ADDITIONS to the Article, Of Regular Winds, vol. i. p. 367.

I.

Of Reflected Wind, p. 379.

I SHALL here mention a fact which ſeems to have eſcaped the obſervation of natural philoſophers, though every man is in a condition to convince himſelf of its truth. The fact is, that the reflected wind is more violent than the direct, and ſtill more ſo in proportion to the nearneſs of the obſtacle by which it is reflected. I have often made the experiment by approaching a tower, of near a hundred feet high, and ſituated at the north of my garden at Montbard. When a ſtrong ſouth wind blows, we are violently puſhed back, at the diſtance of thirty paces: After which, there is an interval for five or ſix paces, where the violence of the reflected wind ceaſes, and ſeems to be in equilibrium with the direct. The nearer we approach, the ſtrength of the reflected wind augments, and

and puſhes us back with much greater force than the direct wind puſhes us forward. The cauſe of this general effect, which may be perceived oppoſite to any high buildings, precipices, &c. it is not difficult to diſcover. The air in the direct wind acts only by its celerity and its common volume; but this volume or maſs is conſiderably augmented by the compreſſion it receives from the obſtacle by which it is reflected; and, as the quantity of every motion conſiſts of the celerity multiplied by the volume, this quantity is much greater after being compreſſed than before. It is a volume of common air which acts in the firſt caſe, and a volume of air of double or triple the denſity which acts in the ſecond.

II.

Of the State of the Air at the Top of high Mountains.

IT has been proved by a thouſand experiments, that the higher we riſe above the level of the ſea or of plains, the column of mercury in the barometer ſinks the lower; and, conſequently, that the weight of a column of air diminiſhes in proportion to the elevation of the place; and as air is an elaſtic and compreſſible fluid,

philoſophers have unanimouſly concluded from theſe experiments, that the air is much more denſe and compreſſed in the plains, than on the tops of mountains. For example, if the barometer, which ſtands at 27 inches in the plain, falls, on the top of a mountain, to 18, a difference of one third of the whole weight of the column of air, we ſay, that, the compreſſion of this element being always proportioned to the incumbent weight, the air at the top of the mountain is, of courſe, one third leſs denſe than that in the plain, becauſe it is compreſſed by a weight one third leſs. But ſtrong reaſons concur in making me ſuſpect the truth of this concluſion, which has hitherto been regarded as natural, and perfectly legitimate.

Let us, for a moment, abſtract this compreſſibility of the air, which ſeveral cauſes may augment or diminiſh, deſtroy or compenſate: Let us ſuppoſe the air to be every where equally denſe; if its thickneſs exceeded not three leagues, it is certain, that, in mounting one league, the barometer, being loaded with one third leſs weight, would deſcend from 27 to 18 inches. Now the air, though compreſſible, appears to me to be equally denſe at all heights; and this opinion I ſhall ſupport by the following facts and reaſonings.

1. The winds are equally ſtrong and equally violent at the tops of the higheſt mountains as

as in the loweſt valleys. With regard to this fact all obſervers are agreed. Now, if the denſity of the air were one third leſs, the action of the wind would neceſſarily be one third weaker, and all the winds at the height of a league would be only zephirs, which is abſolutely contradicted by uniform experience.

2. Eagles, and ſeveral other birds, not only fly to the tops of the higheſt mountains, but riſe to great heights above them. Now, I aſk if theſe animals could either fly, or even ſupport themſelves, in a fluid one third leſs denſe than common air, and if the weight of their bodies, notwithſtanding all their efforts, would not oblige them to ſink lower?

3. All obſervers, who have climbed to the tops of the higheſt mountains, agree that they reſpire as freely as in any other ſituation, and that the only inconveniency they feel ariſes from the cold, which augments in proportion to the elevation. Now, if the air was one third leſs denſe at the tops of mountains, the reſpiration of man, and of birds which mount ſtill higher, would not only be injured, but ſtopped, as actually happens to animals in an air pump when one fourth or one third of the air contained in the receiver is exhauſted.

4. As cold condenſes as much as heat rarefies the air, and as, in proportion to the elevation of mountains, the cold increaſes, does it

not follow, that the degrees of condenſation of the air correſpond to the degrees of cold? This condenſation may equal, and even ſurpaſs that of the air in plains, where the heat eſcaping from the internal parts of the earth is much greater than at the tops of mountains, which are the moſt advanced and coldeſt points on the ſurface of the globe. Hence this condenſation of the air by cold, in high regions of the atmoſphere, ſhould compenſate the diminution of denſity produced by a decreaſe of the incumbent weight; and, of courſe, the air ſhould be equally denſe on the cold ſummits of mountains as in the plains. I am even led to think, that the air is more denſe on the tops of mountains, becauſe there the winds ſeem to be more violent, and the birds which ſoar above the higheſt ſummits appear to ſupport themſelves in the air with more eaſe in proportion to the height they riſe.

