The use of dynamical field geometries to describe material structure and interaction

Abstract

A theory is introduced in which material structures are described by field geometries and interactions are due to the intersection of their field potentials. A photon in isolation is conceived of as having a magnetic dipole potential which we perceive as an electromagnetic wave when it intersects with electric field potentials. The electron's field is defined as a photon rotating on its axis at angular speed c and its gravitational field is due to the angular acceleration of the same field. Experimental evidence is cited to show that intersecting fields, not the fields themselves, are what we observe as the cause of forces; and that at higher intensities they may assume particle properties. This allows quantum mechanics and elementary particle theory to be assimilated into field theory nearly unchanged. When the proposed models are implemented the inverse square law is found to be inadequate for describing gravitational field energy, starlight, and incoherent sources. A laboratory experiment is proposed as a way to verify this for light sources. Interpretations for dark matter and dark energy are proposed. This is the last in a series of papers which taken together outline a theory of everything[1,2,3,4,5].

Resumé

La théorie exposée dans le présent article envisage les structures de la matière en termes de géométrie des champs, et conçoit les interactions comme les résultantes de l’intersection de leurs potentiels de champs. Un photon isolé est assimilé au potentiel vecteur d’un dipôle, observable sous la forme d’une onde électromagnétique à l’instant où il traverse des potentiels de champs électriques. Le champ de l’électron est définit comme un photon en rotation sur son axe à la vitesse angulaire c, son champ gravitationnel étant dû à l’accélération angulaire de ce même champ. Des preuves expérimentales sont apportées que ce sont bien les intersections de champs qui sont les causes observables des forces, et non les champs eux-mêmes, et que pour des niveaux d’intensité plus élevés, ils présentent les caractéristiques de particules. Dans cette perspective, la mécanique quantique et la théorie des particules élémentaires peuvent être subsumées sous la théorie des champs sans avoir à subir de modifications majeures. Dans les modèles issus de cette théorie, il apparaît que la loi en carré inverse ne décrit pas de manière satisfaisante l’énergie des champs gravitationnels, la lumière issue des étoiles ni les sources incohérentes. Nous proposons un dispositif expérimental pour vérifier cette hypothèse dans le cas des sources lumineuses. Des interprétations des matière et énergie noires sont proposées. Cet article clôture un ensemble d’articles qui dessine les grandes lignes d’une théorie du Tout.

Key words: unified field theory, theory of everything

1.0 Introduction

Two distinct approaches have emerged in the quest for an all-encompassing final theory. The first is based on the methods of quantum mechanics. It attempts to unify the forces; gravitational, electromagnetic, electroweak, and strong; by providing a set of laws to describe all known interactions such that particles are the carriers of forces. An alternative attempt, favored by Einstein, would describe only fields. Forces are derived by introducing suitable field laws while particles are interpreted as concentrations of field. The simplicity of a field theory is appealing; however, efforts to join the gravitational and electromagnetic fields have proven unsuccessful.

Although the mathematical unification of fields has failed physical unification already exists in the form of electrons and other particles. The electromagnetic and gravitational fields coexist harmoniously within these particles and are superposed in four-dimensional space without influencing each other. In other words, they are unified by particle structure, but are manifested and experienced independently. To attempt to unify fields by only looking at their external properties, which behave independently, ignores this common origin. Instead we must seek a solution by taking the opposite viewpoint and asking, Why do fields that have the same physical origin interact according to completely distinct laws? To be sure a successful field theory must account for the many complexities of fields, but more importantly it must explain how this complexity can arise from simple structures. Thus the key to understanding fields lies in correctly interpreting the field source.

The electromagnetic field of a charged particle depends upon relative velocity. Therefore a reference system is needed that can describe the field variables of the particle in all inertial systems, not just as static fields. The determination of a valid reference system to describe a field source is a problem that has been encountered in the past (cf. ref. 1). For example, the problems inherent to the Ptolemaic system were finally resolved when a *gravitational field law formulated on earth was referred to the point of physical origin, the sun, for interpretation*. This change in perspective permitted mathematical laws to be successfully applied to planetary motions. If the same logic is applied to electromagnetic fields, then we must refer them to the point of their physical origin in order to properly understand them. However, electric and magnetic fields are currently believed to be different aspects of the same electromagnetic wave, changing back and forth in continuous succession as they travel through space. No attempt has been made to determine if they can be described as separate fields that derive from independent sources. Let us analyze radiation fields more closely.

