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WOOL AND WOOLLEN MANUFACTURES.

Of all the warm blooded animals, man alone is unprotected against the vicissitudes and rigours of climate by a natural covering; all the others, wanting the intellectual faculties necessary to provide raiment for themselves, possess the advantage of a wise, bountiful, and most admirable provision of nature, whereby they are clothed by the functions of their organization—the skin being the soil as it were out of which hair, feathers, and wool grow, receiving their nutriment from organs appropriate to its secretion.

Man, most keenly sensitive to atmospheric influences, is left to clothe himself. It would be a pleasing and perhaps not unprofitable occupation to trace him step by step in his progress to the present results. Deep research in this direction, however, is incompatible with the limits of this article, and we must be content with a very brief skeleton outline. It is quite possible that man's first covering consisted of leaves, and afterwards vegetable fibre, plaited or interwoven by hand, in the rudest and most imperfect manner. No doubt, however, he soon availed himself of the skins of animals slaughtered for this special purpose or for his food.

How many ages passed in the infancy of the race before he learned to spin and weave the wool of the sheep we have no means of knowing, nor have we any positive knowledge even as to whether he found the sheep such as we have been taught to regard that animal, namely, as the wool producing companion of man around the seats of ancient and modern civilization, or whether these external qualities by which *we* distinguish the sheep from the goat grazing on the rich alluvial soil of Egypt and in the green pastures of Judea, were the result of man's fostering care.

If we had seen the sheep neglected by the migratory tribes who, to pursue less peaceful courses, left him to his *own ways*—to "*go astray,*" herding with, and putting on the habits and *appearance* of the native *Argali* on the high table lands of Asia, we might ask the question, do animals thus readily leave their *natural* state and pass into some other, or is the sheep merely relapsing *into his natural state,* from whence he was originally taken?

The first generation of man, as history makes us acquainted with him, cultivated the sheep. Among the patriarchal tribes their herds were their chief care and most fruitful source of wealth. So early as the days when Jacob served Laban for his wives, we find in the story of the peeled rods allusion to the great impressibility of the sheep in breeding, which impressibility has rendered him so available for the service of man, and had, perhaps, long before Jacob's time.

The great care and kind attention paid to the sheep from the earliest ages down to the Christian era are shown by the comparisons, similes and parables, &c., in the Scriptures—"The Good Shepherd." How beautiful the expression, how *pastoral*—"He maketh me to lie down in green pastures, He leadeth me beside the still waters." There is no doubt that at a period long anterior to historical record, there were, as there are now, numerous flocks feeding on the mountains near the valley of Cashmere, constituting the chief wealth of their owners, and giving employment to the dwellers in the valley. As early as the time of Moses, the Egyptians were great sheep breeders, and so well have they succeeded that they have shorn their sheep twice a year. Weaving, and consequently spinning, was practised by the Egyptians from time immemorial. Representations of looms have been found by Sir J. G. Wilkinson amongst the ancient monuments of the Egyptians, and they were celebrated for their textile manufactures of fine linen and other cloths, which were exported to and eagerly purchased by foreign nations. Their fine linen and embroidered work, the yarn and woollen stuffs of the upper and lower country, were frequently mentioned and highly esteemed; woollen work of an ornamental character bearing the evidence of a high antiquity, has recently been found at Thebes.

That the woollen manufacture formed a considerable part of the industry of Babylonia and Phonecia cannot be doubted, but it appears they were unable to raise the finer sorts of wool, or, at least, in sufficient quantities for the requirements of their trade, for Heeren in his learned researches concerning Eastern nations, says: "The finest descriptions of wool manufactured in Babylonia and the Phœnician states are the productions of many parts of Asia."

We have a description of the Arabian sheep by Herodotus, distinguishing the two sorts to which it owed its origin, as the long and the broad tail.

Passing on westward through the pastoral regions of Asia Minor, we come to Miletus, renowned throughout the world for her wools and woollen manufactures. Situated on the eastern shore of the Ægæan Sea, south of the bay in which the river Latmus emptied, and having the advantage of four bays, either of which could accommodate a fleet, she possessed facilities of which she availed herself, to carry on a most extensive commerce with the Greek cities on the other side of the Ægæan, as well as with those on the Euxine, the principal ports of the Mediterranean, Italy, and even the distant coast of Spain. Through the medium of her industrial and commercial enterprise, she succeeded in forming seventy-five or eighty colonies. The Greeks esteemed the "Milesian fleeces" above all others; and there is little doubt but their celebrated sheep found their way into Greece, Italy and perhaps Spain, at a much earlier date than is generally supposed. At any rate, it is almost universally believed that these are the sheep which afterwards became known in Italy as the Tarentine breed, to which the present Merinos owe their origin. It is supposed that the Milesian sheep were introduced into Greece about 490 years before Christ; and it is said that about the commencement of the Christian era, very great improvements were effected in this breed in Spain, the fleece being previously spotted and often dark colored, now becoming white; and that this regenerated race became known as the Merino sheep, from which have descended the present stock.

It would appear that in the first century before the Christian era, Greece and Rome excelled in woollen manufacture; but Strabo, who lived in the first century of our era, says the fine cloths worn by the Romans were made of wool from Spain; and Pliny, a governor of Spain, describes several varieties of fine woolled sheep as having long been reared in that country. By some the breed is sought to be accounted for in other ways—first, that Columella, a Roman residing near Cadiz, and just before the time of Pliny, coupled fine woolled Tarrentian (Italian) ewes with wild rams brought from Barbary, and this cross is said to have been repeated thirteen, and again fifteen centuries later, first by Pedro the Fourth of Castile and Cardinal Ximenes, so that the Merino would have acquired its perfect character in the seventeenth century when it began to attract the attention of foreign nations. Others who discredit this explanation, say the cross was with the Chuna, a long woolled sheep of Spain, altogether distinct from the Merino. The other account, which receives support from several Spanish writers, is that the famous Merino flocks of Spain owe their origin to the English sheep exported thither, about the thirteenth or fourteenth century: the date assigned by Savila is 1393. However this may be, they were found spread all over the country in the seventeenth century, owned principally by the king, nobles and clergy, and cared for and attended in such a way as to deserve all the success which has resulted therefrom. About 1765 the Merino sheep were introduced into Saxony, where, in a few years, the fleece became superior to that of Spain. Near the commencement of this century the Merinos were introduced into Australia, Tasmania, New Zealand, the Cape of Good Hope, and other countries, where the most sanguine expectations of those concerned have been realized. M. Du Pré St. Maur has grown excellent wool from the Merino in Algeria, and from a cross with the native Berber he has produced some very fine samples. This was in the province of Oran.

After the destruction of all that was valuable by the barbarians in Rome, we hear but little of woollen manufactures in Europe until the tenth century; and they can scarcely be said to have received their great impulse until the time of Arkwright. Since that time the progress has been wonderful indeed.

Wool differs from hair chiefly by its felting property, which it owes to the imbricated serratures upon its surface varying from 2,700 in the finest to about 1,850 to the inch. We are now speaking of short wool, of which cloth is made; the long wool is used in the manufacture of worsted goods. The profile line of a filament of wool presents somewhat the appearance of a fine saw, the teeth inclining from the root towards the point; hence it is said to be serrated from the Latin *serra*, a saw, and when these filaments are pressed together (after cleaning), the serratures lay hold of each other and interlock, forming a compact mass. The reason of their not doing so on the sheep's back, and thus rendering the wool useless for manufacturing purposes, is that the skin secretes a kind of natural soap called the yolk, with which these annular and imbricated serratures are covered, and prevented from having a good hold-fast. There is a legend which ascribes the honour of discovering the felting properties of wool to *Clement*, fourth bishop of Rome. Being obliged to fly from persecution, the good man became foot-sore, and put wool between his foot and sandal for ease, and at the end of his journey discovered that the wool had become a kind of cloth. Had the bishop read history by the lights of archæology such as we enjoy now, he would have discovered it covering the tents of antiquity and protecting the bodies of warriors from the arrows of their enemies. The yolk of the wool is all that is required with soft water for washing the sheep, which should always be done before shearing.

The step to be taken with the wool on its arrival at the factory is to sort it, that is to select from the different parts of the fleece those qualities or grades suitable for the purposes assigned to them. We have known wool sorters who had never seen a filament of wool in a microscope, but who could tell the moment they touched it all the manufacturer required to know concerning it. Where many varieties of cloth are made, great discrimination is required, and the practiced touch of the wool sorter is seldom at fault.

FRAZER & CRASHAW'S ONTARIO WOOLLEN MILLS.

We have recently had the privilege of visiting these mills, and of being shown through the principal departments by the gentlemanly and enterprising proprietors.

This manufactory, we believe, is the largest and one of the best of the kind in Canada. It is situated on Ham's Creek, in the town of Cobourg, county of Northumberland, C. W., and was established by Mr. McKechney about fifteen years ago, as a satinet factory, in which character it came into the possession of the present proprietors. The main building is a five-story brick structure, 50 by 100 feet, with a large frame wing and several detached buildings. Most of the old machinery has been replaced by that which is more appropriate to the present business, which is altogether of a superior kind. The annual consumption of wool here is about 200,000 lbs., two-thirds of which is Canadian, and the remainder Michigan and Ohio Merino. The former is worked into five grades, and the latter into four.

The first process proper through which the wool passes is scouring. This is done in hot alkaline liquor, and afterwards rinsed in a cistern close at hand, by directing upon it a very powerful stream of water. The wool that has been washed before shearing requires much less scouring, and takes a better dye: wherever manufacturers can do so, they ought, for their own sakes, to insist upon this as a necessity. In experiments upon wool that had been removed from the skin after death by the liming process, Dr. Calvert found that by steeping the wool for twenty-four hours in lime water, and then passing it through weak hydrochloric acid, not *after* but *before* scouring, the bad effects were removed. The wool we have seen scoured and *well rinsed* is fit for the dye. Messrs. Frazer and Crashaw some time ago kept a French dyer, and introduced the new aniline colours. At present they have an experienced dyer, from a very large establishment in Scotland. This firm is doing all they can to produce good colours in Canada, and they will find it pay. We sincerely hope, for the credit of our woollen manufacturers, that their example will be followed by others.

We now follow the wool up to the fifth story, where it is dried, and then to the "tucker," called indiscriminately by the names Willey, winnow, picker, wool-mill and devil. It is a formidable instrument, having a cylinder, about two feet in diameter and thirty inches long, studded over the surface with hooked teeth—spikes about two inches long. The wool is fed in on an endless apron to two feed rollers, which present it to the hooked spikes whilst the cylinder is going at a high velocity. The wool which went in in tangled locks, comes out at the other end in the shape, but not always the color, of a highly magnified snow-storm. It has now parted with a great deal of dust, and some other foreign matter. Formerly the attendant wore a cloth over his mouth and nose, as a precaution against inhaling the flying dust; but now the mouth of the machine opens, and throws the wool into another apartment; the dust is disposed of in a different way. The wool is now to be oiled, to make it work better, and again passed through the machine, the better to mix the oil, or it may be to mix different colors of wool. The original intention was to open up these tangled locks of wool, as a preparation for the scribbling, and it should pass through several times. The machine here is as good, perhaps better than many others of the kind; but we are satisfied that the truncated conical wool-mill, invented by Mr. Lilly, of Manchester, is infinitely better. If manufacturers would pay a little more attention to this preparatory operation, and carefully examine their wool before it enters the first scribbler, and then again observe the imperfect state in which it leaves that engine, they would agree with us that a better wool-mill is required. At present the delicate card wires are taxed beyond their strength, to do that which could be done more effectually and far cheaper by a stronger machine. We have not space to describe Mr. Lilly's machine, nor could we do full justice to it without a wood-cut. The shape of the cylinder is that of a truncated cone, armed with four rows of strong teeth; the cylinder revolves within a concentric case, armed also with teeth, which are arranged so as to allow those in the revolving cylinder to pass between them. The wool is fed in on an endless apron, on the same principle as the old machine, but the apron extends only about one-third the length of the machine, and is placed near the summit or small end of the cone. Revolving about five hundred times a minute, the wool here receives the minimum impulsion, but by virtue of centrifugal force it is whirled with accelerated velocity up to the base. Its spiral revolution carries it beyond the cylinder, and it falls on another endless apron; coarse foreign bodies fall through the gridiron bottom, and the dust is drawn into, and forced through a pipe into a proper receptacle by a revolving fan. This mill was made for cotton, but suits wool quite as well. Other machines will probably be adopted from the cotton factory, and the sooner woollen manufacturers turn their attention to the beautiful mechanism of the cotton mill, with a view to such adoption, the better.

The scribbling engine to which the wool is next submitted consists of a card-covered cylinder, 36 inches in diameter and 32 inches long, with several smaller cylinders, about 6 inches in diameter, revolving about its upper surface. These are called "workers." These again are accompanied by other cylinders, about 4 inches in diameter, called "strippers" or "cleaners." At one end of the machine is a feed-cloth in motion, conveying the wool which has been spread out upon it evenly by weight into the machinery through the feed rollers, to be taken first by one cylinder, and from it by another, until it has passed over all, and by the perpetual transfer had its fibres opened up, torn shorter, and rearranged many times, until it is delivered at the other end in homogeneous fleecy ribands, fit to be taken into the next engine, from the rollers on which it has been received from this. Mr. Crashaw has effected a great improvement in this machine. Formerly the wool was seized by the tumbler immediately on its coming through, in such a manner as to injure the staple as well as the tumbler card. Now the wool comes over the edge of a dish presenting a greater length of staple before the tumbler takes it, and the arrangement gives great satisfaction.

The second scribbling repeats the operations of opening up, disarranging and rearranging the fibres, till the wool comes to the doffers, from which it is removed by a crank-motion steel comb, and wound on rollers as before, ready for the carding engine; sometimes, however, it will require another scribbling. The carding is but a repetition of the same principle in opening up and adjusting the fibres, but as the fleecy ribands are combed from the doffers they are conveyed between two rollers for each doffer, the object of which rollers is, by their reciprocating motion to rub the ribands into rolls as they are passing on to those rollers which receive them. The doffer is so named because it takes off finally the wool from the main cylinder: formerly, when the wool left the scribbler in a continuous sheet, one doffer was sufficient; but where it is taken off in bands, two are required, each being girdled with bands of card, leaving a space between equal to its own width; the *space* in one being opposite the card on the other, ensures the *doffing* all the wool from the main cylinder. The slubbing billy is not in use here, therefore it is not necessary to describe the method of producing cardings for it.

Spinning is the next process. This consists in taking portions of the rovings, regulated by the mechanism of jacks and mules, into which they are put and elongated, and twisting them into a firmer and longer thread. Our grandmothers could spin but one at a time; that had been done ages before, perhaps by the queen of Sheba, Semiramis and Cleopatra; and it was all that Hercules could do, inspired by the Lydian queen, Omphale. Now, one man, inspired by Arkwright, spins with a two thousand Hercules power!

The tweeds made at the Ontario mills require that two threads should be twisted together. We saw this done, and we must confess we never saw a more beautiful piece of machinery in a woollen mill than that employed here for this purpose. It is a cotton warp twister, adapted to woollen warp. It has 108 spindles; and for the work it performs it occupies very little space, there being no traversing carriage, but every part stationary, having two fronts, with a row of 54 spindles each side, so that the attendant can walk round, and, as every part is within reach, any little derangement can be put to rights instantly; there is no shake nor jar, nor any kind of looseness about the machine, but everything is accurate. The spindles on both sides receive their motion by cords from one tin drum, which is placed in the centre and extends the whole length of the machine. Its cost is $700, and we believe the price is moderate.

Most of the machinery in this establishment owes something to the genius of Mr. Crashaw. We will not enquire about the spooling machines. The warper is so greatly improved that we are almost afraid to attempt a description, lest we should wrong the proprietors, who, we believe have not yet secured a patent for it. We can at any rate testify as to its excellence. Warping is collecting together a sufficient number of threads to form the warp, according to the width of the cloth; and this is done very expeditiously, being warped, sized or dressed, dried and beamed for the loom, all at one operation. The saving in the article of glue by this improved machine is very considerable. Being beamed, the warp is now ready for the loom. There are 45 looms here, but some of them are denuded of much of the mechanism that has heretofore been deemed indispensable, for which a simple camb is substituted; and yet they work with a double shuttle box perfectly, and for four years have been kept going on one kind of work, which meets a very ready sale. We well remember the time when the fulling mills made more noise than all the other machinery in a factory, but now it is quite a relief from the weaving room.

Four pairs of stocks, three rotary fulling mills, and one scourer, comprise the fulling apparatus. Hither the cloth is brought from the loom, and the first thing to be done is to scour it. It will be remembered that the wool had to be scoured and rinsed to remove the "yolk," so that it might be dyed, but afterwards the yolk had to be replaced with one quarter of the wool's weight of oil, so as to render it easy to work; but as the natural oil, or rather soap with an excess of oil, prevented the wool from felting, so will the oil prevent the cloth from felting or fulling. Scour out that oil with soap, fuller's earth, or what you please, and the cloth will felt well enough.

