RECIPROCITY

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## SPACE-TIME DISCRETE OR A CONTINUUM?

The notion that space-time is a continuum is merely a guess that space and time are infinitely divisible and so not finitely divisible, not discrete.

That space and/or time are continuous is an ancient speculation, unchallenged by the revolution in physics at the beginning of this century. Of course, there have always been dissenters. Martianus Capella, Maimonides and Descartes believed that time is discrete, not continuous. In modern physics the space-time continuum has been taken for granted, however, as a necessary truth.

As a meaningful assumption about the structure of space, time and the physical universe, the space-time continuum is true or false. No such assumption is necessarily true. Thus, the space-time continuum is not necessarily a true assumption.

The truth of any physical assumption, whether obvious or apparently wild, is never settled by revelation or authority. Physical truth may be decided only by inquiry and the weight of evidence.

Positive physical evidence is lacking to establish as true that space-time is a continuum. Perhaps the most important reason for which the assumption of a space-time continuum was adopted has been to facilitate the application of mathematics to physics. The conveniences and even the logical necessities of mathematicians, however, are not invariable determinants of physical truth.

The conjecture that space and/or time are infinitely divisible is metaphysical; that is, it goes quite beyond what has been or can be vindicated easily by experiment or actual observation. In any case it is remarkable that this supposition is so widely taken for granted to be a necessary scientific truth.

All presently available evidence indicates that the space-time continuum is not necessarily a scientific truth.

Few physicists have taken the thoughtful position of the distinguished mathematician, David Hilbert: ". . . . . it is not at all necessary to believe that the mathematical space-time representation of motion makes sense physically for arbitrarily small space and time units or, even more, that the mathematical model extrapolates the facts in the sense of the simple formation of a fact."

One who has taken the Hilbert position is the Portland, Oregon engineer, Dewey Larson. Questioning the necessity of supporting the space-time continuum idea, he has assumed that space and time, as forms of motion, are, on the contrary, discrete in structure: "The physical universe is entirely composed of one component, motion, existing in three dimensions, in discrete units and with two reciprocal aspects, space and time."

The Larson conception of motion implies that no natural unit of time itself smaller than $0.1521 \times 10^{-15}$ second exists and that no natural unit of space smaller than $0.4559 \times 10^{-5}$ centimeter exists, notwithstanding the fact that atoms of solid matter appear closer together to about $10^{-8}$ centimeter. The latter appearance and other related anomalies can be explained as effects of the postulated reciprocal connection of time and space in motion.

Several of the more perceptive contemporary physicists have admitted the possibility that time is not continuous or that space is not continuous.

A minimum time length of $10^{-24}$ second, called the chronon, has been mentioned from time to time in the literature of contemporary physics, but not taken seriously. Larson has provided some evidence that the ultimate unit of time itself is actually about $1.5 \times 10^{-16}$ second; if he is correct, then the estimate of $10^{-24}$ second is too short.

At least two imaginative physicists have admitted the possibility that physical space is discrete and not continuous in recent times.

Max Born in 1949 in Natural Philosophy of Cause and Chance concluded that the development of quantum physics brought the infinite divisibility of a physical line element into question and added:

"On the other hand, the appearance of a FINITE length in the ultimate equations of physics can be expected."

Richard Feynman in 1965 in The Character of Physical Law said:

"The theory that space is continuous is wrong, . . . . . I rather suspect that the simple ideas of geometry, extended down into the infinitely small, are wrong."

The philosopher of reason, George Santayana, in 1938 in The Realm of Truth argued that "the axiom" of the infinite divisibility of space and time is "no necessary truth". Acknowledging that "specious space and time (that is, extension and duration as given in intuition, and space and time as defined geometrically) are indeed infinitely divisible", he maintained that "the truth of the axiom" in the chemical or animal or astronomical spheres and even in the physical world is "extremely doubtful".

One should not accept as true any basic assumption in science anymore than in history, politics or medicine without examination.

