THE GATHERER.

Liquid Air.

If the ancient alchemists, who believed it possible to transmute the baser metals into gold, could glance for a moment at the progress of modern science, they would exclaim that their most improbable expectations had been excelled in the laboratories of the nineteenth century. To change the fluid air which we breathe—the invisible breeze which bends the boughs of the forest—into a liquid, that is a substance having the solidity, visibility, and properties of water, is not one whit less wonderful than the magical transmutation of copper into gold. Not only atmospheric air, but oxygen, the most valuable perhaps of its constituent gases, has been rendered liquid, chiefly by the combined effects of cold and pressure. Air can, as is well known, be compressed into a very small space, and becomes highly elastic—as in the air-gun, where it expands with such force as to drive the bullet out like gunpowder. It is now found possible to press the particles, of which oxygen gas is ultimately composed, so close together as to transform it into a liquid. The pressure employed was equal to 4,700 lbs. on the square inch; and the degree of cold, 100° lower than zero (centigrade). Another gas, the protoxide of nitrogen, when liquefied, became as it gradually evaporated, again returning slowly to its original condition, so intensely cold as to freeze mercury put into it. Ammonia, in a liquid state, is used in the formation of artificial ice. Two gentlemen, Messrs. Pictet and Cailletet, conquered oxygen, each independently of the other; and now M. Cailletet has succeeded in liquefying nitrogen, atmospheric air, and hydrogen. This last is believed to be the most difficult of any; and it is, therefore, nearly certain that all other gases will yield to chemical skill. The hydrogen when liquid appeared of a blue colour.

A Novel Source of Heat.

Virginia City, in the Silver State of Nevada, suffers under the twofold inconvenience of a bitter winter climate and a scarcity of fuel. Equal to the occasion, an American civil engineer has boldly undertaken to grapple with these difficulties, and to utilise the spare heat of the adjacent mines in warming the dwellings and public buildings of the citizens. The rapid increase of temperature as we dig down into the earth is one of the tantalising puzzles of the geologist; but concerning the fact itself there is no doubt. In sinking a very deep well the air grows stifling, the mercury in the thermometer rises to tropical pitch, and bottles of beer, or other effervescing liquor, explode with startling noise. It is this internal heat of the earth itself which the enterprising Nevada engineer is striving, by the help of iron pipes, valves, and siphons, to introduce to the hearths and homes of his fellow-townsmen; and he further hopes to effect two good ends at once, and while warming the houses to ventilate the mines.

TREE-FELLING BY STEAM.

Felling Trees by Steam.

To fell a number of trees has hitherto been a tedious and expensive process, for want of a machine which could be substituted for the handsaw and axe. Recently an exhibition of a clever tree-felling machine took place near London, when experiments were made with highly satisfactory results. It consists of a small steam cylinder with a long stroke attached to a cast-iron bed-plate, upon which it is pivoted on its centre, the pivoting motion being worked by a hand-wheel turning a worm, which gears into a quadrant cast on the back of the cylinder. The saw itself is fixed direct to the end of the piston-rod, and is made to work in a true line by guides.

A small portable boiler is supposed to be on the spot, which supplies the machine with steam through a strong, flexible steam-pipe, and additional value is placed on the machine on this account, as the boiler may remain in one place until the tree-feller has cut down all the trees within the radius determined simply by the length of the pipe. This invention supplies a need of long standing, and will prove of much value in clearing forests or estates of unnecessary timber.

Coal on the South Coast.

There is, perhaps, a possibility that at some future day visitors at Dover, Hythe, or Folkestone may have the pleasure of descending a coal-pit close to those favourite watering-places. Apart from the natural interest which the discovery of coal on the south coast would arouse, the immense practical and commercial importance of such an event is at once apparent. London manufacturers are working at a considerable disadvantage as compared with Birmingham, Leeds, Sheffield, and other business centres in the north and midlands which are situated near the collieries, and thus obtain coal—*i.e.*, force to drive their engines—at a much cheaper rate. It follows that if coal could be found near London a great impetus would be given to manufactures in the metropolis; while the south of England would enjoy the privilege of cheaper coal for household purposes. For these reasons the attempt now to be made to find coal near Dover will be watched throughout the country with extraordinary interest. First of all a boring is projected to the depth of 2,000 feet, which is estimated to cost £5,000—now in course of subscription—and which is to be carried out by the apparatus of the Diamond-Rock Boring Company. The great value of this patent apparatus lies in its rapid progress, and in its enabling what is called a solid core of the earth cut through to be taken up. This core is the cylinder of earth or sand enclosed by the boring pipe, and affords a section of the strata penetrated for examination by the geologists. It is believed that a depth of 2,000 feet can be reached in nine months, and an influential committee has been chosen to put the project on foot.