After being dried from the scouring, it is taken by the burler, spread out on an inclined board and freed from knots, and its face thoroughly examined for the purpose of removing whatever would spoil its appearance, picking out gouty threads and mending the gaps thus made by running in even ones, and rendering it as perfect as possible. It is then returned to the fuller, who wets it with water in which is dissolved some soap, and coils it into the trough of the fulling stocks, whose two huge wooden mallets are raised alternately and fall by their own weight, pounding the cloth at such a rate that it becomes warm even in cold weather, under the operation, and this warmth aids the felting process. The serratures are driven in further and further at each blow, and now that the oil is removed, they cannot slip back, thus in the course of some twelve hours—in many cases much more—it is found to have shrunk to about half its width and two-thirds its length. It is rinsed again and dried, when it is fit for the gig.

Where fine cloth depends upon a plain face, and not upon fancy coloured figures for its beauty, dressing on the gig is a process requiring good judgment. Its object is to bring up by scratching with the teazles every little filament from the body of the cloth that that body can part with, without injury to itself. At every half hour the teazles are taken from the gig, and fresh ones, a stage better, that is nearer to being new, put on—for the cloth was commenced upon with those only a stage better than worn out. As the cloth becomes thinnest, the strongest, that is new, teazles are used. We have known this dressing carried a little too far, and the cloth irretrievably ruined. But there is no danger of that kind to be apprehended here.

The gig consists of a cylinder about three feet long and three feet in diameter, and two small ones about a foot in diameter, one above and the other below the large one. The large one is furnished with hook, spring, or T fasteners, to hold the teazle slats securely, and when the periphery or the face of the cylinder is covered with these the cloth is wound from the bottom roller and on to the top one, being in contact for about the space of half a yard with the teazle covered revolving cylinder. The cloth is turned end for end about every half hour, so as to work the nap the contrary way. When the nap becomes inconveniently long for the penetration of the teazles, it is taken off and stretched in the tenter bars to its proper uniform width, and left to dry. Then it is sheared, for facilitating which it has first been run over a revolving cylindrical brush to set up the nap. It is then passed under a rapidly revolving iron cylinder about four inches in diameter, with thin steel blades running spirally from end to end. These are ground so that the edge shall be formed on one side, like that of the shoemaker's or cabinetmaker's steel scraper. These revolve on a ledger blade, which holds the nap while it cuts by the revolving spiral knives. The cloth returns to the gigs again, and is again sheared, in some cases several times. Pressing is here done by an ordinary screw press. The cloth is nicely folded and sheets of thick glazed paper laid between, with some hot iron plates at intervals, when the whole is submitted to powerful pressure. This pressing is repeated so as to bring the former creases under pressure.

It is necessary, of course, to know the length of each piece before it goes away, and this is expeditiously ascertained by drawing it ever so rapidly through a registering measure.

The machinery in this factory is ordinarily driven by two water-wheels of thirty horse power each, and when it is necessary to emp oy more power, there is ready for work a very handsome and efficient steam engine of sixty horse power. In winter, steam is used for heating the building. The number of hands in constant employment here is one hundred, and they turn out eight hundred yards of cloth a day.

AGRICULTURAL ASSOCIATION BY-LAWS.

Notice is hereby given that at the next Annual Meeting of the Agricultural Association, the council will propose the amending of clause fifteen of the By-Laws, so as to give a fixed number of *Single Admission* Tickets to members, instead of *Season* Tickets.

HUGH C. THOMSON, } *Secretaries.*
WM. EDWARDS, }

Useful Receipts.

Processes for Staining Woods.

Mahogany Color (Dark).—Boil ½ lb. of madder and 2 oz. of logwood in a gallon of water; then brush the wood well over with the hot liquid. When dry, go over the whole with a solution of 2 drachms of pearlash in a quart of water.

Mahogany Color (Light).—Brush over the surface with diluted nitrous acid, and when dry apply the following, with a soft brush: dragon's blood, 4 oz.; common soda, 1 oz.; spirit of wine, 3 pints. Let it stand in a warm place, shake it frequently, and then strain. Repeat the application until the proper color is obtained.

To Stain Maple a Mahogany Color.—Dragon's blood, ½ oz.; alkanet, ¼ oz.; aloes, 1 dr.; spirit of wine, 16 oz. Apply it with a sponge or brush.

Rosewood.—Boil 8 oz. of logwood in 3 pints of water until reduced to half; apply it, boiling hot, two or three times, letting it dry between each. Afterwards put in the streaks, with a camel's hair pencil, dipped in a solution of copperas and verdigris in a decoction.

Ebony.—Wash the wood repeatedly with a solution of sulphate of iron; let it dry, then apply a hot decoction of logwood and nutgalls for two or three times. When dry, wipe it with a wet sponge; and when dry again, polish with linseed oil.

Red.—1. Take a pound of Brazil wood and mix it with a gallon of stale urine. Pour over the wood while boiling hot. Before it dries it should be laid over with a solution of alum water. 2. A fine red may also be obtained by a solution of dragon's blood in spirits of wine.

Yellow.—Nitric acid, lightly diluted, will produce a fine yellow on wood. Sometimes, if the wood is not in proper condition, it will create a brown. Care must be taken that the acid used be not too strong, or it will render the wood nearly black.

Blue.—Take of alum 4 parts; water 85 parts. Boil.

Purple.—To produce this color, take of logwood 11 parts; alum, 3 parts; water, 29 parts. Boil.

Mahogany.—1. Linseed oil, 2 pounds; alkanet, 3 ounces. Heat them together and macerate for six hours, then add resin, 2 ounces; beeswax, 2 ounces. Boiled oil may be advantageously used instead of the linseed oil.

2. Brazil wood (ground); water sufficient; add a little alum and potash. Boil.

3. Logwood, 1 part; water, 8 parts. Make a decoction, and apply it to the wood; when dry, give it two or three coats of the following varnish: dragon's blood, 1 part; spirits of wine, 20 parts. Mix.

To Take Stains out of Mahogany.—Spirits of salts, 6 parts; salt of lemons, 1 part. Mix, then drop a little on the stains, and rub them until they disappear.

To Stain Musical Instruments.—Crimson: Boil one pound of ground Brazil wood in three quarts of water for an hour; strain it, and add half an ounce of cochineal; boil it again for half an hour gently, and it will be fit for use.

Purple: Boil a pound of chip logwood in three quarts of water for an hour; then add four ounces of alum.

To Clean Glass.

Dip a moistened rag or flannel into indigo, fuller's earth, ashes, or rottenstone, in impalpable powder, with which smear the glass, and wipe it off with a dry soft cloth. Powder-blue or whitening, tied up in muslin and dusted upon the glass, and cleaned off with chamois-leather, also gives glass a fine polish.

Frosting Glass.

The frosted appearance of ground glass may be very nearly imitated by *gently* dabbing the glass over with a piece of *glazier's* putty, stuck on the ends of the fingers. When applied with a light and even touch the resemblance is considerable. Another method is to dab the glass over with thin white paint, by means of a brush—this is much inferior to the former.

To Fasten Leather on Metal.

Steep the leather in a hot infusion of gallnuts, wash the metal with a hot solution of gelatine. Press the leather on the metal, and allow it to cool, when it will be firmly fixed.

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 I.

Delivered on Thursday Evening, March 31st, 1864.

Bones—Composition of raw and boiled bones. The manufacture of superphosphate of lime. Application to agriculture. Bone-black or char, and its use in sugar refining. *Phosphorus*, its properties, extraction and employment in manufacture of matches. *Horn* and *ivory*, their composition and application.

I shall not take up your time by making many preliminary remarks, but merely state that though the heads of the subject on which I intend to speak are not inviting ones, still we shall find as we progress that the study of the various matters which I shall bring before you is full of interest and instruction. Further, it would be difficult to name subjects which better illustrate the ability of man to turn to profitable account the various materials placed in his hands, or to mention substances which have received more complete and skilful applications than those we shall treat of this evening.

Bones.—The composition of "green bones," or bones in their natural state, may be considered under two general heads, viz.:—the animal matters, consisting of a substance called osséine and a few blood-vessels, and the mineral matters, chiefly represented by phosphate of lime and a few other mineral salts. The composition of bones has been examined by many eminent chemists, but the most complete researches are those published in 1855 by Mr. Fremy, who examined bones, not only from various classes of vertebrated animals, but also from different parts of the same animal; and to enable you to appreciate some of his conclusions, allow me to draw your attention to the following table.*

COMPOSITION OF BONES.

Name of Bone.	Mineral matter.	Phosphate of Lime.	Phosphate of Magnesia.	Carb. of Lime.
Femur–Foetus 6 mo.	63.0	58.9	—	5.8
" Boy 18 "	61 6	58.0	0.5	2.5
" Woman 22 yrs.	60.1	59.4	1.3	7.7
" Man 30 "	63.2	57.7	1.2	9.3
" " 40 "	64.2	56.3	1.3	10.2
" Woman 80 "	64.6	57.1	1.2	7.6
" " 97 "	60.8	51.9	1.3	9.3
" Lion (young)..	64.7	60.0	1.5	6.3
" Sheep	70.0	62.9	1.5	7.7
Sperm Whale..........	62.9	51.9	0.5	10.6
Ostrich	70.0	......	...	......
Carapace of Turtle.....	64.3	58.0	1.2	......
Codfish..................	61.3	......	...	......
Stag's horn..............	61.9	58.1	traces.	3.8
Cow's tooth, Bone......	67.1	60.7	1.2	2.9
" " Enamel...	96.9	90.5	traces.	2.2
" " Ivory	74.8	70.3	1.3	2.2
Scales of the Carp......	34.2	33.7	traces.	1.1

The first conclusion drawn by Mr. Fremy from these researches, is that he found a larger proportion of mineral matter than is generally admitted by chemists. Secondly, that there is no material difference in the composition of various bones taken from different parts of man, or of any one animal, but that age has a very marked influence on composition. Thus, in the bones of infants there is more animal and less mineral matter than in the adult, whilst in old age there is more mineral and less animal matter than in the middle-aged man. The mineral substance which chiefly increases in old age is carbonate of lime. Lastly, he could find no marked difference between bones of man, the ox, calf, elephant, and whale; whilst in the bones of carnivorous animals and those of birds there is a slight increase in the amount of mineral matter. Allow me now to call your attention to a most interesting query. I hold in one hand the mineral matter only of a bone, which you can see retains perfectly its original form, and in the other hand I have the animal matter only of a similar bone, which also retains the form in which it previously existed, but is flexible instead of rigid. The question, therefore, arises, whether the strength and hardiness of bones proceed from these two kinds of matter being combined together, or are their respective molecules merely juxtaposed? The answer is, the latter; for, as you see by this specimen, the mineral matter has been entirely removed without deforming the animal texture. Further, in the fœtus it is found that the bones contain nearly the same proportions of animal and mineral matters as those of the adult. Also, it has been observed by Mr. Flourence and other eminent physiologists, that the wear and tear of bones during life is repaired by the formation of new bone on the exterior surface of the bone, while the old substance is removed through the interior duct, and that the composition of the new layer is the same as that of the original bone. Let us now proceed to examine the chemical properties of the various substances composing bones, and some of the various applications which they receive in arts and manufactures. The general composition of bones may be considered to be as follows:—

* Annales de Chimie et Physique. Vol. xliii. pp. 79, 83, 84.

BONES.

Organic Substances.	Blood-vessels..........................	1
	Osséine	32
	Fatty Matters..........................	9
Mineral Substances.	Water	8
	Phosphate of Lime...............	38
	Phosphate of Magnesia	2
	Carbonate of Lime	8
	Divers Salts	2
		100

The above-named animal matter, *osséine*, C 50.4, H 6.5, N 16.9, and O 26.2, and which has been erroneously called gelatine, is insoluble in water, weak acids, and alkalies, whilst gelatine presents properties directly the reverse. But what has led to this popular error is that osséine, when boiled in water, becomes converted into the isomeric substance commonly called gelatine. As I shall have to dwell on this substance at some length in my next two lectures, I will not detain you now further than to state that osséine is obtained from bones by placing them in weak hydrochloric acid, which dissolves the phosphate of lime and other mineral salts, washing the animal substance osséine until all acid is removed, drying it, and treating it with ether to remove fatty matters. I cannot leave this subject without remarking on the extraordinary stability of this animal substance, for it has been found in the bones of man and animals after many centuries, and even in small quantities in fossil bones.

The fatty matter of bones is made useful in the manufacture of soap, railway grease, and for other purposes; it is obtained by taking fresh bones (as bones which have been kept a long time will not yield their grease easily) and placing the spongy parts, or ends of the bones, (where most of the fatty matter exists) in large boilers filled with water, which is then carried to the boil, when a part of the osséine is converted into gelatine and the fatty matter liberated rises to the surface, and is easily removed. The bones thus treated are called boiled bones, and receive many important applications, to which your attention will be called in a few minutes. Benzine and bisulphuret of carbon have been used as substitutes for water in the above operation, but the advantages do not seem to have been sufficient to lead to their general adoption.

Mineral Matter of Bones.—These, as the foregoing tables show, are chiefly represented by phosphate and carbonate of lime. The immortal Berzellus was the first to establish the fact that phosphate of lime was the only substance possessing the properties necessary for the formation of bone, owing to the extremely simple chemical reactions which cause the soluble phosphates to become insoluble. Let us trace shortly the sources from whence we derive the large proportion of phosphate of lime which exits in our frames. Several of our most eminent chemists have proved the existence of phosphorus in sedimentary and igneous rocks, and the important part played by phosphorus in nature cannot be better conveyed to your minds than by this extract from Dr. Hofmann's learned and valuable Report on the Chemical Products in the Exhibition of 1862:—"Large masses of phosphorus are, in the course of geological revolutions, extending over large periods of time, restored from the organic reigns of nature to the mineral kingdom by the slow process of fossilization; whereby vegetal tissues are gradually transformed into peat, lignite, and coal; and animal tissues are petrified into coprolites, which, in course of time, yield crystalline apatite. After lying locked up and motionless in these forms for indefinite periods, phosphorus, by further geological movements, becomes again exposed to the action of its natural solvents, water and carbonic acid, and is thus restored to active service in the organisms of plants and lower animals, through which it passes, to complete the mighty cycle of its movements into the blood and tissues of the human frame. While circulating thus, age after age, through the three kingdoms of nature, phosphorus is never for a moment free. It is throughout retained in combination with oxygen, and with the earthy or alkaline metals, for which its attraction is intense." After these eminently philosophical views by Dr. Hofmann, I will proceed to call your attention to the application of bones to agriculture. Bones are generally used for manuring in one of these three forms:—1st. As ground green bones; 2nd. As ground boiled bones (that is, bones nearly deprived of their osséine by boiling under pressure, as I shall describe in my next lecture); 3rd. Superphosphate of lime.

Green or raw bones have been used on grass land for a long period, but their action is exceedingly slow and progressive, owing to the resistance of the organic matter to decomposition and the consequently slow solubility of the phosphate of lime in carbonic acid dissolved in water. What substantiates this view is that boiled bones are far more active than the above. It is found that from 30 to 35 cwts. per acre of these will increase the crops on pasture land from 10 to 20 per cent. in the second year of their application. But the great advantage which agriculture has derived from the application of bones as a manure has arisen from their transformation into superphosphate of lime, especially applicable to root and cereal crops. To Baron Liebeg is due the honour of having first called the attention of farmers (in 1840) to the importance of transforming the insoluble phosphate of lime of bones into the soluble superphosphate, rendering it susceptible of immediate absorption by the roots and plants, and of becoming at once available for their growth. These suggestions of Liebig were rapidly carried out on a practical scale by Messrs. Muspratt, of Lancashire, and J. B. Lawes, of Middlesex; in consequence of the valuable results obtained by them, the manufacture of artificial manures has gradually grown into an important branch of manufacture in this country. The manufacture of superphosphate of lime is so simple that any farmer possessing a knowledge of the mere rudiments of chemistry can make it for himself, by which he will not only effect great economy, but also secure genuineness of product. All he requires is a wooden vessel lined with lead, into which can be placed 1,000 lbs. of ground boiled bones, 1,000 lbs. of water, and 500 lbs. of sulphuric acid sp. gr. 1·845 (or concentrated vitriol), mixing the whole, and stirring well for about twelve hours. After two or three days a dry mass remains, which only requires to be taken out and placed on the land by means of the drill, or to be mixed with water and sprinkled on the land. When very large quantities of this manure are required, the plan devised by Mr. Lawes appears to me to be the best. It consists in introducing into the upper end of a slightly-inclined revolving cylinder a quantity of finely-ground boiled bones, together with a known proportion of sulphuric acid of sp. gr. 1·68. As the materials slowly descend by the revolution of the cylinder they become thoroughly mixed, and leave it in the form of a thick pasty mass, which is conducted into a large cistern capable of containing 100 tons, or a day's work. This is allowed to remain for twelve hours, when it is removed, and ready for use. Most manufacturers find it necessary to add to the phosphate of lime of bones other sources of phosphates, such as coprolites, or the fossil dung of antediluvian animals which have been found in large quantities in Suffolk, Cambridgeshire, and elsewhere, and contain from 36 to 62 per cent. of phosphate of lime, and from 7 to 38 per cent. of organic matter. Others employ a mineral substance called apatite containing about 92 per cent. of phosphate of lime, and found also in large quantities in Spain, Norway, France, &c. Others, again, employ guanos rich in phosphate of lime, such as those of Kooria Mooria Islands and Sombrero phosphates. The following is the average composition of the superphosphate of lime of commerce:—

Soluble Phosphate	22	to	25	per cent.
Insoluble "	8	"	10	"
Water	10	"	12	"
Sulphate of Lime	35	"	45	"
Organic Matter	12	"	15	"

Nitrogen 0·75 to 1·5 per cent.

