

Matter and the Universe

The bewildering vastness of space is a fascinating study, if a little awe-inspiring. In the following article, broadcast as a W.E.A. talk from 2YA by Professor P. W. Robertson, Professor of Chemistry at Victoria University, is outlined a lucid conception of space according to modern theories.



WITHIN quite recent times much attention has been directed to the nature of the universe. We find not only scientists but also philosophers and divines attempting to arrive at a solution pleasing to all.

In the pages of the popular press, and noticeably in the Sunday papers, usually devoted to the foibles and vagaries of mankind, there have been long articles attempting to reconcile science and religion, explain the nature of life, and define our position in the universe. The frequent occurrence of radio talks by the British Broadcasting Company on these and kindred topics is further evidence of the general interest, and a book by Sir James Jeans, "The Mysterious Universe," containing much deep speculation, has proved a best seller. Authorities in every branch of knowledge have joined the man in the street in its praise. A well-known comedy actress confessed that she had not missed a single word of it, and that it contained things every girl should know.

Now, there are probably various reasons for this exceptional interest in matters apparently so remote from everyday life. Two of these I shall indicate.

Since the Great War man has found himself intellectually in a much less stable world than heretofore. Institutions which he regarded as permanent have tottered, ideas such as that of democracy seem to have lost their value, economic laws fail in their action. What wonder, then, that we should attempt to gain solace by imagining ourselves in a universe which worked by a definite plan, whether mathematical or divine?

Another reason would seem to be this: The world-famous physicist Einstein has proved, apparently conclusively, that space is curved. As a direct consequence we must regard our universe as finite—immensely large. It is true—but how satisfying is that compared with the awful thought of a hostile infinity.

The Origin of Matter.

BEFORE we proceed to a consideration of the nature of the universe, a brief account will first be given of matter and its origin.

At the very beginning was space—at least so much need be postulated. Now, a peculiar and inherent property of space is that it demands the existence of protons, positive units of electricity, and electrons, the corresponding negative units. It has happened that these gradually united to atoms of hydrogen, the lightest of the elements. Then these hydrogen atoms in the course of time conglomerated to immense balls of fire—stars, like our own sun.

As the suns aged they became smaller in size and lower in temperature, and at the same time their hydrogen con-

densed to heavier atoms, in the first place helium, then elements such as carbon, oxygen, silicon, and later the metals such as iron. The process has not been uniform because we find certain stars, the hottest, containing hydrogen and helium, and others, relatively cooler, like our own sun, made up of many elements. How then, we now ask, came our earth and the planets into being?

Here we must make reference to the theory of indeterminacy. A law of causality was formerly thought to rule natural phenomena, that is, with a perfect knowledge of scientific data, any result could be accurately foretold. Apparently this is not always so.

Formation of the Earth.

ALTHOUGH analogies make a dangerous way to the finding of truth, I shall nevertheless give one here.

If all the inhabitants of Wellington divided into groups of four and dealt themselves continuously hands of bridge, sooner or later at one table there would be found dealt four hands, each containing one suit only. This might happen the very first time or it might not happen for years—but what we can determine is this, that if play continued for, say, a million centuries, exactly so many of this type of hand would be obtained.

By some law, then, or principle of indeterminacy, our earth was formed. There was less chance of its taking place, as it did, than you might have of sitting down and dealing yourself a hundred consecutive hands of bridge, each with the four suits equally divided. I shall now attempt to indicate how it happened.

The stars, although they appear in the sky to be packed closely together, are relatively removed from one another by enormous distances. If we imagine a space the volume of our earth, and in it equally distributed half a dozen balls about a foot in diameter, these would represent the size and relative distances apart of the stars.

That any two of them should come into contact is an almost inconceivable possibility. Yet once a star must have approached so near our sun that great

fragments of it were swept off and made into the planets. This occurred at an astronomical time interval when the sun was of moderate age. If the collision had been earlier in its life the planets would have been balls of dissipating gas, if later, masses of metal.

Our earth was formed at a time when the element carbon was a significant unit in the sun, and on this unique element carbon, life as we know it depends. For carbon has the special property among elements of being able to form extremely complicated compounds, limitless in variety, and on the existence and interactions of these the complex life processes depend. Furthermore, the general temperature of our earth on its surface is favourable for these compounds; not only that, but also for them to react at a rate commensurate with a life-process.

If the average temperature were much lower, the rhythm of life would be unutterably slothful: if the temperature were much higher, such delicate compounds would not be capable of existence, and all the subtlety of life would be lost. We can say with assurance that life in any way comparable with ours does not exist other than on the earth.

The Enormity of Space.

MAN, then, is only a brief accident in the universe, which he regards for a moment and then disappears, not, however, without noting his utter insignificance.

When we look up into the summer night we see the delicate maze of the stars, and flung across them like a great scarf, the Milky Way. This merely is the light from an enormous cluster of distant stars which we cannot see separately, and it represents approximately the limits of the star system, or nebula, of which our sun is a unit.

In general shape it has been likened to a great wheel with most of the stars in the rim (the Milky Way), and the other stars distributed in spoke-like fashion. Our own sun happens to be toward the centre of the whole system. The dimensions of our nebula, although enormously great, can be ascertained

with fair accuracy, but to give you the figure, say, of its extent would be merely confusing.

The Curved Space of Einstein.

NOW, in the sky not only can we see planets and stars, and the Milky Way, but also less definite points of light, which are due to distant nebulae, comparable in magnitude, although generally smaller than ours.

The nearer of these are many times further off than the furthest stars in the Milky Way, and the more remote ones are so far distant that the light which we see from them set out on its journey to us actually at a time before life of any sort had appeared on the earth.

Beyond these are other nebulae, still more distant, as yet not within the reach of our most powerful telescopes. But if we could see them, we should find that their light approached us in two exactly opposite directions, for space is curved. What this implies I shall now attempt to convey to you.

Imagine a soap bubble the size of the room in which you are, and let a tiny point of red in the film represent our own star system. Near it, a few feet away, let there be other points of red. These would correspond with the size and relative position of the nearer nebulae, and you can imagine the further ones distributed over the surface.

Now note particularly that space is inside and without, the answer is simply nothing, non-space. This apparently unwarranted statement we must accept, for its complete understanding requires special mathematical knowledge.

This, then, is our Universe, no longer mysterious. If it is a universe of thought, its creation was an act of thought; but it must have been one of mathematical thought, one regardless of morality and beauty, which would become then just the playful invention of man in his less clear moments of mathematical abstraction.

Man has reduced space to the limits of a tiny bubble in one of the cells of his brain. Time he can estimate with precision when he relates that the life of his kind on earth is but a single tick of the astronomical clock. In vain to seek consolation with his mate in the soft beauty of a summer night! When the rays of that nebula above the tree-top set out to deliver their warning to him, life on this earth had not begun. By identical token, when the light from our own Milky Way can reach thus far, all life will have ceased.

Yet we are unwilling to believe that the spirit of man is destructible—that he will not live to tell a profounder tale.

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Evolution

Tides in the ocean of stars and the infinite rhythm of space;

Cycles on cycles of aeons adrone on an infinite beach;

Pause and recession and flow, and each atom of dust in its place

In the pulse of eternal becoming; no error, no breach,

But the calm and the sweep, and the swing of the leisurely measureless roll

Of the absolute cause, the unwhitened effect—and no haste,

And no discord, and nothing untimed in a calculus ruling the whole;

Unfolding, evolving; accretion, attrition; no waste.

From "Om," by TALBOT MUNDY.