Letters to the Editor.

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Relativity and Physical Reality.

IN a review by Prof. H. Wildon Carr entitled "The New Way of Thinking Physical Reality," which appeared in NATURE of October 7, p. 471, the writer (speaking of a work by Prof. Léon Brunschvicg) says regarding physical reality: "According to Einstein, we cannot say, speaking absolutely, that there is any picture even for God."

It seems to follow from this that not even the Almighty himself could understand the theory of relativity. If this be so I cannot help thinking that the fault lies with the theory of relativity and not with the Almighty.

The writer then proceeds to say: "The picture is only known as a function of the frame. That is, the things measured are only known through the measurings, and the measurings are bound up with the things they serve to measure."

This seems to imply that measurement is the fundamental thing to be considered in space-time theory, and with this I am not in agreement.

In my book, "A Theory of Time and Space," published in 1914, I showed that the ideas of measurement could be built up from the ideas of *before* and *after*, which were regarded as absolute and not dependent on any particular individual.

In my smaller book, "The Absolute Relations of Time and Space," I gave an abbreviated account of this work and added an appendix showing how the various complicated geometries which are treated of in Einstein's generalised relativity could be obtained by means of a modified measure of interval.

However, most relativists have been too busily engaged in praising Einstein to spare the time to go into my work.

One result of this has been that, by taking the idea of measurement as the fundamental thing, a very large number, if not the majority, of relativists have fallen into the very serious error of asserting that the length of what they call a "world-line" is a minimum between any two points of it. In my "Theory of Time and Space" I showed (p. 360) that this is not correct.

Finding that a number of writers were making this mistake, I wrote a letter which appeared in NATURE (February 5, 1920, p. 599) in which I invited attention to this matter and pointed out that in what I called "inertia lines" the length, so far from being a minimum, was actually a maximum in the mathematical sense; while, in what I called "separation lines" the length was neither a maximum nor a minimum.

In this letter I gave actual numerical examples to illustrate these points. I invited attention to the matter again in my "Absolute Relations of Time and Space" (p. 71), published in 1920.

In spite of these efforts of mine, I again find this blunder cropping up in works published this year. Now it seems to me that it is a very important point since, in ordinary geometry, there is no such thing as a "longest" line joining two points.

The idea would, I think, be apt to cause bewilderment in the mind of a person meeting it for the first time, unless it were properly presented to him. The idea of a "straight line" which was neither a maximum nor a minimum would, I fancy, cause even greater bewilderment, and he would wish to know how such lines were to be defined.

In Einstein's generalised relativity, the element of interval is taken as a starting-point, although the idea of an interval in the minds of many writers is so obscure that they ascribe a minimum property to it which it does not possess.

Although I have tried so often to impress on relativists that the ordinary method of treating space-time theory is unsatisfactory, I propose to make one more attempt to show that the measurement of intervals is not the simple thing that is so often supposed.

Let us consider the simple time-space theory in which the length of an element ds of what I call a "separation line" is given by the formula:

$$ds^2 = dx^2 + dy^2 + dz^2 - dt^2.$$

Let O be the origin of co-ordinates and let P be any point on the axis of x, at a distance l from O, measured, say, in the positive direction.

Let $F(x)$ be any arbitrary differentiable function of x which is continuous and single valued, and which is equal to zero for $x = O$ and for $x = l$.

Now consider the space-time curve the equations of which are:

$$y = t = F(x),$$
$$z = 0.$$

It is evident that this curve passes through O and P.

But now we have

$$dy = dt,$$
$$dz = 0,$$

and so $$ds^2 = dx^2.$$

Thus we have $ds = dx$, and so the length measured along the space-time curve from O to P is equal to the length from O to P measured directly along the axis of x. That is, it is equal to l.

Thus a space-time curve the equations of which contain an arbitrary function can have the same length between two points as the direct length measured between those points.

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The Miraculous Draught of Fishes—an Explanation.

WE have in the Gospel according to Saint John, in his twenty-first and last chapter, an account of the miraculous draught of fishes in the lake of Galilee for which modern research into the habits of the Galilean fishes offers a perfectly reasonable explanation. The account is as follows:

"Simon Peter saith unto them [certain of the disciples], I go a fishing. They say unto him, We also go with thee. They went forth, and entered into a ship immediately; and that night they caught nothing. But when the morning was now come, Jesus stood on the shore. . . . Then Jesus saith unto them, Children, have ye any meat? They answered him, No. And he said unto them, Cast the net on the right side of the ship, and ye shall find. They cast therefore, and now they were not able to draw it for the multitude of fishes."

Simon Peter then girded his fisherman's garment around him and leaped overboard. But the other disciples brought their boat to shore dragging the net full of fishes with them. Further on we read: "Simon Peter went up, and drew the net to land full of great fishes, an hundred and fifty and three: and for all there were so many, yet was not the net broken."

The explanation of this is to be found in a study of the habits of the fishes living in the lake of Tiberius or