The valuable and extensive researches of Messrs. Lawes and Gilbert, and Boussingalt and Ville, have not only demonstrated the importance of phosphates to the growth of cereal and root crops, but also that phosphates determine in a great measure during vegetation the absorption of nitrogen from the nitrate or from ammonia, as will be seen by the following table:—

AMOUNT OF NITROGEN FIXED BY WHEAT UNDER THE INFLUENCE OF THE FOLLOWING SALTS:—

	Without Nitrogenated compounds.	With Nitrogenated compounds.
Phosphate of Lime and Alkaline Silicate	8·15	20·08
Phosphate of Lime	7·25	19·17
Earths and Alkaline Silicates	5·71	11·16
Earth	3·00	9·50

Bone-black or Char.—In 1800, Löwitz made the interesting observation that wood charcoal possesses the remarkable property of removing colouring matters from their solutions. In 1811, Figuier also observed that animal black has far greater decolorating power than wood charcoal, and bone-black has consequently become one of the principal agents in sugar-refining, and has been the means, more than any other substance, of producing good and cheap white sugars. To give you an idea of the extent to which bone-black is used at the present day for decolorating purposes in the refining of sugar, I may state that in Paris alone it is estimated that about eleven million kilogrammes of bones are used annually for that purpose. The preparation of bone black is simple in principle. It consists in placing in cast iron pots about 50 lbs. of broken boiled bones, that is, bones which have been deprived of their fat, of most of their osséine, and piling these pots in a furnace, where they are subjected to a gradually rising temperature, during 24 hours, such as will completely decompose the organic matter, but not so high as to partly fuse the bones, and thus render them unfit for their applications. But a more economical process is generally adopted. It consists in introducing the crushed bones in horizontal retorts, which are themselves in connection with condensers, the ends of which are brought under the retorts to assist by their combustion in the distillation of the animal matter. By this arrangement, not only is char obtained, but oily matters which are used by curriers, and also ammoniacal salts employed in agriculture and manufactures. The extraordinary decolorating action of animal blacks may be considered as partly chemical and partly mechanical—mechanical, because it is proved by some interesting researches of Dr. Stenhouse, to which I shall refer further on, that the action is due to the minute division of the carbon and the immense surface offered by its particles to the colouring matter, char being composed of 90 parts of mineral salts to 10 per cent. of carbon. On the other hand, the action is proved also to be chemical, by the fact that water will not remove the colouring matter, whilst a weak solution of alkali will dissolve it. Dr. Stenhouse's valuable researches not only illustrate fully this fact, but also prove the possibility of producing artificially substitutes for bone-black. In 1857 he published a paper describing the production of an artificial black, called by him aluminized charcoal. This he obtained by mixing intimately, and heating, finely pulverized charcoal and sulphate of alumina, when he obtained a powerful decolorating agent containing 7 per cent. of alumina, and well adapted for decolorating acid solutions, such as those of tartaric and citric acids, in chemical works. He also prepared what he called coal-tar charcoal, by melting one pound of pitch in a cast iron pot, adding to it two pounds of coal tar, and mixing intimately with it seven pounds of hydrate of lime, then carrying the whole to a high temperature, allowing it to cool, removing the lime by washing the mass with hydrochloric acid, and then with water, when carbon in a high state of division was obtained, possessing powerful decolorating properties. The following series of experiments by Dr. Stenhouse perfectly illustrate the chemico-physical action of animal black as a decolorating agent. He boiled a certain amount of char and his two charcoals, with a solution of logwood, then treated each black separately with ammonia, when the following results were obtained: Aluminized charcoal yielded no colour. Bone black but a slight amount. Coal-tar charcoal, large quantities. But it would be wrong in me to leave you under the impression that animal black can only remove colours from solutions. Purified animal black, that is to say, animal black deprived of its mineral matters by the action of muriatic acid and subsequent washing, has the power of removing certain bitters from their solutions. Thus Dr. Hofmann and Professor Redwood applied this property with great skill, some years ago, to the detection of strychnine in beer. Again, Mr. Thomas Graham, Master of the Mint, published a most interesting series of researches, in which he established the fact that purified animal black had the power to remove a great number of saline matters from their solutions, such as the salts of lime, lead, copper, &c.

Revivification of Bone Black.—After a certain quantity of syrup sugar has percolated through the cylinders containing bone black, the interstices become so clogged with impurities that it loses its power of decolorating the syrup. Sugar refiners are therefore in the habit of restoring the power of their bone black, generally speaking, by submitting it to a process of calcination, which volatilizes or destroys the organic matter fixed by the char. It has been proved by experience that char may undergo this operation about twenty times before its pores become so clogged with dirt as to render it useless. [Here the lecturer described, with the aid of drawings, several of the various apparatus used in sugar refineries for the above process, alluding particularly to that of Messrs. Pontifex and Wood, by which a ton of char is revivified every 24 hours.] A new process, however, has been devised by Messrs Leplay et Cuisinier, which as a whole deserves the attention of refiners, though I am aware that several of the details of their process have been used for some time. The char which has served its purpose in the cylinders, instead of being removed, is treated at once by the following processes. It is first thoroughly washed, treated by steam to remove all viscous substances, then a weak solution of alkali is allowed to percolate through the char, which removes saline matters and a certain amount of the lime salts liberates the colouring matters, the char is again washed with weak alkali to remove the remaining colouring matter, and lastly the decolorating power of the black is restored by passing through it a solution of biphosphate of lime. It is to be hoped that the high praise bestowed upon this process on the Continent may induce our manufacturers to try it, as they would obtain two distinct advantages by its use:—First, the economy of operating at once upon the black and restoring its properties without removing it from the cylinders: Secondly, the prevention of the noxious odours given off during the revivification of char by the ordinary methods. It is interesting to note one of the results of the different employment of char in this country and on the continent. In England the wear and tear in sugar refinery is constantly repaired by the introduction of fresh char, and there is no spent or old char for sale. In France, on the contrary, owing to the great impurities in their beet root sugar syrups, and to the use of blood in refinery, the char becomes rapidly clogged with organic matter, and is so completely animalized that its value as a manure exceeds what the char originally cost the refiner. The result is that French "spent" char is annually exported to the French colonies to the amount of 120,000 tons, and is there used as a manure to promote the growth of the sugar cane.

So important is this article of commerce considered, that the French government have appointed special analytical chemists to determine its value for the trade.

Phosphorus.—I am now about to call your attention to one of the most marvellous and valuable substances ever discovered by chemists. In 1660, Brandt, a merchant of Hamburgh, discovered a process for obtaining phosphorus from putrid urine, but though he kept his secret, a chemist named Künckel published the mode of obtaining it from this fluid. A hundred years later, Gahn discovered the presence of phosphorus in bones; and Scheele shortly afterwards gave a process to obtain it therefrom. The process devised by this eminent chemist was shortly afterwards improved upon by Nicolas and Pelletier, and their method was so completely worked out by Fourcroy and Vanquélin, that it is still the process used in the present day. The preparation of phosphorus consists of four distinct operations:—1st. 80 parts of thoroughly calcined and pulverized bones are mixed with 80 parts of sulphuric acid, sp. gr. 1·52, to which is then added 400 parts of boiling water; 2ndly. after a few days the clear liquor, containing bi-phosphate of lime, is removed from the insoluble sulphate, and evaporated until it has the specific gravity of 1·5; 3rdly. this liquor is mixed with 20 per cent. of finely pulverized charcoal, and the whole is dried at a moderately high heat, when, 4thly. it is introduced into an earthenware retort, placed in the galley furnace, and on heat being slowly applied phosphorus distils, and the operation is continued at a high heat for two or three days. It is, however, necessary that the phosphorus thus obtained should be purified, and this is effected by melting the phosphorus under water, and pressing it through a chamois skin. It is then boiled with caustic alkali to remove other impurities, but what is still better is to heat the phosphorus with a mixture of bichromate of potash and sulphuric acid. The phosphorus thus purified is drawn through slightly conical glass tubes by the suction of a caoutchouc pouch, or is allowed to run by an ingenious contrivance into tin boxes. As will be seen by the following formula, the manufacturer only obtained from the bones one-half of the phosphorus they contained:—

$2\,(PO_5,\ 3\ CaO)$	$+\ 4\ SO_3\ HO$	$=\ 2\,(PO_5\ CaO,\ 2\ HO)$	$+\ (4\ SO_3\ CaO)$
Bone phosphate of lime.	Sulphuric acid.	Acid phosphate of lime.	Sulphate of lime.

$2\,(PO_5\ CaO)$	$+\ 5\ C$	$=\ PO_5\ 2\ CaO$	$+\ 5\ CO$	$+\ P$
Bi-phosphate of lime.	Carbon.	Pyrophosphate of lime.	Oxide of Carbon.	Phosphorus.

Consequently many attempts have been made to devise a chemical reaction by which the whole of the phosphorus might be secured. The most successful attempt of late years is that made by Mr. Cary-Montrand, whose success is based on the following chemical reaction:—

Action of Hydrochloric Acid on Bone Phosphate.

$2\,(PO_5\ CaO)$	$+\ 4\ H\ Cl$	$=\ 2(PO_5,CaO,2HO)$	$+\ 4\ Ca\ Cl$
Bone phosphate of Lime.	Hydrochloric Acid.	Acid phosphate of Lime.	Chloride of Calcium.

Action of Hydrochloric Acid on Biphosphate.

$2(PO_5\ CaO)$	$+\ 2\ H\ Cl$	$+\ 12\ C$	$=\ 2\ Ca\ Cl$	$+\ 12\ CO$	$+\ 2\ H$	$+\ 2\ P$
Biphosphate of Lime.	Hydrochloric Acid.	Carbon.	Chloride of Calcium.	Oxide of Carbon.	Hydrogen.	Phospherus.

He arrives at this result by treating calcined bones with hydrochloric acid; the liquor is then mixed with charcoal, and the whole dried at a moderate heat. The prepared mass is then introduced into cylinders through which a stream of hydrochloric acid is made to percolate, and, as shown above, chloride of calcium, hydrogen, carbonic oxide, and two proportions of phosphorus are produced. (The process of Fleck was also described.) Phosphorus prepared and purified by the above processes is a solid, semi-transparent body, having a sp. gr. 1·83, fusing at 110·5° F., and boiling at 550°. It is so inflammable that it ignites in the open air at several degrees below its fusing point; but Professor Graham made, some years ago, the interesting observation that this slow combustion of phosphorus could be entirely checked by the presence of certain combustible vapours. Thus he found that one volume of vapour of naphtha in 1,820 of air, or one volume of vapour of oil of turpentine in 4,444 of air, completely prevented the spontaneous combustion of phosphorus. Further, phosphorus presents the curious property, that, if heated to 160° F., and suddenly cooled, it becomes black, and if heated to 450° or 460° for several hours, it becomes amorphous, and of a dark brown colour. This allotropic state of phosphorus, first noticed by Schrotter, has enabled it to render grave service to society, owing to its not being spontaneously combustible (as in fact it only becomes so at a temperature approaching its point of fusion), and also to its not being poisonous, so that it can be substituted for common phosphorus in the manufacture of matches with advantage. Lastly, owing to this brown amorphous phosphorus not emitting any vapours, those employed in the manufacture of chemical matches now avoid the risk of the dreadful disease of the jaw-bone, called phosphonecrosis. Notwithstanding the great difficulties attending the manufacture of this valuable product, Mr. Allbright, of Birmingham, has, with praiseworthy perseverance and great skill, succeeded in obtaining it perfectly pure on a large scale, and at such a price as to bring it within the scope of commercial transactions.

Chemical Matches.—Although I do not intend to enter at great length upon this subject, yet as it is a highly important one, I deem it my duty to lay a few facts before you. The first application of chemistry to the discovery of a substitute for the old tinder-box of our fathers, was made in 1820, when the sulphuretted ends of matches were covered with a mixture of chlorate of potash, lycopodium, and red lead, and the matches so prepared were dipped into asbestos moistened with sulphuric acid. In 1836, lucifer matches were first introduced, and the explosive matches were soon followed by the non-explosive ones. The composition of these matches is as follows:—

	Non-Explosive.	Explosive.
Phosphorous..........................	25 or 30	9 or 4
Red Lead..........................	5 " 20	16 " 3
Nitre..........................	0 " 0	14 " 10
Sand..........................	20 " 20	....
Vermillion..........................	1 " 0	....
Gum or Glue..........................	20 " 25	16 " 6

The danger as well as the disease attendant upon this manufacture was greatly mitigated by Professor Graham's discovery of the property of turpentine vapour already alluded to. Until lately, the only successful application of amorphous phosphorus to lucifer matches was that of Messrs. Coignet, Frères, of Paris, who caused a rough surface to be covered with it, and so prepared their matches that they would not ignite except when rubbed upon the prepared surface. Similar matches, under the name of "special safety matches," have also been introduced into this country of late by Messrs. R. Letchford & Co., who have also effected several important improvements in this branch of manufacture, in one of which paraffin is made use of to carry combustion to the wood, instead of sulphur, which gives rise to the noxious fumes of sulphurous acid, and as the substitution is made by Messrs. Letchford without any increase of cost, the price of these matches is as low as that of the common ones. These gentlemen have also found the means of diminishing the amount of phosphorus used to a very considerable extent, so that the disagreeable smell of this substance is also avoided. But the greatest improvement that Messrs. Letchford have made is in what they call their hygienic matches, or lights, in which for the first time amorphous phosphate is substituted for ordinary phosphorus, and in small quantities. The advantage of these matches cannot be overrated, for children can eat them with impunity, as amorphous phosphorus is not poisonous; they are not nearly so combustible, and therefore not so likely to cause accidental fires; and lastly, all source of injury to the health of those employed in the manufacture is removed. I cannot leave this subject without still drawing your attention to one or two important facts. Messrs. Hochstetter and Canouil, besides others, have lately introduced chemical matches free from phosphorus, which are stated to have the following composition:—

Chlorate of Potash	10	10	10
Hyposulphite of Lead	26	26	20
Peroxide of Lead	...	9·8	...
Peroxide of Manganese	...	...	33·6
Chromate of Lead	17	4	8·8
Gum Arabic	4	4	4

An important improvement in the manufacture of chemical matches is the reduction of the proportion of phosphorus to a minimum. This is effected by reducing the phosphorus to an infinitesimally minute division, by which the manufacture is rendered more economical, and the matches, when ignited, have less of the unpleasant odour of phosphorus. This division is accomplished by using a solution of phosphorus in bisulphuret of carbon, by which a saving of 19·20ths of the phosphorus is obtained. Another invention is that of Messrs. Puscher and Reinsch, who have proposed the employment of sulphide of phosphorus.

Ivory.—The lecturer, having given some details respecting the properties of ivory, said:—I will now call your attention to the substitution of the following mixture for ivory tablets as applied in photography. Finely pulverized sulphate of baryta is mixed with gelatine or albumen, compressed into sheets, dried, and polished; these sheets are ready for use in the same way as ivory plates. You are all doubtless aware that the nut of the *Phytolephas macrocarpa*, of the palm tree tribe, has for many years been used in this country as a substitute for ivory, and it may be interesting to you to be made acquainted with the following facts, viz., that the nut is composed of—

Pure cellulose	81	per cent.
Gum	6	"
Nitrogenated principles	4	"
Water	9	"
Total	100	

and Dr. Phipson has recently published a method of distinguishing this vegetable ivory from the animal one by means of sulphuric acid, which gives a beautiful purple colour with the vegetable ivory, but none with the animal.

Horn.—Horns of the best quality, and especially the beautiful ones obtained from the buffaloes in India and America, receive a great variety of applications at the present day, owing to their great toughness and elasticity, as well as to their remarkable property of softening under heat, of welding, and of being moulded into various forms under pressure. To apply horns to manufactures they are treated as follows:—They are first thrown into water, and slight putrefaction commences, by which ammonia is produced, when the horn begins to soften. To carry this action further the horns are transferred into a slightly acid bath, composed of nitric and ascetic acids, with a small quantity of various salts. When the horns are sufficiently softened, which requires about two weeks, they are cleaned and split into two parts by means of a circular saw, and these are introduced between heated plates, and the whole subjected to an intense pressure of several tons to the square inch. The plates may be moulds, and thus the bone may be compressed into any required shape. A great improvement has recently been effected in this branch of manufacture, which consists in dyeing the horn various colours. To accomplish this the horn is first dipped into a bath, containing a weak solution of salts of lead or mercury, and when the horns have been thus impregnated with metallic salts, a solution of hydrophosphate of ammonia is rubbed upon them, when a black or brown dye is produced. Another method consists in mordanting the horn with a salt of iron, and dipping it in a solution of logwood. Of late, very beautiful white fancy articles have been produced from horn by dipping it first into a salt of lead, and then into hydrochloric acid, when white chloride of lead is fixed in the interstices of the horn, which then simply requires polishing.