Precis of the article by Frederick Ferré, "Grünbaum on Temporal Becoming: A Critique," in INTERNATIONAL PHILOSOPHICAL QUARTERLY, Vol. XII, No. 3, September, 1972, pp. 427-445. Ferré criticises the work of Adolf Grünbaum, as developed principally in PHILOSOPHICAL PROBLEMS OF SPACE AND TIME, New York, Knopf, 1963. -- by Carla L Rueckert, Associate Editor, RECIPROCITY.

To become or not to become: that is the question explored by Adolf Grünbaum and Frederick Ferré.

Grünbaum denies the reality of becoming. He suggests that time exists as a bunch of isomorphic instants, which are inherently tenseless. The human mind, he says, creates the sense of past, present, and future which is the human experience of time. Grünbaum denies the reality of becoming because "contemporary physics requires disbelief in becoming." Grünbaum, thus, affirms the reality of time itself, but denies the objective reality of the passage of time. He suggests that all past (and future) instants are as real as that one which is 'now.'

Frederick Ferré disagrees with Grünbaum's denial of becoming, since he feels that our common experience gives us data that are unaccounted for on his theory.

In order to support this disagreement with Grünbaum, Ferré sets forth several seeming logical difficulties in Grünbaum's system. His central critique is, "How can we adequately account for the sort of transiency that is so conspicuous a feature of experience?" To Grünbaum, all times indifferently exist. This, feels Ferré, creates the problem of "temporal location:" one cannot ask why one's mind is "at" one moment rather than another, if all times are objectively the same. Actual temporal experience becomes sheer mystery.

Secondly, there is the problem of the order of events. Why are they experienced in a certain order, and not another, if all times indifferently exist?

Specifically, Ferré challenges Grünbaum to explain why time is experienced as an irreversible process. If nothing objective prevents it from proceeding in more than one order, says Ferré, then why doesn't it?

Ferré further points out, under this general critique of Grünbaum's "arbitrariness of temporal data in experience," a series of objections which center on the fact that when Grünbaum calls becoming mind-dependent, he fails to consider that our minds are not only aware of transiency, but they are also transiently aware. Can a mind-dependent phenomenon process itself?

Ferré's second critique develops from his first. He points out the further difficulty to the mind-dependent theory of becoming when two subjects, which are aware of the same nowness, exist. Grünbaum says that two people can be intersubjectively aware of the same 'now' in the same way as two people can be aware of the color of a chair. Ferré objects to the analogy, since there is a physical object, the chair, with objectively testable properties within a given temporal framework, which can be used to determine the chair's color. But 'now' has no such objective correlative, on Grünbaum's theory: thus the analogy begs the crucial question: the "givenness <u>of</u> the framework itself."

Ferré concludes by stating that he has "attempted to show that Grünbaum has not succeeded in arguing that we can disavow intrinsic becoming in the world of physical events without serious intellectual penalties." His last remark is a pointed request that philosophers not be "slavishly bound to the set of abstractions current in mathematical physics."

## READER COMMENT

Readers are invited to contribute unedited comment and opinion to this feature column.

Comment on Gravatational Theory
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I would like to call to the attention of readers of RECIPROCITY a paragraph by D. B. Larson in a letter report " A New Theory of Gravitation" (probably issued in the latter half of 1965) made as a comment on his published book, "The Structure of the Physical Universe", 1959.

Larson asserts ". . . For each aggregate of matter there is consequently a gravitational limit beyond which the net movement is outward instead of inward . . . ." I would interpret this to mean that under certain conditions matter which normally has an effective motion opposite to the direction of normal space-time progression (hence an attractive force, gravity), can manifest itself as a repulsive force when the net movement is outward.

If my interpretation is reasonable, then a news item in the New Scientist, 26 October, 1972, p. 191 should be of great interest. According to this report, C. Chiang and A. E. Hwang (University of Texas report CPT-146) indicated that a new solution of Einstein's gravitational field equations provided for a short-range repulsive term in the field equations. This new solution is alleged to be consistent with existing observational data on globular clusters and pulsars.

