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Motion of Light

The second part of Einstein's light postulate declares that the velocity of light *is independent of the state of motion of the emitting body.* In other words, the motion of light is not related to the motion of its source. This conclusion is based on the result of the Michelson-Morley experiment, the same experiment which served as a point of departure for the relativity postulate. This means that both postulates start from the same premise, namely that the velocity of the Earth and the velocity of light are non-additive, but arrive at opposite conclusions in respect of the two motions. The first is declared to be relative, unmeasurable and undetectable, while the second is absolute, detectable and measurable. It is obviously difficult to sustain an argument which asserts that the absolute motion of one physical entity is non-existent because there is no basis for determining such motion and at the same time ascribes absolute motion to another physical entity and implies that there is a basis for determining such motion.

The concept of motion is indivisible. There are no apriori or theoretical grounds for declaring any motion non-existent or for arbitrarily deciding that a particular motion is, in principle, indeterminable. The central and immutable idea of any motion is a spatio-temporal change in relation to two physically meaningful points, units or entities. If we have only one point, unit or entity, it is not possible to ascribe motion to it. The difficulty in the use of the concept of motion arises from the meaning of "spatio-temporal change", i.e. from the role of space and time in the definition of motion. It is possible to argue that space and time are not pre-conditions of motion, but consequences of it. This is, in effect, what Einstein does in relation to the motion of his inertial systems. However, he does not use the same argument in relation to light. Here he apparently accepts the spatio-temporal background in the traditional sense, at least at the time of formulating his special theory.

The two components of the physical background, space and time, have their specific identities. One distinctive feature which separates them is of crucial importance for the concept of motion. If we analyse motion dynamically in terms of space points, time points and mass points, we will find that space points have something in common with mass points, but not with time points. Both space points and mass points are geometrical points which can serve as reference points for the purpose of establishing the existence of motion. Although motion cannot occur between two space

points, it can occur between a space point and a mass point. In other words, space has traditionally been endowed with a dual nature or function as far as motion is concerned. It is a distinctive component of the spatio-temporal background, enabling the dynamical relationship between two mass points, but at the same time it can act as one of the two partners in the relationship.

We have to distinguish two types of motion: (a) between two reference points when one of them is represented by a mass point and the other by a space point, and (b) between two reference points when both are represented by mass points. It is a basic tenet of Einsteinianism that space points have no ontological status and that only motion between mass points is to be considered physically valid. The trouble with this tenet is that it cannot be applied to the motion of light. The light quantum represents the equivalent of a mass point in motion. But in relation to what is it moving? The emission point, associated with the light source, is the only other relevant mass point, but it is specifically excluded from consideration by declaring that light is independent of it. However, space points are also specifically excluded from consideration by declaring that the aether and the capacity of space to serve as a reference system are non-existent. Thus the concept of the motion of light in relativity is afflicted with a fundamental deficiency. The relativists cannot demonstrate that light is in motion, that it has a velocity, that it can be used to establish a link between his inertial systems and to determine whether they are in a state of relative motion or not.

Three factors equivalent to geometrical points participate in the Michelson-Morley experiment: (a) the light emission point rigidly connected with the centre of the Earth, (b) the kinetic mass point of the light quantum, and (c) the reference point component of empty space. In order to simplify the terminology we will refer to these three factors as source, light and aether. As motion requires only two factors we will be able to distinguish three separate motions in the experimental situation: (a) the source-light motion, (b) the source-aether motion, and (c) the light-aether motion.

It was assumed that all three motions inherent in the experiment are physically meaningful and can be discovered and measured. It was further assumed that they are all basically mechanical motions and subject to the Newtonian laws of motion. This meant that the motions were considered to be interrelated and additive. The source-aether motion, i.e. the orbital revolution of the Earth, and the light-aether motion, i.e. the propagation of light, had already been examined and measured when the Michelson-Morley experiment was performed. The purpose of the experiment was to find out whether the source-light motion was in accordance with the prevailing mechanical assumptions. The result of the experiment indicated that there was something wrong with the assumptions. Perhaps there was an error in the assumptions, or an additional assumption was necessary pointing to hitherto unknown physical phenomena. The two factors in the source-light motion did not interact as expected. Their relative motion was not a sum of the other two motions, but the same as the light-aether motion, and this meant that the source, rigidly connected with the Earth, was motionless in

respect of the aether. This was, of course, contrary to empirical observations concerning the motion of the Earth.