This lecture, as well as those which followed, were illustrated by numerous specimens and experiments.

LECTURE II.

Delivered on Thursday Evening, April 7th, 1864.

GELATINE, GLUE, BONE-SIZE, CHONDRINE, their preparation, chemical properties, nutritive value, and application to arts and manufactures. Artificial tortoise-shell. *Isinglass*, its adulterations and adaptations to the clarification of fluids. *Skins* and the art of tanning.

As the syllabus will show you, I intend to draw your attention, especially in this lecture, to gelatinous substances, as well as to the art of tanning. There are four distinct gelatinous substances obtained on a commercial scale from animal tissues and bones, viz.:—*Osséine*, which I mentioned in my last lecture, *Gelatine*, *Chondrine*, and *Isinglass*.

Osséine, as already stated, is the animal matter existing in bones, and no doubt it is the same substance which also exists in skins, both during life and when recently removed from the animal. It is characterized by its insolubility, its inability to combine with tannin, and lastly, the facility with which it undergoes a molecular change, and becomes converted into gelatine, slowly, when boiled with water at 212°, rapidly, when boiled under pressure at a higher temperature, and very gradually under the influence of putrefaction.

Gelatine is a solid semi-transparent substance, which absorbs water in large quantities (40 per cent.), becoming thereby transparent. It is very slightly soluble in cold water, but very soluble in boiling water; and this solution has the characteristic property of forming a jelly on cooling. So powerful is gelatine in solidifying water, that one part of gelatine will form a jelly with 100 parts of water. It has been observed that gelatine loses this valuable property if boiled for a long time at ordinary pressure, or if carried to a temperature above 223° F. Before examining the interesting action of acids upon gelatine, allow me to mention that whilst solid gelatine resists putrefaction for a long time, its solutions have a tendency to putrefy rapidly, but I have the pleasure to inform you that a few drops of a substance called carbolic acid will prevent putrefaction for a long period. Gelatine dissolves readily in ascetic acid, of moderate strength, or vinegar, and this solution, which is used as glue, has the useful property of remaining fluid and sound for some time. But a Frenchman, named Demoulin, has introduced of late years, in Paris, a solution of glue which is superior to the above and to that in common use, because it does away with the trouble of constantly heating the glue-pot. His process consists in melting one pound of best glue in one pound of water, and adding gradually to the two one ounce of nitric acid of sp. gr. 1·36, heating the whole for a short time, when the fluid glue is prepared. The action of concentrated nitric acid on gelatine is most violent, giving rise to several compounds, amongst which may be mentioned oxalic acid. The action of sulphuric acid on gelatine is important in a scientific point of view, as an alkaloid called leucine is produced, as well as a sweet substance, called glycocolle, or sugar of gelatine. Gelatine is distinguished from other organic substances by the following chemical reactions:—it gives a white precipitate with alcohol, also with chlorine, none with gallic acid, but one with tannin, or tannic acid. The properties of this precipitate are most important to us, as it is on the formation of it in hides that we ascribe their conversion into leather. The relative proportion of these two substances (gelatine and tannin) in the precipitate varies with the respective proportions brought in contact, but precipitates containing as much as 46 per cent. of tannin have been examined. It is insoluble in water, and presents the invaluable character of not entering into putrefaction. Beautiful fancy ornaments have recently been introduced in Paris by M. Pinson, called artificial tortoise shell, which he obtains by melting, at a moderate temperature, gelatine with a small amount of metallic salts, running the whole into moulds, staining the mass with hydro-sulphate of ammonia, so as to produce an imitation of the grain of tortoise-shell. The objects so produced are then polished and ready for sale. Before entering on the manufacture of various qualities of gelatine, I should wish to state that there can be no doubt, from the researches of Magendie, as well as from the Report of the Commission appointed by the Netherlands Academy of Sciences, that gelatine as food possesses no nutritive value whatever. Allow me now to give you a rapid outline of the methods followed in the manufacture of various qualities of gelatine. The first quality of gelatine is prepared by taking the clippings, scrapings, and fleshings from the tanyard, treating them with lime water or alkali, to remove any smell and certain impurities. They are then well washed and left in contact for a day or two with a solution of sulphurous acid. They are then placed in a suitable apparatus with water, and heated, when the osséine is converted into gelatine. This is run into a second vessel, and a little alum added, to throw down any impurities that may be in suspension. The liquor is now ready to be run into another pan, where it is concentrated to the necessary consistency, so as to become solid, when it is run into wooden moulds. Eighteen hours afterwards the gelatine is turned out of these moulds on to a wet slab, where it is cut into slices by means of a copper wire; these slices are placed on wire gauze frames, and left in a drying shed until they are perfectly dry and ready for the requirements of trade. The second quality of gelatine is prepared by placing bones in large cylinders, and allowing high-pressure steam to arrive at the bottom of the cylinder, which rapidly converts the osséine of the bones into gelatine, and the removal of this is facilitated by allowing a stream of hot water to enter the upper part of the cylinder. The solution of gelatine thus obtained is evaporated, and is usually employed for the preparation of glue. A third quality is prepared by treating bones with hydrochloric acid (as referred to in my first lecture), and submitting the osséine thus obtained to the action of steam. Lastly, a fourth quality of gelatine, called bone-size, is manufactured by boiling more or less decayed bones, as imported from South America and elsewhere, the flesh of dead animals, &c., and concentrating the solution to the consistency required for the various applications it receives in commerce. [The lecturer then described the mode of obtaining the beautiful thin coloured sheets of gelatine used in photography and other fancy purposes, and also the characteristics which distinguished good from bad glues.]

Chondrine, or cartilage gelatine, first noticed by Messrs. Müller and Vögel, Jun., is interesting as possessing qualities, not only different from those of gelatine, but such as injure the quality of the latter when mixed with it. In fact it gives precipitates with acetic acid, alum, persulphate of iron and other salts; and as gelatine is often used in connection with these substances, it is easy to foresee how these precipitates may interfere with its application. On the other hand, the quality possessed by this peculiar gelatine, may, I think, render it serviceable in the art of calico printing, for fixing colours, or as a substitute for albumen or lactarine. Thus, the solution of chondrine and acetic acid may be mixed with any of the new tar colours, and the whole printed, allowed to dry, and steamed; the acetic acid will be driven off, leaving the colour fixed by the chondrine on the fabric. Chondrine is prepared by submitting to the action of heat and water the cartilaginous tissue of animals or the bones of young animals.

Isinglass is obtained from the air-bag or swimming-bladder of several kinds of fish, especially those of the sturgeon tribe, and, although imported from various parts of the world, the principal supplies are from Russia, from whence the best qualities come, which bear the names of Beluga, Volga, or Caspian Sea leaf. Brasil, New York, the East Indies, and Hudson's Bay, also supply various qualities of this valuable substance. It also reaches this country in different states, viz., in leaf and in honeycomb, that is, the bag is cut open, cleaned, and dried; and the quality called snow-bleached is enhanced in value by having been buried in the snow on the banks of the Volga for a long period, by which the isinglass is whitened. Pipes, purses, and lumps are bags which have been cleared but not opened; and a quality called ribbons is made by rolling the bag and cutting it into strips before shipping it to this country.

I shall now endeavour to explain to you how the beautiful preparations before you, for which I am indebted to the kindness of Mr. James Vickers, are obtained. The leaf bladder is first softened in water, and rolled out, under high pressure, into thin leaves, which may extend to several feet long; these in their turn are drawn under a number of revolving knives, making 1,000 revolutions per minute, by which 6,000 of the well-known fine threads are produced in every minute. For commercial uses the purses or lumps above mentioned are chiefly employed. These are soaked in water for two or three days, cut open, certain useless parts removed, further softened, rolled, and cut into various dimensions, according to the requirements of trade, their chief use being the clarification of beer and other alcoholic fluids, for which gelatine cannot be employed, because it dissolves in water whilst isinglass merely swells. The result is that the highly-swollen and extended mass, when poured into beer, wine, or other alcoholic fluids, is on the one hand contracted by their alcohol, and on the other hand it combines with their tannin, forming an insoluble precipitate, which, as it falls through the liquors, carries with it the impurities in suspension, and thus clarifies the fluid. As isinglass is very slow in swelling out in water, brewers employ an acid fluid for the purpose, but, strange to say, instead of using pure acetic acid, many of them take sour beer. I have known instances of great losses occurring in this way, acetous fermentation having been thus spread through the entire brewery during the summer months. As a large quantity of gelatine, cut into shreds, in imitation of isinglass, is sold at the present day, it may be useful to know that detection is very easy, by the following method:—Place a small quantity in hot water, in which gelatine will readily dissolve, whilst isinglass will do so very slowly. I cannot conclude the examination of this interesting class of substances without drawing your attention to the fact that osséine, gelatine, chondrine, and isinglass, present marked differences in their textures and general properties, although their chemical compositions may be considered identical, thus:—

	Osseine.	Gelatine.	Chondrine.	Isinglass.
Carbon	50·4	50·0	50·61	50·56
Hydrogen ...	6·5	6.5	6·58	6·90
Nitrogen	16·9	17·5	15·44	17·79
Oxygen	26·2	26·0	27·37	24·75

Esculent Nests.—I must not omit to mention, in connection with this interesting class of substances, these curious gelatinous products, which are not only considered great delicacies in China, India, but even in Europe, where they realize from £3 to £7 per pound; considerable quantities are imported into England. It has long been a disputed question what is the chemical nature of the substance composing these nests, which are the product of a peculiar kind of swallow; but Mr. Payen, by his recent researches, has left no doubt in the minds of chemists that it is an animal, not a vegetable matter. In fact, it is a peculiar mucous substance, secreted by the bird, and composed of carbon, hydrogen, oxygen, nitrogen, and sulphur. Further, it is insoluble in cold water, but soluble in boiling, and differs from gelatine and isinglass in that it does not gelatinize as it cools.

Skins.—Skin consists of two principal parts, one a mere film, called the epidermis, and the other constituting the bulk of the skin, and called the dermis. There are also found in skin a large quantity of blood-vessels, and a small quantity of pigment cells, which hold the colouring matter. Further the skin contains a small amount of nerves and a number of glands, among which may be cited the sebacious glands or follicles, which are intended to secrete the unctuous matter constantly accumulating upon the skin, and keeping it soft and pliable; then there are the perspiratory glands, which play a most important part in the physiological construction of the skin. These are so numerous that Mr. Erasmus Wilson has calculated that there are 3,528 of them in a single square inch of human skin, so that in an ordinary sized body there are no less than 2,300,000 of these pores. But still the most important part of the hide for us is that called the "dermis." The skins of animals are commercially divided into three distinct classes. The hide is the name given to the skin of full-grown animals, such as oxen, horses, and buffaloes; and these are further subdivided into fresh hides, that is to say, those which are obtained from animals slaughtered in this country; dry hides, that is, hides which have been dried in the sun, and which are principally imported from South America; and dry salted hides, principally from the Brazils, where they are salted and then dried in the sun; and salted hides, which are preserved in Monte Video and Buenos Ayres by salting them, and which are shipped imbedded in salt, to this country. The composition of a fresh hide may be considered to be as follows:—

Real skin	32·53
Albumen	1·54
Animal matters soluble in alcohol	0·83
Animal matters soluble in cold water	7·60
Water	57·50
	100·00

A second class of hides is that called kip skins, which are skins flayed from the same kinds of animal as the foregoing, only when young. Thirdly, the term skin is applied to those of small animals, such as the sheep, goat, seal, &c.

I will now endeavour to give you an idea of the preparation which hides undergo to fit them for the art of tanning. These operations are four. The first consists in washing off the dirt from the hide, softening it, if a dried one, or removing the salt, if salted. The second has for its object the removal of the hair, which is effected by two or three different methods. The most usual plan is to place the hides in large vats, containing a weak milk of lime, for two or three weeks, care being taken to remove and replace them every other day, after which time the hair is sufficiently loosened to be removed. A second plan consists in piling up the hides, allowing them to enter slightly into a state of putrefaction, and then placing them in weak milk of lime, so as to complete not only the loosening of the hair but also the swelling of the hide, for lime also possesses that property. Another process, which is called the American plan, is to hang the hides in pits for two or three weeks, keeping them at a temperature of 60° and constantly wet, when the hair can be easily removed. Weak alkalies are sometimes substituted with advantage for lime in the above processes, and this plan is certainly the best, as it does not leave in the hide any mineral residue, as is the case with lime, either in the form of an insoluble soap of lime or of carbonate, both of which are highly objectionable in the subsequent process of tanning, as they act on the tannic acid of the tan, facilitating its oxidation, and thereby rendering it useless. Depilation of hides is sometimes effected by the employment of weak organic acids; thus the Calmuck Tartars have used from time immemorial sour milk for that purpose. In some parts of France, Belgium, and Germany, the unhairing of the skins is also effected by an acid fluid, produced by the fermentation of barley meal, which gives rise to acetic and lactic acids. To carry out this process generally speaking five vats are used. In the first the hides are cleaned; in the second they are softened, and the hair and epidermis prepared for depilation; and the third, fourth and fifth are used to swell and give body to the hide. This operation, which is called white-dressing, does not work so well as lime for heavy hides, as it swells them to such an extent as to render them unfit to prepare compact leather. When the hair can be easily pulled off, the hides are placed on a convex board, called a beam, and scraped with a double-handed concave knife, which not only removes the hair, but a large amount of fatty lime-soap, and other impurities, from the hides. The third operation consists in fleshing the hides, by shaving off all useless flesh, fat, and other matter by means of a sharp tool. The fourth operation is called swelling or raising the hide, the purpose of which is the following:—First, the removal of any lime or alkali which may remain in the hide: and secondly, to swell or open the pores of the hide, so as to render them better adapted to absorb the tannic acid of the tanning liquors. This is effected by dipping the hides in weak spent tanning liquors, or liquors which have lost the tannic acid, but which contain more or less of gallic acid, for not only do all tanning matters contain gallic acid, but its proportion is greatly increased during the operation of tanning, by a process of fermentation which goes on during that operation, and which converts tannic acid into gallic acid and a peculiar sugar.

