ON THE PHYSICS OF THE SHROUD OF TURIN (1.0.0)

For all that is secret will eventually be brought into the open, and everything that is concealed will be brought to light and made known to all.

Luke 8:17

Physicist, and founder of the Shroud of Turin Research Project (STURP), John P. Jackson. has proposed that the image features of the Shroud of Turin were produced by radiation emanating from the body of Jesus at the moment of resurrection. To many, the concept of resurrection is patently absurd, but it is argued here that any apparent absurdity is the result of a conflict between this concept and a false world-view in terms of which resurrection contravenes physical laws. Jackson has proposed also that "the Shroud image presents, if you will, some type of "new physics" that ultimately requires an extension or even revision of current concepts, and the purpose of this note is to show that, if certain deep-rooted but inadequate concepts are extended and revised, we will be able to explain the resurrection, and the image on the Shroud, in a way that coheres with both with the biblical account of the life of Yeshua ben Yosef (a.k.a. Jesus of Nazareth) *and* with science. We will also be able to explain much in this world that is mysterious.

PART 1: INTRODUCTION OF THE SHROUD

Background

The Shroud of Turin is a 14.3 foot by 3.7 linen cloth bearing the faint double-image (ventral and dorsal) of a naked man who appears to have been crucified (together with burn marks and water stains resulting from fires, one in 1532). It is supposed by millions of Christians to be the burial Shroud of Jesus of Nazareth, or more correctly Yeshua ben Yosef.

Figure 1. The Holy Shroud by Giovanni Battista della Rovere

There is a puncture wound on his left wrist (his right wrist is hidden from view), and there are puncture wounds on his feet as if they were pierced by a nail or nails. The back of the man is covered with over 120 scourge marks, apparently imposed by the roman instrument of torture known as the flagrum (a whip with two or three thongs to which were attached small balls of lead). There is a large puncture wound on the right side between the ribs from which blood and a watery serum have flowed. The image resides only on top-most fibrils of the threads with which the Shroud is woven, and it is a negative image.

Although very faint when viewed as a positive, the image becomes much clearer when darks and lights are reversed:

Figure 2. The front image on the Shroud, in positive on the left and in negative on the right.

The positioning of the hands over the groin area, the prominence of the chest, the invisibility of the neck, and the foreshortened forehead all indicate that the man in Shroud was, not flat, but was lying with knees and waist bent, and his head bowed:

Figure 3. The posture of the man in the Shroud deduced from the foreshortening of the body image

The Shroud was involved in a fire in 1532, and its most predominant features are scorch marks where molten silver dripped on the cloth, and triangular patches used to mend holes resulting from that fire. In 1978 group of scientists known as STURP (Shroud of Turin Research Project) performed an intensive series of tests on the Shroud. Many were skeptical and expected that they would quickly discover it to be a fake, but after three years of analyzing the data they collected they wrote in their final report:

We can conclude for now that the Shroud image is that of a real human form of a scourged, crucified man. It is not the product of an artist. The blood stains are composed of hemoglobin and also give a positive test for serum albumin. The image is an ongoing mystery and until further chemical studies are made, perhaps by this group of scientists, or perhaps by some scientists in the future, the problem remains unsolved.

The Age of The Shroud

In 1988, 3 independent laboratories carbon-dated samplings of a sample taken form the corner of the Shroud (Rae's corner) and judged this same sample to have been produced with 95% confidence between 1260 and 1390 AD.

Figure 4. Scientists publicly announce the results of the radiocarbon dating of the Shroud.

This period coincides with the time that the first known expositions of the Shroud are made in the French town of Lirey in 1355. Large crowds of pilgrims converged on Lirey and medallions were struck to mark the occasion. The findings initially limited the popularity of Shroud research, but from the beginning, the question wasn't *if* the carbon date was right but *why* it was wrong, for the Shroud clearly predates 1260. If the medieval date is right, then this implies that the Shroud is a forgery, when all the scientific evidence we have other than this date implies that it is *not* a forgery: the image on the Shroud was not drawn or painted (there are no binding agents or particulates on the Shroud in the region of the image); it is a negative created at a time when photography didn't exist, but it is not a photograph (it contains 3d information that photographs do not), it is not a contact print (parts of the Shroud that were not in contract with the body bear impressions as clear as parts that were in contact with the body); the man in the Shroud has truly been subject to horrific and mortal injuries; he has wounds associated with crucifixion, and the exit wound on the wrist contradicts depictions of the crucifixion in medieval art, but reflects the way in which people must really crucified; he is covered with scourge marks clearly inflicted by the roman instrument of the torture known as the flagrum, and he has puncture wounds on his head consistent with the wearing of a roughly prepared cap of thorns rather than the elegant wreath of thorns depicted by medieval artists; there is a large wound on his right side which matches a spear used by roman executioners and from which postmortem blood and a watery serum (visible only by ultraviolet fluorescence photography) have flowed; the blood on the Shroud -that of real man- contains a high level of bilirubin , a substance associated with severe physical trauma; there are no signs of decomposition, meaning that body was removed from the Shroud within a few days; the Shroud contains traces of pollen from plants growing only in the area of Jerusalem, some of which are extinct since antiquity, and there are microscopic traces of dirt at the foot of the man in the Shroud that only match limestone found in the area of Jerusalem... It may even be that there is a faint image of a coin minted by Pontius Pilate between 29 - 32 AD over the right eye of the man in the Shroud...