I cannot critically comment on these results and observations or upon the apparent substantiation (?) of Larson's theories. I hope others more qualified can take the lead and perhaps even suggest an experimental test for the Chiang-Hwang proposal.

## REST

It is odd to think that there is a word for something which strictly speaking does not exist, namely, rest.

Max Born, The Restless Universe

## ADDITIONS TO RECIPROCITY STAFF

The Editor wishes to announce the appointment of three volunteers to the editorial staff of RECIPROCITY. They are: Ms. Carla L. Rueckert, Kentucky, Associate Editor; Dr. E. L. Lippert, Jr., Ohio and Ms. Frances Boldereff, Pennsylvania, Assistant Editors.

There is plenty for each and all of us to do to stimulate our science newsletter to grow.

## SUPPORT RECIPROCITY

The sum of $41 has been donated by readers of RECIPROCITY since publication of last issue. The editors thank these readers, who have made possible publication of the present issue.

The newsletter RECIPROCITY is published to produce an adequate evaluation of the integral reciprocal conception of motion in terms of time and space, proposed by Mr. Dewey Larson, author, of Portland, Oregon. A further aim of the newsletter is to advocate an inquiring, questioning and critically constructive investigation of all allegedly scientific speculation about the structure of the physical universe.

NEW SCIENCE ADVOCATES, publisher of RECIPROCITY, is a non-profit organization, formed for the above purposes. If you are willing to support the newsletter and have not done so recently, please send a voluntary annual donation in an amount of your choice or, if you prefer an amount to be specified, say, two dollars. Please send it to Mr. Ronald Satz, NEW SCIENCE ADVOCATES, P.O. Box 223, Watervliet, N. Y. 12189 and mark that it is for RECIPROCITY. As many issues of the newsletter on an annual basis will be published as desired and supported. One more issue is planned for this year in December.

NEW SCIENCE ADVOCATES should consider incorporating at the start of 1974 to reduce mailing costs of RECIPROCITY.

Please address all communications about RECIPROCITY to the editor, Professor Frank H. Meyer, University of Wisconsin-Superior, Physics Department, Superior, Wisconsin 54880.

## EXPERIMENTAL STUDY OF TIME

Ms. Frances Boldereff has called attention to a paper on Possibility of Experimental Study of the Properties of Time. The author is N. A. Kozyrev of the U.S.S.R., date of paper is September, 1967.

An English translation of it has been reproduced by National Technical Information Service of the U.S. Department of Commerce as JPRS-45238.

Furthermore, an interesting book, The Study of Time, a record of the Proceedings of the First Conference of the International Society for the Study of Time, August-September, 1969, West Germany, has been published by Springer-Verlog, 1972.

Since time and space, although distinguishable, are evidently physically inseparable as physical motion, the nature of time would be studied better in relation to space, while the nature of space would be examined better in its relation to time.

It would be well to prosecute an inquiry concerning the magnitude of rate of passage of clock time in relation to the passage of space, assuming that physical space is not absolutely immovable.

## NOTE ON PROFESSOR FERRÉ

Dr. Frederick Ferré, whose critique of Professor Grünbaum's view of time is published in this issue of RECIPROCITY, is Charles A. Dana Professor of Philosophy in Dickinson College, celebrating its bicentennial in 1973, at Carlisle, Pennsylvania.

Dr. Adolph Grünbaum, whose work on time and space has been influential, is Professor of Philosophy at the University of Pittsburg, Pennsylvania.

## LARSON ON GRAVITATIONAL REPULSION

A situation in which gravitational motion appears as a repulsive force is in the time region, discussed in Section 4, pp. 18-20, by D. B. Larson in his STRUCTURE OF THE PHYSICAL UNIVERSE. In the time region discrete space remains at its minimum value ($0.4559 \times 10^{-5}$ cm), unity, and all variability is in time. Inside the natural unit of space gravitation tends to move objects to positions which in effect are further apart, while the space-time progression tends to move such objects to positions which in effect are closer together.

## BENJAMIN FRANKLIN ON TIME

Dost thou love life? Then don't squander time, for it is a stuff that life is made of.

Franklin's Autobiography