The Tanning of Hides.—The old process of tanning consisted in placing layers of wet tan and of hides alternately, and after two or three months removing the whole from the pit and replacing the old by fresh tan. These operations were repeated until the hides were tanned, which took from eighteen months to two years, owing to the difficulty of the tannic acid reaching the interior of the hide. Of late years the process of tanning has been greatly shortened by treating the bark with water, and steeping the hides in the liquor, first weak and afterwards strong. By this means good leather can be obtained in the space of eight or ten months. More rapid tanning, but probably giving inferior leather, is effected by employing, in conjunction with, or as a substitute for, bark, a decoction of dividivi, valonia, myrobalan, catechu or terra japonica, gambia, &c. Many efforts have been made of late years to apply the laws of hydraulics, as well as several physical and physiological principles discovered by eminent philosophers, with the view of shortening the period of tanning, but as I believe that none of them have received the general sanction of the trade, I shall confine myself to giving you an idea of the most successful ones. The first attempt to accelerate the process of tanning consisted in forcing the tanning fluids into the substance of the hide by means of hydraulic pressure. Mr. Spilbury, in 1831. employed a process which consisted in making the hides into sacks, and plunging them into a tanning liquor, and as the fluid percolated through the skin into the interior of the bag the air was allowed to escape. By this means a certain amount of time was saved in bringing the tanning liquor in contact with the various parts of the skin. Mr. Drake soon followed in the same direction, his plan being to sew hides together, forming bags, which he filled with a solution of tan; and to prevent the distention of the skins by the pressure of the liquid within, they were supported in suitable frames; as the pores became gradually filled with tannin, artificial heat was applied to increase the percolation of the fluid. Messrs. Chaplin and Cox's process is also very similar to the above, the difference being that the tanning fluid is placed in a reservoir, and allowed to flow into the bag of hides through a pipe, the fluid being thus employed at pressures varying according to the height of the reservoir. The bag of hides is at the same time plunged into a solution of tannin to prevent excessive distention. Messrs. Knowles and Dewsbury have recourse to another principle to compel the percolation of the tanning liquor through the hide. To effect their purpose, they cover vessels with hides, so as to form air-tight enclosures, and, having placed the tanning fluid they employ on the hides, the vessels are exhausted of air, and atmospheric pressure then forces the fluid through the skins into the vessels below. Mr. Turnbull's process, being an imitation of that used for tanning Morocco leather, need not be described. Attempts have been made from time to time to mineralize hides, that is to say, to substitute for tanning, mineral salts, as will be described in my next lecture, when speaking of the art of tawing skins. The processes which have attracted most notice in this branch of the art of preparing leather are those of Messrs. D'Arcet and Ashton, M. Bordier, and M. Cavalier. M. Bordier's plan is that of dipping hides in a solution of sesqui-sulphate of iron, when the animal matters of the hide gradually with a basic sesqui-sulphate of iron, rendering the hide imputrescible, and converting it into leather. M. Cavalier's method is to dip hides first into a solution of protosulphate of iron, and then into one containing alum and bichromate of potash. A chemical action ensues by which the protosulphate of iron is converted into a persulphate, combining with the animal matter, and by its preservative action, together with that of some of the alum, the hide is converted into leather I think, however, that I shall be able to satisfy you, from the results of many examinations of leather and hides which I have made, that there are good and sufficient reasons why most of these processes have necessarily failed. Inventors have been led to believe, by the statements of many eminent physiologists (as can be proved by reading some of the most recent works on that science), that skin is composed of blood-vessels, glands, &c., plus gelatine, and that if by any mechanical contrivance the tanning liquor could be brought into contact with this gelatine, the leather would be tanned; and many ingenious schemes have been devised, and much money expended to obtain that result. The fact, however, is that there is no gelatine in skin, for if there were, when hides were placed in water, the gelatine would be dissolved and washed away. But what is supposed to be gelatine in the hides is in reality the isomeric substance called osséine or one greatly resembling it. The great discovery to be made in the art of tanning, therefore, is that of a chemical or fermentative process, by which the the isomeric change (that of the osséine into gelatine) may be rapidly produced, instead of by the slow putrefactive process which occurs in the old method of tanning. Further, I would observe that to convert a hide into leather it is not sufficient that the whole of its animal matter be combined with tannin, for the leather thus obtained would present two great defects; 1st. the hide would not have increased in weight, and the tanner's profits therefore would suffer; 2ndly. the leather would be so porous as to be useless for many of the purposes for which leather is required. The reason of this is, that when, after a period of several months, the osséine has been converted into gelatine, and this has become thoroughly combined with tannin, a second series of reactions is necessary to render the leather more solid and less permeable to water, and to increase materially its weight. These reactions constitute what is called feeding the hide, and are brought about by leaving it to steep in more concentrated tanning liquor for a considerable period; and this necessary process, beneficial to the wearer as well as to the producer, appears to me to be that which offers the greatest impediment in the way of shortening the period of tanning. The hides as they leave the tanning vat require several operations before they are ready to be used for soles, or to be curried for various commercial purposes. They are first slightly washed and placed in a shed to partially dry, and are then rubbed with a brush and rough stone on the face of the leather, or hair side, to remove any loose tanning material that may remain on the surface; but this rubbing is not applied to the back, as buyers attach great importance to the peculiar appearance called the bloom, which enables them to judge of the goodness of the tanning. The tanned hides are again slightly dried, and oiled on the face, and then submitted to the pressure of a roller passed over the surface, which has the effect of rendering the leather more flexible and the surface perfectly uniform. These operations are repeated two or three times, when the leather is ready for soles. Before the tanned hides intended for shoe-soles are considered fit for that purpose, they must be slightly compressed and softened, so as to again diminish the permeability to water. This was formerly effected by beating with a hammer called the mace, but of late years this slow process has been superseded by compressing machines; and I believe those most appreciated in the trade were invented by Messrs. Cox and Welsh, and Messrs. Iran and Schloss.

ON PROPER CLOTHING.

BY EDWIN LANKESTER, M.D., F.R.S.

From "Popular Science Review."

Whilst fresh air is essential to health, there can be no doubt that one of the disadvantages that follows its possession is exposure to cold. From the earliest periods of his history, man has had recourse to various expedients for maintaining the warmth of his body. His house and his clothes are arrangements which he makes for protecting himself from cold. It follows, then, in a natural sequence, that when we have spoken of the importance of fresh air, we should proceed to speak of the necessity of maintaining the warmth of the body; and as clothing is one of the most natural ways of protecting the body from cold, we will now put together a few remarks on the matter of clothes. We shall take up here the whole subject of Dress, and speak of its use and abuses.

Clothing is not only employed by man for warmth, but also for coolness—contradictory as that may be—for protection, and for ornament.

As, however, in this climate, dress is mostly worn for the sake of its warmth, we shall speak first of the reasons for this, and the kinds of dress which are most adapted for the purpose.

If we take a Fahrenheit's thermometer and place it in contact with any internal part of a human body, we shall find that it rises to the temperature of 98°. This temperature, which is called on the thermometer "blood-heat," is found to be constantly the same, whether the human being is living in temperate climes like our own, dwelling in the Arctic or Antartic zones, or under the torrid sun of the tropics. Every animal with a perfect heart, as birds and mammals, has its own peculiar temperature, and each species maintains its own temperature, to whatever external temperature it may be exposed. Slow-moving animals, as the elephant, hippopotamus, and rhinoceros, have a lower temperature, whilst quick-moving animals, such as birds of rapid flight, have a much higher temperature than man.

The constancy of this temperature of animals shows clearly that it originates independently of external circumstances. It is, in fact, produced by the combustion of food in the blood and tissues, in contact with the oxygen of the air which is taken in during respiration. If a sufficiency of food is taken, and there is due exposure to atmospheric air, the temperature of the human body is maintained at 98°. It may then be asked, where is the necessity of clothing to keep us warm? If man were a mere animal—if, like the beasts of the field, the only objects of his existence were a sufficiency of food and the propagation of his race, he could live without clothing. There are savage races of men all over the world, in both cold and temperate regions, who live but with little or no clothing. The moment, however, that man rests from the chase, that he begins to till the ground, and forms tastes connected with comfort and indulgence, then he discovers the necessity of protecting himself from that external cold which rapidly diminishes the temperature of his body, and which requires large supplies of food, as fuel to this internal fire, and active exercise, to enable the digestive organs to fit the fuel for burning. Just as man is active in his habits, and can digest abundance of food, is he independent of the necessity of clothing.

In proportion, however, as we find him devoting himself to commerce, and engaged in manufactures, do we find him building warm houses and putting on warm clothing. Clothes, in fact, act in two ways: they diminish the necessity of consuming large quantities of food, and prevent the tax upon the digestive organs which such large quantities of food would imply. Just in accordance to the external temperature is the demand made upon the system to keep up its temperature by supplies of food. Even with our artificial habits of clothing, the men who live in the coldest climates consume the largest quantity of food, and in this country we eat more in the winter than the summer. Nay more, we consume our own substance more in the winter than the summer, and weigh least in winter, and most in summer.

It is one of the great objects of civilised man to adapt himself to all external temperatures, so as to maintain his temperature at 98°. This he does by consulting his instincts and using his reason, and adapts his diet, his house, and his clothing, to this necessity of his life. He does it by his instincts vaguely and uncertainly, falling into errors which are constantly destructive of his health and life. One of the most universal of instincts of civilized man is to shut out the cold. He huddles himself with his fellows in cots and cabins, and the dens of civilized towns, to maintain his warmth and spare his food; but in doing this he contaminates the air he breathes, and shuts out that oxygen which is more necessary to his life than even the warmth of his body. So terrible is the effect of atmospheric poison on his body, that when the cold comes, it finds more victims among the overcrowded homes of the poor than among any other class. Thus one weeks' continuous cold — the thermometer ranging from ten to twenty degrees below the freezing-point during the second week of January in this year—added nearly 2,000 victims above the average deaths of the season of the year to the mortality of London. This "wave of cold" was felt more acutely in that class of our metropolitan population whose systems are rendered less able to resist the influence of cold in attempts to secure warmth by the exclusion of fresh air.

The materials of clothing used by man are obtained from both the animal and vegetable kingdoms. Types of the substances obtained for clothing purposes from the vegetable kingdom are afforded in cotton and linen. Cotton is the hair of a plant, obtained from the inside of the fruit. By the accident of a twist during its growth it is possible to spin it into a thread, and it thus becomes the basis of our great cotton and muslin manufactures. The fibres of linen are the vascular tissue of the common flax, which, when prepared, are formed into threads, which are woven ino the textile fabrics known as linen. These materials are bad conductors of heat. It is on this account that they are used for clothing purposes. Where the object of dress is to keep in warmth, those substances form the best articles of dress which conduct heat least. Another class of substances used for dress are the hairs and fibres of animals. The wool of the sheep, and the silk produced by the silkworm, are the substances most constantly woven into the articles of dress. Both wool and silk are worse conductors than cotton or linen. Hence we find that animal substances are preferred to vegetable substances, when the object is to keep in warmth.

It is, in fact, practically known that cotton and linen are cooler than silk or cloth: and whilst in this country we prefer the latter in winter, we have recourse to the former in summer Men clothe themselves in winter with great coats of cloth, but they wear cotton and linen jackets in summer. In the winter, women clothe themselves with cloth mantles, but in the summer they put on their muslin, calico, and other light dresses. This is quite correct, and it should be recollected as a rule that cotton and linen garments are the coolest, the linen being cooler than the cotton, and that woollen and silken garments are warmest.

The colour of our clothes is not altogether a matter of indifference. White and light-coloured clothes reflect the heat, whilst black and dark-coloured clothes absorb the heat. Hence, in the summer it is clearly policy to wear white and light-coloured clothes, because they reflect the heat of the sun, and prevent its heating the body through the clothes. But what then with regard to winter clothing? It might be supposed that black is the right colour; but if we consider that this colour radiates heat, we shall see that a man in black loses his heat faster than if he were dressed in white. The fact is, white is the best colour both in summer and in winter; for it keeps off the heat in the summer, and retains the heat in the winter. This undoubtedly looks like blowing hot and cold, but is nevertheless true. The coachman will tell you that his white duffel coat is warmer in winter and cooler in summer than any other kind of coat. The brewer's drayman will wear his white stockings all the year round, and tells you that any colour would be less agreeable to his feelings.

It will now be better understood how clothing can become a source of coolness. A black man exposed to the tropical sun will find that a white dress acts by protecting his body from the rays of the sun, whilst the white man will feel the advantage of a covering to reflect the same rays, rather than that his own skin should be used for the purpose. Hence, in hot climates, clothes are worn to keep the body cool.

In many parts of the world, man is exposed to the attacks of the animal creation, especially insects, the bites of which are prevented by covering the body with some sort of textile fabric. The skin is also protected from the accumulation of dirt by the covering of the clothes. In our own climate, those parts of the body which are exposed to the air need constant washing, from the tendency of the dirty particles of the air to adhere to the skin. Certain parts of the body are also exposed to pressure, which it is found exceedingly desirable to prevent. This is especially the case with the soles of the feet, and man, at a very early period of his civilization, puts his feet into sandals, or clothes his foot with boots or shoes.

Whilst clothes are thus worn for utility, no one can look upon clothed man without seeing that he has not put his clothes upon his back merely with a utilitarian object in view. Look at that Indian squaw ; see how she has ornamented the single garment which she wears. Look at her husband with a simple dress, and yet he has stuck peacock's feathers into his head-dress, and glass beads in rows on his neck to ornament his form. Pass on, step by step, through the various grades of civilization, and you see that both in form and colour, dress is made subservient to the great idea of decorating and beautifying the person.

This decoration is principally seen in colour and form. Nor let any one for a moment condemn this natural tendency to adornment. Deep in the instincts of our nature is laid the admiration of colour, and to meet this feeling, the Creator adorns his Creation with all the tints of the rainbow. In the dark unfathomed caves of ocean, a thousand forms of coloured beauties meet the eye, unnumbered insects expand their wings, coloured with varied tints, whilst birds and flowers vie with each other in presenting the primitive colours of the rainbow in all their possible tints to meet the eye of man. Surely, then, if God has adorned so brilliantly His lower creatures, it is left for those who have the power of imitating their Creator, to deck themselves in a similar manner. This subject should have much further study and development than it has hitherto received. There is a harmony of colours as of sounds, and there is a discord of colours as of sounds. It is this discord of colours that often makes dress so offensive, and which disguises the form and grace which naturally belong to man.

It is by this natural taste for ornamentation in dress that the arts of the dyer and calico-printer have been called into existence, and to which we owe the more extensive use of bright colours, now so often seen in red petticoats, stockings, and other brightly-coloured articles of dress. The desire for rich and varied colours in clothing has given an impetus to those chemical researches which have resulted in the discovery of the glowing tints of Magenta, Mauve, and Solferino. The taste for ornamental dress has given many branches to our industry, and is an example of those pure and simple tastes of the human mind, by which it is led on to cultivate an admiration for the beautiful colours of nature, and in its highest tendencies to admire and imitate the work of the landscape-painter.

The form of dress has also been a worthy object of study. Not that modern men or women either have succeeded in this respect. But certainly to the other sex must be given a greater appreciation of beauty in the form of dress. Even the utmost departure from the ordinary conventional rules of dress which female attire has recently taken, in the diminutive size of the bonnet and the inordinate extension of the skirts, can be defended on the ground of their having some shade of artistic merit. Even the chisel of a Phidias might not have despised the graceful folds of the flowing skirts of a modern belle. But when we turn to male attire—whether as a soldier, a sailor, an aristocrat, or a plebeian, there is scarcely a curve or a line that can be said to be beautiful. An ancient sculptor would have regarded it with horror ; and if the angels are allowed to look down upon the earth, and have their feelings kindled by its beauty, there must be one object amidst its charms that must excite in their minds mingled feelings of disgust and pity at its ugliness, and that is the clothed civilized man of the nineteenth century.

Having said thus much of the use of dress, let us proceed to speak of its abuses. First, then, as all articles of dress must be attached to the body in some way or other, we will speak of the dangers of their attachment under the head of *undue compression*. We begin at the head, and this leads us to speak of hats, caps, and bonnets. Why wear them at all? Of all parts of the body, the head seems least to need clothing. A most beautiful, warm, and natural covering has been created upon the head, and why it should be covered by hats, caps, and bonnets nobody has any very definite notion. It seems, however, in hot countries that head coverings prevent the too powerful rays of the sun striking upon the head, and thus producing a *coup de soleil*, or some other minor inconvenience. In wet climates, too, like our own, it is uncomfortable to have wet hair. So for one cause or another modern men and women have got into the habit of wearing some kind of head-gear. That modern man may discover one day that it is unnecessary is not at all improbable. Some thirty years ago, he invariably placed a heavy cap upon his new-born babes, but recently he has found that his innocents do better without them. It is not then I say altogether beyond the bounds of probability that he may see fit to get rid of his own head-dress. In fact, the women a few years ago did nearly get rid of this article of dress, and I never heard that they suffered from it. But I am now to speak of the danger of compressing the head from the weight or fitting on of this article of dress. Children and women seem to be in little danger in this respect. The caps of children are light and fit loosely on their heads; so of women's bonnets. This cannot be said of the hats of man. The hat is a melancholy instance of the utter inability of man to throw off the shackles of custom. The modern chimney-pot hat, with its small brim, is about as ridiculous and unsuitable an article of dress as could possibly be devised. Who could for a moment see it on the head of a Greek Apollo, Mercury, Cupid, or Hercules, without roaring with laughter? Who that wears it does not feel its inconvenience? Its weight necessarily compresses the head; and in order that it may resist the currents of our atmosphere, it is always pushed down upon the head in such a way as to produce a dangerous compression of the blood-vessels of the scalp, and may lead to headaches, giddiness, and even more serious results. The head-dress of our soldiers is even more objectionable still. The shako frequently weighs from ten to fifteen ounces, whilst the bear-skin hat reaches a weight of between two and three pounds. Such head-gear can perhaps be borne by courageous men, even under the influence of a July sun in this climate, but it becomes insupportable in hot climates, especially when long marches have to be made.

A recent physiological writer attributes the more frequent baldness among men as compared with women to the heat and compression of the hats that are usually worn. If no other form can be devised, and they must be made of the unyielding materials employed for their manufacture, they should at least be made as light as possible, and instead of black they should be white. In hats, as well as in body-clothes, white has the advantage of keeping off the heat in summer, and keeping in the heat in winter.

From the head I pass to the neck. If any one will attentively consider the structure of the human body, he will see that the great veins which carry the blood from the interior of the head are placed not very low down in the neck, and are easily compressed from the outside. Such compression congests the brain, and may produce even effusion on the brain. The necks of children are not often compressed by collars or other articles of dress, and women generally dress their necks with great freedom from restraint. It is amongst men that the ridiculous and entirely unnecessary custom of clothing the neck has come to be through fashion, a source of serious mischief by compressing the great veins of the neck. The habit of fastening the collar tight round the throat, and of covering this with a neckcloth or stock, is almost universal amongst European and Anglo-American men. It has been adopted by the armies of Europe, and has nowhere been carried to greater excess than in the English army. One object of this arrangement is undoubtedly to keep the head up, and this has the advantage of throwing up the chest so as to keep the whole body upright over the great centre of support, the pelvis. It is however quite worthy of consideration as to whether this object could not be much better obtained by proper drill, than by an arrangement which endangers the circulation in the brain, and may be productive of dangerous disease. With whatever impunity such strangulation may be borne by the young and the vigorous, there can be no question as to its disastrous results among the feeble and aged, in whom the walls of the blood-vessels of the brain are necessarily weakened, and which at any time may give way from any obstruction to the free return of their contents to the heart.