2.0 The field concept

2.1 Field superposition

Spontaneous emission may be conceived of as a continuous classical excitation followed by a discrete quantum mechanical decay. During excitation independently oscillating wave train fields superimpose randomly as they resonate with a bound electron. If a sufficient field intensity is realized the electron will be raised to a higher energy state along a continuous classical trajectory. A photon is then released and the electron returns to the ground state. Thus electron excitations and the detection events that accompany them may be attributed to field superposition rather than photon absorption. Wave phenomena such as diffraction and interference are accounted for in the normal way by field superposition while the discrete nature of quantized fields is due to the discontinuity of energy levels in the detection process. Thus quantization is conceived of as a transformation of fields from continuous to discrete forms and its statistical nature is a result of their random fluctuation. By describing quantization as a continuous process, fields rather than particles are the mediators of force. Because field is local in its action the non-local characteristics of quantum theory such as entanglement are avoided (cf. ref. 3).

Frequency doubling occurs when laser light encounters a crystal that has an outer electron with an appropriately spaced energy level[6]. Using the above model of excitation we may conclude that the laser's frequency is doubled because the electron becomes a driven oscillator, emitting a photon for each half cycle of the laser light (cf. ref. 3). This would mean that the superposition of transverse fields and the resulting forces occur instantaneously and suggests further that the photon consists of a single wave cycle with a 1/r axial field distribution. This simplified model of the photon accurately reproduces all classical and most quantum phenomena. A more complete description is given elsewhere (cf. refs. 3 and 4).

2.2 Field energy

Due to the wide application and logical clarity of Maxwell's equations inconsistencies are often overlooked or minimized. However, as Einstein shows in his paper on special relativity they do exist and are important[8].

Figure 1. Spark discharges from a Tesla coil showing greater intensity in the center.

> It is known that Maxwell's electrodynamics—as usually understood at the present time—when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. Take, for example, the reciprocal electrodynamic action of a magnet and a conductor.

As Einstein pointed out, we use a different field equation depending upon whether the magnet or the conductor is placed in motion. He used this example to show that "the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest". However, the asymmetry of the fields themselves, which indicates that the field laws are inadequate, is not addressed. The laws are deficient because *mathematically* only one of the fields is used at a time to calculate force; whereas *physical symmetry* demands that both fields interact simultaneously[9].

In fact experiments clearly show the deficiencies of Maxwell's equations. Ordinary Tesla coil discharges are of uniform brightness. However, when very brief spark discharges of two or three cycles are recorded (Fig. 1) they are found to be brighter in the middle rather than at the electrodes where field intensity is highest. This finding is also confirmed in a more precisely controlled experiment where it is found that sparks do not initiate close to the electrodes at the point of highest field intensity rather they exhibit physical symmetry by first developing at the center of the gap where field intersection is highest[10]. Both experiments demonstrate that the energy of ionization required to initiate a spark derives not from field, but from field intersection. Therefore the force between charged particles should be described the same way that general relativity theory describes gravitational force, by means of a *local* field geometry caused by the superposition of field potentials rather than by the action at a distance of a central force field.

Instead of defining field as something real existing unto itself and having observable properties, we shall describe it as a potential which is not realized unless it intersects with a second field. Field intersection results in the transformation of field to field energy. Fields from a single source cannot intersect because it would violate energy conservation and the principle of relativity. Thus field cannot be defined by using a test charge and taking the limit as it tends to zero. This is because first, there is no such thing as an infinitesimal charge; second, all measurement must be finite; and third, a field in isolation has no physical significance. For the same reason that Einstein's principle of relativity demands symmetry for inertial frames we require physical symmetry for the interacting particles/field sources so that they pivot about a common center. In this way symmetry is introduced, not to the field equations (which are after all mathematical conveniences), but to the behavior of the field sources and thus to the conservation laws as well. Although gravitational and electrostatic forces may appear to be transmitted by a central force field, this only occurs when a large imbalance exists so that the pivot point is close to the larger of the sources. It is hypothesized therefore that force is not proportional to field, but to field intersection.

