with the distribution and movements of the aggregate of extra-galactic nebulae. It employs equation (1) in the form

$$ds^2 = g_{44}dt^2 - \sum g_{ij}dx_i dx_j \qquad (i, j = 1, 2, 3)$$

The g_{ij} are defined by appealing to an equivalent set of observers who, if they assign coordin tes by the same ~~xthod~~ method, find that the development of the universe appears to be the same for each. This "cosmological principle" is further restricted by settling down to a Lorentz-Einstein invariance, by special rules for measurements, and by assuming a basic event of common significance. Finally, statistical considerations are added.

Methodological observations regard the opposition between this type of kinematical theory and General Relativity. From the more general methodological viewpoint, the g_{ij} can be given as many different meanings as there are distinct fields of inquiry. In cosmological theory, though General Relativity opened the subject, it can very well be that gravitation is not the sole nor even the principal determining factor. In a new field it is important to ~~xiiow~~ acknowledge, as was argued above, for the heuristic use of imagination. Finally, since relativity is an explanatory theory, since an explanatory theory holds at the instant and does not, in general, provide a premise for deductions that leap over ~~x~~ a thousand million years, there is needed some statistical consideration. In brief, if abstract methodological considerations may be presented in the more concrete form of a surmise, one might say 1) that it is not surprising that General Relativity could not handle the cosmological problem, 2) that it will have its chance at making its contribution when the solution is much further advanced than present knowledge makes possible, 3) that kinematical theory's devotion to a modified Special Relativity involves incompatibility with General Relativity only on the assumption that Special Relativity is considered a particular case, not of methodological, but of General Relativity
of inquiry; further, even though the distinction is provisional and has no basis except present ignorance, still one has to operate on that ~~xaix~~ basis to overcome it.
Not a little of the opposition stems, perhaps, from the view that, if General Relativity is not attacked, then Special Relativity has to be confined to empty space. This view is removed by methodological relativity which allows as many distinct meanings for the g_{ij} as there are distinct fields of inquiry.

always has been, in fact if not in opinion, an immediate conjuggte, so also there is no peculiar difficulty in effecting the transition from the data of sense to the relativity concepts of extension, duration, velocity, mass, and energy.

The second question is more recondite but it possesses a greater methodological interest. Can one argue that the constancy of the velocity of light is a law of physics, that laws of physics hold at all places and times, that therefore the invariance of the expression for the velocity of light must be acknowledged? I do not think so. A transformation supposes a frame of reference. A frame of reference supposes that there is some process referred to the frame. But while all processes are at determinate places and times, and so can be referred to frames of reference, laws are abstract; they are not at any particular place or time; they cannot be referred to frames of reference; they cannot, then, be subjected to transformations in any spatio-temporal meaning of transformation; and so they cannot be invariant under such transformations.

This answer indicates the difference between methodological relativity and the foundations that commonly enough are supplied it. Its significance is not unimportant, for it shows that it is conceivable for both Special and General Relativity to be true in restricted domains. Were Special Relativity tied to the assumption that the constancy of the velocity of light is a law of nature, then one could not use Special Relativity in some departments and also accept the General Theory's account of the deflected path of a light ray in a gravitational field. are supplied it. Whether the difference is of any ulterior significance is, perhaps, questionable. It might have some moment in reconciling the constant velocity of light in Special Relativity with its deflected path in a gravitational field according to General Relativity.

The third particular case of the methodological generality is supplied by Einstein's General Theory of Relativity. Here the g_{ij} are given the physical meaning of gravitational potentials. Equation (1) is retained with four variables independent/ The condition of its invariance is that the g_{ij} satisfy a covariant tensor of the second order.

The success of the theory has lain in its ability to take over the highly developed results of the Newtonian theory of universal gravitation and adjust them to solve a few outstanding problems. However, the field of contemporary inquiry to do with lies in the problems that arise in connection with the distribution and movement of a large number of spiral nebulae. And investigators and theorists do not find General Relativity satisfactory and other relativities have been developed.