But in any case, the carbon-date contradicts the history of the Shroud. First up there is a Hungarian manuscript dating between 1192 and 1195 -the Pray Codex- that depicts the Shroud with the L-shaped burn marks sustained in an earlier fire:

Figure 5. The Pray Codex

Critics maintain that the dots in the Pray codex are decorative, and that the apparent match is purely coincidental.

Harder to explain -and suggestive of a *much* earlier origin for the Shroud than the middle ages- are the 'Vignon Markings' named after Paul Vignon, a biologist and artist who studied the Shroud. These are features -including features of the cloth itself rather than the image on the cloth- belonging to the face on the Shroud and to Byzantine portraits of Jesus. The earliest known icon of Christ Pantokrator, for example, was painted in encaustic on panel in the 6th or 7th century and is preserved in Saint Catherine's monastery deep in the Sinai desert.

Figure 6. The Vignon Markings.

The depiction Jesus known as the Pantokrator (meaning 'ruler of all') and numerous portraits of Jesus produced after the 6th century exhibit some sub-set of the following:

A deep line in the forehead (1)
A U-shape, between the eyebrows (2)
A downward pointing triangle or V on the bridge of the nose (3)
A second V (4)
A raised left eyebrow (5)
Accentuated left cheek (6)
Accentuated right cheek (7)
An enlarged left nostril (8)
An accent line below the nose (9)
A dark line just below the lower lip (10)
A gap in the beard below the lower lip (11)
A forked beard (12)
A line across throat (13)
Accented owl-like eyes (14)
Two strands of hair (15)

Critics argue that the Shroud was based on the paintings, rather than the paintings on the Shroud, but this argument can account of the non-artistic aspects of the Shroud (such as the line across the throat) only by appeal -again- to coincidence.

Then there is the smaller cloth known as the Sudarium of Oviedo, which according to tradition was wrapped around the head of Jesus after he died. Like the Shroud of Turin, the Sudarium of Oviedo is bloodstained, and many stains on the Sudarium match those on the head portion of the Shroud (also the bloodstains on both cloths belong to the same rare and Middle-Eastern type (AB)):

Figure 7. The Shroud of Turin compared to the Sudarium of Oviedo

The Sudarium of Oviedo was carbon-dated to 700 AD, but is mentioned in *570 AD* as being in a cave near a monastery in Jerusalem. Critics: both are forgeries, the apparent match is an illusion, and the shared blood type is coincidental, but the coincidences are mounting. I could go on and on, but the topic of the authenticity of the Shroud is very well covered by the work of Shroud apologists such as Ian Wilson and Mark Antonacci, whose books (such as Wilson's *The Blood and the Shroud* and Antonacci's *The Resurrection of the Shroud*) clearly shows that, if the Shroud is examined in depth, these coincidences continue to mount, and the faithful defenders of the hypothesis that the Shroud is a medieval forgery are forced further and further out on a limb that ultimately breaks beneath the weight of its improbability.

PART II: THE IMAGE ON THE SHROUD AS A PROJECTION

The Shroud in 3D

That there are no pigments or binding agents on the area of the Shroud where the image of the man appears shows that it is not a painting, and the undistorted nature of the dorsal image -in spite of the fact that the bottom part of the cloth must at some point have born the weight of the man's body- shows that it is not a contact print. Technically, the body-image on the Shroud is the result of the degradation- the aging- of the linen fibers of which the cloth is woven, but question is what *caused* this degradation. A clue comes from one of the most striking characteristics of the image on the Shroud (and the thing the first prompted the creation of STURP). i.e. the image contains 3D information. This was discovered in 1976 when photograph of the Shroud was fed into a 'VP8 image analyzer', a device that is able to convert 2D images into 3D by interpreting darker aspects of the image as being closer, and lighter aspects further away:

Figure 8. 3D properties of image on the Shroud

Photograph generally don't contain 3D-information, which arguably leaves us with the sole possibility that the image on the Shroud is an orthographic projection (the representation of a 3 dimensional object on a 2-dimensional surface). Since the image is imprinted only on the *underside* of the Shroud, it is the result of projection whose light source was the body itself, and since the image does not extend beyond the upper-most fibers of the Shroud, this light source must have possessed a short wave-length. One way in which the image might be construed as a projection involves the the effects of the radiation emanating from the body. *Wikipedia*:

Since 1930 several researchers (J. Jackson, G. Fanti, T. Trenn, T. Phillips, J.-B. Rinaudo and others) endorsed the flash-like irradiation hypothesis. It was suggested that the relatively high definition of the image details can be obtained through the energy source (specifically, protonic) acting from inside. The Russian researcher Alexander Belyakov proposed an intense, but short flashlight source, which lasted some hundredths of a second. Some other authors suggest the X-radiation or a burst of directional ultraviolet radiation may have played a role in the formation of the Shroud image. From the image characteristics, several researchers have theorized that the radiant source was prevalently vertical. These theories do not include the scientific discussion of a method by which the energy could have been produced.

In regard to the lack of a method, Jackson in particular suggests that new physics is required to account for it:

...perhaps the time has come to ask if we ought to start thinking about the Shroud in categories quite different from those that have been considered in the past. In particular, perhaps we need to be more flexible in our scientific approach and consider hypotheses that might not be found readily in conventional modern science, for it is conceivable that the Shroud image presents, if you will, some type of "new physics" that ultimately requires an extension or even revision of current concepts.

Following on from the research of Benford and Marino, one of the original STURP team, Ray Rogers, showed in 2004 that there are a number of significant differences between the Raes sample and samples taken from the main part of the Shroud in the first scientific examination of the Shroud in 1973. For example, the Raes sample alone contained cotton fibers. Brendan Whiting's 2006 book, *The Shroud Story*, argued the general case that these differences are due to re-weaving performed on the corner section of the Shroud in the middle ages. Doubtless this is a legitimate objection to the veracity of the carbon-14 date, but is it sufficient to explain an error of over a thousand years? The figure below -which depicts the high levels of Carbon-14 in the atmosphere during the years in which hundreds of nuclear bombs were being tested- hints at why the radiation/dematerialization hypothesis by itself may offer a *better* explanation of the incongruously young radio-carbon date:

Figure 9. Atmospheric C-14 in New Zealand and Austria

Jackson's view is that the radiation that formed the image accompanied the disintegration of the atoms -the dematerialization- of the body in the Shroud. But if the image on the shroud was produced by the same mechanism as that behind nuclear detonations from 1945, then a great deal of energy would have to be diffused as the body of man in the Shroud dematerialized. This would have wreaked devastation on the surrounding environment. As Manny Carreria objected:

From the viewpoint of the forces that hold the nucleus together, a very obvious objection can be formulated against any such dematerialization that pulls the particles apart. ...the preparation of a 75 kg body requires that about 500 g of mass be changed into pure energy, according to the famous equation of Einstein, E=mc^2 . This same amount of energy will be needed to undo the process and liberate the particles now bound in the heavy nuclei this is the energy of a Megaton nuclear bomb, about 50 x 10^15 joules. Nothing is said about the source of so much energy or about the way to channel it exclusively into the splitting of body atoms, without destroying or drastically affecting all objects in the immediate surroundings.

A solution to this problem is going to require radically different understanding of the natural world than that provided by the Theory of Relativity and The Standard Model of Particle Physics. To the extent that these theories are right/complete, there is no realistic way to explain how dematerialization could possibly produced the image on the Shroud that makes any sense. Of course, one could simply appeal to a sense of miraculous that buys you any desired manipulation of nature for free, and give up the quest for scientific sense entirely, but as Jackson says "it is conceivable that the Shroud image presents, if you will, some type of "new physics" that ultimately requires an extension or even revision of current concepts." As Lee Smolin shows in *The Trouble with Physics*, many of these concepts are flawed -Relativity and Quantum Mechanics contradict each other, and each is beset by absurdities, inadequacies, and unexplained phenomena- and so we need not be afraid to rethink. One of these absurdities concerns the equation E = MC^2 itself, which describes the conversion of mass into energy. A seemingly equivalent form of this equation -E/C^2 = M- describes the reverse conversion of energy into mass, and the question arises as to whether the initial condition of the universe was one of energy or mass. The General Theory of Relativity -which attributes gravity to the curvature of space-time, and the curvature of space-time to mass- implies that this initial condition was one of infinitely compressed matter, i.e. an infinitely massive state. But putting aside the objection that it is impossible by the Pauli exclusion principle and logic alone to compress massive objects into a zero-dimensional location, it takes a unit of mass multiplied by the speed of

light squared to produce a unit of energy, which implies that there this original unit of mass contained more than a unit of energy... Energy it is arguable must be prior to mass, and the initial state of the universe must have been one of infinite energy and zero mass, from which it follows that curvature cannot be due to mass (which is a combination of energy and space) but to energy alone. A first step toward developing the mathematical foundations of a better theory than Relativity can be taken by considering Euler's argument in *Variae observations circa series infinitas* (1737). Here he notes that the product continued to infinity of this fraction

