding matter at its will—mind triumphing over physical difficulties—man asserting his great supremacy—"intellect battling with the element." And how exquisitely complete is every detail!—how subordinate every part toward the one great end!—how every little bar and screw fit and work together! Vast as is the machine, let a bolt be put the tenth part of an inch too long or too short, and the whole fabric is disorganised. It is one complete piece of harmony—an iron essay upon unity of design and execution. There is deep poetry in the steam engine—more of the poetry of motion than in the bound of an antelope—more of the poetry of power than in the dash of a cataract. And ought it not to be a lesson to those who laugh at novelties, and put no faith in inventions, to consider that the complex fabric, this triumph of art and science, was once the laughing-stock of jeering thousands, and once only the waking phantasy of a boy's mind as he sat, and, in seeming idleness, watched a little column rise from the spout of a tea-kettle?

Nothing New under the Sun.

Great inventions do not spring into existence in a state of perfection, and hence there is some pertinence in the words of Solomon, "There is no new thing under the sun," in their frequent application by those disposed to detract from the merits of the ingenious men who have invented or perfected the most important elements of our modern civilization.

The beginning of most inventions is very remote. The first idea borne within some unknown brain passes thence into others, and at last comes forth complete, after a parturition, it may be, of centuries. One starts the idea, another develops it, and so on progressively, until at last it is elaborated and worked out in practice. It is not possible to measure the share of each in the merit of the invention, and apportion it duly; but mankind is most indebted to him who gives it vitality and practical utility. Sometimes a great original mind strikes upon some new vein of hidden power, and gives a powerful impulse to the inventive faculties of man, which lasts through generations. More frequently, however, inventions are not entirely new, but based upon contrivances previously known. Glancing back over the history of the useful arts, we occasionally see an invention seemingly full-born, when suddenly it drops out of sight and we hear no more of it for centuries. It is taken up anew by some inventor, stimulated by the needs of his time, and falling again upon the track, he recovers the old footmarks, follows them up, and completes the work.

The history of the steam engine is now to a certain extent familiar to most reading men; and the progress of its invention can be traced at intervals through a period of over 2,000 years. An old German book, printed in the year 1577, speaks of the reaping machine as a worn-out invention which was wont to be used in France, and the description therein contained shows it to have been, at least, somewhat like the modern machines for the same purpose. Breech-loading cannon and fire-arms, made at least three hundred years ago, and revolvers two hundred years old, are now in existence. Anesthetics were used by the ancient Egyptians. Something like the daguerreotype, printed by the light of the sun, was known to Leonardo da Vinci four hundred years ago. The idea of propelling vessels by steam seems to have been experimented upon by Blasco de Garay as early as the year 1543. The conception of the electric telegraph dates back over two hundred years. The use of coal gas for lighting purposes was known to the Chinese many years before it was known in Europe or America. And something like the modern postage stamp is said to have been used in Paris in the year 1653. Yet, in view of these facts, no candid mind will refuse to acknowledge Watt as the inventor of the condensing steam engine and the most important feature of the high-pressure engine as we now know and use them, or grudge the honor due, and, by common consent, accorded to Fulton, McCormick, Colt, Daguerre, Morse, Murdock, and other great inventors now living or but recently passed away, for their labours in developing and perfecting the machines, processes and contrivances which have now become the very essentials of civilized life. He is most essentially the true inventor who gives practicability to ideas, whether they have originated in his own brain or in the minds of others.

Oxygen Oils.

Before entering upon a description of the methods employed for the purification of the before-mentioned oils, it is considered necessary to give some account of their component parts and their derivatives. Oxygen enters into the composition of all animal and vegetable oils, unless those oils have been submitted to distillation, which, in general, removes their oxygen and changes their characters. The oils distilled from plants with water are known as essences, or essential oils. They seldom contain oxygen, and are therefore called hydrocarbon oils. The volatile vegetable oils contain oxygen, perhaps without an exception.

