kind have fallen upon ſeveral contrivances to enjoy the benefit of fire, without being annoyed by ſmoke. The moſt univerſal of theſe contrivances is a tube leading from the chamber in which the fire is kindled to the top of the building, through which the ſmoke aſcends, and is diſperſed into the atmoſphere. Theſe tubes are called *chimneys ;* which, when conſtructed in a proper manner, carry off the ſmoke entirely ; but, when im­properly conſtructed, they carry off the ſmoke imper­fectly, to the great annoyance of the inhabitants. As our maſons at preſent ſeem to have a very imperfect knowledge of the manner in which chimneys ought to be built, we can hardly perform a more acceptable ſervice to the public than to point out the manner in which they ought to be conſtructed, ſo as to carry off the ſmoke entirely ; as well as to explain the cauſes from which the defects ſo often complained of generally proceed, and the method of removing them.

@@Thoſe who would be acquainted with this ſubject, ſhould begin by conſidering on what principle ſmoke aſcends in any chimney. At firſt many are apt to think that ſmoke is in its nature, and of itſelf, ſpecifically lighter than air, and riſes in it for the ſame reaſon that cork riſes in water. Theſe ſee no cauſe why ſmoke ſhould not riſe in the chimney though the room be ever ſo cloſe. Others think there is a power in chimneys to *draw* up the ſmoke, and that there are different forms of chimneys which afford more or leſs of this power. Theſe amuſe themſelves with ſearching for the beſt form. The equal dimenſions of a funnel in its whole length is not thought artificial enough, and it is made, for fancied reaſons, ſometimes tapering and narrowing from below upwards, and ſometimes the contrary, &c. &c. A ſimple experiment or two may ſerve to give more cor­rect ideas. Having lighted a pipe of tobacco, plunge the ſtem to the bottom of a decanter half filled with cold water; then putting a rag over the bowl, blow through it, and make the ſmoke deſcend in the ſtem of the pipe, from the end of which it will riſe in bubbles through the water ; and being thus cooled, will not afterwards riſe to go out through the neck of the decanter, but re­main ſpreading itſelf and reſting on the ſurface of the water. This ſhows that ſmoke is really heavier than air, and that it is carried upwards only when attached to or acted upon by air that is heated, and thereby ra­refied and rendered ſpecifically lighter than the air in its neighbourhood.

Smoke being rarely ſeen but in company with heat­ed air, and its upward motion being viſible, though that of the rarefied air that drives it is not ſo, has naturally given riſe to the error. It is now well known that air is a fluid which has weight as well as others, though about 830 times lighter than water ; that heat makes the particles of air recede from each other, and take up more ſpace, ſo that the ſame weight of air heated will have more bulk than equal weights of cold air which may ſurround it, and in that caſe muſt riſe, being forced upwards by ſuch colder and heavier air, which preſſes to get under it and take its place. That air is ſo ra­refied or expanded by heat, may be proved to their comprehenſion by a lank blown bladder, which laid before a fire, will ſoon ſwell, grow tight, and burſt.

Another experiment may be to take a glaſs tube about an inch in diameter, and 12 inches long, open at both ends, and fixed upright on legs ſo that it need not

be handled, for the hands might warm it. At the end of a quill fallen five or six inches of the fineſt light fila­ment of silk, ſo that it may be held either above the upper end of the tube or under the lower end, your warm hand being at a diſtance by the length of the quill. If there were any motion of air through the tube, it would manifeſt itſelf by its effect on the silk ; but if the tube and the air in it are of the same tempe­rature with the ſurrounding air, there will be no ſuch motion, whatever may be the form of the tube, whether crooked or ſtraight, narrow below and widening up­wards, or the contrary, the air in it will be quieſcent. Warm the tube, and you will find as long as it continues warm, a constant current of air entering below and passing up through it till diſcharged at the top ; becauſe the warmth of the tube being communicated to the air it contains, rarefies that air, and makes it lighter than the air without; which therefore preſſes in below, forces it upwards, follows and takes its place, and is rarefied in its turn. And, without warming the tube, if you hold under it a knob of hot iron, the air thereby heat­ed will riſe and fill the tube, going out at its top ; and this motion in the tube will continue as long as the knob remains hot, becauſe the air entering the tube below, is heated and rarefied by paſſing near and over that knob.

That this motion is produced merely by the difference of ſpecific gravity between the fluid within and that without the tube, and not by any fancied form of the tube itſelf, may appear by plunging it into water con­tained in a glaſs jar a foot deep, through which ſuch motion might be ſeen, The water within and without the tube being of the ſame ſpecific gravity, balance each other, and both remain at reſt. But take out the tube, ſtop its bottom with a finger, and fill it with olive oil, which is lighter than water ; then flopping the top, place it as before, its lower end under water, its top a very little above. As long as you keep the bot­tom flopped the fluids remain at reſt ; but the moment it is unſtopt, the heavier enters below, forces up the lighter, and takes its place : and the motion then ceaſes, merely becauſe the new fluid cannot be ſucceſsively made lighter, as air may be by a warm tube.

In fact, no form of the funnel of a chimney has any ſhare in its operation or effect reſpecting ſmoke except its height. The longer the funnel, if erect, the greater its force when filled with heated and rarefied air to draw in below and drive up the ſmoke, if one may, in compliance with cuſtom, uſe the expreſſion *draw,* when in fact it is the ſuperior weight of the ſurrounding at­moſphere that preſſes to enter the funnel below, and ſo drives up before it the ſmoke and warm air it meets with in its paſſage.

What is it then which makes a ſmoky chimney, that is, a chimney which, inſtead of conveying up all the ſmoke, discharges a part of it into the room, offending the eyes and damaging the furniture ?

The cauſes of this effect may be reduced to *nine,* dif­fering from each other, and therefore requiring different remedies.

1. *Smoky chimneys in a new houſe are ſuch frequently from mere want of air.* The workmanſhip of the rooms being all good, and juſt out of the workman’s hands, the joints of the boards of the flooring, and of the pannels of wainſcotting, are all true and tight ; the more ſo as

@@@[mu] Transactions of the American Philosophical Society.