Excerpted from "The Nature of the Physical World" by A. S. EDDINGTON

Linkage of Entropy with Becoming

When you say to yourself, “Every day I grow better and better”, science churlishly replies—”I see no signs of it. I see you extended as a four-dimensional worm in space-time; and, although goodness is not strictly within my province, I will grant that one end of you is better than the other. But whether you *grow* better or worse depends on which way up I hold you. There is in your consciousness an idea of growth or ‘becoming’ which, if it is not illusory, implies that you have a label ‘This side up’. I have searched for such a label all through the physical world and can find no trace of it, so I strongly suspect that the label is non-existent in the world of reality.”

That is the reply of science comprised in primary law. Taking account of secondary law, the reply is modified a little, though it is still none too gracious— “I have looked again and, in the course of studying a property called entropy, I find that the physical world is marked with an arrow which may possibly be intended to indicate which way up it should be regarded. With that orientation I find that you really do grow better. Or, to speak precisely, your good end is in the part of the world with most entropy and your bad end in the part with least. Why this arrangement should be considered more creditable than that of your neighbour who has his good and bad ends the other way round, I cannot imagine.”

A problem here rises before us concerning the linkage of the symbolic world of physics to the world of familiar experience. As explained in the Introduction this question of linkage remains over at the end of the strictly physical investigations. Our present problem is to understand the linkage between entropy which provides time’s arrow in the symbolic world and the experience of growing or becoming which is the interpretation of time’s arrow in the familiar world. We have, I think, shown exhaustively in the last chapter that the former is the only scientific counterpart to the latter.

But in treating change of entropy as a symbolic equivalent for the moving on of time familiar to our minds a double difficulty arises. Firstly, the symbol seems to be of inappropriate nature; it is an elaborate mathematical construct, whereas we should expect so fundamental a conception as “becoming” to be among the elementary indefinables—the A B C of physics. Secondly, a symbol does not seem to be quite what is wanted; we want a significance which can scarcely be conveyed by a symbol of the customary metrical type— the recognition of a dynamic quality in external Nature. We do not “put sense into the world” merely by recognizing that one end of it is more random than the other; we have to put a genuine significance of “becoming” into it and not an artificial symbolic substitute.

The linkage of entropy-change to “becoming” presents features unlike every other problem of parallelism of the scientific and familiar worlds. The usual relation is illustrated by the familiar perception of colour and its scientific equivalent electromagnetic wavelength. Here there is no question of resemblance between the underlying physical cause and the mental sensation which arises. All that we can require of the symbolic counterpart of colour is that it shall be competent to pull the trigger of a (symbolic) nerve. The physiologist can trace the nerve mechanism up to

the brain; but ultimately there is a hiatus which no one professes to fill up. Symbolically we may follow the influences of the physical world up to the door of the mind; they ring the door-bell and depart.

But the association of "becoming" with entropy-change is not to be understood in the same way. It is clearly not sufficient that the change in the random element of the world should deliver an impulse at the end of a nerve, leaving the mind to create in response to this stimulus the fancy that it is turning the reel of a cinematograph. Unless we have been altogether misreading the significance of the world outside us— by interpreting it in terms of evolution and progress, instead of a static extension—we must regard the feeling of "becoming" as (in some respects at least) a true mental insight into the physical condition which determines it. It is true enough that whether we are dealing with the experience of "becoming" or with the more typical sense-experiences of light, sound, smell, etc., there must always be some point at which we lose sight of the physical entities ere they arise in new dress above our mental horizon. But if there is any experience in which this mystery of mental recognition can be interpreted as *insight* rather than *image-building*, it should be the experience of "becoming"; because in this case the elaborate nerve mechanism does not intervene. That which consciousness is reading off when it feels the passing moments lies just outside its door. Whereas, even if we had reason to regard our vivid impression of colour as insight, it could not be insight into the electric waves, for these terminate at the retina far from the seat of consciousness.

I am afraid that the average reader will feel impatient with the long-winded discussion I am about to give concerning the dynamic character of the external world. "What is all the bother about? Why not make at once the hypothesis that 'becoming' is a kind of one-way texture involved fundamentally in the structure of Nature? The mind is cognisant of this texture (as it is cognisant of other features of the physical world) and apprehends it as the passing on of time—a fairly correct appreciation of its actual nature. As a result of this one-way texture the random element increases steadily in the direction of the grain, and thus conveniently provides the physicist with an experimental criterion for determining the way of the grain; but it is the grain and not this particular consequence of it which is the direct physical counterpart of 'becoming'. It may be difficult to find a rigorous proof of this hypothesis; but after all we have generally to be content with hypotheses that rest only on plausibility."

This is in fact the kind of idea which I wish to advocate; but the "average reader" has probably not appreciated that before the physicist can admit it, a delicate situation concerning the limits of scientific method and the underlying basis of physical law has to be faced. It is one thing to introduce a plausible hypothesis in order to explain observational phenomena; it is another thing to introduce it in order to give the world outside us a significant or purposive meaning, however strongly that meaning may be insisted on by something in our conscious nature. From the side of scientific investigation we recognise only the progressive change in the random element from the end of the world with least randomness to the end with most; that in itself gives no ground for suspecting any kind of dynamical meaning. The view here advocated is tantamount to an admission that consciousness, looking out through a private door, can learn by direct insight an underlying character of the world which physical measurements do not betray.

In any attempt to bridge the domains of experience belonging to the spiritual and physical sides of our nature, Time occupies the key position. I have already referred to its dual entry into our consciousness—through the sense organs which relate it to the other entities of the physical world, and directly through a kind of private door into the mind. The physicist, whose method of inquiry depends on sharpening up our sense organs by auxiliary apparatus of precision, naturally does not look kindly on private doors, through which all forms of superstitious fancy might enter unchecked. But is he ready to forgo that knowledge of the going on of time which has reached us through the door, and content himself with the time inferred from sense-impressions which is emaciated of all dynamic quality?

No doubt some will reply that they are content; to these I would say—Then show your good faith by reversing the dynamic quality of time (which you may freely do if it has no importance in Nature), and, just for a change, give us a picture of the universe passing from the more random to the less random state, each step showing a gradual victory of anti-chance over chance. If you are a biologist, teach us how from Man and a myriad other primitive forms of life, Nature in the course of ages achieved the sublimely simple structure of the amoeba. If you are an astronomer, tell how waves of light hurry in from the depths of space and condense on to the stars; how the complex solar system unwinds itself into the evenness of a nebula. Is this the enlightened outlook which you wish to substitute for the first chapter of Genesis? If you genuinely believe that a contra-evolutionary theory is just as true and as significant as an evolutionary theory, surely it is time that a protest should be made against the entirely one-sided version currently taught.