

### The Habitability of Mars.

INASMUCH as Dr. Wallace has sent me his book through his publishers, as I gather from the wrapper—though it is not so expressed—I suppose it is incumbent on me to acknowledge it, since he clearly expects some sort of reply. The effect of its perusal is to show me again how cogent is the argument for the habitability of Mars, for only by many misstatements of fact, wholly unintentional, of course, can Dr. Wallace make out even a seeming case upon the other side. A physicist will not need to have these errors pointed out to him, but as most readers are unable to correct them for themselves it may be wise to instance a few to show how his house of cards tumbles down in consequence.

On p. 22 he quotes from Miss Clerke to prove that the cap could only supply 2 inches of water over the irrigated districts. Let us assume her own estimate of snow deposited, and merely correct her mathematical and topographic mistakes. She states the maximum area which the cap covers to be 2,400,000 square miles. Now the south cap comes down to  $36^{\circ}.5$  latitude on the average, and an easy calculation shows this to occupy 11,330,000 square miles, or to be more than four times as great. Next, she supposes the natural dark areas of the planet to be irrigated, which they are not, mistaking them for the canal system, which, instead of 17,000,000 square miles, covers, oases and all, only about 4,750,000 according to our measures, remembering that the whole of it is not watered from one cap. By combining these two corrections we find, not 2 inches of water for each bit of ground, but  $2\frac{1}{2}$  feet, and this according to her own estimate, which there is no reason to suppose not to be two or three times too small. So that it is the argument of Dr. Wallace, and not the cap, that fails to hold water.

An equally fatal flaw affects Dr. Wallace's argument for temperature. Here he bases his deduction on a misstatement of Prof. Poynting. Prof. Poynting states that in my paper on the mean temperature of Mars I took no due account of the blanketing effect of air. Not only did I expressly take it into account, but I did so in the only way it can correctly be taken, not by hypothesis, but by direct appeal to what takes place on earth under a clear and under a cloudy sky by night; and I am glad to know that in a paper he has sent to the *Phil. Mag.* on the subject Prof. Very, the bolometric authority on matters of temperature to-day, agrees with both my method and my conclusion for Mars, and points out where Prof. Poynting's calculations are fallacious.

Another omission is no less telling. Dr. Wallace apparently is unaware that Prof. Very's bolometric determination of the moon's heat, which for delicacy surpasses any previous ones, makes the temperature on the moon during the lunar day reach  $356^{\circ}$  F. above Fahrenheit zero.

Many more such misunderstandings might be mentioned occurring throughout the book, such as where, from not giving its context, he makes me appear to say that water-vapour is one of the heavier gases, which, of course, I did not.

Again, his theory, taken from Chamberlin, that the interior of Mars can have completely lost its heat in the very process of contraction, and yet later have suffered a meteoric bombardment sufficient to give it a heated outer layer, is mechanically whimsical, not to say impossible. For it can be shown that Mars could not have captured any meteoric swarms not substantially travelling in its own orbit when it coalesced into a planetary mass, and any meteors subsequently encountered could only have fallen on it as it passed through a swarm, yielding a relatively insignificant amount of matter. Any such effect would be even more pronounced on the earth, of the occurrence of which there is no evidence.

Misstatements cannot be too carefully avoided in science,

especially when a man, however eminent in one branch, is wandering into another not his own. Dr. Wallace, whose intentions are of the highest, will appreciate this. Indeed, if criticism were confined, as common-sense counsels, to those versed in the phenomena, we should hear very little about the inhabitability of Mars.

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