From the head and neck we may pass to the body. One of the great objects of clothing is to keep the body, independent of the head and extremities, warm. Hence the great bulk of all kinds of garments are attached to the body by belts, braces, stays, bandages, and other devices. We need hardly refer to the now exploded practice of swaddling children in innumerable folds of bandages. This practice is now pursued amongst barbarous races, but the evils attendant upon it are generally perceived amongst intelligent communities. It still, however, occasionally happens that the clothes of an infant are so tightly placed round its body, as seriously to interfere with the proper functions of the lungs, and lead to diseases which end in death.

The active occupations of men have led them very generally to dispense with body-clothing that seriously interferes with the muscles of respiration, and the functions of the abdominal viscera. Those men who are not beyond the reach of the caprices of fashion, have sometimes adopted a dress which has involved a very grave departure from that freedom of movement of the muscles of the body which is essential to health.

It is, however, in the other sex that a style of dress has been adopted which is open to the strongest possible condemnation., from its dangerous compression of the body. The loose robes of the women of antiquity have been exchanged for the bandages and corsets of modern dress. This system has resulted in the adoption of articles of dress which not only compress the blood-vessels of the body, producing congestion, but restrain the action of those muscles which are essential to the proper movement of the whole body, and the due performance of the functions of respiration. A further evil has been demonstrated, in the fact that these articles of dress being worn by growing girls, the skeleton of the body has been actually distorted by the artificial pressure, and personal deformity has been the result. This has not been an exceptional result; whole classes of our countrywomen have laboured under this deformity, and the only class amongst them in which the thorax has been allowed free development is that which, performing the labour of men, have found out that an artificial method of dressing is incompatible with their work. The reign of fashion has perhaps recently relaxed in some measure in this respect; but the idea of woman as to what should constitute the central portion of her dress, must be revolutionized before we can expect this dangerous and deforming system of dress to be abolished. There ought to be no tampering with it, and a new idea of comeliness in female dress must be substituted, if we would wish to get rid of the evils which result from the present fashion of compressing the bust with stays or corsets.

Every writer on Hygiene has unequivocally condemned this absurd custom, and there is no practitioner of medicine but has witnessed the destructive influence that the corset has on health. The compression produced by it diminishes the action of the lungs, and leads to those deposits which fatally destroy life in consumption, whilst the diminished activity and action of the body engendered, lays the foundation of those dyspeptic and nervous diseases to which the great mass of our middle and upper class females are liable.

What is true of the head, neck, and body, is also true of the extremities. Any article of dress so fastened as to prevent a free return of the blood to the heart, congests the vessels below the part compressed. Bracelets, armlets, wristbands, and garters, may all be so worn as to produce painful affections of the limbs compressed.

There is no member of the extremities which has been more disgracefully used than the foot. This wonderful organ, by the perfection of which God has "made man upright," and whose structure so pre-eminently distinguishes him from his recently so called "great-grandfather," the Gorilla, has been made to suffer from compression more generally than any other organ. The thought at once suggests the cruel practice of the Chinese, who prevent the growth of the female foot, by placing it in infancy in an unyielding shoe. This fact has had the universal testimony of travellers, in China, and if anything more was wanted to prove it, a collection of the feet of Chinese women is at present to be seen in the College of Surgeons of England, in which, by the careful dissections of Mr. Flower, the Curator, the sad havoc to natural growth produced by this heartless custom is scientifically demonstrated.

The great object of the shoe is to protect the sole of the foot from the injury it is likely to sustain by the weight of the body pressing it against the irregularity of the surface of the earth. The sole of the shoe is therefore its chief use. It is, however, necessary to use some kind of strap or bandage to keep the sole upon the foot. The simplest form of foot dress in which this object is secured is the sandal, worn by the less civilized nations of the earth, as well as the more ancient. It is found, however, that other objects may be accomplished by aid of the pressure necessary for keeping the sole on the foot, and coverings for the foot and leg have been attached to the sole; hence the modern boot and shoe. Hence also the suffering of the modern foot. The form of the boot and shoe has proved no exception to that love of the grotesque, which has compelled mankind in all ages to submit to the sufferings inflicted by fashion. Boots and shoes have been made of every form almost, save that of the human foot, and the consequence has been the production of painful diseases on the surface of the foot, and a distortion of its bones and muscles. This is not a mere assertion. Let any one take a model of the feet of the beautiful Grecian statues, and compare it with the model of a living foot—the foot of the Medician Venus, for instance, with that of a modern belle, or the foot of Hercules with that of one of our labourers or soldiers. It will at once be seen how terribly our unthinking and unnatural way of dressing the foot has worked against its primitive beauty and strength. That a shoe made of leather should fit the foot would seem a proposition to which every one would assent, yet the assertion may be safely made, that not one shoe out of ten thousand made by modern shoemakers fits the foot at all. By dint of custom, like the Chinese women, we manage to submit, without complaining, to the vulgar caricatures of the form of the foot, which characterize our modern boots and shoes.

Nor is this compression, which produces corns and bunions, chilblains, ulcerations between the toes, and loss of the nails, the only fault to be found with modern shoes. The Creator has made this part of the human sole flat, but the shoemaker has discovered that the foot of the gorilla and chimpanzee, which compels them to walk on their toes, is more elegant. They accordingly exalt the heel by an extra piece of leather on the sole, and thus give to the human figure a monkey-like gait. If our young women knew how they are distorting their appearance by this practice, surely they would give up wearing high-heeled boots.*

But we must leave the subject of compression to say a few words on other abuses of dress. Fashion and indolence have brought on an evil which ought to be avoided, and this is the insufficient clothing of young females and children. The fashion of exposing the neck and shoulders in women has undoubtedly led to serious evils. The cooling down of the whole body thus produced is more than the circulating system can bear, and congestion of the lungs and the great vascular organs in the interior of the body is the result. It is too often the case that this system of dressing engenders a susceptibility to slight draughts, which, being prevented, more serious mischiefs than any which lead to the access of fresh air are produced. It is in such cases as this that we see the folly of attempting to remedy one set of evils without knowing what may follow from another. Fresh air, however necessary to life, is death to those who are clothed insufficiently. This should be especially recollected with regard to little children, whose tender frames are far less able to endure cold than those of grown-up persons. Yet they are excluded from fresh air, and the greatest carelessness is displayed in dressing them. Directly a baby leaves off its long clothes it is in danger of being underclothed. This danger is increased when it can run alone, and it is exposed to the outside air, with an amount of destitution of garments for its lower extremities, which, if it occurred in grown-up persons, would at once suggest the necessity of further clothing for the sake of warmth. If the idea, then, can once be comprehended that children of tender years are more susceptible of cold than grown-up persons, a very different kind of dressing would take place, and a holocaust of victims at the shrine of inflammation of the lungs would be saved.

I need hardly enter here upon the importance of changing and cleaning clothes. At the same time, this is a subject that demands more attention than it has yet received. The habit of wearing dark-coloured clothes instead of light-coloured ones has its origin in economical considerations, and it

* Those who do not consider the health and comfort of their bodies as too insignificant for attention, will do well to consult on this subject Mr. Humphreys' book on the "Structure of the Foot and Hand," and Mr. Dowie's book on the "Foot and its Coverings."

would be well to consider whether an amount of dirt is not thus tolerated, which may go far to the spread and production of disease. Dark-coloured clothes after they are worn a little time become dirty, and are as objectionable as light-coloured clothes under the same circumstances, although the dirt cannot be seen.

But I must leave all other abuses of dress, to consider evils of a wider extent. To heap more clothes on the back than is necessary, is a great evil in both sexes. One of the dangers of too much dress is that, unless it is adjusted so as to press equally and bear directly upon the pelvis—the chief centre of support of the body—it is likely to produce deformity. Heavy coats, shirts, or body dresses of any kind, may have their weight thrown too much before or behind, or on one side, and produce deformity. The evil is one to which man is much less exposed than woman. To obtain an ample surface on which to display the beautiful fabrics of cotton and of silk, which have been expressly manufactured for her in patterns of the most wonderful variety and in colours of surpassing beauty and harmony, she has submitted to an enlargement of the skirts of her dress, which, by its weight, endangers the symmetry of her frame; and by its extending beyond the reach of her control, runs the risk of perils which exposes her to the most horrible of deaths. This fashion of extended skirts has come in and gone out, from mere caprice. Our grandmothers wore hoops, and our mothers laughed at their folly; but our sisters, wives, and daughters have revived the folly, with results more melancholy than any connected with the previous exhibitions of this fashion.

I have not alluded in this paper to the *inconveniences* of dress, and I shall not therefore, consider, the present fashion of female dress on this ground. That our rooms have grown less—that our freedom of intercourse in the drawing-room is interrupted—that our vehicles are encumbered—that our places of worship will hold fewer—that our sick-rooms are unnecessarily swept, and our shins injured by steel hoops—are grievances that no one would think of referring to; but when the question is one of life and death, then it seems necessary that the subject should be discussed. Are we justified in submitting to any fashion which can be proved annually to sacrifice several hundreds of victims in our own country alone?

I will state a few facts. In one year—from the 1st of August, 1862, to the 31st of July, 1863—forty-eight inquests were held on persons burned to death, in the central district of Middlesex, comprising nearly a million of people. Of these, thirteen were males, and thirty-five were females. Of the males, eight were under five years of age; and of the females, nine were under that age. Of the whole, thirty-one were above five years of age. Now mark the influence of dress. Of the thirty-one who were burned over five years of age, there were three boys and two men; but there were eight girls and eighteen women. Above a third of the whole were women above twenty years of age. But the deaths from burning in this district of London are actually below the average deaths from this cause in the whole community; and the Registrar-general's returns present us with the frightful fact, that eight persons are burned to death every day in England and Wales, and of these, above one-eighth are grown-up women.

I cannot here give any facts to show whether the health of women has been improved by the introduction of the recent fashion of wearing extended dresses, but it is a most notorious fact that the more extended the dress the more likely it is to catch fire. Not only do I think it worthy the consideration of women how far they can divest themselves of the extent of skirt which endangers their lives, but I think it a question deserving their utmost consideration as to whether their dress is not altogether unfitted for a climate where fires, and gas-lamps, and candles, are the necessary adjuncts of our civilization. It is all very well to talk sentiment about what is becoming to women, or to make fun of those who wish to reform their dress; but it is a question in morals, as to whether we ought to support, on the ground of fashion, a mode of dressing which, in this country alone, immolates every five years as large a number of women as perished in the heartrending catastrophe of Santiago.

It should, however, be remembered that extent of dress alone is not the only cause of these accidents. The nature of the materials of which women's dresses are composed is greatly conducive to the production of accidents by fire. Cotton and linen are eminently combustible materials, and as long as the boy is dressed in his Holland pinafore and his calico frock he is as much in danger of being burnt as his little sister. But directly he gets into breeches his chances of being burned diminish, as much on account of the form as the nature of the material he wears.

If it must be denied to our girls and women to wear either the form or the material of the dress of boys, there is one thing left that we can do. Chemistry has put into our possession a variety of compounds, soluble in water, which if applied to linen and cotton will render them flame-proof, if not inflammable. Such compounds are, tungstate of soda, sulphate of ammonia, sulphate of zinc, sal-ammoniac, alum, and common salt. Any of these substances may be put into the starch with which cotton and linen goods are got up after they are manufactured and washed. Starches have been patented with these substances in them, and druggists sell the salts, with directions for use; but up to the present moment little or no effect has been produced. Every now and then the newspapers startle the community with the fact that another mother of a family has been burned by crinoline. Society duly observes, regrets, and forgets the circumstance. Some effect might perhaps be made if each daily newspaper could record, as it occurred, the deaths of the women that die every day victims to burning. If the children and men were added to this portion of the eight who die, it might increase the anxiety of society on the point. But it should be recollected that there must be added to this the sufferings of those who do not die. Where *one* burned person dies, *ten* get well, amid the greatest suffering and the most acute of agonies. Are not these sufferings, and this death, worthy of an effort to save?

I must now, however, leave the whole subject of dress to the consideration of thoughtful persons. I have been prompted to make these remarks in the hope that I may assist any who may seriously think it worth their while to make an effort to rescue the art of dressing from the domain of Fashion, and place it under the laws and direction of Reason.

THE PHILOSOPHY OF BATHING.

There are in the human body 2,700,000 glands and 7,000,000 pores, from 2,000 to 3,000 to the square inch, and one-eighth of an inch in depth—making twenty-eight miles of human drainage!

Five-eighths of all that is eaten passes off through these pores, and but one per cent. of all the perspirable matter consists of solid substances. The change in the muscles, tissues and bones occurs in from one to three years, and in the entire body in from six to seven years. If this old matter be retained, it causes disease—it is a real virus.

Some diseases are relieved almost instantly by opening the pores. Diarrhœa is frequently cured; matter from mucnou membrane is expelled through the skin; tobacco, opium and mercury have been thus excluded. Whatever through the skin the body can expel, it can absorb. Hold the end of your finger in spirits of turpentine—it is absorbed; goes through the system, and may be detected by its odor. Constant handling of arsenic has produced death by absorption.

The doctor relates an account of a gentleman in Barbadoes, who was in the habit of daily intoxication, and had constructed a tub, with a pillow to accommodate his head, and when in this state was placed therein, and the tub was filled with cold water, in which he reposed for two or three hours, and would then arise refreshed and invigorated. When his wife or family required him, they would wake him up by taking out the plug, and allow the water to escape, when he would pleasantly complain of the "loss of his bedclothes."

Dr. Crook, a student of Sir Astley Cooper, once poisoned a dog, which immediately plunged into a neighboring river, and remained for some time with his body entirely submerged, after which he left his watery hospital and ran home cured. Dogs have been repeatedly cured of hydrophobia by holding them in water.

Thirst has often been relieved by immersion, even in salt water, the salt, probably, being excluded during the process of transudation. Mutton bones, boiled a long time in soft water, with a slight addition of calcined potash, made fresh every day, have imparted to the water such nourishing properties that the patient bathing therein daily, and taking nothing save a few teaspoonfuls of tea twice a day, and one tablespoonful of tonic syrup, gained 15½ pounds in as many weeks, simply by bsorption.

Perspiration is eliminated from all parts of the body, and the excretions, cutaneously forced, may from some parts of the surface, be re-admitted to the circulation, and if poisonous or injurious, whenever the blood visits it, it must carry disease. Nature keeps her side of the interior clean and soft, and demands an unobstructed exterior, and exudes to the surface the refuse matter for removal by bathing and evoporation. A dry, light powder, mixed with sweat and oil from the glands, and dust, clogs upon the pores. As all parts of the cuticle have pores, as well as the face and arms, all the body should be bathed at least one-third as many times as those are.

On board a slave-ship the small pox suddenly broke out. Medical aid was powerless. Every morning the dead in great numbers were thrown overboard. In the midst of terror and anguish, the negroes cried out, "Let us do as we do in our own country with the sick," and permission being given, they gently lowered their sick companions into the sea, letting them remain a few minutes, and then raised them, and placed them in the sunlight on deck until dried, when the disease left them and they were cured.

At Charleston, S. C., during the recent epidemic, among several northern mechanics who had gone thither in company, but one escaped the prevailing fever, and he alone bathed frequently, and never slept at night in any of the clothes worn by day. The others cast off only the outer garments, slept in their perspiration, and died.

Cold water is used and prescribed much more than formerly, though many would think a physician not worth sending for who should prescribe so simple a remedy. Abernethy's advice to one of his wealthy patients was—"Let your servant bring to you three or four pailfuls of water and put it into a washtub. Take off your clothes, and get into it, and you'll recover." "This advice of yours seems very much like telling me to wash myself," said the patient. "Well," said Abernethy, "it is open to that objection."

Dr. Currie used fresh water generally, and by long and careful experience, he found that bathing prevented or cured most diseases.

Machinery and Manufactures.

TURBINE WATER WHEELS.

By C. Schiele.

* * * *

The construction of a practically perfect turbine wheel is a subject which severely taxes the intelligence of him who undertakes to solve that problem, the points to be watched, or the conditions to be realised being so numerous and sometimes at variance with each other. We will now pass in review the various conditions, the realization of which should be aimed at in the construction of turbines, and these are as follows:—

1st. Economical adjustability to the variation of water quantities, or to the variation of power.

One great desideratum is to realise the same per centage of useful effect, whether the wheels be worked to its full power or not, that is, whether the wheel consumes its maximum quantity of water or any smaller quantity; a water engine, in fact, ought to be like a steam-engine. In the case of the latter when there is little work, less steam ought to be consumed, and in a similar manner should the former admit of the adjustment of the flow of water in proportion to the work to be performed; and, moreover, it should do this by means of self-acting apparatus, as is almost invariably done in the steam-engine. At the same time the smaller quantity of water should be used to the greatest possible advantage, or in other words should yield the same per centage of useful effect. This condition is easily realised in a common bucket wheel so long as the water course is not flooded, but as soon as the water in the tail race rises so as to immerse the buckets, so soon is there an end to the economical working of the wheel, and it is an event of frequent occcurrence that water-wheels are stopped not from want of, but from excess of water.

