Contemporary Scientific Mythology.
R. W. Crammer, Leicester, Michael Polanyi and Robert E. D. Clark.
The Listener (London, England), Thursday, March 15, 1951; pg. 423; Issue 1150.(1245 words) Category:Letter to the editor
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Letters to the Editor
The Editor welcomes letters on broadcasting subjects or topics arising out of articles or talks printed in THE LISTENER but reserves the right to shorten letters for reasons of space
Contemporary Scientific Mythology
Sir,—I agree with Mr. Toulmin in his talk published in The Listener of March 8, that we should not worry about the running-down of the universe—for I think we have not enough evidence for it—but I am disturbed by the methods of his argument. Mr. Toulmin suggests that there is a logical impossibility involved in applying the Second Law of Thermodynamics to the universe, and he illustrates this by the impossibility of weighing fire. He ascribes this impossibility to the fact that, in our present system of chemical classification, the word " fire " does not figure as the name of a stuff'. But surely, whatever limitations are imposed on the verbal context in which we may use the word ' fire ' are derived from our knowledge of fire, and it is therefore wholly circular to derive any knowledge about fire from the way the word * fire ' may be used.
In playing with 'fire' Mr. Toulmin is playing with fire; his linguistic critique, bent on casting out verbalism, lets it in with a vengeance. There are half-a-dozen alternative formulations of the Second Law of Thermodynamics which do not mention any. system ' completely shielded from exchange of heat ' and which hence can be applied to the universe without assuming that it is ' lagged ' against something outside. Indeed, the astonishing variety of apparently quite dissimilar and yet equivalent formulations of the Second Law should warn us against regarding any particular set of words as the strict expression of a natural law. The words of science are intended to report on our knowledge of nature, and it is on this knowledge, and not on any particular verbal usage reflecting it, that we must ultimately rely for our conclusions.
Yours, etc.,
Manchester Michael Polanyi
Sir,—Mr. Stephen Toulmin's talk on the subject of entropy, printed in The Listener for March 8, contains a quite astonishing medley of misunderstandings. He starts by presenting the Second Law of Thermodynamics in such a guise as to make it appear as academic as possible. We are informed that the law is concerned with heat engines and so has as little to do with philosophy as the intestines of birds have to do with the fall of cities—his own analogy.
Now it is a truism, of course, that the law of increasing entropy was first recognised in science in connection with the theory of heat engines. But since the time of Boltzmann physicists have been well aware that the fundamental basis of the law is concerned with probability and the degeneration of ordered systems. The connection with steam engines is accidental, not fundamental. Professor Dingle has shown that it is possible so to frame the laws of heat that they do not show any progressive tendency of this kind, but he points out that if we do so, we shall then have to postulate some-
thing akin to the law of entropy for mechanics. Had Carnot lived before Newton this might conceivably have been done! But the point which needs to be underlined is not that entropy

is concerned with heat engines but that it is related to something which is an everyday experience— the fact that order degenerates in physical processes; that the photograph is never a perfect replica of the original, that the card pack becomes more and more mixed as we shake it in a hat (a dangerous analogy but serviceable to a point), that houses are demolished slowly by time, quickly by bombs, but are demolished just the same. This is, or seems to be, a universal rule applying to all ordered systems—biological systems included. Are we to imagine, then, that it applies to the universe—to the whole universe? Certainly not, says Mr. Toulmin. For the entropy law applies to isolated systems, but you cannot speak of the universe as isolated. Isolated from what?

This is slippery reasoning. If the universe be infinitely large we can consider it as made up of an infinite number of zones of space, each as large as we please. They are not isolated from one another, to be sure, but it needs little mathematics to see that the larger we consider them to be, the more nearly isolated they will become. (Transfer of energy is proportional to their surface and so to the square of the radius, but energy content is proportional to its cube.) So the law applies to the whole universe, even if it is infinite in extent. Mr. Toulmin's analogies from gravitation and tooth-cleaning only befog the issue. A more apt analogy would be this': if the whole universe consisted of hats, with a pack of cards in each, and if all the hats were shaken —would the cards become mixed up? Of course they would.

Now for the metaphysics. The entropy law does not, it is true, show that the world will die a heat death. What it does show is that unless the physical universe is a closed system it will die a heat death—a very different story. But it is the entropy law which shows us that the universe cannot be a closed physical system. It matters not if we go back in time with Jeans and postulate an original creation which happened against the laws of physical science, or if with Hoyle we postulate continuous creation (or for that matter if we postulate a combination of the two possibilities). Whichever way we have it, the conclusion seems inevitable that that which 4 is seen hath not been made out of things which do appear '. Th'e universe exists because a force or forces are or have been at work about which observational science can tell us nothing, for it is undetectable by any conceivable physical means. And when we consider the outcome of this Force it is hard to avoid the conclusion that It or perhaps He is intelligent—indeed is possessed of an intelligence far surpassing that of man. This, surely, is the significance for philosophy of the entropy principle.—Yours, etc.,

Cambridge Robert E. D. Clark

Sir,—In support of Professor H. Dingle's criticism of Mr. Toulmin's remarks on Newton's view of the relations between physics and theology, it may be of interest to quote some very relevant sentences from Professor P. Frank's book, Modern Science and its Philosophy. In the chapter which deals with the philosophic meaning of the Copernican revolution Professor Frank says:

Newton himself was very well aware that 4 motion relative to absolute space ' has no operational meaning, that is, that by no physical experiment can the speed of a body in rectilinear motion with respect to absolute space be measured. Therefore, the Newtonian system of principles is not a logically coherent system within the domain of physics. Newton himself restored logical coherence by enlarging his system of physical statements by the addition of some theologic propositions.

Professor Frank goes on to quote a passage from Burtt's Metaphysical Foundations of Modern Physical Science, in which Burtt says:

4 The divine consciousness furnishes the ultimate centre of reference for absolute motion. Moreover, the animism in Newton's conception of force plays a part in the premisses of the position. God is the ultimate originator of motion '. Professor Frank ends by saying: 4 Strange as it may seem, by the abandonment (long after Newton) of theologic argument, the Newtonian physics lost logical coherence '.—Yours, etc.,

. Leicester R. W. Crammer

Science as a Solution to Our Problems

Sir,—Mr. Malone's letter is as inaccurate as it is in bad taste. As an undergraduate of the London School of Economics, I find it as unnecessary to question the authority of Mr. Beales as it is to discuss Mr. Malone's manners. I would, however, give 3 per cent, of the annual value of my scholarship grant to any charity Mr. Malone wishes to name, if he can prove that economics, as expounded at the L.S.E., is a 4 left-wing economics '. He really must get into his head—as must many others—the fact that the L.S.E. is a part of the University of London, and not an intellectual hothouse maintained under the auspices of either Transport House or King Street.—Yours, etc.,

Christopher Rowland London School of Economics

Framework of the Future

Sir,—I must beg your indulgence to answer Commander King-Hall's challenge, printed in your columns last week.

If, as the Commander puts it, my letter wanders 4 stratospherically ' from the point, then his reply, in astronomical terms, must be perilously near approaching Venus—or should I say Mars? I am afraid I must disregard his salvos of sarcasm and lead him gently back to the main point of my letter, which he contrives

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