

MAN'S PLACE IN THE UNIVERSE.

A REPLY TO DR. WALLACE.

A STATEMENT about matters of fact, and an argument founded upon them, to which the name of Alfred Russel Wallace is subscribed, are always deserving of our serious attention; for we know that the statement is made by a keen, able and experienced collector of facts, and the reasoning is that of a man who once reasoned rightly when all the rest of the world, except Darwin, were wrong. When, further, the statement is that we are at the centre of the visible Universe, and the inference that "the supreme end and purpose of this vast Universe was the production and development of the living soul in the perishable body of man,"¹ our attention is not only deserved, but compelled; if there is a chance that Dr. Wallace is right, as once he was, whatever we put aside in order that we may earnestly attend to him is well neglected.

I trust that I have not been wanting in this respect. I have read his paper with great care several times, and compared it with the sources of information which he quotes, and with others. Moreover, my own work in astronomy during the last decade has given me some acquaintance with the regions of knowledge from which the facts are drawn. I cannot see that Dr. Wallace has suggested anything new which is in the least likely to be true. He seems to me to have unconsciously got his facts distorted, and to indicate practically nothing wherewith to link them to his conclusion; and having stated thus briefly the result of my examination, I must endeavour to justify it.

There is a convenience in considering the inference first, and the facts afterwards: for if we find that, even granting the facts, the conclusion does not follow, the need for examination of the facts is rendered less pressing. The division between fact and inference is, of course, to some extent arbitrary; but we cannot do better than accept that indicated by Dr. Wallace himself. On p. 411 he writes:—

The three startling facts—that we *are* in the centre of a cluster of suns, and that that cluster is situated not only precisely in the *plane* of the Galaxy, but also *centrally* in that plane, can hardly now be looked

upon as chance coincidences without any significance in relation to the culminating fact that the planet so situated *has* developed humanity.

To these three assertions of fact must be added another, on which I do not here propose to offer any remarks; Dr. Wallace considers it highly probable that the Earth is the *only planet in the Solar System* on which humanity has been developed. The three facts just quoted lead him to the further conclusion that it is probably *the only planet in the whole Universe* on which humanity has been developed; and we have now to examine how far we can accompany him. We may again state in Dr. Wallace's own words the question to be answered.

It may be asked, even if it be conceded that both by position, by size, and by its combination of physical features, we really do stand alone in the Solar System in our adaptation for the development of intelligent life, in what way can the position of our Sun at or near the centre of the stellar universe, as it certainly appears to be, affect that adaptation? Why should not one of the suns on the confines of the Milky Way, or in any other part of it, possess planets as well adapted as we are to develop high forms of organic life? (P. 409.)

Now, these two questions, which have the look of being the same expressed in slightly varied language, are in reality essentially different. The first question is the one Dr. Wallace must answer satisfactorily in order to reach his conclusion; but with the deftness of a conjurer he substitutes the second. He is to prove, or at least suggest, some property of the "centre of the stellar universe"; he immediately distracts our attention to the "confines of the Milky Way," and holds it there to the best of his ability for the whole of the subsequent argument. He never mentions the "cluster of suns" of which, by his own account, our sun is a mere unit, albeit the central unit. Why should not any one of them "possess planets as well adapted as we are to develop high forms of organic life?" And why, at least, should not Dr. Wallace have noticed the question? He has mentioned the utmost boundaries of the Universe, and he has mentioned the centre; but *ignored everything else* (with the exception only of two empty phrases which need not be noticed). His argument accordingly stands thus:—

Life is impossible at the uttermost boundaries of the Universe. Therefore it is only possible at the exact centre.

This, at any rate, is all that I can make of the reasoning in the last two pages of Dr. Wallace's article, where we look for him to make use, in a manner suited to his conclusion, of the premises he claims to have established in the preceding pages.

Moreover, the reasons he gives for considering even the "con-

finest of the Milky Way" to be unsuitable for life are of the vaguest and most unsatisfactory kind. The following passage will serve as an example:—

Comparing the stars of the Milky Way to the molecules of a gas, must not a certain proportion of these stars continually escape from the attractive powers of their neighbours, as a result of collisions, or in other ways, and wandering into outer space, soon become dead and cold and lost forever to the Universe?

The comparison is altogether misleading. We have no reason for supposing that if the stars were blotted out of existence our Sun would become dead and cold sensibly sooner than under present conditions. The accepted belief is that his slow contraction is sufficient to account for the energy radiated, and other observed phenomena; and it has never, so far as I am aware, been suggested that we are kept alive by the "attractive powers of our neighbours," the fixed stars, or by their influence in any other form. We might "wander into outer space" without losing anything more serious than we lose when the night is cloudy and we cannot see the stars. As regards what Dr. Wallace adds about the behaviour of the ether, the Röntgen rays, etc., near the "borders of the Universe," it must be remarked that he is making the considerable assumption that when the visible stars fail, the ether fails also, which requires separate proof.

