heat, and forms a particle of elaſtic fluid, ſo related to the adjoining new formed particles, as to repel them to a diſtance at leaſt a hundred times greater than their distances in the ſtate of water. Thus a maſs of elaſtic vapour of ſenſible magnitude is formed. Being at leaſt ten thouſand times lighter than an equal bulk of wa­ter, it muſt riſe up through it, as a cork would do, in form of a tranſparent ball or bubble, and getting to the top, it diſſipates, filling the upper part of the veſſel with vapour or steam. Thus, by toſſing the liquid in­to bubbles, which are produced all over the bottom and sides of the veſſel, it produces the phenomenon of ebulli­tion or boiling. Obſerve, that during its paſſage up through the water, it is not changed or condenſed ; for the ſurrounding water is already ſo hot that the ſenſible or uncombined beat in it, is in equilibrio with that in the vapour, and therefore it is not diſpoſed to abſorb any of that heat which is combined as an ingredient of this vapour, and gives it its elaſticity. For this reaſon, it hap­pens that water will not boil till its whole maſs be heat­ed up to 212⁰ ; for if the upper part be colder, it robs the riſing bubble of that heat which is neceſſary for its elaſticity, ſo that it immediately collapſes again, and the ſurface of the water remains ſtill. This may be perceived by holding water in a Florence flaſk over a lamp or choſſer. It will be obſerved, ſome time be­fore the real ebullition, that ſome bubbles are formed at the bottom, and get up a very little way, and then diſappear. The diſtances which they reach before collapſing increaſe as the water continues to warm farther up the maſs, till at laſt it breaks cut into boiling. If the handle of a tea-kettle be graſped with the hand, a tremor will be felt for ſome little time before boiling, ariſing from the little ſuccuſſions which are produced by the collapſing of the bubbles of vapour. This is much more violent, and is really a remarkable phenomenon, if we ſuddenly plunge a lump of red hot iron into a veſſel of cold water, taking care that no red part be near the ſurface. If the hand be now applied to the side of the veſſel, a moſt violent tremor is felt, and ſometimes ſtrong thumps : theſe ariſe from the collapſing of very large bubbles. If the upper part of the iron be too hot, it warms the ſurrounding water ſo much, that the bubbles from below come up through it uncondenſed, and produce ebullition without this ſuccuſſion. The great reſemblance of this tremor to the feeling which we have during the ſhock of an earthquake has led many to ſuppoſe that theſe laſt are produced in the ſame way, (See Earthquake, n⁰ 88 — 98); and their hypothesis, notwithſtanding the objections which we have elſewhere ſtated to it, is by no means unfeaſible.

It is owing to a similar cauſe that violent thumps are ſometimes felt on the bottom of a tea-kettle, eſpecially one which has been long in uſe. Such are frequently crusted on the bottom with a ſtony concretion. This ſome­times is detached in little ſcales. When one of theſe is adhering by one end to the bottom, the water gets be­tween them in a thin film. Here it may be heated conſiderably above the boiling temperature, and it ſud­denly riſes up in a large bubble, which collapſes imme­diately. A ſmooth ſhilling lying on the bottom will produce this appearance very violently, or a thimble with the mouth down.

In order to make water boil, the fire muſt be ap­plied to the bottom or sides of the veſſel. If the heat be applied at the top of the water, it will waste away without boiling ; for the very ſuperficial particles are firſt ſupplied with the heat neceſſary for rendering them elaſtic, and they fly off without agitating the rest @@(a).

Since this diſengagement of vapour is the effect of its elaſticity, and ſince this elaſticity is a determined force when the temperature is given, it follows, that fluids cannot boil till the elaſticity of the vapour over­comes the preſſure of the incumbent fluid and of the atmoſphere. Therefore, when this preſſure is removed or diminiſhed, the fluids muſt ſooner overcome what re­mains, and boil at a lower temperature. Accordingly it is obſerved that water will boil in an exhauſted receiver when of the heat of the human body. If two glaſs balls A and B (fig. 1.) be connected by a ſlender tube, and one of them A be filled with water (a ſmall open­ing or pipe *b* being left at top of the other), and this be made to boil, the vapour produced from it will drive all the air out of the other, and will at laſt come out itſelf, producing ſteam at the mouth of the pipe. When the ball B is obſerved to be occupied by tranſparent va­pour, we may conclude that the air is completely ex­pelled. Now ſhut the pipe by sticking it into a piece of tallow or bees-wax ; the vapour in B will ſoon condenſe, and there will be a vacuum. The flame of a lamp and blow-pipe being directed to the little pipe, will cauſe it immediately to cloſe and ſeal hermetically. We now have a pretty inſtrument or toy called a Pulse glass. Graſp the ball A in the hollow of the hand ; the heat of the hand will immediately expand the bub-

@@@(a) We explained the opaque and cloudy appearance of steam, by ſaying that the vapour is condenſed by co­ming into contact with the cooler air. There is ſomething in the form of this cloud which is very inexplicable. The particles of it are ſometimes very diſtinguiſhable by the eye ; but they have not the ſmart ſtar like brilliancy of very ſmall drops of water, but give the fainter reflection of a very thin film or veſicle like a ſoap-bubble. If we attend also to their motion, we ſee them deſcending very ſlowly in compariſon with the deſcent of a ſolid drop ; and this vesicular conſtitution is establiſhed beyond a doubt by looking at a candle through a cloud of steam. It is ſeen ſurrounded by a faint halo with priſmatical colours, preciſely ſuch as we can demonstrate by optical laws to belong to a collection of veſicles, but totally different from the halo which would be produced by a collection of ſolid drops. It is very difficult to conceive how theſe veſicles can be formed of watery parti­cles, each of which was ſurrounded with many particles of fire, now communicated to the air, and how each of theſe veſicles ſhall include within it a ball of air ; but we cannot refuſe the fact. We know, that if, while linſeed- oil is boiling or nearly boiling, the ſurface be obliquely struck with the ladle, it will be daſhed into a prodigious number of exceedingly ſmall veſicles, which will float about in the air ſor a long while. Mr Sauſſure was (we think) the firſt who diſtinctly obſerved this veſicular form of miſts and clouds ; and he makes considerable uſe of it in explaining ſeveral phenomena of the atmoſphere.