The Michelson-Morley experiment was performed in 1887 with a highly sensitive interferometer which would have been able to detect, through interference patterns, the minute difference in the motion of light caused by the addition of the motion of the Earth. No difference was observed. To explain the non-additivity of the two motions Lorentz and Fitzgerald suggested independently in 1892 that the anticipated additivity may be annulled by a contraction of matter in the direction of motion. The hypothesis required that the contraction must be in numerical terms exactly equal to the difference between the motion of light and the sum of the two motions. Quantitatively the contraction was represented by the already mentioned Lorentz factor. And as it was attributed to all matter in motion, it was assumed to have affected also all parts of the experimental equipment used by Michelson and Morley. This caused measurements to be distorted in such a way that no interference patterns were observed.

The Lorentz-Fitzgerald hypothesis was clearly not a well-founded and convincing explanation of the observed result. It was too contrived and artificial. It was not supported by any physical evidence, and there were no compelling logical or theoretical reasons in its favour. It was arbitrary, and one could have just as well suggested that it is not a contraction in the direction of motion which nullifies the expected result, but an expansion perpendicular to the direction of motion. The very nature of the hypothesis precluded its falsification and testing. Although it contributed nothing positive and practically worthwhile to science or philosophy, it received considerable attention because it was advanced by two eminent physicists and sympathetically reviewed by other, equally eminent, physicists. Ultimately, the Lorentz-Fitzgerald hypothesis was completely overshadowed by Einstein's special relativity and it is still remembered mainly for two reasons: (a) because it proposed for the first time a radical departure from an established physical concept, namely that of the rigidity of matter, and thus paved the way for other departures, and (b) because it used a formula which re-appeared in a modified version in special relativity and later achieved significance in particle physics.

Despite the somewhat radical idea of deformation without a physically identifiable cause, the Lorentz-Fitzgerald hypothesis sought to reconcile the source-light motion with the source-aether and light-aether motions within the classicial spatio-temporal framework of physics. It acknowledged that relative motion requires something which is ultimately at rest and it preserved the aether. However, the aether was still thought of as a very tenuous substance filling space and serving as a carrier for electromagnetic waves as well as an absolute rest frame. Although the aether was only a theoretical and passive constituent of physical reality, Lorentz and Fitzgerald nevertheless considered it necessary to retain it.

Einstein proposed an even more radical hypothesis than Lorentz and Fitzgerald in order to explain the result of the Michelson-Morley experiment. He said that the aether is superfluous and non-existent. The

motion of the Earth does not require any aether because there is only relative motion, and the motion of light does not require any aether because it is absolute and independent. The result of the Michelson-Morley experiment served to justify both assertions. Alternatively, the existence of relative motion between inertial systems and the independence of the motion of light from any reference frame had to be accepted as an act of faith.

Einstein's abolition of the aether was dictated by the metaphysical requirements of his theory and not by the consequences of the Michelson-Morley experiment. The aether had to go not only because it represented a physically inactive carrier of electromagnetic waves, but also because it was thought of as something absolutely at rest, and this was contrary to Einstein's theoretical outlook. But even the source-independence of light was not strictly a necessary consequence of the Michelson-Morley experiment, but an explanation preferred on metaphysical grounds and requiring corroboration by further evidence. For some physicists it made sense to abolish the unobservable aether, but to remove the velocity of light from its natural reference frame, the source, appeared to them equivalent to throwing out the baby with the bath water.

Ritz, in 1908, tried to modify Einstein's proposition of the source-independence of light. While supporting the elimination of the aether, Ritz suggested that light quanta behave like ballistic missiles, that is, that their motion is measured in relation to their emission point. This was a possible interpretation of the result of the Michelson-Morley experiment because the emission point in the experimental set-up was stationary within the laboratory and terrestrial frame. Unfortunately for Ritz, the ballistic hypothesis was in conflict with Maxwell's theory and the analysis of light rays from binary stars. This evidence indicated that the velocity of light is not affected by the state of motion of the source. The evidence pointed clearly in the direction of light being source-independent, but it did not explain the basis of light propagation and the reason why it has a velocity.

As has been pointed out, it is not possible to speak of motion or to use terms implying motion without at the same time naming the reference points between which the state of motion is said to exist. For this reason the concept of "independent motion" in the complete sense is philosophically as well as physically objectionable and unacceptable. If, as is the case in regard to the motion of light, the reference point is not the source, then there is only one alternative—the substratum, i.e. the aether or whatever is its substitute. There are no other things which can serve as a rest and reference frame for the motion of light.