3.0 Electrodynamics

3.1 Classical theory

The new conceptual basis for fields described in 2.1 and 2.2 requires that radiation theory be reformulated. Detection events caused by "photons" are now viewed as electron transitions caused by superposed wave train fields intersecting with electron fields. Field energy, the work performed on the electron, is a result of combining their field potentials. Thus the fields themselves cannot be observed and are only realized when they intersect with other fields. The field energy of an isolated photon or electron is a meaningless concept. To see how to proceed formally we need only look at the existing mathematics. Transverse radiation fields are given by the vector potential alone. Thus the fields of an electromagnetic wave may be expressed separately, where the magnetic field is given by

$$\vec{B} = \nabla \times \vec{A} \qquad 1)$$

and the electric field is written in terms of the same vector potential as,

$$\vec{E} = -\nabla \phi - \partial \vec{A}/\partial t$$

Since only fields will be considered we may eliminate terms containing charge, leaving

$$\vec{E} = -\partial \vec{A}/\partial t \qquad 2)$$

We seek now to define a field potential that satisfies equations 1) and 2) yet produces sinusoidal wave motion when it intersects with charged matter. All three requirements are met if the field geometry of the vector potential takes the form of a magnetic dipole whose axis is aligned with its path. The completed interaction picture of an electromagnetic wave frozen in time is shown in Figure 2, where shaded ellipses represent negative charges and closed lines represent **B** field. In other words, if we could look at a photon while traveling at speed c it would appear to have a constant **B** field consisting of a series of closed loops to infinity.

Transverse wave motion results when the static magnetic potential moves past positive or negative charge centers. This occurs without an exchange of energy because experiments show that a static magnetic field does not contribute to the energy of charges in uniform relative motion. Force vectors are given by the right hand rule together with the Lorentz force equation **F**=q/c(**v**X**B**), where **v**=**c**. Thus electric fields are not needed to describe wave motion at speed c.

