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MAN'S PLACE IN THE UNIVERSE.

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THE problems which the eminent naturalist, Russel Wallace, has just brought under discussion are certainly among those which may well engage the attention of thinkers, no matter to what school of philosophy they belong. It would take too long to examine them in detail, but we can, in a glance, easily take account of the weakness and fragility of the foundation upon which he seeks to raise his new anthropocentric theory.

The fundamental astronomical thesis of the author may be thus summarized: The number of the stars is not infinite; the entire universe is represented by the agglomeration of stars, of which the Milky Way marks the principal plane; our sun is in the centre of the universe.

We may at once grant that the number of the stars is not infinite. Besides, there are here two contradictory terms. Any *number* whatever cannot be infinite. On the contrary, we can easily imagine to ourselves another star

placed here or there, or two stars, or ten, or a hundred. But the infinite is that to which nothing can be added.

But it is of consequence that we should not confound the stars with space. Space cannot be otherwise than infinite. It is boundless, illimitable. If we imagine any confine to it whatever, immediately we pass in thought beyond it. Doubtless we could criticise even the definition of space. Some philosophers, and those by no means minor ones, have defined space as that which separates two bodies in such a manner that without matter there would be no space. On the other hand, theologians refuse to admit the infinity of space, so as not to give to it an attribute of God. They maintain that space is finite, and assert that beyond its limits there is nothing. I venture to think that here there is a mere sophism. If matter did not exist there would still be space, that is to say, a place* in which we might imagine matter to exist.

One of the most curious arguments which Dr. Wallace urges against the "infinite number" of the stars is, that if it were so, there would be stars everywhere over the entire sky, without any empty space, and since that every star is a sun, all these contiguous points of light should form a dazzling sphere, whose brightness should equal that of the sun. This objection to the infinitude of the stars was the subject of long and learned discussions during the course of the 18th century and up to the middle of the 19th. It would not be difficult to settle it to-day.

In the first place there is nothing to prove that the light of the stars does not suffer a diminution greater than the square of the distance, owing to the imperfect transparency of the cosmical medium. Space is not empty. Why may not the ether exercise any absorption on the luminous rays?

In the second place, why think only of the bright stars, of the incandescent suns? And the dead suns? May not as many or more dark stars exist as bright ones? Might not the milliards of dark stars interpose between us and the most distant luminous ones?

In the third place there is nebulous matter. Space is full of it; photography has discovered it everywhere. Why should nebulous matter be necessarily luminous? Originally it may have been obscure.

In the fourth place we may not neglect the cosmical dust to which we owe the Zodiacal Light (a reflection of the solar light), the shooting stars, which the earth encounters by hundreds of milliards in a year, as well as other interstellar phenomena to which it gives rise.

The agglomeration of stars of which our sun forms one is not infinite, it is limited; it is very heterogeneous, as we see it, composed of thousands of clusters of stars of diverse densities, and scattered at diverse distances. The immensity which encompasses it is relatively void, and our sidereal universe is composed of but a determinable number of stars.

It is this stellar agglomeration which Dr. Wallace considers as representing the entire universe, a position which has not been proved. Moreover, in this agglomeration he considers the sun as being central and preponderant. Let us see if it is so.

We are within the Milky Way, since this encloses us under the form of a great circle, but we are neither exactly in its medial plane, nor exactly at its centre. Moreover, the Milky Way is not a uniform and organised sidereal

* Some object that this is tautological. Not so. But we make use of words for speaking and writing. Our conception of space is bound up closely with our sense of touch, our muscular sense. Our ideas are derived from our impressions undoubtedly. But we must not confuse the relative with the absolute unknowable to us in its essence. The exterior world is not conditioned by our sense of it. Without us the Sun, Sirius, and space would exist.

system of which our sun is a preponderating star. The Milky Way is made up of an agglomeration of clusters of stars disposed pretty nearly in the same fairly wide plane.

The telescope has disclosed a great number of clusters of stars and of nebulae—about six thousand. But if we place on a chart, representing the two celestial hemispheres, these clusters and nebulae, a fact is made clear worthy of the greatest attention. It is that most of the clusters are gathered into the plane of the Milky Way, and that most of the gaseous nebulae are collected, on the contrary, away from this plane, and near the poles of the Milky Way.

This has a significance of great importance to our knowledge of the structure of the sidereal universe.

On the other hand, if we examine the law of distribution of stars in the sky, we ascertain that their numbers gradually increase—for all magnitudes—in proportion as we approach the Galaxy.

But it is of consequence to note that neither for stars nor for stellar clusters is this condensation uniform. It is not, for example, by zones parallel to the Milky Way that we must proceed, for that method is insufficient, but by the direct examination of the sky. If we trace isophotic charts giving the sidereal density as is done on hypsometrical charts for contour relief, these differences are made evident.

On a clear summer night, our eyes, trained astronomically, can observe in this vast celestial girdle of the Galaxy very different stellar densities, and we gain the impression that far from being a regular system, comparable to the solar system, for instance, the Milky Way is a perspective image formed by the superposition of an innumerable multitude of stellar clouds, scattered over immense distances in one chief plane. We see it divided into two unequal branches in Cygnus and the Scorpion, and rent here and there into numberless stars.

Our sun is no more at the centre than his neighbour Alpha Centauri (which lies about forty-one trillions of kilometres from us) or than our other neighbour 61 Cygni (about sixty-nine trillions distant)—both right in the plane of the Milky Way—or than the majority of the stars whose parallaxes have been measured. These stars are distant from us several light-years, whilst the limits of the Galaxy are situated at thousands of light-years.