The oils distilled from the bituminous and oleaginous substances contain no oxygen when they are pure; they are composed of carbon and hydrogen, and are therefore hydrocarbon oils. The greater the quantity of carbon, in proportion to the hydrogen any of them contains, the greater is its specific gravity, the higher its boiling point, density of vapor, and tendency to smoke when employed for the purpose of illumination. An excess of carbon, however, does no harm to any oil designed for lubrication, but rather gives it consistency and durability. Regarding lamp oils, the greater amount of carbon they contain the greater will be their illumination powers, and therefore that is the best lamp, which, when lighted, will decompose the greatest amount of carbon in the flame. It is to the equivalents of carbon and hydrogen contained in oils the attention turns as to a starting point in this inquiry.

Wonders of the Universe.

What assertion will make one believe that in one second of time—one beat of the pendulum of a clock—a ray of light travels over 150,000 miles, and would therefore perform the tour of the world in about the same time it requires to wink with our eyelids, and in much less time than a swift runner occupies in taking a single stiride.

What mortal can be made to believe—without demonstration—that the sun is over a million times larger than the earth; and although so remote from us, that a cannon ball shot directly toward it, and maintaining its full speed, would be twenty years in reaching it? Yet the sun affects the earth appreciably by its attractions in an instant of time. Who would not ask for demonstration, when told that a gnat's wing, in its ordinary flight, beats many hundred times in a second? Or that there exist animated and regularly organized beings, many thousands of whose bodies laid together would not cover the space of an inch?

But what are these to the astonishing truths which modern optical enquries have disclosed, and which teach that every point of a medium through which a ray of light passes is affected with a succession of periodical movements, regularly recurring at equal intervals, no less than five hundred millions of millions of times in a single second! That it is by such movements, communicated to the nerves of the eye, that we are enabled to see; nay, more, that it is the difference in the frequency of their recurrence which affects us with the sense of the diversity of color. That, for instance, in acquiring the sensation of redness our eyes are affected four hundred and eighty-two millions of millions of times; of yellowness, five hundred and forty millions of millions of times; and of violet, seven hundred and seven millions of millions of times per second.

Do not such things sound more like the ravings of a madman than the sober conclusions of people in their waking sense? They are, nevertheless, conclusions to which any one may certainly arrive who will only be at the trouble of examining the chain of reasoning by which they have been obtained.

Isomeric Oils.

Oil of lemons and oil of turpentine are composed of the same elements in the same proportions; an atom of either being formed by the combination of 5 atoms of carbon and 4 of hydrogen.

Rather Severe on the Girls.

An exchange says:—"The number of idle, useless girls in all our large cities seems to be steadily increasing. They lounge or sleep through their mornings, parade the streets during the afternoon, and assemble in frivolous companies of their own and other sex to pass away their evenings. What a store of unhappiness for themselves and others are they laying up for the coming time, when real duties and high responsibilities shall be thoughtlessly assumed! They are skilled in no domestic duties—nay, they despise them; have no habit of industry nor taste for the useful. What will they be as wives and mothers? Alas for the husbands and children, and alas for themselves! Who can wonder if domestic unhappiness and domestic ruin follows?"

Small vs. Large Windows.

The Maryland *Farmer and Mechanic* publishes a plea for stone houses, in the course of which are the following remarks upon small windows, which contain a good deal of truth, and are worthy of attention:—"In building the walls (of our houses) we should introduce one important change. For our climate our windows are too large and too many. The multiplicity of panes of glass draw the heat in the summer, as in a hot bed; and present but a thin film of obstruction to the entrance of the winter's cold. These, then, should be smaller, as they invariably are in hot countries elsewhere. It should, moreover, be borne in mind that these smaller windows which keep out the heat in summer, are equally serviceable in winter, in shutting out the cold, and such windows with thick solid walls, are what are demanded by our contrasts of climate. They are also applicable to the two-fold conditions of coolness in summer and warmth in winter."