

IS THE UNIVERSE RUNNING DOWN?

BY VICTOR S. YARROS

PERHAPS the greatest and most fascinating scientific and philosophical controversy of all time is that which has been carried on for some years by the two brilliant groups of physicists, mathematicians and astronomers, respectively headed by Sir James Jeans of Great Britain and Prof. Robert A. Millikan of the United States. The issue in this dispute is this: Is the Universe dying, running down like a clock, or is it immortal, endowed with the power of self-perpetuation, automatic self-winding, as it were?

It is scarcely necessary to call particular attention to the metaphysical and theological implications of this issue. If the Universe is doomed, condemned to a "heat death," then it is absurd to predicate rationality of Nature. All the known theologies at once lose their basis and their meaning. Speculations concerning human survival after death, concerning redemption and salvation, concerning the mission of so-called saviors, become puerile. Philosophy must purge itself of the last vestiges of theology and become strictly scientific.

Religion—as contradistinguished from theology—and Ethics would also be deeply affected by the general acceptance of the theory of inevitable death for the Universe, although the results to either would not be fatal or even very grave from the viewpoint of human reason and human good-will. We, the proud lords of Creation, the crowning glory of Evolution, would need principles and rules of conduct, social and other, for the duration of our franchise on the earth, as would inhabitants of other planets—if there are such—fortunate enough to have developed conditions favorable to life in its higher forms and manifestations. Clearly, the question of life or death some billions of years hence would be wholly irrelevant

and incompetent to any discussion of human relations, responsibilities, opportunities and privileges in the present and the calculable, predictable future.

Still, to repeat, the issue as to the ultimate fate of the Universe would mold and shape *all* our thinking if we treated it with the gravity and solemnity with which a rather small, select company of men of science approach and discuss it.

The indifference of the average person to this question of questions, however, cannot be shared by the intellectually curious, the seekers of truth and knowledge for their own sake, the quiet adventurers in the realms of abstract thought.

What, then, is the truth regarding the destiny of the human race, of the tiny globe which that race inhabits, and of the whole Universe?

Sir James Jeans, in his new book, "The Mysterious Universe," as well as in several recent lectures, has asserted that there can be but one end to the Universe—"a heat-death," in which the total energy will be evenly distributed and the substance of the Universe will have the same temperature throughout. Both astronomy and physics, according to Sir James, lead up to that melancholy conclusion. Both are forced to deduce it from the second law of Thermodynamics. To quote Sir James:

"Just as Tantalus, standing in a lake so deep that he only just escaped drowning, was yet destined to die of thirst, so it is the tragedy of our race that it is probably destined to die of cold, while the greater part of the substance of the Universe still remains too hot for life to obtain a footing."

All roads lead to universal death, then, and there is no way of escaping that doom!

But, many ask, what will become of the human spirit, the human intellect and conscience? What terrible, amazing waste the fatalistic view implies! To evolve Man, with all his faculties and potentialities; to produce saints, heroes, martyrs, great savants, and then destroy all life without remorse or mercy!

Well, this objection, which even eminent men of science not infrequently advance, is disposed of by Jeans and his followers by directing attention to the littleness of our world in space, the rarity of planets capable of sustaining life, the absurdity of imagining that the universe is interested in human beings. Life, says Jeans, seems

to be an unimportant by-product; living things appear to be "off the main line of cosmic evolution."

Consider the fact that life can exist only inside of a very narrow zone, and the further fact that, perhaps, only one star in 100,000 has a planet revolving around it in the zone in which life is possible, and it becomes incredible that the Universe can have been designed primarily to evolve human beings. As to the appalling wastefulness of nature if the universal death theory be true, Jeans reminds us that modern science regards the Universe not as a mechanism, but as pure mathematical thought. "It would now seem to be beyond dispute that nature is in some way more closely allied to the concepts of pure mathematics than to those of biology or engineering," he says. If the Universe had a designer, that designer was a pure mathematician, not a moralist or prophet. To pure mathematical thought, the ideas of waste, conservation, matter and spirit are quite alien and irrelevant.

There are inconsistencies and even paradoxes in Sir James Jeans' argument, but we cannot now stop to deal with these. He doubtless would admit the charge, for he frankly recognizes that his metaphysics may not follow strictly and irresistibly from his physics and astronomy. But upon one conclusion—that of the ultimate fate of the Universe—he is firm and insistent. He simply finds no possibility of escaping the heat-death verdict for the Universe.