I may therefore conclude, that the free air is nearly of equal denſity at all heights, and that the atmoſphere extends not ſo high as has been determined, by conſidering the air as an elaſtic maſs compreſſed by an incumbent weight. Thus the total thickneſs of the atmoſphere may not exceed three leagues, inſtead of from fifteen to twenty, as has been conjectured by philoſophers *.

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* Alhazen, from the duration of the twilights, pretended that the

The firſt ſtratum of the atmoſphere is filled with vapours exhaled from the ſurface of the globe, both by its own heat and that of the ſun. In this ſtratum, which extends to the height of the clouds, the heat ariſing from exhalations produces and ſupports a rarefaction that forms an equipoiſe to the ſuperior air; ſo that the lower ſtratum of the atmoſphere is not ſo denſe as it ought to be in proportion to the preſſure it receives. But, at the height where this rarefaction ceaſes, the air undergoes all that condenſation which is produced by the cold of this region, where the heat ariſing from the earth is much diminiſhed; and this condenſation appears to be even greater than that which might be produced, by the weight of the ſuperior ſtrata, in the inferior regions, which are ſupported by rarefaction. This idea is ſtrengthened by another phænomenon, which

the height of the atmoſphere is 44331 fathoms. Kepler, upon the ſame principle, makes it 41110 fathoms.

M. de la Hire, when treating of the horizontal refraction of 32 minutes, fixes the mean height of the atmoſphere at 34585 fathoms.

M. Mariotte, from his experiments on the compreſſibility of air, makes the height of the atmoſphere 30000 fathoms.

However, comprehending under the atmoſphere that part of the air only in which refractions take place, M. Bouguer aſcertains the height not to be above 5158 fathoms, i. e. two and a half or three leagues; and I believe that this reſult is more certain and better founded than any of the others.

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is the condenſation and ſuſpenſion of the clouds in that elevated region where they are formed and ſupported. Beyond this middle region, where the cold and condenſation commence, the vapors riſe, but ceaſe to be viſible, except when a part of a cold ſtratum ſeems to be puſhed back toward the ſurface of the earth, and when the heat eſcaping from the earth being for ſome time extinguiſhed by rains, the vapours then collect and thicken around us in the form of miſts and fogs. Without theſe circumſtances, the vapours never become viſible till they arrive at that region where the cold condenſes them into clouds, and ſtops their further aſcenſion: Their gravity, which augments in proportion as they become more denſe, fixes them in an equipoiſe which they cannot ſurmount. We perceive that the clouds are generally higher in ſummer, and ſtill higher in warm climates. It is in this ſeaſon and in theſe climates that the ſtratum formed by evaporation from the earth riſes higheſt. On the contrary, in the frozen regions near the pole, where the evaporation produced by the heat of the globe is much leſs, the ſtratum of denſe air ſeems to touch the ſurface, and there to retain the clouds, which never riſe higher, but ſurround theſe gloomy regions with perpetual fogs.

III.

Of ſome Winds which have a regular Variation.

THERE are certain climates and particular countries where the winds vary regularly; ſome at the end of ſix months, others in a few weeks, others from morning to night, and from night to morning. In vol. i. p. 388. I remarked, That, *at St. Domingo, there are two different winds which riſe regularly every day; the one, which is from the ſea, comes from the eaſt, and begins at* 10 *o'clock before noon; the other, which is a land-wind, riſes at ſix or ſeven in the evening, and continues the whole night.* M. Freſnaye writes me, that my information has not been exact. 'The 'two regular winds,' he remarks, 'which blow 'at St. Domingo, are both from the ſea, and 'blow, the one in the morning from the eaſt, 'and the other in the evening from the weſt, 'which is only the ſame wind returned. It is 'evidently occaſioned by the ſun; for, every man 'perceives, that between one and two o'clock 'after noon, a tranſient guſt ariſes. When the 'ſun declines, by rarefying the air on the weſt, 'it drives to the eaſt the clouds which the morn-'ing wind had confined toward the oppoſite 'quarter.