

on which life may conceivably exist. If even one such system were found, the present theory of planetary origins would collapse. Failing any such invention of a super-telescope, there remains the possibility of wireless communication. As I have already indicated, I have no doubt that there are many other inhabited worlds, and that on some of them beings exist who are immeasurably beyond our mental level. We should be rash to deny that they can use radiation so penetrating as to convey messages to the earth. Probably such messages

now come. When they are first made intelligible a new era in the history of humanity will begin. At the beginning of the era the opposition between those who welcome the new knowledge and those who deem it dangerously subversive will doubtless lead to a world war. But the survivors, when they extricate themselves from the economic consequences of the peace treaty, will begin what we may correctly term a strenuous correspondence course. I should like to be living then. We might get a true understanding of the evolution of the universe.

By SIR OLIVER LODGE, F.R.S.

IT is well known that a physical theory which ignores some of the elements of the problem is incomplete, and is therefore liable to break down when confronted with the facts. A physical theory cannot take the whole universe into account; but if it is to be complete enough to be satisfactory, and to make trustworthy predictions, it must take all relevant factors into account.

Sir James Jeans began his discourse by saying that in Section A we were concerned only with the physical universe—that is, with material bodies and the forces that act upon them. I suppose that is true. But the fact that it is true seems to make it impossible for this Section to enter upon a philosophical discussion of such a subject as the universe as a whole, and to decide its fate upon purely deterministic lines. For the universe certainly contains more than we deal with in this Section. We must remember that there are Sections D and K and I and J—that is, we must realise that the universe is not solely inorganic. Some of the matter is animated; and although it is still obedient to the laws of physics and chemistry, an animated body behaves in a spontaneous manner not predictable by those laws. When a thing behaves as if it were alive, physics loses interest in it and hands it over to another section; for it is incompetent to deal with motions attributable to spontaneity and free will. Wherever life has entered in, the predictions of physicists and astronomers and mathematicians are spoilt. Laplace's calculator might reckon the behaviour of every particle in the universe so long as it was not interfered with by life and mind.

I have looked sometimes at the ripples coming over the sand on a sea beach and leaving a deposit of foam. I have thought whether a mathematician, given sufficient data, could predict every ripple and every line of foam. Yes, he could, theoretically, provided there were no boats, nor any fish. The splash of a fish, the ripples of a boat, would put his calculations out. Given even a spark of free will, there are no data that can be supplied. It may be said that our sense of free will is an illusion. Well,

that is a philosophical question that can be raised. But it cannot be settled in this Section. So I venture to think that before we can philosophise upon such a theme as the ultimate fate of the universe, we must be able to take everything into account, and philosophise with a very wide and comprehensive knowledge of reality.

Maxwell showed how the effect of mind could be introduced into the scheme of physics without contravening any of the laws of energy, except the purely statistical second law of thermodynamics. His 'demon', by dealing with the particles individually and selectively directing them, could interfere with and neutralise the consequences supposed to be deduced from that law. I claim as a physicist that too much attention has been paid to this second law of thermodynamics, and that the final and inevitable increase of entropy to a maximum is a bugbear, an idol, to which philosophers need not bow the knee.

It is doubtless instructive to learn from high and competent authorities what the unadulterated or rather unvivified laws of physics applied to the universe will lead to. We are faced with a steady running down or degradation of energy to a predetermined end: without hope of novelty introduced at any stage of the process, all settled and dull, events just going through the hollow form of taking place. But it is all on the assumption that there is nothing or no one to wind it up or to guide it to some nobler end. Guidance has only recently intruded itself into the scheme of physics; but already there are guiding waves which determine the path of a particle of matter. What the significance of those guiding waves may be, whether they have any connexion with the observed phenomena we know as life and mind, is at present an unanswered question.

To philosophise from a restricted point of view is interesting enough, but it is not conclusive. It does not fully account for the state of the world to-day, nor can it be depended on to formulate its course to-morrow.