Sir Arthur Eddington, the author of "The Nature of the Physical Universe," finds himself in complete agreement with Jeans. In his recent presidential address before the British Mathematical Association, this eminent scientist not only predicted the end of the world, but somewhat reluctantly, according to his own admission, attempted to draw a picture of the world as it would appear after the inevitable end.

If, he said, matter slowly changes into radiation, then the world will and must "become in time a ball of radiation, growing ever larger, the radiation passing into longer and longer wave-lengths. About every 1,500,000,000 years it will double its size and its radius, and go on expanding in geometrical progression forever." Time may extend to infinity, but after the destruction of matter the term time can have no definite sense, he added.

And why, according to Eddington, *must* the world die? Because of the fact of Entropy, "the law of disorganization." Evolution, it

is true, means that more and more highly organized systems develop as time goes on, but science knows that evolution has its limit, and that, on the whole, there is a steady loss of organization. Finally, a state of complete disorganization will be reached, and the universe will become "a uniform featureless mass in thermodynamic equilibrium."

Prof. Millikan and his followers do not admit, however, that the laws of Thermodynamics condemn the universe to complete disorganization and a heat-death. They affirm, first, that science is still too undeveloped to justify dogmatic conclusions concerning Entropy. And they plead, in the second place, that certain phenomena, not otherwise satisfactorily explicable, render it *probable*—at least—that a law of compensation is at work in the Universe, and that matter is being created as well as converted into radiation.

In the words of Prof. Millikan, the Creator is still on the job and will remain there, replacing loss and waste and renewing or rebuilding his universe. This view of Dr. Millikan has been set forth in scientific as well as popular lectures on several occasions, but the best exposition of it is to be found in an article on "The Origin of the Cosmic Rays" which was published in *The Physical Review* in 1928. In that paper evidence is offered in support of the theory that the so-called Millikan or cosmic rays owe their origin to the formation of helium, oxygen, silicon and, perhaps, iron out of hydrogen. This atom-building is taking place continually in the universe, but not inside the stars at all. According to Dr. Millikan, this type of atom-building is apparently favored by the extreme and thus far unexplored conditions of low temperature and density existing in interstellar space.

It will be useful and instructive to quote in full the following important paragraphs from Dr. Millikan's article. In these he discusses what he calls an "incomplete cycle," the elements of which have the credentials of actual experience, and then points out how the cycle can be scientifically completed. He writes:

"1. Positive and negative electrons exist in great abundance in interstellar space. (See the evidence of the Spectroscope.)

"2. These electrons condense into atoms under the influence of the conditions existing in outer space,—*viz.*, absence of temperature and high dispersion. (See the evidence of the cosmic rays.)

"3. These atoms then segregate under their gravitational forces into stars. (See the evidence of the telescope.)

“4. In the interior of stars, under the influence of the enormous pressures, densities and temperatures existing there, an occasional positive electron, presumably in the nucleus of a heavy atom, transforms its entire mass into an ether pulse, the energy of which, when frittered away in heat, maintains the temperature of the star and furnishes most of the supply of light and heat which it pours out. (See the evidence of life-time of the stars—Eddington-Jeans.)

“The foregoing is as far as the experimental evidence enables us to go, but the recent discovery of the second element of the above unfinished cycle, namely, that the supply of positive and negative electrons is being used up continually in the creation of atoms the signals of whose birth constitute the cosmic rays, at once raises imperiously the question as to why the process is still going on at all after the eons during which it has apparently been in progress—or better why the building stones of the atoms have not all been used up long ago. And the only possible answer seems to be to complete the cycle and to assume that these building stones are continually being replenished throughout the heavens by the condensation with the aid of some as yet wholly unknown mechanism of radiant heat into positive and negative electrons.”

Thus Prof. Millikan regards the Universe as reversible. The cosmic catastrophe predicted by the Jeans-Eddington school is not only not unescapable, but impossible.

There are weaknesses in the Millikan theory, as he is frank enough to admit by using the terms “probable” and “probably” in building it up. But it will have been noted, perhaps, that Sir James Jeans is also forced to speak of probability in developing his alternative theory.

Neither school has completed its work or said the final word. But the controversy between them challenges the attention of the realms of science and philosophy. Many thinkers choose to remain neutral, but we may expect interesting contributions to the great debate in the next few years. One of these contributions, according to indications, will take the form of a new theory of the structure of matter, a radiational theory Prof. James Mackaye, the author of this theory, expounds it in a work entitled “The Dynamic Universe,” and this interesting book merits serious consideration. It may or may not find acceptance, but it is not to be ignored.

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