It is true that Dr. Wallace puts forward these hypotheses very tentatively, pending the suggestion of a better link between his starting-point and his conclusion. How to fill this gap he regards as a question involving "the most difficult problems in mathematical physics; and only our greatest thinkers, possessing the highest mathematical and physical knowledge, could be expected to give any adequate answer" to it. It is of course possible that some great and ingenious thinker may supply the missing link; but meanwhile we are impressed by the fact that Dr. Wallace, with an obvious desire to suggest it, however vaguely, has conspicuously failed.

Such being the intangible nature of the edifice erected on the assumed facts as foundation, it may be questioned whether there is any pressing need to test the security of the foundation itself. Does it matter very much whether the Sun is at or near the centre of the visible Universe if no better reasons can be given for assigning any great significance to this position? Without the tremendous inference, the fact itself, if fact it be, can only invite our polite attention as a curious coincidence. Even as a coincidence it does not take high rank; for it can in any case only be temporary. If there *is* a centre of the visible Universe, and if we occupy it to-day, we certainly did not do so yesterday, and

shall not do so to-morrow. The Solar System is known to be moving among the stars with a velocity which would carry us to Sirius within 100,000 years if we happened to be travelling in his direction, as we are not. In the 50 or 100 million years during which, according to geologists, this earth has been a habitable globe, we must have passed by thousands of stars on the right hand and on the left; and if at any time we had a claim to a central position, the claim must have been inherited from others who held it before us, and passed on to yet others who came after. In his eagerness to limit the Universe *in space*, Dr. Wallace has surely forgotten that it is equally important, for his purpose, to limit it *in time*; but incomparably more difficult in the face of ascertained facts. Indeed, if we take his own conception of the approximate dimensions of the Universe (if I rightly interpret his words), so far from our having tranquilly enjoyed a central position in "*unbroken continuity* for scores or perhaps hundreds of millions of years" (p. 409), we should in that time have traversed the Universe from boundary to boundary. He says (*italics mine*):—

Other stars of the first magnitude which have had their distances measured have a parallax of considerably less than one-tenth of a second, and are therefore among the remoter stars (p. 401).

If this means that he reckons a star with a parallax of one-hundredth of a second "among the remoter stars," then the time we shall take to travel from our present position to the remoter stars is less than five million years; and, similarly, five million years ago we were among the remoter stars, where he considers life to be impossible. The actual dimensions of the visible Universe are, however, probably much greater than this. Professor Simon Newcomb, whose book¹ is several times quoted by Dr. Wallace, gives in his "Summary of Conclusions" (p. 319) the following inferior limit:—

The boundary of our Universe is probably somewhat indefinite and irregular. As we approach it, the stars may thin out gradually. The parallax at the boundary is probably nowhere greater than $0''.001$, and may be much less. The time required for light to pass over the corresponding interval is more than three thousand years.

And the time required for the Solar System (which is moving about 15,000 times more slowly than light) to pass over the same interval is accordingly forty-five million years. It is thus clear that whether we adopt the views of Dr. Wallace himself (if I

(1) "The Stars: a Study of the Universe." By Professor Simon Newcomb. (London: John Murray, 1901.)

have interpreted him rightly) or those of Professor Newcomb, whom he quotes (and he could not do better), the Solar System must have essentially changed its position in the visible stellar Universe within geological time.

The importance of the question whether we are at the present moment approximately near its centre is accordingly reduced within very narrow limits, and it only remains to examine how far it is probably a fact, as Dr. Wallace asserts. After being in direct conflict with him so far, it is a pleasant relief to be able to admit that he has in the main drawn his facts from the best sources of information available; for few astronomers would demur to this description of a book, dated 1901, by Simon Newcomb, labelled on the back "A Study of the Universe." Whatever we may think of Dr. Wallace's facts, it must at any rate be allowed that they are to be found essentially, although stated rather more provisionally, in the "Summary of Conclusions" at the end of this thoughtful work, which might reasonably be regarded as the last word on the matter. It is fortunate for me that on one very important point I need not challenge the authority of the utterance, but can simply point to the date which makes it ancient history. It is a striking illustration of the rapidity of advance in astronomy that since 1901 a new fact has been discovered which renders insecure some of the steps by which Professor Newcomb arrives at the conclusion that the "collection of stars which we call the Universe is limited in extent." On the night of February 21st-22nd in that year, Dr. Anderson discovered that a new star had suddenly blazed up in the constellation Perseus. The discovery is mentioned in Professor Newcomb's book, and before it was passed for press he was able to add that "on June 25th, 1901, Professor Pickering reported that the spectrum of the new star had been gradually changing into that of a gaseous nebula"; but he could follow its history no further. In the autumn of the same year, photographs were taken of the region surrounding the star at the Yerkes and Lick Observatories, which showed wisps of a vast nebula; and which showed, further, or seemed to show, that this nebula was expanding in all directions outwards from the star. But it was not found possible to reconcile other observed facts with an actual movement of *matter* of the kind indicated; and the accepted view is that the nebula was already there, and is comparatively stationary, and that the *illumination* from the flash of the original outburst travels from one portion to another. The whole phenomenon is of extraordinary interest, but what immediately concerns us is the fact that we seem to have positive evidence of the previously unsuspected existence of a *vast nebula, not self-luminous, but capable of reflecting light, and therefore of partially*

obstructing it. We have known of "dark stars" before—here we learn of a "dark nebula." How many such bodies are there? We can only learn of their existence in very exceptional cases when they disturb the motion or the shining of bright objects. Thus, in the variable star Algol, we have an instance of a bright star which is periodically eclipsed by a dark star. In this case the dark body is of such modest dimensions that the eclipse only lasts ten hours; but with a vastly extended body like a nebula we might have eclipses lasting so long as to be practically permanent.

