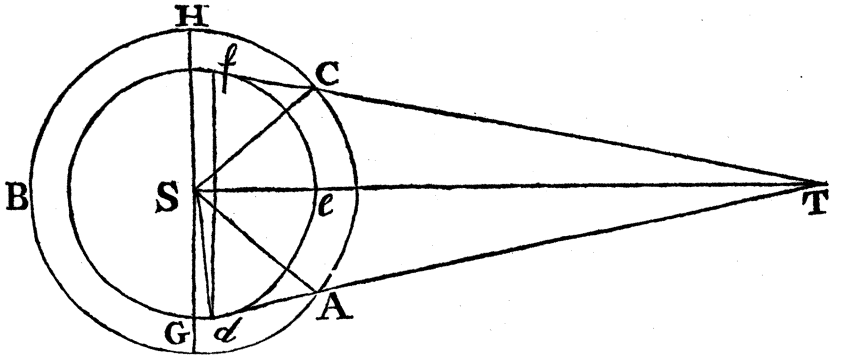
XXXVIII. *An Attempt to determine the Height of the Sun's Atmoſphere from the Height of the Solar Spots above the Sun's Surface: In a Letter to Mr.* J. Ellicot, *F. R. S. from the Rev. Mr.* Horſeley, *F. R. S.*

Read July 9, 1767. I Return you many thanks for your obliging communication of the obſervations of the late tranſit of Venus by Mayer and Rohlius. The phænomena which they relate of the atmoſphere of that planet are highly curious. They were perhaps the more intereſting to me, as they confirmed ſome conjectures of my own, concerning the great height of the atmoſphere of the ſun, and of thoſe of the two nearer planets. I once attempted to make a rough compariſon between the height of the ſun's atmoſphere and that of our own, by comparing the height of the ſolar ſpots above the ſurface of the ſun with that of our clouds above the ſurface of the earth, which I did in the following manner.

The inclination of the Sun's equator to the place of the earth's orbit is ſo ſmall, that in this enquiry I think it may ſafely be neglected; and I conſider the two planes as one. Let T be the center of the earth, S that of the Sun. Join T S, and let *def* be a great circle of the ſun's ſphere, formed by the interſector of the plane of the earth's orbit with the ſun's ſurface.

face. Let ABC be the circle deſcribed by the revolution of a ſpot. From T draw T*f* and T*d* touch-



ing the circle *def* in *f* and *d*, and cutting ABC, in C and A. Join *df*; through S draw HSG, parallel to *df*. Join SC, SA, S*d*. The ſpots are hid behind the ſun three days longer than they are viſible. That is, they are hid 15 days, and are ſeen only 12. The earth's motion in 15 day is 14° 17′. The ſpots traverſe the like area in 1d. 0h. 50′ nearly. Hence, if the earth ſtood ſtill, the ſpots would be hid only 13d. 23h. 10′, and their whole ſidereal period being 25d. 5h. they would be viſible 11d. 5h. 50′, and the time of their occultation would exceed the time of their appearance by 2d. 17h. 20′. Hence the arc AC is leſs than the arc ABC, by the motion of 2d. 17h. 20′, that is, by 38° 52′ 56″. And the ſemi-circle being a mean arithmetic between AC and ABC, AC will be leſs than the ſemi-circle by half as much; that is, by 19° 26′ 28″. Hence each of the angles GSA, HSC is 9° 43′ 14″. The angle *bsd* = *d*TS = 16′ 1″ 27‴. Therefore *d*SA is 9° 27′ 12″. Hence SA = 1,013767 ſuch parts as S*d* is 1.

The

The diſtance therefore of theſe ſpots from the center of the ſun is 1,013767 ſemi-diameters of the ſun, and their diſtance from his ſurface is in in decimal parts of his ſemi-diameter ,013767. Hence it is evident that the height of the ſolar ſpots above the ſurface of the ſun, is above 54 ſuch parts, as bear each to the ſun's ſemi-diameter, the proportion of one Paris mile to the ſemi-diameter of the earth, which is that of 1 to 3923 nearly. The height of our atmoſphere is generally reckoned about 50 miles. That of the lighteſt clouds fall ſhort of one mile. The whole height of our atmoſphere therefore is, at leaſt, 50 times that of our higheſt clouds. If the whole height of the ſun's atmoſphere bear as large a proportion to the height of theſe ſolar ſpots or clouds (and I think the proportion is likely to be much larger), the height of the ſun's atmoſphere is not leſs in proportion to his ſemi-diameter, than 54 times that of the earth's, and exceeds two thirds of his ſemi-diameter, being in decimal parts thereof ,68835.

The probability ſeems to be that the height of the ſun's atmoſphere is almoſt double of this; for I queſtion whether the mean height of our clouds exceeds $\frac{1}{2}$ a Paris mile. The ſolar ſpots, therefore, are 108 times as high in proportion; and then, ſuppoſing as before, that the whole height of the ſun's atmoſphere bears the ſame proportion to the height of his ſpots, as the whole height of our atmoſphere to the mean height of our clouds, the ſun's atmoſphere will be 108 times as high in proportion to his ſemi-diameter as ours is, and will riſe

to the diſtance of more than $\frac{4}{3}$ of his ſemi-diameter from his ſurface.

Let philoſophers conſider, whether theſe indications of the vaſt height of the ſun's atmoſphere give any degree of probability to a conjecture of Sir Iſaac Newton's, that the diſſipation of the ſun's ſubſtance, which might be expected to enſue from his intenſe heat, may in great part be prevented by the prodigious preſſure of the incumbent atmoſphere.

The height of the atmoſphere of Venus is conſiderably greater according to the obſervations of Mayer and Rohlius than they imagined. Rohlius follows Caſſini in the eſtimation of the ſun's apogee ſemi-diameter, which Caſſini over rated by $3'' 45'''$. This quantity, therefore, is to be added to the height of Venus's atmoſphere (15,5) as ſtated by Rohlius; which makes the true height $19''.25$, that is above $\frac{1}{3}$ of the diameter of the planet. I cannot but reflect with ſome degree of national triumph on the great part that our own country may juſtly claim in many of the moſt curious diſcoveries in all parts of the world. Mr. Meyer generouſly confeſſes how much he ſtood indebted to Engliſh artiſts. You told me that it is your intention to preſent that curious tract to the Royal Society. You may likewiſe communicate this if you think it contains any thing worthy of their notice.

I am, Sir, with great eſteem,

Your moſt obedient

and moſt humble ſervant,

Broad-Street,
June 11, 1767.

Sam. Horſley.