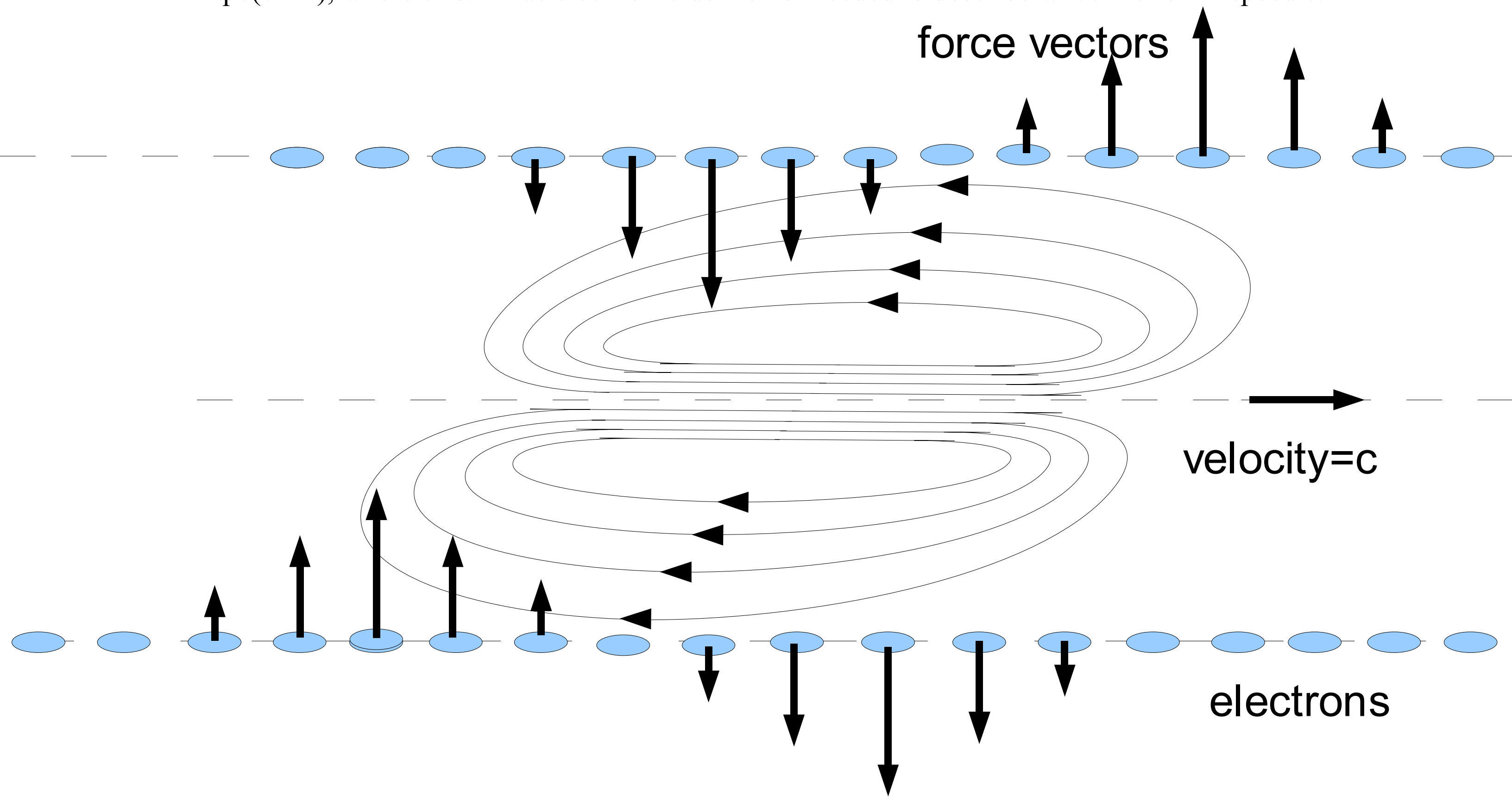

Figure 2. The intersection of magnetic and electric field potentials give the appearances of a wave.

3.2 Quantum theory

Many simplifications may now be implemented, the foremost being an elimination of photons as field singularities and the introduction of magnetic field sources to balance the existence of electric field sources. This allows much of quantum theory to be interpreted using classical field theory. The dual wave-particle nature of photons is explained by means of field geometry and vector addition. Diffuse external fields cause wave behavior while the concentrated fields at the photon's core cause particle behavior. This photon model vindicates Einstein's program for unification by showing that wave and particle properties can both be accounted for by field geometry. Moreover because field intersection and its geometric expression as energy occur at speed c all interactions are indeterminate. This gives a precise conceptual basis to indeterminacy that is postulated in quantum theory.

In rest frames, however, we use electric fields defined by the equation $\nabla \times \vec{E} = -\partial \vec{B}/\partial t$ to describe wave motion. Because the changing electric field in fig. 2 does not cause a changing magnetic field Maxwell's equations are not reversible and only these three equations are needed to describe radiation fields. Note that two types of time with distinct physical origins are postulated. The flow of time that determines the speed c is continuous, while the time that determines phase is only active during field intersection. The disappearances and/or reversals of **E** field which occur during wave motion are **B** field cancellations that are automatically determined by the vector product (**v**X**B)**. The absence of magnetic waves in free space means that fictitious "displacement currents" are unnecessary. Magnetic fields from real currents are not present in a pure radiation field and need not be considered. The "poles" of magnetic dipoles in free space do not influence each other because it would require forces that propagate faster than the speed of light. This model of the photon allows radiation fields to be described in terms of field sources. As proposed in the introduction electromagnetic field laws formulated in a laboratory frame have been referred to the point of their physical origin to be interpreted.

In quantum mechanics field energy is equated with photon density. This leads to the statistical implementation of the conservation laws in diffraction and interference phenomena. However, direct tests of these laws in individual interactions have confirmed their legitimacy to the highest levels of accuracy possible. If instead photons are conceived of as ordinary particles surrounded by a continuous field as in figure 2, detection events may be viewed as field superpositions bringing quantum theory into strict adherence with the conservation laws. This eliminates the use of virtual photons as transmitters of force, a model which lacks in conceptual clarity since it cannot explain attractive forces. A force law based upon fields eliminates these problems.

