

## MAN'S PLACE IN THE UNIVERSE.\*

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PERHAPS the greatest drawback under which Science—not one science alone but each and all of the sciences in turn—labours at the present time is the impatience of the general public to receive precise, definite, and striking results. Thus, for example, most popular scientific lecturers find that their audiences look to them to lead up to some clear, crystallised conclusion. It demands some courage, and great skill, to press home upon a popular audience the truth that just in proportion to the advance of our knowledge so is the increase in the number of the problems which are presented to us for solution. The horizon recedes as we advance, and, more than that, it widens at the same time.

A striking example of the eagerness with which the conjecture of a scientific man will be caught up, if only it be sufficiently definite and far-reaching, is afforded by Mädler's celebrated suggestion that the sun with its attendant planets might be travelling in a gigantic orbit of which the focus might be within the group of the Pleiades. In how many thousands of essays, lectures, books, and sermons the statement has appeared that science has proved that the centre of attraction of the universe is located in Alcyone, the chief of the Pleiads, it would be useless to guess. Contradicted a thousand times, the legend seems to have lost none of its pristine vigour. Give a fable a yard's start, and Truth appears to be unable to overtake it in less than a century.

We greatly fear that just such another myth has been started on its career, and by one of the most highly and

\* "Man's Place in the Universe, as indicated by the New Astronomy," by Alfred Russel Wallace, D.C.L., F.R.S. *Fortnightly Review*, March, 1903.

most justly honoured of living men of science. The *Fortnightly Review* for March, 1903, opens with an article, at once striking and attractive, on "Man's Place in the Universe, as indicated by the New Astronomy," by Alfred Russel Wallace, D.C.L., F.R.S. The article leads up to a theological application which it does not lie within our province here to discuss; it is the astronomical basis of the article alone with which we are concerned.

Dr. Wallace's first thesis is that the stellar universe is finite in extent and the stars finite in number. His next point is that the proper motions of stars furnish the best indication of their distances. Then he argues that the solar system is about equally distant from all parts of the Milky Way, and exactly in its plane. Then that the sun is one of the central orbs of a globular star cluster, and that this star cluster occupies a nearly exactly central position in the exact plane of the Milky Way. "Our sun is thus shown to occupy a position very near to, if not actually at the centre of the whole visible universe, and therefore in all probability in the centre of the whole material universe."

This completes the first part of Dr. Wallace's enquiry; the second part deals with the earth's position in the solar system as regards its adaptability for organic life. Here Dr. Wallace leaves strictly astronomical questions and is on his own ground. His point is that the conditions for the development of organic life are far more stringent than has been generally recognised. The surface temperature of the planet must remain stable within a very limited range, not for hundreds or thousands of years, but for millions, perhaps for hundreds of millions. The chief favourable conditions which in their combination appear to have rendered the development of a complex system of organic life possible on our earth are, its distance from the sun securing the equability of temperature just mentioned; an atmosphere of sufficient density; broad and deep oceans, stirred into tides by the action of a large satellite; and the presence of deserts and volcanoes for the distribution of atmospheric dust. The stringency of these conditions appears to indicate that our earth is the only home of organic life within the solar system, and Dr. Wallace considers that suns near the confines of the stellar universe cannot have systems sufficiently stable for their planets to fulfil these conditions there. In his view, therefore, the position of the solar system in the centre of the material universe renders it probable that here, and here alone, has organic life reached its full development.

It will be seen that the entire argument falls to the ground if the first point, the demonstration that our universe is finite, is not complete. As Dr. Wallace himself remarks: "Infinite space has been well defined as a circle, or rather a sphere whose centre is everywhere and circumference nowhere," and unless the material universe can be proved to be finite, we certainly cannot prove that any particular body occupies its centre. Dr. Wallace's argument is, first, that the telescopes of greatest size have failed to reveal to us fainter stars in anything like the same proportion which smaller telescopes had done; as if we were looking right through the stellar universe, and out into the blackness of space beyond. This is partly accounted for by the fact that the increase in aperture of a refractor is necessarily accompanied by an increase in the absorption of its object-glass, and we are approaching the limit where the gain and loss will be balanced. So too with the photographic plate. For medium luminosities it is perfectly true that an increase of exposure will compensate for inferiority of light in a strictly commensurable degree; but the correspondence ceases to hold good when we are dealing with very faint lights.

Dr. Wallace's next argument is an extraordinary one. He tells us, and quotes Prof. Newcomb\* in his support, that were the stars infinite in number, then we should receive an infinite amount of light from them. A reference to what Prof. Newcomb actually has written shows that Dr. Wallace has omitted two important limitations which Prof. Newcomb attaches to this conclusion. It rests upon the hypotheses "that light is never lost in its passage to any distance however great," and "that every region of space of some great but finite extent is, on the average, occupied by at least one star." In short, Prof. Newcomb's demonstration rests on the two conditions that light must come through space to us without any loss, and that the stellar universe must, on the whole, be uniform in constitution; it must not be structured. We know that neither of these conditions holds good. As there are bright bodies in space, so are there dark bodies. If the first be infinite in number, so must also be the second; we may almost say that the infinity of the second must be of a higher order. As Sir Robert Ball recently put it, "the dark stars are incomparably more numerous than those that we can see . . . and to attempt to number the stars of the universe by those whose transitory brightness we can perceive would be like estimating the number of horseshoes in England by those which are red hot." The same line of argument which would infer that from an infinity of bright suns the background of the sky should shine as the sun at noonday, will lead yet more forcibly to the conclusion, when the dark stars are the basis of the argument, that we are shut in by a veil which no light from an infinite distance can pierce. On the second point, that of structure, we need only the evidence of our eyes. The existence of the Milky Way is proof that our stellar system has a strongly marked form. There is no approach to uniformity of the stars as to direction, why should we assume that there is in distance? But Dr. Wallace does not see that these two conditions are vital. He writes: "Even if we make an ample allowance for the stoppage of light by intervening dark bodies, or by cosmic dust, or by imperfect transparency of the ether, we should at least receive quite as much light from them as the sun gives us at noonday," forgetful that the entire argument depends upon the exclusion of these three causes of absorption.

