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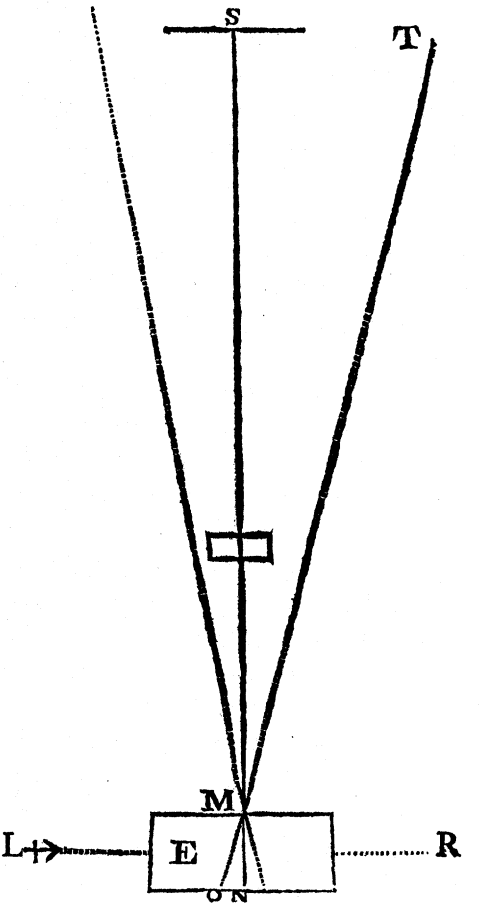
XXX. *Extract of a Letter from* John Winthrop, *Esq; F. R. S. Hollisian Professor of Mathematics and Natural Philosophy, at* Cambridge, N. England; *to* B. Franklin, *LL. D. F. R. S. Dated Sept.* 6. 1769.

Read April 5, 1770.

I FIND that Mr. Bliss and Mr. Hornsby, in their calculations in the Philosophical Transactions, suppose the phases of the transit of Venus, to be accelerated by the equation for the aberration of light, which amounts to $55''$ of time. According to my idea of aberration, I should think the transit would be retarded by it. I can very easily suppose that I am in an error; and that I may more readily be led out of it, I beg leave to lay before you the several steps by which I have been led into it. And I think it will be best to take some similar instance, rather than to consider the thing in a general abstract manner.

1. Let



1. Let the parallelogram E repreſent a veſſel ſailing in the line LR, from left hand to right; and S, a fixed ſtation, *e. g.* a caſtle, diſcharging balls in the right line SM, perpendicular to the route of the veſſel. If the veſſel had been at reſt, a ball arriving at the middle of it, M, would have gone right acroſs it, to N. But as it is ſuppoſed to be ſailing, the ball will not go right over from M to N, but will croſs the deck obliquely, in another right line, as MO, and ſo will be left behind towards the ſtern as much as the veſſel had gone forward, while the ball was croſſing it; and MN will be to NO as the velocity of the ball to the velocity of the veſſel. Thus, to the people on board, the ball would ſeem to move obliquely acroſs the deck, as if it came from ſome point

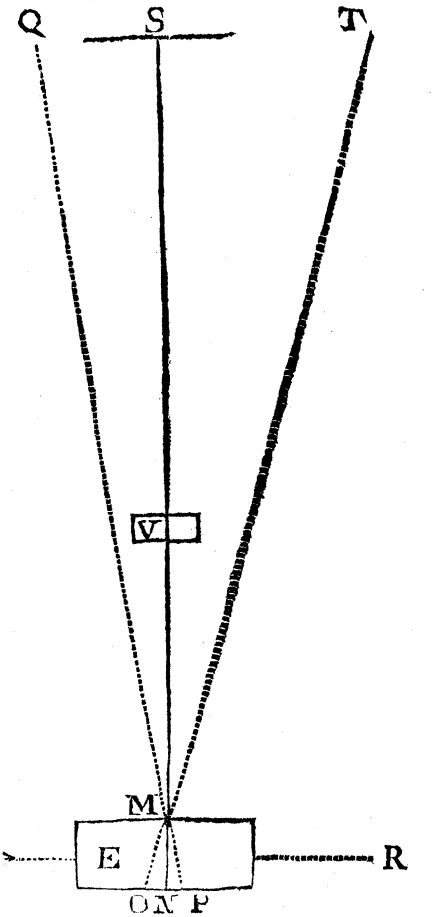
point T in the line OM, produced, inſtead of coming from S. And a tube capable of receiving the ball, would allow the ball to paſs through it without ſtriking its ſides, if it were inclined forward in the direction OM; which it would not do in any other ſituation. The angle OMN or SMT anſwers to the aberration; and ſuppoſing S to be the ſun, and E, the earth, this angle is 20″; and the general effect is, to make the ſun, or any fixed ſtar, to appear farther that way towards which the earth is moving.

2. Let us ſuppoſe another veſſel V, between S and E, ſailing the ſame way as E, in a parallel direction. If both the veſſels ſailed with the ſame velocity, a ball from V coming to M, would go right acroſs to N, juſt as if both of them had been at reſt; becauſe the ball, while croſſing the veſſel E, would be carried juſt as far to the right hand as the points M and N are. And a tube to receive it muſt be held in the direction MN. So here would be no aberration of the veſſel V.

3. Suppoſe V to move the ſame way, but ſlower. A ball from V would now be really carried forward, that is, to the right hand, though not ſo far as in the ſecond ſuppoſition; and therefore would be left behind in reſpect of the veſſel E; and ſo, would come to the ſide of the veſſel ſomewhere between O and N; but the greater its velocity towards the right, the nearer to N. So that if the velocity of V were to be continually increaſing from nothing till it became equal to that of E, a tube to receive the ball muſt be held firſt in the direction OM, looking forward, and afterwards, more and more inclined

clined till it came into the perpendicular direction MN. From hence it is natural to conclude,

4. That if V move the ſame way, but ſwifter, a tube to receive the ball muſt be reclined backward. For the ball would now be carried to the right hand farther than in the ſecond ſuppoſition; and therefore would come to the other ſide of the veſſel at ſome point P on the right hand of N, as if it proceeded from ſome point Q on the left hand of S.



This laſt ſeems to be the caſe of the tranſit, by ſuppoſing S to be the ſun, E the earth, and V the planet Venus paſſing between them from left to right, and with a greater velocity than the earth (greater, nearly as 24:20). And it ſhould ſeem that the aberration muſt make Venus appear farther to the left hand, or to the Eaſt from

the ſun, and conſequently retard the tranſit, and make it happen later than it would otherwiſe do.

Thus, Sir, I have explained very particularly my apprehenſion of the matter; and I make no doubt you will immediately diſcover where the error lies, and ſhall take it as a great favour if you will pleaſe to point it out to me.

XXXI. *Extract*