If we examine Einstein's attitude to the aether and the reasons why he rejects it, we will find that what we are dealing with is pure metaphysics and also that statements made by Einstein at various times are in conflict with each other. In 1905 he clearly pronounced that the concept of the aether is entirely superfluous and consistently eliminated any reference to it from his discussion. But in 1924 he published a paper *On the Aether* in a Swiss journal in which he quite sensibly argued that although the mechanical view of the aether has been superseded, other aspects of the aether concept

continue to play a role in physics. Einstein particularly referred to the characteristics of space which are expressed in such terms as "substratum" and "field". What happened between 1905 and 1924 that made Einstein change his mind, at least to some extent? It was the publication of his general theory of relativity in which the concepts of space-time and field occupy a prominent position without being observable or adequately defined. The field concept in particular, which was of no consequence in the special theory, became a cornerstone of theoretical physics and, in the form of the unified field theory, occupied Einstein's thinking for many years although its conceptual content and ontological status was never elucidated or even touched upon. Not the slightest attempt was made to analyse or to explain the physical nature of the field.

Einstein had justified his opposition to the aether, to the idea of absolute rest inherent in the aether or physical space, and to Newtonian absolute space and time in general by metaphysical statements of this type: *Every physical thing exerts an influence on other things and, in general, is itself influenced by other things. The latter, however, does not apply to the aether.* In another frequently quoted Einstein citation we are told that *it conflicts with one's scientific understanding to conceive a thing which acts but cannot be acted upon.* This is an expression of pure metaphysical relativity. Physics cannot exist without at least some things *which act but cannot be acted upon.* For instance, Planck's quantum and other fundamental constants are all acting but cannot be acted upon. Furthermore, Einstein's two postulates of the special theory are also things of this kind and must therefore, according to his own words, *conflict with one's scientific understanding.* And again, the field concept of the general theory was a thing *which acts but cannot be acted upon.* Obviously, the rejection of the aether on this ground could not be justified.

Relativists are prone to advance circular arguments to prove their point of view, and this also applies to the non-existence of the aether. Born, for instance, quite seriously offers the following argument: *If each of two observers who are moving relatively to each other can assert with equal right that he is at rest in the aether, there can be no aether.* Apparently Born does not recognise that this is not a valid argument. It proves nothing unless one is already a converted relativist. Furthermore, relativists are reluctant to state the real target of their attack and confuse the issue by making a lot of fuss about the aether and concentrating their attention on a phantom target. The real problem is not the aether, it is space. And the question is whether space is rigid and at absolute rest and can serve as a reference frame.

The aether was an auxiliary and theoretical concept which was used to explain some functions of space which could be distinguished apart from the uniformity and emptiness of space and its extension, place and containment connotations. The possibility of gravitational interaction between material bodies in empty space required something more than the static nature of space appeared to embrace, and the view gained acceptance that there must be some sort of substance in space enabling the transmission of physical action. Then there was the propagation of light through empty space. Light was considered to have the character of a mechanical wave,

similar to sound, and as such waves required a carrier substance, light also required one—the aether. Finally, the effects of magnetism and electricity manifested themselves outside magnets and electric conductors. Energy was distributed in some mysterious way in empty space, and here again the aether was used to provide a model. Somehow the idea that forces can be transmitted and physical bodies can move through empty space without being carried, suspended or supported by a medium was difficult to apprehend, and the aether model offered an opportunity to imagine the transmission of action as a mechanical process and the rest or motion of physical bodies as a state of being immersed or floating in a tenuous substance not unlike a fluid. The aether provided the lacking perceptional support. Finally, the notion of absolute rest was also difficult to apprehend without something actually resting in space. Thus at least five functional components could be distinguished in the aether concept associated with the following notions: (a) transmission of action, (b) light carrier, (c) distribution of energy, (d) support medium, and (e) absolute rest.

