

The Earth's Place in the Universe

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NO less a scientist than Alfred Russell Wallace, in his celebrated book, "Man's Place in the Universe," endeavors to show that the earth is the only planet in the solar system, and the solar system the only system in the universe where life is possible. He assumes that only on the surface of this earth that most wonderful combination and adjustment of conditions is accomplished which allows the elements of which the universe is made up to form those most complex and very unstable chemical compounds, which are characteristic of organic matter. In this theory the cosmologist Wallace seems to me to completely abandon the ideas of the evolutionist Wallace, whom we should expect to hold fast to the adaptability of the organism to its environment, to the variation of the species according to changed conditions. We should expect him not to confine the possible conditions to which organisms could adapt themselves within the limits of terrestrial changes. There is no logical ground for such a limitation, and we see no reason why the celebrated author should not assume that even in a change of conditions beyond the range of experience on this planet the fittest might survive. We may point out a few propositions and assumptions which Wallace takes as self-evident, and which nevertheless stand logically on a very questionable basis. Thus, for instance, he seems to adhere to the popular distinction of living and dead matter as a settled thing, whilst everybody of a reflective turn of mind must admit that we have no other criterion of life than voluntary movement, which we are able to ascertain with absolute certainty only in ourselves, and which with reference to life other than our own is a matter of inference on the basis of analogy. We have no right to declare will or purpose absent where we do not see it. Consequently we have no grounds to declare anything in the universe absolutely dead. It might be that the formation of crystals is the lowest form of life, or even the molecules, the atoms, or ions are alive; and, since according to the law of relativity (which is a fact and not a speculation) there is nothing absolutely great or small, it might be that a molecule of dust beyond the reach of our microscopes may be a whole solar system, with central body, or bodies, and planets and satellites, and full of a life forever be-

yond the reach of our senses. Further, since all assumptions about the space properties of matter, and its elements, lead to contradictions when regarded in the light of the fact of the relativity of all magnitudes,* it might be that the ions or sub-ions are in the last instance nothing but life (or energy, as Professor Ostwald would say).

On the other hand, the whole universe known to us with the solar system, as one atom or ion of it, may be a small particle only of a greater organism absolutely unfathomable by us. In fact the spheroidal stellar system, of which our solar system is a part, the galactic system, which, according to the disputable idea of Wallace is the whole universe, has some great likeness to a single organic cell. The milky way, with its concentration of stars, its clusters and resolvable nebulæ, forms its equatorial belt, whilst the poles are marked by the predominance of genuine (*i.e.*, irresolvable) nebulæ. The two so-called magellanic clouds of the Southern Hemisphere, which are distinctly different from the galaxy, as well as from the polar regions, in that they abound in both genuine and resolvable nebulæ, resemble the nuclei of the cell.

Mr. Wallace claims that organic bodies are made up chiefly of the four elements—carbon, nitrogen, oxygen, hydrogen—the so-called four organogens. On other stars the conditions of gravity and heat, etc., are not of such a nature that these substances could form characteristic compounds of organic chemistry. Consequently there cannot be any life on them. But besides the fact that we have no definite knowledge that the four organogens, though constituting the bulk of the organism, are more essential than other substances participating in it in smaller quantities, like iron, phosphorus, calcium, sulphur, etc., there remains the question: Has it ever been proved that these four substances are the organogens all over the universe? They play the role under the condition of pressure and heat, as they prevail on our planet. On other planets, or in other solar systems under different conditions of heat and pressure, totally different elements may play the part of organogens, and combine in those very complex and changeable chemical combinations, which answer with partial or complete decomposition to slight stimulation.

If, on a smaller planet, where gravity is not sufficient to retain the hydrogen in the atmosphere, no water exists, another

* Vide Kirschmann—Die Dimension en des Raumes, p. 104 ff.

material may take its place. Thus, for instance, it is by no means certain that the white polar caps so well observed on Mars, which indicate a change of seasons analogous to our own, consist of snow or ice like our own, for it is questionable whether the atmosphere of Mars contains any water vapor at all. But they might just as well be precipitations of carbonic acid.

Just here I may call attention to the fact that it is customary to dwell upon the continuous loss of hydrogen at the boundaries of the atmosphere, especially in the case of smaller celestial bodies, but the possibility of a gain of that substance seems never to be mentioned. Water must exist in inter-stellar space, and most likely in the form of more or less great masses of ice—let us call them ice-meteorites. They will scarcely ever reach the planet's surface, as other meteorites do, but nevertheless they will supply its atmosphere with a certain quantity of water.

And after all, are the seventy-nine or eighty chemical elements of the present day final? or are they elements only because we have not hitherto succeeded in further separating them? If we consider their grouping in series, with regard to their atomic weight, their chemical affinity and electrolytic properties, and the similar behavior of certain composite radicals, we may soon come to the conclusion that they are only modifications of one or several elements. Moreover, the spectroscopic evidence establishes only the existence of oscillations of a certain frequency, and since the lines of the gases broaden, and their spectra thus approach the continuous spectrum when the gas is under high pressure, and since at very high temperatures all chemical compounds dissociate, a continuous spectrum may just as well be regarded as the manifestation of an infinite series of elements, of which only those are known to us, which show their characteristic chemical qualities at temperatures within the limits of our investigation.