2nd. To maintain the highest top level and uniform speed.

In properly constructed machines the power is just proportional to the head; and it is important, therefore, to establish and maintain the highest possible level; the speed, moreover, varies in a certain ratio with the head, and thus there are two very cogent reasons why the head should not be allowed to vary. Uniformity of speed, however, is aimed at also, by varying the quantities of water with the quantity of work to be performed, but this condition is of such vital importance in certain operations, as for instance in spinning, that the machinery must be stopped when the driving apparatus moves too quick, and its realisation, therefore, should be aimed at by every possible means.

3rd. To maintain clear open water ways, without liability to choke up by sticks, leaves, or other floating materials which might pass the usual strainer.

This is a point which requires great attention, and which has always been a great drawback to turbines, for when leaves, branches of trees, or other obstructions get into them, they become as bad as water wheels in back-water. I have seen one of my own turbines of the old patent, which had become so fast that a four ton crane had to be used to tear up the rubbish.

4th. To bring the water into the turbine without cutting it up into too many small veins.

This is important also because the more the water is cut up, the greater is the loss of power by friction.

5th. Simplicity and durability in construction.

6th. To introduce the water in a direction tangential to the rotary motion of the wheel, and to obtain a radial outflow; this efflux, moreover, should be perfectly smooth, and should produce no foaming and no agitation.

Whenever this takes place, the whole energy originally contained in the water has been given up to the wheel, and the only loss of useful effect is that due to the friction of various parts of the machinery; but when there is any considerable disturbance, any bubbling up of the effluent particles of water, this is a sure sign that the whole of the energy has not been given up. The curve of the vanes of the turbine should be such as to transform the originally tangential motion into a radial motion by easy degrees without shocks.

7th. The turbine should admit of a certain variation of speed without lessening the per centage of useful effect.

8th. Where backwater diminishes the fall in times of flood, the construction of the turbine should admit of a greater body of water passing through it in the unit of time, in order to give out the same power as before.

Turbines, as a general rule, are not affected by backwater in the same way as ordinary water-wheels, and this indeed constitutes one of their greatest advantages; but when the water in the tail-race, if that term can be used here, and whenever the backwater rises so much as to reduce considerably the effective head, the power given out must of necessity diminish in the same proportion, unless a greater mass of water is sent through the turbine.

9th. Where reservoirs are provided, the turbines ought to open for such consumption of water as will drain the reservoirs towards stopping time, and be allowed to fill again with the water otherwise washing over the weirs.

10th. The greater portion of the weight of the turbine should be floated or balanced, so as to diminish the friction on the foot-step.

11th. The rotary motion of the turbine should be perfectly smooth and steady, without shocks or tremour.

12th. The flow of water through all the orifices of the turbine should be continuous and without periods of intermission.

13th. The water should meet with the least possible frictional resistance during its flow through the turbine.

14th. There ought to be the least possible waste of water by leakage.

15th. The construction of the turbine should be such as to realise the benefit of any fall below the turbine, and this even where it does not work to its full power. To this effect a pipe should be attached to the turbine, through which the water is taken down to the tail-race, and the water is then said to act by suction.

16th. The turbine should run horizontally, or in other words it should revolve upon a vertical axis.

17th. The construction of turbines should be such as to make them applicable to falls even less than twelve inches.

Utilization of Waste Products.

Mr. Mayhew, of London, tells us that, according to information which he received, about 78,000 lbs. of exhausted tea-leaves, dried and blended with cheap genuine tea, are sold annually by inferior shop-keepers to the poor Irish and others.

Beet and turnip leaves are largely employed in the manufacture of segars.

The waste made by the sawyer and turner has several economic uses. Mahogany dust is valuable for smoking fish; box-dust for cleaning jewelry; the shavings of cedar for making the otto of cedar wood, a hundred pounds producing 28 ounces.

It may not be uninteresting to know that there are woolen rags too poor for shoddy, and these may be used as manure; 2½ lbs. of woolen rags are considered equal to 100 lbs of farm-manure.

The following estimate has been made of the carcass of a dead horse, the average weight of which is from 12 to 13 cwt.:—

Hair of mane and tail, 1½ lbs., used for hair-cloth, stuffing mattresses, and for making bags for crushing seed in oil-mills, and other purposes. Fat, 20 lbs., used for lamps after distilling, and other purposes. Intestines, 80 lbs., for gut strings. Heart and tongue a mystery. Bones, 160 lbs., for knife-handles, phosphorus, super-phosphate of lime. Hoofs, gelatine, prussiate, for fancy snuff-boxes.

Shoes, 5 lbs., used for shoes again, sold for old iron.

A correspondent of Mr. Simmonds, editor of the *Technologist*, London, states that a foreman of the bindery department of Messrs. Harper & Brothers came in one morning with a bar of gold valued at $307½, the proceeds of the gold dust swept from the floor and wiped off on rags used by binders during three months. This was a few years ago. He further states that the gold sweepings were worth $1,500 a year; shavings from paper, $5,000; shavings from pasteboard $700; scraps from leather $150; making in the aggregate $7,850.

Waste.

There must be, of necessity, a per-centage of loss in all the material transactions of every day life, whether these be carried on in the workshop, the counting-room, the kitchen or the laboratory; but this inevitable waste can be so far reduced by good management that it amounts to but little in the course of the year. Recent observation has convinced us that the loss in large workshops must be considerable, for in a great majority of cases we have seen materials lying about under foot—bolts, nuts, washers, kicking around in the mud out in the yard, new work exposed to injury from the elements, tools misplaced, essential articles, or tools necessary to the perfection of certain parts of the work at great distances from each other, and an infinite number of abuses which, although small of themselves, when summed up, make a grand total lost at the end of the year. As the thirty-second part of an inch too little on one piece of a steam engine, a sixty-fourth on another, and as much on still another will result in great derangement of the functions of the machine, so infinitessimal wasto, continually occuring, is the representative of hundreds of dollars for which there has been no return. No matter what the nature of the trade or manufacture, it is very certain that a material reduction of the expenses of every department can be made by careful attention to the minor matters, and these remarks are made with the hope that all interested will give them attention.—*Scientific American.*

Enormous Casting, Sheffield.

We have to record, says the *Sheffield Telegraph*, the casting of a 160-ton anvil block, which was successfully accomplished on Friday, at Messrs. T. M. Stanley and Co's., of the Midland Works. The casting shop in which the monster was brought into shape and form was that in which the previous castings had been made. In the centre of the floor a great pit was dug, and in this the mould was formed, the anvil being cast with its face downwards. The mould was 12 ft. square at the base. and 11 ft. 6 in. deep, and it was estimated that nearly 170 tons of iron would be required to fill it. At intervals outside the shop were five furnaces, and at six o'clock on Friday morning these commenced to pour their molten contents into the huge chasm, and continued until about five o'clock, when the operation was declared to be successfully completed. The scene in the casting shop was most animated. From four or five different points, streams of liquid fire were slowly rolling to the edge of the pit, where they fell amidst showers of starry sparks into the vast mass beneath. A metal rod was thrust through the mass to test its perfect liquidity, and, this having been satisfactorily proved, the top of the pit was carefully closed, to be opened no more until the metal has cooled, which will probably be in about seven weeks.

The anvil is intended to be placed in the gun manufactory of Messrs. Firth, which is close to the Midland Works, on the Sheffield side of the second railway bridge. The predecessors of this anvil are fixed in an immense and admirably arranged forge, where seven huge Nasmyth hammers are continually employed in the forging of guns, and the great shafts and cranks of marine engines. The "160-ton" will be placed in a forge that is now building at the corner of the works nearest the railway. The distinguished stranger will be amply provided for, as one of his weight and substance should be.

The block will have to sustain the blows of a 25-ton steam hammer (Nasmyth), which will be employed in forging the 600-pr. and 300-pr. guns that Messrs. Firth are making for Mr. Whitworth.

A New Alloy.

A new alloy, described as applicable to the manufacture of all metal articles, bells, hammers, anvils, rails, and non-cutting tools, has been patented by Mr. M. H. Micolon, of Paris. The alloy consists of iron with manganese or borax. The patentee takes 20 parts of iron turnings or tin waste, 80 parts of steel, 4 parts of manganese, and 4 parts of borax; but these proportions may be varied. When it is desired to increase the tenacity of the alloy, 2 or 3 parts of wolfram are added. When the cupola is ready, the iron and steel are poured in, and then the manganese and borax; finally, the vessel is filled up with coke; the metal is thus in direct contact with the fuel in the cupola, and by quickly running the fused mass into moulds, bells which possess the sonority of silver, whilst the cost is less than bronze, may be obtained.

Friction Match Manufacture.

One firm in Boston, U. S., use 5,000 cords of wood per annum, and manufactures 14,440,000 matches per day. Under the new war tax each bunch requires a one-cent stamp, or a daily tax of $1,400—nearly $450,000 per annum. The *Scientific American* estimates that the Government will derive a revenue from this branch of manufacture, of not less than $3,500,000 per annum.

Improvement in Fire Grates.

A correspondent of the *Scientific American* writes:—"If some one of your numerous readers will produce a simple and convenient device for raising and lowering the fire-grate in our common cooking ranges, he will confer a public favor, and find a ready sale for it. Range fires are placed some 12 to 15 inches below the kettle bottoms, which at times is necessary for the purpose of heating the ovens and water-back. But it daily happens in the work of the kitchen, that a sharp heat is wanted at the top of the range, and although a sufficiency of coals may be burning on the grate, the distance down is too great to make it effective. A new fire must be made, a bucket of coal used, and an hour's time required, which could be saved if the grate with its fire could be raised and lowered at pleasure. The invention should be made applicable to any and all ranges already in use. One-half the coal now used in my range could be saved by the use of such a device. Who will produce it?" The suggestion is a good one—cannot some one of our Canadian inventors take it up, and at once realize it? It is equally applicable to wood as to coal grates.

Practical Memoranda.

TABLE

Of the Weight of a Superficial Foot of Plate or Sheet Iron, Copper, and Brass, in pounds.

Thickness in parts of an inch.	Iron.	Thickness by the wire guage. No.	Iron.	Copper.	Brass.
$\frac{1}{32}$	1·25	1	12·5	14·5	13·75
$\frac{1}{16}$	2·5	2	12	13·9	13·2
$\frac{1}{8}$	5	3	11	12·75	12·1
$\frac{3}{16}$	7·5	4	10	11·6	11
$\frac{1}{4}$	10	5	8·74	10·1	9·61
$\frac{5}{16}$	12·5	6	8·12	9·4	8·93
$\frac{3}{8}$	15	7	7·5	8·7	8·25
$\frac{7}{16}$	17·5	8	6·86	7·9	7·54
$\frac{1}{2}$	20	9	6·24	7·2	6·86
$\frac{9}{16}$	22·5	10	5·62	6·5	6·18
$\frac{5}{8}$	25	11	5	5·8	5·5
$\frac{11}{16}$	27·5	12	4·38	5·08	4·81
$\frac{3}{4}$	30	13	3·75	4·34	4·12
$\frac{7}{8}$	35	14	3·12	3·6	3·43
1	40	15	2·82	3·27	3·1

Note.—No. 1 wire gauge equal $\frac{5}{16}$ths of an inch.
" 4 " $\frac{1}{4}$ "
" 7 " $\frac{3}{16}$ "
" 11 " $\frac{1}{8}$ "
" 16 " $\frac{1}{16}$ "
" 22 " $\frac{1}{32}$ "

The great variety of thicknesses into which copper is manufactured cause in trade the weight to be named whereby to determine the thickness required, the unit being that of a common sheet, so designated, viz. 4 feet by 2 feet, in lbs., thus:

A 70 lb. plate is $\frac{3}{16}$ths of an inch in thickness.
" $46\frac{1}{2}$ " $\frac{1}{8}$ " "
" 23 " $\frac{1}{16}$ " "
" $11\frac{1}{2}$ " $\frac{1}{32}$ " "
" 6 " $\frac{1}{64}$ " "

The thickness of lead is also in common determined or understood by the weight, the unit being that of a square or superficial foot; thus:

4 lbs. lead is $\frac{1}{16}$th of an inch in thickness.
6 " $\frac{1}{10}$ " "
$7\frac{1}{2}$ " $\frac{1}{8}$ " "
11 " $\frac{3}{16}$ " "
15 " $\frac{1}{4}$ " "

Pipes for Conveyance of Water.

In laying pipes, the following directions are not unimportant; the mouth, both for ingress and egress, should be trumpet shaped; bends should be as far as possible avoided, and especially sharp angular bends; at junctions the smaller pipe should be brought round in a curve to agree in direction with the main. And, lastly, where a pipe rises and falls much, air is apt to collect in the upper parts of the bends, and thus reduce the section at that part, and it is advisable to make provision by a cock or otherwise, for draining it off at intervals.—*Fairbairn.*

Comparative Weights of Different Bodies.

Bar iron being 1,		Cast iron being 1,	
Cast iron	= ·95	Bar iron	= 1·0
Steel	= 1·02	Steel	= 1·08
Copper	= 1·16	Brass	= 1·16
Brass	= 1·09	Copper	= 1·21
Lead	= 1·48	Lead	= 1·56

Ebullition of Water and Boiler Explosions.

"Water, when deprived of air," says M. Dufour, "as Mr. Grove has shown, does not boil steadily, and hence he thinks boiler explosion results. Let it be kept well supplied with air, then, by carrying into the boiler two platinum wires connected with a voltaic pile."

Statistical Information.

Statistics relating to Canada.

Square miles of territory in Upper Canada	121,260
" " " Lower Canada	210,020
Total square miles.........	331,280
Acres disposed of in U C. by sales and free grants.....................	20,853,971
Acres disposed of in L. C. by sales and free grants.....................	18,477,820
Total acres.....................	39,331,791
Population of U. C. in January, 1861.....	1,396,091
" L. C. " "	1,111,566
Total population	2,507,657
Population to the square mile	8·40
Estimated population in U. C., Jan. 1864.	1,586,130
" " L. C., "	1,196,949
Total	2,783,079
Revenue of 1863, exclusive of loans......	$9,760,316
Expenditure of 1863, exclusive of redemption of debt.....................	10,742,807
Funded debt in 1863, less sinking fund...	60,355,472
Imports of 1863	45,964,493
Exports of 1863............................	41,831,532
Difference in imports and exports.....	4,132,961
Revenue per head of population...........	$3 51
Expenditure " "	3 86
Debt " "	21 69
Imports " "	16 51
Duties on " "	1 85
Exports " "	15 03

Length in miles of telegraph lines	3,180
" " wire used................	4,145
Stations open to the public..................	146
Number of instruments	208
" public messages sent in 1863*	832,779

Income and Expenditure of Great Britain.

A few days ago was issued an account of the gross public income of the United Kingdom of Great Britain and Ireland in the year ending the 30th of June. The total revenue amounted to £69,992,960 4s., and the total expenditure (including £900,000 for fortifications) to £67,543,078 2s. 3d., leaving an excess of income over expenditure of £2,449,882 1s. 9d. The balances in the Exchequer on the 30th ult., amounted to £7,339,271 8s. 3d.

Religious Census of the British Army.

A parliamentary return states that in April 1864, 109,700 non-commissioned officers and men in her Majesty's land forces were Episcopalians, 20,789 Presbyterians, 5,200 other Protestants, and 58,500 Roman Catholics. The number of Episcopalians is decreasing. The Roman Catholics in the artillery increase; in 1861 there were but 3,344, but by April, 1864, they had increased to 8,161. But still, out of the 58,508 Roman Catholics in the army, 46,348 were in the infantry; of the 135,848 Protestants only 82,518. In the royal marines there were in the first quarter of 1864, 22,398 Episcopalians, 216 Presbyterians, 2,379 other Protestants, and 1,448 Roman Catholics.

Alphabets.

The number of letters in the alphabets of different languages is as follows: English, 26; French, 25; German, 26; Spanish, 24: Dutch, 26; Greek, 24; Latin, 25; Slavonic, 27; Arabic, 28; Persian, 31; Turkish, 33; Georgian, 36; Hebrew, Chaldee, Syriac, and Samaritan, each 22; Coptic, 32; Sanscrit, 50; Bengalese, 21; Burmese, 19.

The Federal Navy.

The Federal navy is composed as follows:—Screw steamers: first-rates, 12; second-rates, 35; third-rates, 9: fourth-rates, 29. Paddle-wheel steamers: first-rates, 1; second-rates, 9; third-rates, 36; fourth-rates, 3. Iron-clads: first-rates, 9; second-rates, 5; third-rates, 31; ditto, on the Mississippi, 25. Of sailing vessels there are 2 first-rates, 5 second-rates, 12 third-rates, and 7 fourth-rates. The number of men and officers is estimated at from 50,000 to 60,000.

Increase of Insanity.

On January 1, 1849, there were 6,931 patients in private asylums and 7,269 in public. In the former there are now only 4,455, and in the latter as many as 23,830. The Commissioners in Lunacy exercise a watchful care over the welfare of 44,695 persons of unsound or defective intellect.—*London Chemist and Druggist.*

* These are in addition to reports furnished 22 newspapers, and companies' private messages.