The branding of the aether as an unobservable and therefore useless concept by the protagonists of positivism and by Einstein was a metaphysical and emotional gesture which did not consider the real issues. What was necessary was not to abolish the aether, but to transform it by freeing it from the misleading idea that it was a kind of substance apart from space, similar to a rarefied gas. The emphasis on a separate identity, the analogy with a fluid, and the use of aerodynamic imagery were misplaced. They overshadowed the real purpose of the aether model and its obvious close association with, or even inseparability from, space. In fact, the process of disencumbering the aether from its substantial and mechanical connotation and transforming the transmission, carrier and distribution functions into the field properties of space was already under way, and to some extent Einstein himself assisted in this transformation. The incorporation of the support and rest functions in the general properties of space did not present any difficulties.

The carrier of light function is a property of space. What has been referred to as the aether-dependence of light must be considered as identical with space-dependence. Since all functions of the aether merge with the functions of space, it can be nothing else but space which, in conjunction with time, provides light with constancy of velocity, rectilinearity of motion and wave or corpuscular characteristics as well as independence of the state of motion of the source and any other attributes of its ontological status. The fact that the physically valid aspects of the aether concept still remain valid, although sublimated in the concept of space, has never been acknowledged by Einstein, at least not openly. In reality these aspects cannot be disregarded, and they have not been disregarded. They have continued their existence within the framework of relativity, either by implication or under other names. In the special theory, for instance, they have emerged as the vacuum and they remain very much implied in the term "velocity of light". In the general theory and in other areas of physics they are referred to as "fields". They all represent, in the same way as the aether, a potential inherent in empty space to impose a specific pattern or

sequence on microevents. The power of this potential to accomplish its design is complete and immutable. It cannot be influenced by any physical action.

Whenever Einstein discusses the velocity of light he seldom misses to point out that he refers to the velocity of light *in vacuo*. The vacuum, or empty space, is thus an indispensable concomitant of special relativity, and we are confronted with an unstated, but nevertheless clear, inference that although light may be independent of its source, it is not independent of what is called vacuum or empty space. Einstein must insist on the velocity of light *in vacuo* because non-empty space would affect the constancy principle and this would render inoperative his subsequent definition of simultaneity, his ontological interpretation of the Lorentz transformations and other consequences. For this reason empty space has to be admitted as a necessary evil, as a silent but unavoidable partner in the business of special relativity. In reality, of course, the terms "vacuum", "empty space", "free space" and simply "space" are synonyms, and there is no difference between saying that the motion of light depends on empty space and that it depends on space. But Einstein denies the dependence of motion on space. Special relativity treats space as a by-product of the relative motion of inertial systems and the motion of light. One is not certain whether it has or has not a separate existence. Later, Einstein speaks of *the gradual modifications of our ideas of space resulting from the influence of the relativistic view-point* and reveals that space *is not necessarily something to which one can ascribe a separate existence.* In a note to the 15th edition of *Relativity: the Special and the General Theory* Einstein finally announces that the concept of empty space has lost its meaning. Of course, if empty space has lost its meaning, then the constancy of the velocity of light, together with the whole of special relativity, has also lost its meaning.

Within the framework of the special theory the velocity of light must be *in vacuo* because otherwise the specific Einsteinian consequences of the theory will not function. A cloud of dust, for instance, positioning itself between two Einsteinian inertial systems and slowing down the motion of light would upset the relativistic definition of simultaneity, distort the Lorentz transformations and render inoperative their "ontological" effects, i.e. length contraction, time dilation and mass increase. Special relativity requires space to be at all times absolutely free from impurities. In fact, Einstein would be happy if space with its problems would disappear from the stage altogether, and only the unimpeded and clinically sterile and impeccable velocity of light *in vacuo* would be left. However, reality is stubborn, and space and light not only refuse to behave as Einstein wants them to, but delight in creating difficulties and putting obstacles in his way.

One essential characteristic of the motion of light in empty space is that the motion is not really unimpeded, but, in fact, impeded. It is kept at a constant and finite level. In areas of space containing particles of matter light is moving with different and also finite velocities, but always less than the velocity in empty space. The nature and distribution of material singularities in a medium impede and determine the velocity of light in it. The question arises: what is impeding and determining the velocity of light

in empty space? We have already said that the motion of light is kinematically dependent on space as a reference frame, but the dependence is more profound than that. From the fact that the properties of a medium other than free space impede and determine the velocity of light in that medium the inference can be drawn that free space must have properties which are in some way analogous to those of non-free space. What these properties could be in more specific terms is not immediately clear, but, using analogy again, because it is the pattern of singularity and discontinuity in a medium which is associated with a specific velocity of light, it is not unreasonable to infer that empty space is endowed with something which can be described as a pattern of singularity and discontinuity. In other words, space may well have a microstructure which produces certain effects, such as the specific value of the velocity of light and its constancy. That any microstructure of space would remain hidden from our view is to be expected. Our instruments are not precise enough. We have no idea what a photon looks like. Furthermore, it would be, in principle, impossible to observe, measure or investigate something which represents an ultimate and physically indivisible unit of space.