Not only does our sun not mark the centre of our universe more than our neighbours in space do, but it has no greater weight than they. Alpha Centauri is a splendid binary system and its mass is more than twice the sun's. We do not know what planets may circulate round one or other of these two stars, whose mutual revolution is nearly a century. It is not surprising that we cannot see them, since if our sun were at their distance Jupiter would be a star of the 24th magnitude, separated by 4' from the sun, which would itself be of but the second rank. Seen from the distance of stars of the 1st magnitude, themselves very diverse, our sun would appear but of the third, fourth, fifth or sixth rank, and might be even invisible from Rigel or Canopus, which have no measurable parallax. The mass of Sirius is equal to that of four suns. Vega is seventy times as bright, and Canopus surpasses the sun in brightness by more than ten thousand times. Dr. Wallace's theory might be excusable for an inhabitant of the systems of Sirius or Capella or Antares, but not for a dweller in our own modest hamlet. If there were a central sun, and if that central sun were ours, the illusion might be granted. But there is nothing of the kind. The solar system is a monarchy with the sun for autocrat. Our sidereal universe is a republic, a federation without a dominating authority.

According to the calculation of Lord Kelvin, the amount of the proper motions of the stars indicates that the

number of the suns of our sidereal universe does not seem to exceed one thousand millions. The force of gravitation of these suns, taken in the mean to be similar to our own, would produce the velocities observed of twenty to one hundred kilometres per second. A number ten times greater could only have been deduced if those movements were much more rapid. Granted this milliard of stars, it in no wise proves that it alone exists in the infinite, and that beyond an immense void there may not be a second milliard, nor a third, nor a fourth, nor more. Whatever may be its extension, our Milky Way is but a point in the infinite.

It would even now appear that we know of stars which do not belong to our sidereal system. We might cite with Newcomb, the star 1830, Groombridge, the swiftest of those whose motion has been determined, its speed exceeding 300,000 metres per second. The attractive force of the milliard of stars of which we have just spoken would not appear sufficient (except under special circumstances) to produce such a velocity, and many astronomers think that this star has come from the beyond, and traverses our universe like a projectile. This star is not the only one in such a case.

On the other hand, certain *globular clusters* do not seem to form a part of our agglomeration.

This agglomeration represents a universe. It approximates, in spite of its heterogeneity, to the general form of a flattened spheroid, of which the Milky Way marks the equator. Facts seem to indicate that the forces which influenced its evolution exercised their greatest intensity and activity in its equatorial zone rather than at the circumpolar regions, which have remained backward, less dense in actual stars or in those in the making, colder, and, so to speak, benumbed. Everything is more advanced in the equatorial region than at the poles. Our sun itself appears to be in its summer. There red stars are crowded, and there also are temporary resurrections.

On the whole, then, the astronomical theory of the distinguished naturalist has not been established, and, in fact, is quite inadmissible. It would be superfluous, therefore, to occupy ourselves with its biological consequences relative to our planet, the assumed object of the creation. In our solar system, this little earth has not obtained any special privileges from Nature, and it is strange to wish to confine life within the circle of terrestrial chemistry. Nor is it less so to see a naturalist (whose theories of evolution demand the action of time as the principal factor in the succession of species) forgetting that the epoch in which we now happen to be has no special importance; that the different worlds of our solar family are at different stages of their evolution; and that, for instance, if the Moon is a waif of the past, Jupiter, on the contrary, is a world of the future. The effect of the hypothesis of Dr. Wallace is to narrow our horizon, and to take us back again to the time of Ptolemy, into the prison of a useless firmament. The greatness of modern astronomy, on the contrary, is to burst all barriers, for our science is but a shadow in the face of the reality. Infinity encompasses us on all sides, life asserts itself, universal and eternal, our existence is but a fleeting moment, the vibration of an atom in a ray of the sun, and our planet is but an island floating in the celestial archipelago, to which no thought will ever place any bounds. Never lose sight of the fact that space is infinite, that there is in the void neither height, nor depth, nor right nor left; and in time neither beginning nor end. We must understand that our conceptions are relative to our imperfect and transitory impressions, and that the only reality is the Absolute.

What right have we then to suppose that the limits of our knowledge are the limits of the power of Nature?

Every day we have proofs to the contrary. If we examine into the conditions of life, it would not be difficult to conclude that terrestrial chemistry does not necessarily include the universal vital circle. To limit the work of Nature to the sphere of our knowledge is to reason with singular childishness. Of old, our fathers considered the four elements "earth, air, fire, water" as the principles of all, and saw in them the conditions of life. How many solemn dissertations have been written on this subject? To-day we affirm the necessity of carbon for the constitution of living organisms. But no one knows what carbon is. Our successors will, no doubt, smile at our assertions, and, doubtless, the inhabitants of the systems of Rigel, and of Deneb—stars characterised by the rays of titanium and silicon—would understand nothing of the necessity for carbon.

The careful study of our planet shows that the forces of Nature have LIFE as their supreme end.

Yes, life is universal, and eternal, for time is one of its factors. Yesterday the moon, to-day the earth, to-morrow Jupiter. In space there are both cradles and tombs. The red carbon stars will soon be dead; the hydrogen stars like Vega and Sirius are the stars of the future; Procyon, Capella, Arcturus, are the stars of the present. Aldebaran seems to be already an autumn fruit. Let us open the eyes of our understanding, and let us look beyond ourselves in the infinite expanse at life and intelligence in all its degrees in endless evolution.