Soaps and Soaps.

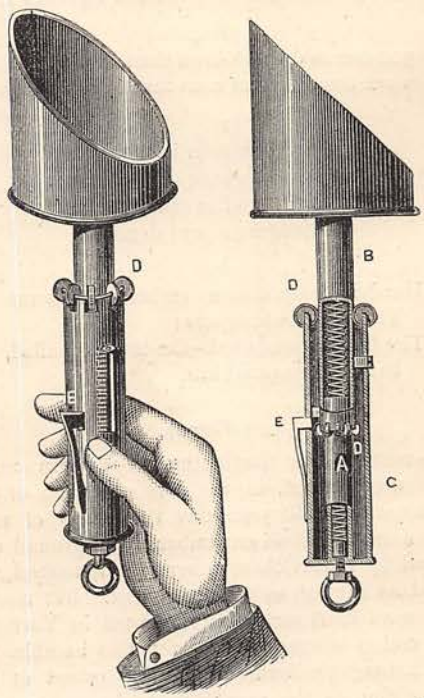
Some of our readers have applied to us for further information and advice on the subject of our Family Doctor's paper, "Harmless Requisites for the Toilet" (see p. 178). In reply to one question we are glad to have this opportunity of stating, it was not the intention of the writer to utter a sweeping condemnation of all soap which happens to be transparent or semi-transparent. On the contrary, we are aware that Dr. Erasmus Wilson, one of the highest authorities upon all matters connected with the skin, has given especial commendation to one particular species of "transparent," or more properly translucent, soap. The immediate purpose of the observation made by our Family Doctor was to caution the reader against an indiscriminate use of "transparent" soaps, some kinds of which have certainly been found to contain deleterious matter.

The Magic Arrow—a Problem.

A negro recently attracted some attention in the streets of London, by a clever trick with a reed resembling a rather long arrow-shaft—without the iron point or feathers. Holding this in an upright position in his hand, he gave a sweep with his arm as if to impart force and motion to the slender cane or reed, and in an instant, with the rapidity of lightning, it shot up into the air. A thin shining streak alone marked its course, and in a second or two it was out of sight. People standing by naturally supposed that the arrow was gone and would fall at a distance, and be irrecoverable. But the negro kept his eye intently fixed upwards, and presently, in the course of perhaps a minute or more, the arrow again came into view, descending with a slowness of motion as remarkable as the speed of its ascent. It came down in a perpendicular position—not aside or falling anyhow, but as it were upright—and finally reached the pavement within a few yards of the negro's feet. The negro doubtless used some elastic substance, perhaps a strong ring of india-rubber stretched to its full length, to impart the velocity of motion; but why did the reed or cane descend always perpendicularly, and always almost into his very hand?

Two Useful Articles in One.

We give an illustration of a neat little invention combining a scoop and weighing machine. The scoop has a movable stem, B, which slides into the handle



C, and outside the spring case A. The rollers, D, serve to keep the stem in position, so that the stem be loose enough to work easily, and to prevent friction during the weighing process. A similar set is fixed to the lower end of the stem, so as to work between the outer and inner case. A spring stop, E, is conveniently arranged on the handle of the scoop, to bring it immediately under the thumb when the handle is firmly held; and a little pressure of the thumb upon it, when the scoop is thrust into any material, prevents the stem from being pressed back. When the material to be weighed is held up in the scoop the stop is released, and the weight of the material is proved by the graduated scale fixed in the handle of the scoop. This little invention is likely to be of great service to tradespeople, particularly when a large amount of material has to be weighed into small quantities.

Double Acrostic.

Three little children playing on the sand:
Which of those boys will win the maiden's hand?
* * * * * *
He won it, but on ocean's tide
Long years he wandered far and wide;
Returning found she was his rival's bride;
He gazed on them in mute despair—and died!

I.

My mistress was as fair as rose fresh-blown,
My spouse a base, insinuating rogue,
Who, when his wicked calumnies were sown,
Brought on us all a fearful epilogue.

II.

Before his men all obstacles gave way,
And soon the tyrant king was brought to bay,
Nor e'en that stronghold on the craggy rock
Could long withstand our general's vigorous shock.

III.

If you can make *this* even then I'll say,
You are the cleverest man that e'er saw day.

IV.

Ladies oft are seen in me,
So happy, warm, and cheery;
Yet am I found in every sea,
Oft dangerous and dreary.

V.