The discovery affects the case for a finite Universe in two ways. In the first place there are the "dark rifts" in the Milky Way, the most notable of which is called the "Coal-sack." Are these really tunnels through the visible Universe into an outer space void of stars? This is the view favoured by Professor Newcomb. But another view has been suggested—that there is some screen which obstructs the light from stars beyond. When Professor Newcomb's book was written there was no positive evidence to support this view; since it was written, we have obtained indications of a dark nebula such as might satisfy the conditions.

Secondly, there is the argument that if there were an infinite succession of *bright bodies only* as we proceed outwards from our system, the whole sky would be infinitely bright with them; we can arrange a series of successive spherical shells of stars which would each contribute a finite brightness, and the totality of which would give infinite brightness. The italics are mine, and are intended to draw attention to a necessary limitation of the argument; for if we have a similar succession of *dark bodies only*, however sparsely scattered, it can be shown in the same way that we should ultimately obtain a completely effective screen from the light of any bodies beyond. What then would happen if we had an infinite succession both of bright bodies and dark bodies intermingled? The question has some resemblance to the old puzzle, "What will happen when an irresistible force meets an immovable obstacle?" But it is easier to answer, and the answer is that we should probably get the sort of appearance which we actually see. I venture to think that Professor Newcomb did not sufficiently consider the "dark stars" when he wrote his book, and that if he had done so, he would have modified his conclusions. Now that we have positive evidence of the existence of dark nebulae as well, the argument against an infinitely extended Universe is considerably weakened.

The remaining statement is that we are at the centre of the Universe, if, perhaps, it be limited in extent. Now there is one important previous question: has the Universe a centre? Has a saucepan a centre? The bowl may have a centre, but if we

claim a centre for the whole saucepan we must not leave the handle out of account. There is an exceptional and extraordinary feature of the Universe of stars which has something in common with the handle of a saucepan, and cannot be left out of account in a discussion of this kind. I will take the description of it from Professor Newcomb's book:—

Pickering found that the stars of the fifth spectral type are mostly distributed along the central line of the Milky Way. An exception occurs in the case of a group situate in the "Magellanic Clouds," a cloud-like mass of small stars too far south to be visible in our latitudes, and detached from the main course of the Milky Way itself. The total number of the stars in question is 91, of which 70 are in the Milky Way and 21 in the Magellanic Clouds (p. 256).

The seventy stars along the Milky Way lie within a degree or two of its central line, and thus indicate a plane cutting across the Universe in which we undoubtedly lie, and this is a noteworthy fact. But this plane does not cut the whole saucepan symmetrically; it only divides the bowl; there is the handle which must be taken into account, and its importance may be gauged from the fact that while seventy stars encircle the bowl, no less than twenty-one are in the handle. It seems probable that some important secret about the structure of the Universe lies locked up in that handle. We are only at the beginning of our knowledge of these extraordinary objects—most of them have been discovered within the last decade—and our views of the structure of the Universe may require continual modification as new discoveries are made. A German astronomer, in reviewing Professor Newcomb's book, expressed a doubt whether the problems dealt with were ripe for popular exposition; meaning, probably, that it is difficult to give the average reader at the same time an idea of the present state of our knowledge and a fair notion of the possibilities of error. One cannot help feeling that he was so far right that even a man of the scientific training of Dr. Wallace, on reading the book, has been seriously misled.

To sum up, Dr. Wallace stated:—

- (1) That the Universe is limited in extent.
- (2) That it has a definite centre, and that we are, and have been for millions of years, near that centre.
- (3) That by reason of being at the centre the Earth has had an opportunity to develop humanity; and that probably nowhere else in the Universe has there been this opportunity.

In reply it is claimed:—

- (1) That the limitation of the Universe is not proved. The view had the support, so lately as the middle of 1901, of so high

an authority as Professor Simon Newcomb; but even in the intervening eighteen months a new fact has come to light which weakens his arguments.

(2) That there is no true centre of the Universe, even if limited, and even if there were we could not occupy it for long. The path of the Solar System in millions of years would be a large fraction of the dimensions suggested for the limited Universe.

(3) That no reason whatever has been given why life should not be developed in any part of the interior of even a limited Universe, and that some reasons indicated for doubting whether it could be developed near the boundaries are not in accordance with accepted facts.

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