Wallace claims that a certain temperature variable only within narrow limits is necessary to secure the continuation of life on a planet. When he holds that the inner planets are too hot, and the outer ones too cold, he forgets that a dense atmosphere, as it certainly exists on Venus and on Jupiter, must have a mitigating influence in both directions; and he also forgets that physically there is no such thing as cold. The selection of oscillations which act on our sense of temperature, the transformations of the physical series of possible temperatures (from absolute zero to infinity) into an antagonistic system of two

qualities, hot and cold, with an indifference point of somewhat variable position between, is, of course, purely a matter of our psychical nature, and must from a physical standpoint appear absolutely arbitrary. We could very well imagine the sense of temperature of the inhabitants of another planet differently constructed from us, considerably changed, and their indifference point shifted for hundreds or thousands of degrees. Jupiter's surface is said to be red-hot yet, but if the zero-point of the sense of temperature of the Jovians is shifted for a few hundred degrees, they will have as pleasant a walk on that red-hot surface as we do on the green grass. Many of the assumptions of Mr. Wallace with regard to the constancy of the earth's surface-temperature, the unchanged quantity and surface distribution of the water, the permanence of the configuration of the continents, etc., are certainly contrary to the results of modern geological research.

All these objections to Wallace's theory are raised from the standpoint of the physical and biological sciences, but there are others of equal significance from an astronomical standpoint. Wallace gives the solar system a position at the outskirts of the central cluster of the galactic system, which it is somewhat shielded from too great an inrush of matter by a surrounding ring of smaller stars, whilst it is yet in a position to annex just the right quantity of meteoric matter to keep up a constant temperature for a very long time. Just this constancy of temperature for an exceedingly long period Wallace regards as the *conditio sine qua non* for the production of life at all, and of the high degree of development which it has attained.

Apart from the fact that Wallace lets the very centre of the cluster be filled with a great number of stars already cold and darkened, and consequently invisible for us (his reasons for the absence of any obscurations through these dark suns are very vague), the greatest weakness in the argument seems to consist in the fact that to me no sufficient reason is given why other similarly eccentrically situated solar systems, of which there must be thousands, should not have the same advantage.

The conclusion that the earth is nearly in the centre of the stellar universe, because the solar system is situated in the plane of the milky way, and not far removed from the centre of the plane, is logically rather questionable, especially since there still remains the distance of many a light-year between the

solar system and the middle of the central cluster of the galactic system.

In all these discussions Wallace assumes that the galactic system to which, no doubt, the most of the brighter stars of our heavens belong, is the whole universe—there is nothing beyond. Herschel and with him many other astronomers have regarded the milky way and all its belongings as a ring-formed or spiral system, outside of which there were many others of similar nature, but at enormous distance. Wallace regards all the other ring and spiral nebulæ as parts of the galactic system. Now this question must be open to dispute as long as our knowledge of the third dimension in stellar affairs is in its present stage, where only the parallax of a comparatively small number of the nearer stars is ascertained, whilst the distance of the milky way and the different clusters and nebulæ can only be the subject of widely diverging guess work. There is one theory, which, though old, plays a conspicuous part in Wallace's argument—and the falsity of which nobody hitherto seems to have realized. It is said that if infinite space were throughout populated with stars, no matter at what distances from one another, we should see the whole firmament ablaze, illuminated with the brightness of the sun. For if the whole infinite space were spangled with stars we would necessarily meet at some distance a star in any direction in which we might look. Even Mr. Proctor, who held to Herschel's theory, and who so vigorously advocated a view diametrically opposed to that of Mr. Wallace, saw no other escape from this difficulty than to assume that light might yet lose some energy on the way (it is generally accepted that the intensity of light is inversely proportional to the square of the distance, which implies that it loses nothing in traversing space) if enormous distances have to be considered.

But the whole argument quite unjustly leaves out of consideration the factor of time. Light needs time to traverse space, and though it needs only eight minutes to travel from the sun to us, it requires years to come even from the nearest fixed stars to us, and certainly many thousands of years from the outskirts of that galactic system to which we belong. The limitation of the stellar universe perceptible to us is consequently not only a question of distance and intensity, but also one of time. A star may not be seen, because its light is not old enough. Its messages in the form of rays of light have not yet reached us. A star at a distance of ten thousand light-years from the earth must have been shining for ten thousand years before its first message

arrives at our planet. If the whole infinite space is strewn with suns of different age, and if they are not just distributed in such a manner that the oldest ones are at the greatest distance, which would require infinite age of their light for infinite distance, then the number of stars we can see must decrease with the distance. The further we go from the earth the less will be the number of stars whose light messages have reached us. And if the light of the stars is not eternal (according to Wallace it is of comparatively short duration, our sun having, according to him, the greatest chance for a prolonged light and heat-giving period), then there must be a distance in which we can see no stars at all, no matter how many there may be. Thus we have no right to declare the limits of the stellar world visible to us, as the limits of the existing universe.

But beside the question of visibility we must not forget that we can perceive only that part of the universe which by some kind of vibratory movement, *i.e.*, only a certain selection of oscillations, appeals to our senses. When it comes to X-Rays, ultra violet rays, electrical waves, etc., we have to play a trick on nature to make these agencies manifest themselves. There are vast regions within the range of possible vibrations from zero to infinity, of which we could not perceive anything, even if they existed around us. It is, therefore, not a mystical, but a perfectly scientific conclusion that there may be unseen worlds in the universe, and we should not fall into the pantheistic error of making that which we have fathomed and are acquainted with, the ALL. The fault of naturalistic pantheism is not that it makes the world and ourselves a part of God (for whether we say a part of God, or a creation of God, is only a matter of words, and even St. Paul is a pantheist in this sense, when he says: "In whom we live and move and have our being"), but its fault is that it makes the world, which we have so far learned to know, the ONLY part of God.