Her beauteous charms embroiled in arms
Two nations long ago;
The Greeks prevailed—the town, assailed,
In ashes was laid low.

Iron Fleece.

Iron-masters are beginning to discern merits, hitherto unsuspected, in the slag or refuse of their blast furnaces. Till yesterday the heaps of rough cindery material which encumbered the ground overshadowed by tall brick chimneys, flame-topped, were regarded as rubbish of the worst sort. But now, as mineral wool in America, as slag wool in Yorkshire, and as cotton silicate in Germany, this humbler Cinderella among products finds itself prized at last. Silica, or flint, as the manufacturer knows too well, is sure to be present in iron ore, and has to be got rid of, and for this reason he flings into the roaring furnace those cart-loads of broken limestone, the lime of which unites with the silica, and runs off, a lava-stream, leaving behind it the saleable "pigs" of molten iron. Quite recently it was discovered that this lava-stream, till now sheer lumber, could be manipulated into a fibrous substance, light, pliant, and bearing a remarkable similarity to wool, and perhaps still more so to the fine strong hair of the Himalayan shawl-goat.

The hot slag, by ingenious contrivances, is made while yet in a fluid state to develop, as it trickles forth, into vitreous threads. Of this slag-yarn there are three numbers, or qualities. Let us take the finest, No. 3, a cubic foot of which is but 8 lbs. in weight, while a cubic foot of the parent slag weighs no less than 192 lbs. It is difficult, when surveying the huge bundle of woolly fibres, first to believe in the mineral origin of what looks so very like the carded fleece of sheep, and then to realise that the countless threads were drawn from a compact little slab of slag of equal weight with the imposing fibrous heap.

Sometimes the wool is white, often grey, occasionally pink or red, and now and then green, or greenish coloured, as when it contains manganese. And now for its uses. In America it is chiefly valued because it is a non-conductor of heat, and in this capacity it far surpasses asbestos, felt, and every other substance employed in the arts. It enwraps boilers, it packs steam cylinders, and forms a fireproof jacket for hot-water piping; while, in virtue of the same quality, it is invaluable as a lining to the walls of an icehouse. It does duty also as a filter, and can readily be worked up into matting more durable than even the cocoa-palm yields. Clearly, however, higher destinies than these await this child of the blast furnace. Wool that is cheaply produced in any quantity, wool that defies moth and mildew, that is fireproof and almost indestructible, and which can keep in heat and keep out cold, must be available for carpets, tents, sails, packing-cloths, and even overclothing. Improvements in what is after all an infant industry, will probably suggest other uses for this mineral textile fabric, and if less romantic than the Golden Fleece of Jason, the Iron Fleece may one day become a standard and profitable staple of modern manufacturing skill.

A Sunlight Stove.

It has been said that when we burn coal we really warm ourselves, or cook the dinner, by the rays of the sun which fell on the earth thousands of years ago—before the Pyramids of Egypt were erected, or Cleopatra's Needle cut out of the quarry. The heat and light of past ages are stored up in another form in the coal, which is fossil vegetation that when alive, as trees or gigantic ferns, owed its growth to the sun. A successful attempt has now been made to store up the heat of the sun's rays for immediate and practical use. It was carried out in India, where the sun is, of course, much more powerful than here. The rays were first made to pass through glass fixed an inch away from the actual apparatus, which was consequently entirely surrounded by hot air. The enclosed apparatus, a copper receptacle, was blackened outside—a colour which is well known to absorb heat, as any one may prove by wearing a black coat on a warm summer's day. The heat thus retained was further assisted by a conical reflector of silvered glass, and a quantity of mutton and vegetables placed within was perfectly cooked. To further aid in retaining the absorbed heat, when the apparatus was removed from the sunlight it was covered with a rug, as ladies place a "cosy" over the teapot to draw the tea. Since then the inventor has improved upon the process, and can now cook chops or steaks in the open air as quickly as by an ordinary fire, and entirely by the sun's rays. The most remarkable point is, perhaps, that the heat is kept in the apparatus for as long as three and a

half hours. In connection with this subject, just to test the power of the sun's rays in our own country, let any of our readers on a hot summer's day place their hand on the slate roofing of an accessible shed. Where they slope to the south, the slates will be found sometimes so extremely heated that the hand can hardly bear to touch them.

Signalling at Sea.