I do not think that this lack of success can occasion surprise. Cosmological theory 1) is a relatively new field in which the heuristic use of the human imagination is accordingly relevant; 2) considerations of gravitation are not, probably enough, the principal determinants; 3) there is involved a concrete process in which statistical theory would have some relevance both with regard to initial distributions and with regard to the qualifications to be imposed upon deductions that leap over 10^9 to 10^{12} years.

The difference between invariant and relative expression of truth arises from the very nature of our knowledge. Abstract truth prescinds from the individual person or thing and from the particular place and time. Proper expression of such abstract truth will be equally abstract. It will not contain any reference to individuals or to particular places or to particular times. Because it contains no such reference, it cannot be subject to variation when it is uttered by different people in different places at different times. On the other hand, particular truths are not abstract; they are known by recurring to imagination or external sense; their proper expression will be relative to the imaginative or sensible data to which recurrence is made; and since change of that relation results from change of the individual that recurs, of the place where he is when he recurs, of the time at which he recurs, it follows that the expression of one and the same particular truth will be variable not invariant but relative to variable.

The foregoing considerations hold for all human sciences dealing with material objects. But they have a special relevance to mathematical physics as developed since Descartes introduced coordinate geometry, i.e. the application of algebra to spatial and temporal problems. For within coordinate geometry

The foregoing considerations hold for all human sciences dealing with material objects. In general the distinction between invariant and relative expression is observed spontaneously, for really it is as simply and obvious as the foregoing argument indicates. However, when Descartes introduced coordinate geometry, he construcetd an algebra that
However, the Cartesian invention of coordinate geometry was the invention of an algebra in which the distinction between abstract principle and concrete application was systematically obscured; for coordinate geometry is simply an algebra with its geometrical applications immanent within it from the beginning and throughout the procedure

However, there does arise a special difficulty in sciences concerned with space and time. Space is an ordered totality of particular places; time is an ordered totality of particular durations. Since abstract knowledge and invariant expression prescind from all particular places and all particular durations, they cannot deal directly with space and time which, so far from prescinding, actually include all particular places do not prescind from but rather include all particular places and durations. Hence abstract knowledge as abstract deals only with the order. It follows that directly they deal with the order between places and durations

always has been, in fact if not in opinion, an immediate conjuggte, so also there is no particular difficulty in effecting the transition from the data of sense to the relativity concepts of extension, duration, velocity, mass, and energy.

The second question may seem more recondite but it possesses, perhaps, a greater interest. Can one argue that the constancy of the velocity of light is a law of nature, that such laws hold at all places and times, that therefore one must maintain the invariance of its mathematical expression under transformations?

The difficulty with this argument is that there is a difference between a law and a concrete process subject to the law. The concrete process is always at some determinate place and time; it can be referred to one reference frame; by a transformation it can be referred to another frame. But the law itself is not located spatially or temporally; to speak of referring it to some frame is therefore meaningless; to maintain the invariance of its expression under transformations is also meaningless.

However, one may ask whether a concrete process, as subject to a law, must be invariant under transformations. The answer to this seems to be negative. For the act of transforming can involve an attribution to the concrete process of subjecting subjection to further laws or rules, e.g., the laws of rotating bodies. Clearly the mathematical expression that represents a process not under accelerations will not be the same as the mathematical expression representing the same process under accelerations.

There follows a twefold corollary. Methodological relativity posits a physical geometry that is identified and defined by the invariance of the infinitesimal interval, ds; in virtue of this invariance there follows an invariance of the expressions of laws under the transformations of the geometry; but this invariance is a mathematical property of mathematical expressions, and the transformations involved are mathematical substitutions but not changes of spatio-temporal reference.

The second corollary is that methodological relativity completes the division between description and explanation. Description is in terms of extensions, durations, colors, sounds, pushes, pulls, etc., as experienced. Explanation is of extensions, durations, colors, sounds, etc., as implicitly defined by empirically established correlations. Again, description is of objects as related to us. Explanation is of objects as related to one another. It follows that complete explanation completely eliminates the range of qualities-for-us: it replaces "blue as experienced" with "blue as a wave-length of light"; in like manner it replaces an imaginable space-time with a non-imaginable set of spatio-temporal relations that inhabit the same abstract realm as the laws