The attempted demonstration of the finite nature of the universe thus breaks down entirely; it is based upon a careless reading of Prof. Newcomb's book. In his next point Dr. Wallace again rests upon Prof. Newcomb, whilst again ignoring his deductions. He quotes:—"If we should blot out from the sky all the stars having no proper motion large enough to be detected we should find remaining stars of all magnitudes, but they would be scattered almost uniformly over the sky, and show no tendency towards the Milky Way." Prof. Newcomb's words are actually somewhat different. He writes, "show little or no tendency to crowd towards the Galaxy, unless, perhaps, in the region near 19 hrs. of R.A. From this, again, it follows that the stars belonging to the Galaxy lie farther away than those whose proper motions can be detected." This conclusion of Prof. Newcomb's cannot be disputed, but Dr. Wallace substitutes for it another, viz.: that stars with measured proper motions constitute a globular mass, and that we must be situated very near indeed to the centre of this solar cluster.

The points upon which Dr. Wallace lays stress as to the Galaxy, namely, that the sun is situated in its central plane, and nearly centrally with regard to it, are indeed

\* "The Stars: A Study of the Universe." By Prof. Simon Newcomb.

matters of fact. But, on the one hand, so far from his having led the way in pointing out these facts, they have been fully considered by every astronomer who has treated of the Galaxy at all; and, on the other hand, he gives to the two facts a greater precision than he is warranted in doing. The Galaxy marks out roughly a great circle in the sky; it is far too irregular an object for anyone to be able to declare that its axis lies precisely along a great circle. But it is exceedingly convenient to treat it as if it did, and no error can arise from such a convention except when an argument like Dr. Wallace's is seriously based upon it. But with regard to our sun being placed in its centre, the estimate of the distance from us of the mean mass of the Milky Way is roughly three hundred light-years; a "light-year" being the distance which it takes light a year to traverse, nearly six millions of millions of miles. Our distance from Alpha Centauri is a little over four light-years, so that we have no right to say that we are nearer the centre than this twin sun of ours; nor indeed would it be safe to assert it of any of the stars whose parallax can be considered really well-determined. From the nature of the case, a distance of over thirty light-years involves a parallax too small for really satisfactory handling, and yet makes but an inconsiderable fraction of the diameter of the ring of the Milky Way.

More than that, our sun is itself travelling at a pace sufficient to bridge the distance to Alpha Centauri in sixty-five thousand years, a mere moment in our world's complete life-history. If this pace has been maintained in a straight line, five million years ago we were deep in the actual stream of the Milky Way; five million years hence we shall have completely crossed the gulf which it encircles, and again be a member of one of its constituent groups, but on the opposite side. And ten million years are regarded by geologists and biologists as but "a trifle on account" to meet their demands upon the bank of Time.

The paragraphs on "The Earth as Adapted for Life" are rather for biologists to criticise than for astronomers, but the conclusion of the paper contains several statements which almost lead us to doubt whether we have not been mistaken in supposing the article to be a serious one, and whether it was not intended as an elaborate skit on astronomical cosmogonies. How else can we regard the statement that "we can actually *see* beyond the outer boundaries" of the material universe, "a limited universe of matter and ether." To see beyond the luminiferous ether reminds one of the inventor who discovered a universal solvent, but did not know of what to make the bottle in which to hold it, so that the precious liquid was all lost. Dr. Wallace compares the stars of the Milky Way to the molecules of a gas, and suggests that "a certain proportion of them would continually escape from the attractive power of their neighbours, and wandering into outer space soon become dead and cold and lost for ever to the universe." The process, he not obscurely intimates, will be continued indefinitely, until this earth of ours, from being the centre of the universe, will become the centre of a space from which the universe has all departed. He thus offers to our poor planet only the cold comfort which Polyphemus tendered to Odysseus, that he should be eaten last. Dr. Wallace further intimates that "at any considerable distance beyond the central portion of the universe gravitation would vary in intensity in different directions," and gravely suggests that this variation may possibly be detected by means of the motions of remote binary stars.

To sum up, the little in Dr. Wallace's paper which can fairly be said to be demonstrated fact is anything but new, and that which is new, whether true or not, is as yet but speculation. His conclusions are, at the best,

premature, and lie in a region which, from its very nature, must probably always be outside the bounds of our knowledge. The Milky Way, which forms the chief portion of the structure of that sidereal system in which we are placed, no doubt is finite in extent, and we can make certain statements with regard to it. But we are not yet in a position to say that all of the objects revealed to us by the telescope are included in that system; nor can we legitimately assert that what is apparently true of such of it as we can see is absolutely true of the entire material universe. Dr. Wallace's underlying error is, indeed, that he has reasoned from the area which we can embrace with our limited perceptions to the Infinite beyond our mental or intellectual grasp. We are on the earth, and can only reason, only guess, from our earthly experience of the laws, of the materials, of the conditions elsewhere. Our eyes have limited powers of vision, our mental grasp is confined, our days are but few on the earth, and our experience small; all these boundaries limit for us the universe, however vast it may actually be, and inevitably tend to make our view-point seem to be the centre of our horizon.