3.3 Incoherent light

Just as the field singularity is an invalid physical concept so too is the use of the point source as a model for stars and other light sources. All incoherent light sources contain large numbers of coupled and uncoupled oscillators packed into a small space radiating with approximately equal intensity. If the photon model given in 3.1 is used, sinusoidal fields are generated laterally to infinity. This invalidates the use of geometric optics and rays to represent the propagation of radiation fields. Furthermore the close proximity of source atoms to one another will cause interference effects to occur. As the light travels outwards photon trajectories will separate, changing the superposition of fields and the dynamics of the interference effects. Therefore the inverse square law must be revised to include a linear dependence that is determined by the coherence properties of the source. The linear contribution will be greatest during the initial expansion of the wave front, and it will gradually decrease until at great distances fall off in intensity will approach the inverse square law. However, even at infinite distances superposition will occur because the lateral fields of photons are also infinite. Light from Type 1a supernovae is expected to exhibit this effect more strongly than other types of stars because departure from the inverse square law is dependent upon the density of the source. When compensated for in calculations of star distances this may provide an explanation for dark energy.

A linearly diminishing time-averaged component of starlight has already been observed in what is described as the “long vs. short” anomaly[11]. It is postulated that this is due to the coherence properties of the light. Further tests of this effect may be carried out in the laboratory by comparing the intensity vs. distance of coherent and incoherent point sources. It is predicted that coherent point sources will most closely resemble a $1/r^2$ distribution because less field cancellation occurs.

4.0 Electron structure

The Sagnac effect, the angular rotation of radiation fields in opposing directions, is often used for gyroscopic purposes as an indication of spatial orientation. If the localized fields of a photon are rotated axially the effect may also be used to explain the structure of the electron. Thus in pair production a nucleus alters a photon's field geometry by transforming a 1/r transverse magnetic field into two $1/r^2$ electric fields with their spatial orientations defined by spin. Field rotation in opposite directions produces electric fields of opposing polarity thereby explaining in geometric terms the significance of both electrons and positrons. It is the intersection of the electron's spin with other spatially oriented fields that causes spin to be quantized. Suppose further that field rotates at speed c at *all distances from the origin.* The rotation will appear to an observer to be invariant and cause it to be attracted/repelled by other rotating fields an amount relative to their distance and a proportionality constant, which we call charge. The invariance of the field's speed causes charges in relative motion to have a magnetic field component. The invariance of charge is accounted for by the absolute speed of the magnetic field potential while the non-existence of partial charges is explained if only whole rotations occur.

Because the electron's structure consists of a magnetic field potential rotating at speed c it must be treated relativistically. Charge and spin derive from the internal rotation of field which is why they are invariant properties appearing the same to all observers. We can also use the field model to interpret the physical significance of Dirac's relativistic wave equation for a single electron if the space-time of the electron's internal field is independent of the space-time it resides in. Thus the space-time of the equation defines the internal field geometry unique to the electron, while a second space-time is needed to define the electron relative to the field geometry of other particles. This is why the Dirac equation describes a single electron rather than all electrons. Because two space-times are needed, one for field geometry and one for motion, a total of eight dimensions are necessary to completely describe an electron.

5.0 Gravitational field

5.1 Field acceleration

Einstein believed that all reality must have a physical basis. "Space-time does not claim existence on its own but only as a structural quality of the [gravitational] field"[12] However, the relationship of the space-time metric to the particles is not made clear by general relativity theory. In fact they are very much opposed in their properties since matter is localized and impenetrable, while the metric is infinite and diffuse. Rather than show how gravitational field derives from mass the metric describes the reverse, how mass points are influenced by gravitational potential. Let us instead follow the example of photon creation in 2.0, where field energy derives from the superposition of field potentials. Then gravitons are incompatible with the concept of field geometry because they must be created by the simultaneous action of all matter yet be localized at a specific location, thereby violating special relativity theory. It is hypothesized that gravitational fields superpose continuously and interaction occurs locally in the same way as radiation fields.

