

contrary, in Rivers, at any considerable distance from the Sea, the resistance of the weight of the fresh Water, which is kept suspended during the time of the Flood, is longer overcome by the more potent *Impetus* in the New and Full, than by the weaker in the Quadratures: and from hence this difference should be still more and more considerable as the Port is farther removed from the Sea.

*A Demonstration of the Velocity wherewith the Air rushes into an Exhausted Receiver, lately produced before the R. Society by Dr. D. Papin. Reg. Soc. S.*

**T**Here being several Occasions wherein it would be useful to know the Velocity of the Air, according to the several pressures that may drive it; The Royal Academy at *Paris* hath attempted by some Trials to attain that Knowledge, and by means of a Bladder, which they did sometimes fill up with Water, and sometimes with Air; they found that (although the Weight to squeeze out these Liquors, and the hole to let them out were the same) nevertheless, the Bladder, when full of Air, could be empty'd in the 25<sup>th</sup>. part of the time that was required to squeeze out the Water of the same Bladder: from thence they concluded that the swiftness of the Air is 25 times greater than that of water, when both these liquors bare the same pressure. This Experiment was very well thought on, and might serve till a better should be found out; but those Gentlemen could not but know, that this was not perfect: The Reason is that the Air yieldeth much, and so the Bladder being fill'd with it, will become pretty flatt, as soon as a considerable weight is layd upon it. It is plain therefore that the weight bearing upon a large space doth not press every part with the same force as it would do, if the Bladder did for a while remain Plump, as it doth when full of water: moreouer, the water it self being heavy in the Bladder, makes some pressure: so

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that it appears, that the pressure in this experiment was not quite so great vpon the Air as vpon the water : I haue therefore thought of another way, which I think better, to come to the said Knowledge ; and I do humbly submit itt to the *R. Society*.

My way is grounded vpon this *Hydrostatical Principle*, that liquors haue a strength to ascend as high as their source is ; and although the resistance of the *Medium* doth always hinder *Iets d'eau* in the open Air from reaching quite so high, neuertheless, the liquor at its first spouting out, hath the necessary swiftness to come to that height.

### *Proposition I.*

From this Principle may easily be deduced this Proposition, that of two different liquor's driven by the same pressure, that which is *in specie* lighter must ascend higher than that which is heavier, and their heights will be reciprocally in the same reason as their specifick gravity's are. Thus, Quicksilver being 13 times and a half heavier than water, bears as much pressure when its spring is one foot above the spout hole, as water doth when it's spring is 13 foot and a half high, and the height to which Mercury shall ascend will be 13 times and a half lesser than the height to which water will be driven by those equall pressures.

### *Proposition II.*

From the foregoing Proposition another may easily be deduced, *viz.* That of differing liquors bearing the same pressure those that are lighter *in specie* must acquire a greater swiftness, and their differing Velocity's are to one another as the roots of the specifick Gravity's of the sayd liquor's.

For we haue seen *Prop. 1.* that the heights to be attain'd are in the same reason as the specifick gravity's ; Now *Galileus*, *Hugenius*, and others haue demonstrated that the Velocities

city's of bodies are to one another as the square roots of the heights to which they may ascend: and so in this occasion they are also as the roots of the specifick Grauity's.

If therefore we would know what is the Velocity of Air being driven by any degree of pressure whatsoever, we ought but to find what would be the velocity of water vnder the same pressure: and then take the square roots of the specifick grauitys of these two liquor's; because as much as the square root of the specifick Gravity of Water, doth exceed the square Root of the specifick Gravity of Air; so-much in Proportion will the velocity of Air exceed the velocity of water. For example, when I would compute what should be the swiftness of a bullet shott by the Pneumacick Engine, as hath been described in *Philosophical Transaction*, Num. 179. I should first compute what was the velocity of the Air it self that droue the Bullet: I did therefore take notice that in this occasion the Air bares a pressure much about the same as that of water when it's spring is 32 foot high: now such water would spout out with a sufficient velocity to ascend 32 foot perpendicular, and therefore, according to the rules and obseruation of *Galileus*, *Halley* and others, such water hath the velocity of 45 foot in a second. It remains therefore but to know the proportion of the grauity of Air to that of Water: and we haue found it not to be always the same; because the height, the heat, and the moisture of the Atmosphere are variable: neuertheless we may say in general that the reason between the specifick grauitys of water and Air is much about 840 to 1. Taking then their square roots, as I haue sayd aboue, which roots are 29 and 1, we may conclude that the velocity of Air must exceed that of water by 29 times: and so multiplying 45, the velocity of water, by 29, we shall find that the velocity of the Air driven by the whole pressure of the Atmosphere, is about 1305 foot in a second.