There is a great want, at present, of an efficient and yet simple means by which a vessel at night, or in a fog, may communicate the course she is pursuing to an approaching ship, or *vice versâ*, learn from that ship which way to steer to avoid a collision. In ancient days the mariner, when night came on, hauled up his galley on the beach, and camped upon the shore—at all events, anchored in close proximity. But now our vessels run almost like trains on the railway, at tremendous speed, and at all hours; and consequently, in the narrow channels where hundreds of ships, upon converging courses, pass in twenty-four hours, the dangers of darkness and fog are greatly increased. The terrible disasters which from time to time take place, are sufficient proof that the existing mode of signalling is inefficient. Ships now carry a red light on one side, and a green one on the other; while, for further distinction, steamers show a white light from the mast. But this is inadequate, because the green and red lights do not tell the helmsman of another vessel at what angle the coming ship is steering. The helmsman sees a red light only—he knows then that the ship is approaching in a certain general direction, but she may alter her course several points in a few minutes, and yet without showing the green light, so that he has no information of the change. So steamers, in fog, sound one or two blasts of the whistle to indicate on which side they are steering; but this only tells the general direction, and it is the same with the fog horn, or bells of a sailing ship, in similar weather. What, therefore, is wanted is a series of simple signals by lights and sounds, by which at night or in fog a ship could clearly indicate her exact course to one of the thirty-two points of the compass, and also by a slight and yet marked change of lights or sounds, convey information as to any alteration in her direction. Perhaps some modification of the dot-and-dash system, which has been found useful in so many cases, may be devised to meet these requirements, and afford additional safety at sea.

Answer to Double Acrostic on page 190.

PHANTASMA.—AUTOMATON.

I.	P otass A.	Potash—used in soap and glass.
II.	Honolul U.	In the Sandwich Islands.
III.	A rbalis T.	A cross-bow (cross *beau*).
IV.	N O.	We wish *no* losses.
V.	T ea M.	Oxen, cricket team, &c. &c.
VI.	A ren A.	
VII.	S or T.	No one wishes to be "out of sorts."
VIII.	M ay O.	Earl of Mayo—Mayor.
IX.	A lti N.	A Russian coin of small value.

The Washing of Coal-Smoke.

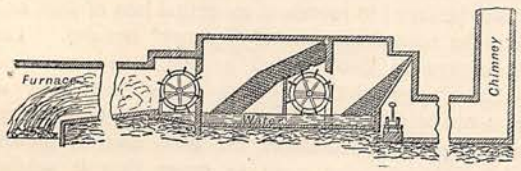
We are all agreed that coals are an expensive necessity of household management and of industrial enterprise. On the score of price there have been grievances enough, and those who sit at home at ease by their "ain fireside" are fully alive to a host of minor nuisances connected with the use of the "black diamond." But it is not by any means generally known that there is an absolute element of danger in coal-smoke, compared with which the objectionable blacks or smuts are nearly, if not quite, harmless. The noxious properties of the smoke are probably not deleterious in the case of household stoves or grates, simply because the volume is not sufficiently large. In factories, however, where the consumption is constant and enormous, the danger is infinitely greater. Let us see how the facts stand.

With the most perfect, as well as the most ordinary, stoking appliances and furnace arrangements, a certain quantity of coal escapes in the form known familiarly as smoke, which is commonly supposed to consist mainly of the before-mentioned "blacks," and is also believed to represent an actual loss of fuel, and —to the manufacturers—of "energy" besides. The percentage of unconsumed carbon, known best as "blacks," has hitherto been stated variously at from ten to fifteen per cent., but careful experiments made by Mr. C. Estcourt, the able analyst for the city of Manchester, tend to prove that it seldom exceeds one per cent. So much for the *visible* constituent of coal-smoke. There is, however, an *invisible* constituent which is far more harmful and deadly, and of whose existence we venture to say the vast majority of our readers have been totally unaware. This is the sulphurous acid gas which is produced by the combustion of the sulphur that is found, in more or less quantities, in all coals. When this gas is given off in the neighbourhood of moist air it is changed into sulphuric acid, impregnating the atmosphere for evil and robbing the breezes of their balm. It is one of the principal destructive agents in the air of our large cities, and very speedily makes its presence known by corroding everything that it comes in contact with. Even in those instances where chimneys consume their black smoke, the invisible element—this sulphurous acid gas—is given off all the same in spite of Acts of Parliament and of Smoke Inspectors, who cannot be expected to have eyes for intangible vapours, but whose olfactory nerves might possibly lead them under certain circumstances to detect the offending gas. The acid is rapidly equipped for its work of danger: "the accompanying moist atmosphere, or more frequent rain," says Mr. Estcourt, "dissolves the acid out of the air, and carries it in a fit condition to exert its influence on any object upon which the rain falls."