Light is not only impeded by space, it is also impelled by it. Quite unlike a bullet or other mechanical projectile in motion, light does not incur any variation of its velocity within free space or a particular medium. Emerging from a medium after passing through it with a reduced velocity light regains its normal velocity instantaneously and without fail. Although we do not know what causes a light quantum to regain and to sustain its velocity, it is highly probable that the cause must be inherent in the nature of space. Light is in every respect intimately connected with space, and it is completely unsatisfactory to associate the velocity of light with empty space, as Einstein does, and then to imply that space and its properties have nothing to do with it, or to hint that it is light which endows space with any meaning.

As far as it is possible to probe into the relationship between light and space, the logical examination of the results points persistently in one direction. The first and inescapable thought is that space represents an absolute and primary constituent of physical reality. Space is metaphysically necessary prior to time and mass, and this means prior to light. The second thought is that emptiness is a positive macroproperty of space which implies a potentiality or ability to contain, to sustain and to direct motion. The third thought is that macrophysical reality is always associated with microphysical reality, and this implies that one must look for microproperties of space. In other words, it is possible that space ultimately consists of a finite multitude of microemptinesses or discontinuities which have the ability to contain, to provide distance and linearity.

A fourth thought resulting from the examination of the relationship between space and light is that if space is a primary category of physical reality, then electromagnetic radiation is a secondary category, genetically and ontologically following after space (and time), but prior to matter represented by rest mass. One consequence of this thought is that if kinetic mass represented by electromagnetic radiation occupies a more

fundamental level than rest mass, then it would be quite natural to assume that mechanics is applicable only to the tertiary category of physical reality, i.e. the rest mass level, and not necessarily to the electromagnetic level. The motion of kinetic mass and mechanical motion are then two ontologically different types of motion which do not have to interact and be additive. All these thoughts remove the ground under Einstein's feet and indicate that he is proceeding in the wrong direction.

It is said that nature abhors a vacuum. Light certainly does not abhor a vacuum. On the contrary, it is in empty space where it can fully realise its potential. But light abhors something else: curves, circular paths, paths representing conical sections. The path of light is always a straight line, and when it is forced by a medium to alter its path, the change is completely abrupt from one straight line into another. There is no hesitation, no deceleration and no deviation from rectilinearity. In refraction the velocity is subject to change, but this change is just as abrupt as the geometrical change. This abruptness and strict rectilinearity is another indication that the motion of light has nothing in common with mechanical motion.

Using the rectilinearity of the motion of light in conjunction with the constancy of its velocity, the argument could be advanced that the light quantum or photon really represents a perfect specimen of an Einsteinian inertial system. Such argument, if pursued further, would be detrimental to special relativity, to put it mildly. Of course, committed relativists will retort that Einstein's light postulate removes the photon from being considered as an inertial system, or that the photon is excluded from consideration because one cannot attach an observer with measuring rods and clocks to it. It is too small and one does not know what it looks like. It may not be able to serve as an intersection for a co-ordinate system. These reasons are very arbitrary, but let us accept them. In this case let us grant Einstein the power to create physical facts by decree and accept, or confirm, the rule that a thing which is small and of unknown configuration, and unable to accommodate an observer, is excluded from the category of Einsteinian inertial systems. And let us stick to this rule consistently. We will see that the rule will have to be cited when we consider the alleged empirical evidence in favour of relativity derived from phenomena in the realm of particle physics.

There is a good reason why relativists must maintain an unbridgeable gap between inertial systems and photons. The units of light have been appointed by Einstein to perform a specific service in his theory which is quite separate from the purpose of the inertial systems. The photons provide the ontological matrix between inertial systems. They provide the necessary cohesion without which the theory would fall apart in view of the downgrading of space. Light is a kind of universal mortar enabling as well as determining the relations between the building blocks of the Einsteinian "multiverse". But light does not mix with the inertial systems. In relativity both must remain pure and be kept strictly apart. In reality, however, there is no unbridgeable gap between light and physical bodies. Both belong to the category of matter and the gap is between matter, on the one hand, and space and time, on the other.

