# THE ABSOLUTE RELATIONS OF TIME AND SPACE

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BY

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# PREFACE

At the meeting of the British Association in 1902, Lord Rayleigh gave a paper entitled "Does motion through the ether cause double refraction?" in which he described some experiments which seemed to indicate that the answer was in the negative. I recollect that on this occasion Professor Larmor was asked whether he would expect any such effect and he replied that he did not expect any.

In the discussion which followed reference was made to the null results of all attempts to detect uniform motion through the aether and to the way in which things seemed to conspire together to give these null results.

The impression made on me by this discussion was: that in order properly to understand what happened, it would be necessary to be quite clear as to what we mean by equality of lengths, etc., and I decided that I should try at some future time to carry out an analysis of this subject.

I am not certain that I had not some idea of doing this even before the British Association meeting, but in any case, the inspiration came from Sir Joseph Larmor, either at this meeting or on some previous occasion while attending his lectures.

Some years later I proceeded to try to carry out this idea, and while engaged in endeavouring to solve the problem, I heard for the first time of Einstein's work.

From the first I felt that Einstein's standpoint and method of treatment were unsatisfactory, though his mathematical transformations might be sound enough, and I decided to proceed in my own way in search of a suitable basis for a theory.

In particular I felt strongly repelled by the idea that events could be simultaneous to one person and not simultaneous to another; which was one of Einstein's chief contentions.

This seemed to destroy all sense of the reality of the external world and to leave the physical universe no better than a dream, or rather, a nightmare.

If two physicists *A* and *B* agree to discuss a physical experiment, their agreement implies that they admit, in some sense, a common world in which the experiment is supposed to take place.

It might be urged perhaps that we have merely got a correspondence between the physical worlds of *A* and *B*, but if so, where, or how, does this correspondence subsist?

It cannot be in *A*'s mind alone, or it would not be a correspondence, and similarly it cannot be in *B*'s mind alone.

It seems to follow that it must be in some common sub-stratum; and this brings us at once back to an objective standpoint.

The first work which I published on this subject was a short tract entitled *Optical Geometry of Motion, a New view of the Theory of Relativity* which appeared in 1911.

This paper, though it did not claim to give a complete logical analysis of the subject, yet contained some of the germs of my later work and, in particular, it avoided any attempt to identify instants at different places. Later on the idea of "*Conical Order*" occurred to me, in which such instants are treated as definitely distinct.

The working out of this idea was a somewhat lengthy task and in 1913 I published a short preliminary account of it under the title *A Theory of Time and Space*, which was also the title of a book on this subject on which I was then engaged.

This book was in the press at the time of the outbreak of the war and was finally published towards the end of 1914.

Unhappily at that period people were concerning themselves rather with trying to sever one another's connexions with Time and Space altogether, than with any attempt to understand such things; so that it was hardly an ideal occasion to bring out a book on the subject.

The subject moreover was not an easy one, and I have been told more than once that my book is difficult reading.

To this I can only reply as did Mr Oliver Heaviside, under similar circumstances, that it was perhaps even more difficult to write.

Be that as it may, the results arrived at fully justified my attitude towards Einstein's standpoint.

I succeeded in developing a theory of Time and Space in terms of the relations of *before* and *after*, but in which these relations are regarded as absolute and not dependent on the particular observer.

In fact it is not a "theory of relativity" at all in Einstein's sense, although it certainly does involve relations.

These relations of *before* and *after*, serving, as they do, as a physical basis for the mathematical theory, were quite ignored in Einstein's treatment; with the result that the absolute features were lost sight of.

Even now, some six years from the date of publication of my book, comparatively few of Einstein's followers appear to realize the extreme importance of these relations, or to recognize how they alter the entire aspect of the subject.

The theory, in so far as its postulates have an interpretation, becomes a physical theory in the ordinary sense, but these postulates are used to build up a pure mathematical structure.

From the physical standpoint the question is: whether the postulates *as interpreted* are correct expressions of physical facts, or in some respect only approximations?

If the postulates are not all correct expressions of the facts, then which of them require emendation and what emendation do they require?

As regards the pure mathematical aspect of the theory: this of course remains unaffected by the physical interpretation of the postulates, and those who are interested only in pure mathematics may find that the method employed has certain advantages as a study of the foundations of geometry.

In particular it may be noticed that by this method we get a system of geometry in which "congruence" appears, not as something extraneous grafted on to an otherwise complete system, but as an intrinsic part of the system itself.

I had intended making further developments of this theory, but the outbreak of the war caused an interruption of my work.

In the meantime Einstein produced his "generalized relativity" theory and the reader will doubtless wish to know how this work bears upon it.

So far as I can at present judge, the situation is this: once coordinates have been introduced, the theory here developed gives rise to the same analysis as Einstein's so-called "restricted relativity" and this latter cannot be regarded as satisfactory apart from my work, or some equivalent.

Einstein's more recent work is extremely analytical in character.

The *before* and *after* relations have not been employed at all in its foundation, although it is evident that, if these relations are a sufficient basis for the simple theory, they must play an equally important part in any generalization. Moreover these relations most certainly have a physical significance whatever theory be the correct one.

A generalization of my own work is evidently possible and, to a certain extent, I can see a method of carrying this out, although I have not as yet worked out the details. (See Appendix.)

In the meantime it seemed desirable to write some sort of introduction to my *Theory of Time and Space* which, while not going into the proofs of theorems, would yet convey to a larger circle of readers the main results arrived at in that work.

A. A. R.

CAMBRIDGE,
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