Coming now to the question of cure, it is reassuring to know that there is at least one effectual means of preventing the escape of this gas, and the consequent pollution of the air. An apparatus has been invented for *washing* the smoke as it leaves the furnace, and the appliance is capable of stopping the emission of the solid or visible, as well as the gaseous, elements of the

smoke. A former objection to this, which we may call the natural remedy, was that it would lower the temperature and seriously impair the heating power of the furnace by checking the draught. But by ordinary stoking the loss of fuel by unconsumed carbon being probably not much more than one per cent., as we have already seen, the requisite invention was a machine not so much solely to secure the combustion of all the carbon (the amount lost being comparatively small, and indeed provided against now in many ways) as to wash both the "blacks" and the gas out of the smoke without interfering with the draught. The machine is the patent of Messrs. Johnson and Hobbs, Manchester, and is in operation at their works, and also in large lead-smelting works which, but for this invention, could not be carried on in populous neighbourhoods. Curiously enough, too, it not only does its work thoroughly well, but the draught, so far from being interrupted, can by the ingenious combination used be almost indefinitely increased.

We give an engraving of this patent apparatus for



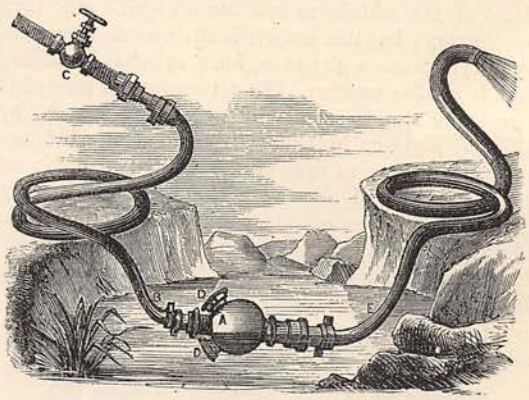
the purification of smoke, and a reference to the illustration will render a detailed description superfluous. On its way from the furnace to the chimney, the smoke is made to pass into a small chamber, at the entrance of which is a paddle-wheel with projections on the blades. The rotation of this wheel produces a spray of finely divided water or liquid, which falls through a series of net-work composed of laths, coke, shingle, or other material, into the tank at the bottom of the chamber from which the spray is raised. Only a small force is needed to move the paddle-wheels, as the tips of the blade-projections alone touch the water, and the motive-power is obtained by straps from the engine where the machinery is applied. The spray thrown up by the wheel is the purifying agent, and by its means the smoke is completely washed and cleansed. The apparatus can be used with any furnace and is placed either in the flue, or an enlargement of it, anywhere between the furnace and the chimney; and by simply increasing the rotation of the wheels, the draught can be proportionately increased.

If this machine were universally adopted, and found in every case to act with efficiency, its effects upon the health of town and city would be very great. The moral well-being of the community largely depends upon the physical, and any improvement in the latter condition must of necessity be beneficial to the former. It is difficult for those who have been familiar for years and years with a smoke-polluted atmosphere, to realise a state of things in which it shall be possible to breathe the pure air of heaven; but such a contingency is becoming less Utopian almost every day, and a serious social and sanitary problem is steadily approaching a satisfactory solution.

It may be necessary to add that there is a third main constituent in coal-smoke, namely, carbonic acid; but this is not very dangerous, and the method by which the sulphurous acid gas is eliminated, at the same time obviously eliminates the carbonic acid as well.

A Steam Siphon Pump.

Here is a useful contrivance, so extremely simple as very possibly to raise doubts in the minds of the reading public as to its efficiency. It is neither a novelty nor a speculative invention, but a device of great merit and practical value. It is a portable siphon pump for railway work, and the principle on which it is constructed is one well known to men of a scientific or mechanical turn of mind, namely, that of creating a vacuum by an injection of steam. There are no valves, rods, or complication of parts in the construction of the pump, and it is simple and inexpensive, and its operations certain and efficient. The illustration represents the complete pump, and the manner of its work in filling a locomotive tender from any body of water within reach near the side of the road. A is a hollow spherical body; B is the steam-hose attached to the locomotive boiler, by means of a steam-cock; C is the steam-cock to be screwed into the boiler; D D are suction pipes; and E is the discharge hose. Steam is let on through the steam-hose B, and water is forced through the discharge hose E into the tender. All the locomotives supplied with this steam siphon pump may be used as fire-engines, by throwing water from the tender, or



tank, or from the nearest pond. One of the recommendations of this pump is that, having no valves or other movable parts, and no obstructions of any kind, sand and gravel may pass through it without creating an inconvenient stoppage. For railways, mines, and for filling water-tanks in our manufactories, there cannot be a simpler or more effectual contrivance.