As noted in 4.0 an electron's field is due to a magnetic field potential rotating at speed c. The acceleration of the field may be described in purely geometric form by the equation $\mathbf{a}=\mathbf{v}^2/r$. This equation indicates that acceleration is greatest where r is small, close to the origin of the field source. Field intensity is also greatest there, close to the dipole's axis. Combining these properties and comparing them with the mass-energy equivalence, $E=mc^2$, leads to the conclusion that mass is a proportionality constant indicating the degree of field acceleration. This is in keeping with Einstein's hypothesis that all natural phenomena be determined by field geometry. Because field accelerations are *potentials* they cannot be experienced directly. An unobservable rotational acceleration produces an observable linear acceleration by intersecting with other field potentials. This explains how more than one field can be produced by a single particle yet coexist harmoniously without interfering. They are different aspects of the same field. It also explains why anti-gravitational force does not exist. Field acceleration is always positive and if it occurs in a "negative" direction it yields positrons with *positive* mass. Thus field and field geometry are sufficient to account for all natural phenomena.

5.2 Dark matter

Macroscopic field accelerations, such as the Sagnac effect and frozen light[13], will also produce tiny mass increments. The acceleration of an alternative field geometry may also act as a source of gravitational field. It is reasonable to suppose, for example, that the neutrino has an associated field of infinite extent that is consistent with special relativity and electrodynamics, a field potential that is lateral and superposes linearly. If the neutrino is now localized in a black hole so that its field undergoes constant acceleration, a gravitational field will be generated that is like the photon's, *constant to infinity*. Because the neutrino has spin, this field will generate a rotational gravitational acceleration that is proportional to the field intensity and is present at all distances from the black hole to infinity. When added vectorially to the radial baryonic acceleration it will give the total gravitational acceleration of mass points. This may provide the additional acceleration needed to account for the motion of stars within galaxies and galaxies within clusters.

As shown by our discussion of starlight in 3.2, radiation fields do not obey the inverse square law; therefore it cannot be assumed to hold for gravitational field energy either. In fact many cosmological questions may be answered if black holes produce both radial acceleration due to baryonic mass and rotational acceleration due to the mass of localized neutrinos. Perhaps the best argument for this connection may be seen in the similar topological structure of galaxies and neutrinos. The constant rotational speed of stars within the galaxy could then be a result of an expected constant acceleration due to the superposed neutrino field. The neutrino fields of black holes would also accelerate elementary particles, thereby acting as a source for the observed extremely high energy cosmic rays. Thus the geometry of superposed neutrino fields provides a possible explanation for dark matter and cosmic ray energy.

6.0 Conclusion

There has been much effort devoted to finding new mathematical methods to solve problems in physics. This concludes a series of papers (cf. ref. 1-5) that propose the reverse: new *physical* interpretations of the mathematics. It is hypothesized that field is an unobservable potential that we observe as energy when it intersects with other potentials. The intersection of field potentials allows field energy to be manifested externally, while its internal space-time geometry generates material structure. These are universal characteristics which are applied to neutrinos based upon what we know about photons. The property of field that causes interaction and structure to have universal meaning is its externally determined absolute speed. However, because analyzing field geometry requires traveling at the speed of light only indirect evidence of field intersection, such as appears in Fig. 1, will be possible. The effects due to field intersection are expected to be more evident as interaction energy increases. In fact, this has been confirmed by high energy particle physics. Asymptotic freedom requires that strong forces possess independent structure in the form of a vector boson, or "gluon", which has no mass or charge. Because gluons cannot exist independently they are better characterized as field geometries. Therefore the quantum mechanical concept of force as an exchange of particles may be transferred unchanged into field theory as field intersection. All particles and their interactions can be explained in terms of the photon and neutrino, and their field geometries.

Although the simplicity of the founding postulates found in 2.0 and 3.0 does not admit any deeper explanation this does not mark an end to physical theory, rather it defines a foundation for future progress. It is claimed therefore that the theoretical framework presented here is the first viable "theory of everything"; not because it explains everything, but because it provides a point of departure from which all phenomena can be included. On the one hand, due to linear superposition and energy transformation; the field concept can explain the evolution of life (cf. ref. 5) and galaxy structure. On the other hand, by showing how fields form stable and unstable geometries it extends into the subatomic realm.

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