Miscellaneous.

PETROLEA.

FROM THE ARABIC.

The *Daily Fair*, a paper which was published at the Philadelphia Sanitary Fair, has found a bard who sings of the wonders of petroleum:—

Strew, strew all your heads with ashes!
Hold your noses firmly and long!
I sing by the lightning's pale flashes
A wild and bituminous song.

The wind by the desert is sweeping
Like fire by the dead Dead Sea;
There a Dervish appointment is keeping
With a maiden from Galilee.

Not a breath of breeze is blowing,
No waves on the waters fall,
Though a strong smell of naptha is flowing—
They said, "We don't mind it at all."

Two dark brown lumps are lying
Like rocks on the Dead Sea shore,
And while tenderly loving and sighing,
They sat down there—to rise no more.

For the rocks were of naphtha, which would not
Allow them to stir e'en a stitch,
And seated in concert they could not
Rise up above concert *pitch.*

Then all the disaster comprising,
They wailed aloud "Allah is great!
We stick, and we stick—there's no rising,
We stick—and for ever must wait!"

There they sat like a lost pot and kettle,
Their wails o'er the wilderness passed;
They petrified little by little,
And were turned to asphaltum at last.

MORAL.

In love, or in turning a penny,
Always study the field of your luck;
In petroleum and naphtha full many
Ere now have been terribly *stuck.*

PROPERTIES OF BENZINE.

One of the first products which comes over, in company with a large amount of water, is a mixture of volatile hydrocarbons, which has received the name of crude naphtha, and when further distilled, is known as rectified coal naphtha; this is further purified by mixing it with ten per cent. of concentrated sulphuric acid, agitating and setting aside for some hours to rest; when the mixture is cold, five per cent. of peroxide of manganese is added, and the upper portion submitted to distillation. This mode of purification has been recommended by the late Prof. Gregory of Edinburgh. The specific gravity of the rectified naphtha is 0·850; it is used extensively as a solvent of caoutchouc, and other allied gums, and also of resins for the preparation of varnish. By repeated purification and fractional distillation, what is termed benzole or benzine, by Pelouze and others, is obtained; naphtha being a heterogeneous liquid, made up of several hydrocarbons, of which benzine is the most abundant and important.

The numerous applications of which this liquid is susceptible, renders it one of the most valuable substitutes for alcohol, ether, turpentine, and other fluids in common use, as a menstruum for dissolving gums, resins, and other commercial products. Its property of dissolving fat, renders it useful for cleaning cloth, leather, &c.. from spots of grease, wax, tar, or resin, without any resulting injury to the color, or permanent odor to the fabric.

Mr. Grace Calvert has pointed out the application of this property in the manufacture of carpets: it had been necessary to oil "slubbing wool" before being spun, and necessary to remove the oil subsequently, so that the color might be more bright; but this removal was very difficult, and the brilliancy of the colors was injured by the presence of the oil, and the carpet soon became faded: but by the use of benzole this oil can be readily removed, and thus the fabric is capable of receiving a brilliant dye.

When treated with strong nitric acid, benzine produces "nitro-benzole," a substance which is now much used as a substitute for Oil of Bitter Almonds, in perfumery: it is not acted on by ordinary sulphuric acid, but with the anhydrous acid it forms a conjugated acid.

Benzole boils at 186°; density of the vapor= 2·38. At 32° it crystallizes in a gelatinous mass, which melts at 44·6°; it is insoluble in water, but very soluble in alcohol and ether. On account of its rapid evaporation, Mansfield applied it for the purpose of impregnating gases by passing them through a layer of it: or by suspending cloths soaked with it in an atmosphere renewed by a fan or blast. The air, when saturated, burns on account of the quantity of vapor present. The evaporation of the benzole, in this process, produces so much cold as, after a time, to check further evaporation; and hence, this method of producing gas is beset with practical difficulties not yet fully overcome.

The formula representing the composition of benzine is $C_{12}H_6$; the substance yields an analysis, in 100 parts, carbon 86, and hydrogen 14. As it contains no oxygen, and, when pure, does not absorb oxygen from the air, it is used to preserve the oxidizable metals, as potassium, &c., from contact with the atmosphere. It yields, when burned, nothing but carbonic acid and water; when sufficient air is not supplied, carburetted hydrogen is produced, and carbon deposited unconsumed.

A Great Blast.

An enormous blast has been made by the contractors under the Tyne Improvement Commissioners at the Trow Rocks, South Shields. 2,400 pounds of gunpowder were used; and it is estimated that 20,000 tons of rocks were dislodged. Immense fissures were rent in the rocks, and huge masses of stone, many tons in weight, were tumbled over in all directions. The workmen's houses, situated within 100 yards of the quarry face, sustained no injury.

Clean Cellars.

If we were asked which should be the first apartment in the house, we should probably answer, "Not in the parlour, not in the drawing room, but the cellar." There are two reasons for this answer. First, a bad, dirty cellar appears to combine the idea of all that repulsive—damp, offensive, musty, putrid air—rotten apples, rotten cabbages, rotten potatoes, rotten boards—The effluvia creeping through every open window and open door, and through the cracks of every closed window and closed door, into all parts of the house—into the kitchen, into the parlour and dining room, into the sleeping apartments—and lying the foundation of of sickness and fevers. Secondly, a neat, well-lighted, mortarfloored, whitewashed cellar, combines a good deal that is pleasant. One room may have in it a supply of sweet butter and milk, and in another excellent apples and delicious melting pears; the food that is placed on every table is known to come from this model cellar, where everything is pure and clean.

Thonger's Patent "Caution" Label.

The object of this label, which is intended to be employed only with poisonous medicines and those used for outward application, as to prevent accidental poisoning by the caution which its peculiar nature involuntarily suggests when the bottle is taken into the hand. The patent consists in the application of a broad bordering of rough glass paper around the label. The effect of this on coming in contact with the hand is so well marked that it is impossible to conceive that it should be taken up without being noticed. This effect is as surely produced during the darkest night as in the daylight; and, as was quaintly remarked to us by a distinguished pharmaceutist, the label almost suggests that a lucifer should be struck on its roughened surface to enable the nature of the contents of the bottle to be seen. It appears to us to be the most practically useful poison label that we have seen. It is manufactured in the various sizes required both for dispensing and retail bottles.—*Chemist and Druggist, London,*

Burning Smoke.

This subject has attracted much attention from engineers, but the object which should be aimed at should have been to burn fuel without smoke. When smoke is once produced in a furnace or flue, it is as impossible to burn it or convert it to heating purposes as it would be to convert the smoke issuing from the flame of a candle to the purpose of heat or light.

When we see smoke issuing from the flame of an ill-adjusted common lamp, we also find the flame itself dull and murky, and the heat and light diminished in quantity. Do we, then, attempt to burn that smoke? No; it would be impossible. Again, when we see a well adjusted Argand lamp burn without producing any smoke, we also see the flame white and clear, and the heat and light increased. In this case, do we say the lamp burns its smoke? No; we say the lamp burns without smoke. This is the fact, and it remains to be shown why the same language may not be applied to combustion in the furnace as to that in the lamp. —*American Artisan.*

Combustion of Gunpowder in a Vacuum.

The eminent French chemist, M. Bianchi, is the author of some curious experiments on the combustion of gunpowder in a vacuum. He found that this substance, and also the fulminates, burned quickly if loose in an exhausted vessel, and suddenly brought to a temperature exceeding two thousand degrees. If, however, the powder was placed, under similar circumstances, in a pistol, it enflamed with the suddenness exhibited in the air. Gun-cotton slowly disappeared; the layer nearest the source of heat going first, but without the production of any light. In all these cases the products of combustion were the same as in air. Combustion also took place in nitrogen, carbonic acid, and other gases which do not support it, with little diminution of the ordinary rapidity of the process.

Cheap Bread.

"Bread and butter" are the only articles of food of which we never tire for a day, from early childhood to extreme old age. A pound of fine flour or indian (corn) meal contains three times as much meat as one pound of butcher's roast beef; and if the whole product of the grain, bean and all, were made into bread, fifteen per cent more of nutriment would be added. Unfortunately the bran, the coarsest part, is thrown away, the very part which gives soundness to the teeth and strength to the bones and vigor to the brain. Five hundred pounds of fine flour give to the body thirty pounds of the bony elements; while the same quantity of bran gives one hundred and twenty-five pounds. This bone is "lime," the phosphate lime, the indispensable element of health to the whole human body, from the want of the natural supply of which multitudes of persons go into a general "decline." But swallowing "phosphate" in the shape of powders or in sirups, to cure these "declines," has little or no virtue. The articles contained in these "phosphates" must pass through nature's laboratory, must be subject to her manipulations, in lembicas especially prepared by Almighty power and skill, in order to impart their peculiar virtue to the human frame; in plainer phrase, the shortest, safest. and most infallible method of giving strength to body, bone and brain, thereby arresting disease and building up the constitution, is to eat and digest more bread made out of the whole grain, whether of wheat, corn, rye, or oats.

But we must get an appetite for eating more, and a power of digesting more. Not by the artificial and lazy method of drinking bitters and taking tonics, but by moderate, continued, and remunerative muscular exercise in the open air every day, rain or shine. And that we may eat the more of it, the bread must be good and cheap, and healthful; and that which combines these three qualities to a greater extent than any other known on the face of the globe, as far as we know, is made thus: —To two quarts of corn (indian) meal and one pint of bread sponge, with water sufficiently to wet the whole. add one-half pint of flour and a teaspoonful of salt. Let it rise, then knead well, unsparingly, for the second time. Place the dough in the oven, and let it bake an hour and a half. Keep on trying until you succeed in making a light, well-baked loaf. Our cook succeeded admirably by our directions at the very first trial. It costs just half as much as bread from the finest family flour, is lighter on the stomach, and imparts more health, vigor and strength to the body, brain and bone. Three pounds of such bread (at five cents a pound for the meal) affords as much nutriment as nine pounds of beef (cost, at twenty-five cents, $2·25), according to standard physiological facts—*Hall's Journal of Health.*

Fishing by the Electric Light.

A first attempt was made to fish by electric light a short time since at Dunkirk. The light was supplied by a pile on Bunsen's principle, composed of about fifty elements, and it succeeds tolerably well, but the employment of the pile was attended with much inconvenience. It was then determined to repeat the attempt with a magneto-electric machine. The new experiments tried at Dunkirk and Ostend had a double object—1. To prove how the light produced by the machine would act under water. 2. To discover the effect the light would produce on the fish. The first object was completely accomplished, and it is now demonstrated that magneto-electric machines and the light they produce are applicable to all submarine works. In fact, this light was constant at 180 feet under water, and it extended over a large surface. The machine, nevertheless, was placed at a distance of more than 300 feet from the regulator of the electric light. The glass sides of the lantern remained perfectly transparent, and the quantity of coal consumed to drive the magneto-electric machine was less than if the light had been in the open air.

Heating Railway Cars.

In France, the waste steam from the locomotives is made to heat the cars in the train behind. It is conducted from the escape pipes through tubes, which inside of the cars are of copper, but outside are of vulcanized india-rubber, with couplings which can be readily managed.

Death from Phosphorus.

Deaths of children occasionally occur from sucking matches made with phosphorus—two little girls have recently died from this cause, at Mile-End, England.

Coal Oil for Wounds.

An assistant surgeon, writing from Gettysburg, says that what water is to a wound in an inflamed state, coal oil is in a suppurating state—it dispels flies, expels vermin, sweetens the wound, and promotes a healthy granulation. He states that he has seen two patients whose wounds have been dressed with it, sleep before he was through with the third. This is a remedy easily applied in our hospitals. If it serves to keep away flies, it will add materially to the comfort of the wounded as well as their cure.

Zopissa.

Is a composition invented by Mr. Szerelmy of London, which has of late acquired quite a reputation, on account of the manifold uses to which it can be applied. Among specimens that have been exhibited, are pieces of tile, chalk gypsum and soapstone, coated with the zopissa composition. Articles of wood and iron which had been exposed for over a year to the influences of the London atmosphere and to sea water, were found not to have been affected by either rust or decay. A cheap and artistic imitation of leather has been made out of cotton tissue, impregnated with the zopissa, and well dyed, imitating the various colors and shades of water-proof animal leather.

Uses of Ice.

In health no one ought to drink ice-water, for it has occasioned fatal inflammations of the stomach and bowels, and sometimes sudden death. The temptation to drink it is very great in summer; to use it at all with any safety the person should take but a single swallow at a time, take the glass from the lips for half a minute, and then another swallow, and so on. It will be found that in this way it becomes disagreeable after a few mouthfuls. On the other hand, ice itself may be taken as freely as possible, not only without injury, but with the most striking advantage in dangerous forms of disease. If broken in sizes of a pea or bean, and swallowed as freely as practicable, without much chewing or crushing between the teeth, it will often be efficient in checking various kinds of diarrhœa, and has cured violent cases of Asiatic cholera.

A kind of cushion of powdered ice kept to the entire scalp, has allayed violent inflammations of the brain, and arrested fearful convulsions induced by too much blood there. In croup, water as cold as ice can make it, applied freely to the throat, neck, and chest, with a sponge or cloth, very often affords an almost miraculous relief, and if this be followed by drinking copiously of the same ice-cold element, the wetted parts wiped-dry, and the child be wrapped up well in the bed-clothes, it falls into a delightful and life-giving slumber. All inflammations, internal or external, are promptly subdued by the application of ice or ice-water, because it is converted into steam and rapidly conveys away the extra heat, and also diminishes the quantity of blood in the vessels of the part.

A piece of ice laid on the wrist will often arrest violent bleeding of the nose. To drink any ice-cold liquid at meals retards digestion, chills the body, and has been known to induce the most dangerous internal congestions. Refrigerators, constructed to have the ice above, are as philosophical as they are healthful, for the ice does not come in contact with the water or other contents, yet keeps them all nearly ice cold. If ice is put in milk or butter and these are not used at the time, they lose their freshness and become sour and stale, for the essential nature of both is changed, when once frozen and then thawed.—*Hall's Journal of Health.*

Grafting Animals.

The *Intellectual Observer* says:—"Dr. Paul Bert has published a work on the curious subject of animal grafts. He succeeded in making Siamese twins of a couple of rats, and in many other monstrosities. He exclaims, 'it is a surprising spectacle to see a paw cut from one rat, live, grow, finish its ossification, and regenerate its nerves, under the skin of another, and when we plant a plume of feathers under the skin of a dog, what a miracle to see the interrupted vital phenomena resume their course, and the fragment of a bird receive nourishment from the blood of a mammal.'"

SALMON EGGS have been successfully transported from England to Australia, although the voyage occupied more than three months. Two or three ova boxes were kept at Melbourne, and others were sent to Tasmania. On being removed to the hatching boxes in the ponds, a large portion of the ova was found to be dead, but those that remained alive amounted to many thousands, and are amply sufficient, if they should all continue to thrive and become living fish, to insure the complete success of the experiment, and stock the waters of Australia with the most delicious known table-fish.

Profits of City Railroads.

From the *American Railroad Journal* we take the statement of dividends on the paid-up capital of the following city railroads:—

Broadway, Boston	9½	per cent.
Cambridge, Boston	9	"
Metropolitan, Boston	10	"
Brooklyn City	9	"
Eighth Avenue, New York	12	"
Sixth Avenue, New York	10	"
Third Avenue, New York	12	"
Green and Coates st., Philadelphia	19¼	"
Second and Third st., Philadelphia	36	"
Citizens', Pittsburgh	20	"

Cure for Dysentery.

Dr. Page, of Washington City, communicates to the *Republican* the following remedy, used both in family and camp practice with remarkable success:

"In a tea-cup half full of vinegar, dissolve as much salt as it will take up, leaving a little excess of salt at the bottom of the cup. Pour boiling water upon the solution till the cup is two-thirds or three quarters full. A scum will rise to the surface, which must be removed, and the solution is allowed to cool.

Dose. Table-spoonful three times a day (for an adult) till relieved.

The rationale of the operation of this simple medicine will readily occur to the pathologist, and in many hundred trials I have never known it to fail in dysentery and protracted diarrhœa.

Paraffine Oil Case.

LAW EXPENSES.—In the paraffine oil case, Young *vs.* Fernie, Sir Hugh Cairns for the respondents, recently stated that the costs to his clients already amounted to £15,000 ($75,00.)

Simple Mode of Purifying Water.

It is not generally known that pounded alum possesses the property of purifying water. A tablespoonful of pulverized alum sprinkled into a hogshead of water (the water stirred at the same time) will, after a few hours, by precipitating to the bottom the impure particles, so purify it that it will be found to possess nearly all the freshness and clearness of the finest spring water. A pailful containing four gallons, may be purified by a single teaspoonful of the alum.

In Philadelphia there are 357 miles of water-pipe and 592 miles of gas-pipe.

An American pint holds 7,000 grains of water.

The specific gravity of pure iron is 7·70, of aluminum 2.67.