After considering various aspects of the light-aether motion and the conflicts with special relativity arising from this motion, some attention must be given to certain consequences associated with the other component of the motion of light—the source-light motion. If the source of light is rigidly connected with the laboratory and Earth frame and the observer is also tied to the same frame, it appears that we cannot say much more than that the motion of light is source-independent, laboratory-independent and observer-independent. It so happens that in the Michelson-Morley experiment all these reference systems coincide, but they don't have to. In particular, the source does not have to be stationary in relation to the laboratory. There is no provision for this super-imposed laboratory-source motion in the special theory, and no mention of its relevance to the interpretation of the Michelson-Morley experiment is made by Einstein, although this motion is of importance to the elucidation of problems associated with the independence of the velocity of light.

It was Maxwell, and those who followed in his footsteps, who established theoretically that the velocity of propagation of electromagnetic waves is independent of the state of motion of the source of the waves. Maxwell had very good reasons for assuming that an oscillating current in an electric conductor produces electromagnetic disturbances in the adjoining space which propagate with the velocity of light, and that this velocity is not affected by any motion of the conductor. Under these circumstances the result of the Michelson-Morley experiment could not have been as unexpected as some people maintained, and Einstein certainly did not express anything new by suggesting that the velocity of light *is independent of the state of motion of the emitting body.* It was Maxwell who clearly formulated this proposition and equally clearly stated that light is propagated in an absolutely stationary medium in a manner determined by the properties of the medium. In Maxwell's theory the source was in a state of motion relative to the aether or space and relative to the laboratory, and the motion of light was relative to the aether or space, and independent of the source and the laboratory. This demonstrated much more vividly all the problems of motion involved in the Michelson-Morley arrangement, and yet Maxwell was not disturbed by the thought that electromagnetic and mechanical velocities had to be considered as non-additive. The question of additivity did not even arise for him.

The motion of photons in relation to a moving source within a laboratory frame stationary in the terrestrial environment has been the subject of theoretical considerations and experimental observations in recent times, especially within the context of particle physics. Basically, what is involved is the acceleration of rest mass particles, such as electrons or protons, to velocities which are approaching the velocity of light, and the creation of conditions under which these particles emit electromagnetic radiation in the direction of their motion. Measured by a stationary observer in the laboratory electrons can, for instance, achieve a velocity of 285,000 km/sec. They emit photons in the direction of their motion and the velocity of the photons is 300,000 km/sec measured by the same observer. The velocity of light in relation to the electrons is thus 15,000 km/sec. If it

would be possible for an observer to be attached to the source and to measure the velocity of the emitted light, the correct value of 300,000 km/sec would be obtained. This exercise indicates clearly all the propositions which have been put forward in our discussion: the source-independence, constancy and non-additivity of the motion of light. One interesting question remains, namely whether a moving observer, corresponding to an observer attached to the electron, is theoretically unable to establish his own velocity. The moving observer is potentially able to communicate with the laboratory-based observer and obtain from him information about his velocity, or he may be able to observe the effects of physical changes, such as mass increase, in his own system when it approaches the velocity of light. There is no reason why the answer must be in principle, negative, as suggested by Einstein. The present practical inability to measure one's own velocity in space does not necessarily entail a theoretical impossibility and does not exclude a practical possibility in the future.

The lesson to be learnt from the examination of the motion of light and the implications of the Michelson-Morley experiment is this. The theoretical as well as practical consequences of the experiment have been misinterpreted and their significance has been vastly overrated. The anti-absolutistic and anti-aether lobby among the physicists inflated peripheral and non-essential facets of the aether concept, promoted the spurious assumption that the motion of light is a mechanical motion, and then convinced the world that the Michelson-Morley experiment was a revelation. Instead of removing the inoperative excrescences of the aether model, largely of their own making, they abolished the whole concept and, for good measure, absolute rest and absolute space as well. In real terms, however, the Michelson-Morley experiment and the recent experiments by Alväger and others have only confirmed Maxwell's proposition that the motion of light is not dependent on its source, but on physical space. The mechanical aether concept may be dead, but the properties of space are more alive than ever. They are a primary and necessary component of physical reality without which the Michelson-Morley experiment would not have any meaning, nor indeed would Einstein be able to propose his light postulate.