$$\frac{2\times 3\times 5\times 7\times 11\times 13\times 17\times 19\ldots}{2\times 4\times 6\times 10\times 12\times 16\times 18\ldots}$$

in which the numerators are prime numbers and the denominators are one less than the numerators, equals the sum of the infinite series

$$1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}\ldots$$

and they are both infinite. To prove his point to Euler invites us to imagine the extraction from the second series a prime denominator and all remaining multiples of that prime denominator until everything except the first term 1 has been eliminated. Let

$$x=1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}\ldots$$

Then

$$\frac{1}{2}x=\frac{1}{2}+\frac{1}{4}+\frac{1}{6}+\frac{1}{8}\ldots$$

This leaves

$$\frac{1}{2}x=1+\frac{1}{3}+\frac{1}{5}+\frac{1}{7}\ldots$$

To eliminate the denominators that are divisible by 3, we divide both sides to get

$$\frac{1\times 1}{2\times 3}x=\frac{1}{3}+\frac{1}{9}+\frac{1}{15}+\frac{1}{21}\ldots$$

Subtracting again eliminates all remaining denominators that are multiples of 3 leaving

$$\frac{1\times 2}{2\times 3}x=1+\frac{1}{5}+\frac{1}{7}+\frac{1}{11}+\frac{1}{13}\ldots$$

Applying this eliminatory process to *all* of the prime numbers leaves

$$\left(\frac{1\times 2\times 4\times 5\times 10\times 12\times 16\times 18}{2\times 3\times 5\times 7\times 11\times 13\times 17\times 19}\ldots\right)x=1$$

This is a thought-experiment -mere imagination- but if these eliminations could be performed in the physical world, they would result in the disappearance of any distinction between the form and the content of a coordinate system, and therefore the shrinking of space and the slowing of time to a zero-dimensional point. With *all* of reality contracted to a zero-dimensional point, the distinction between the world and the mind that surveys it is lost. An idea we can take from Euler's thought-experiment is that, since both prime-density *and* energy-density must at this point be infinite, this is the state of pure energy required by, but conspicuously missing from the Theory of Relativity. From here we can begin to formulate a theory according to which the development of the universe from this singular point is a process that somehow involves the distribution of the prime numbers.

The Light-Before-Dark Universe

Wolfram Mathworld defines a projection in this way:

> A projection is the transformation of points and lines in one plane onto another plane by connecting corresponding points on the two planes with parallel lines. This can be visualized as shining a (point) light source (located at infinity) through a translucent sheet of paper and making an image of whatever is drawn on it on a second sheet of paper.

But a "(point) light source" is the same thing as a zero-dimensional light source, which involves the infinite concentration and the zero diffusion of light. The problem with the *Wolfram Mathworld* definition of projection, and with every physical theory that relies on zero-dimensional point-sources, is that these involve an infinite concentration and zero diffusion of light. Mathematically, this reduces Euler's number line to the fraction 1/0; physically, it is Einstein's universe reduced to a state of pure energy.

A *solution* to the problem is that for every way of positioning the plane that allows for light to be diffused over space, a further point-source is required such that this is greater than zero-dimensional and involves therefore a finite quantity of concentrated light and a non-zero quantity of diffused light:

Figure 10. A light cone/conic section involving a *non-zero* centrifugal force

Note that nothing is to be done to the light, and thus that we have the idea of a universe which is created according to the ancient Hebraic tradition by the projection, not of light, but of space (the Genesis account of creation explicitly says that light came before any materiel source of light). This is a heuristic picture, but we can if we wish extract as much detail as we desire detail by identifying these differences with atoms: as the gap narrows, the atom concentrates light, jumps to a higher energy level; and as the gap widens, the atom diffuses light, jumps to a lower energy level... But what do atoms have to do with the prime numbers? By appeal to work on the primes conducted by Gauss and Riemann after Euler: Gauss speculated privately that the gaps between primes as we count down the number line grows logarithmically ($x \log(x) \approx p_x$) and by appeal to Riemann's 1859 paper *On the Number of Primes Less Than a Given Magnitude*, this was proved independently by Hadamard and de la Vallée Poussin in 1896. The object at the heart of the *Riemann*'s paper is called a "non-trivial zero of the zeta function" (symbolized by the lower case Greek letter Rho (ρ_n) and referring to the complex value of s such that the sum $\sum_{n=1}^{\infty} \frac{1}{n^s}$ is equal to zero), and each of these zeros is associated with a different spiral-wave:

Figure 11. The waves of the non-trivial zeros

Figure 12. A superposition of the waves of the non-trivial zeros

This wave is the same as the difference between the primes and the accurate simulating function

$$\frac{\int_1^x x\, a_1(H_x)\, dn + \left(\int_1^x x\, a_2(H_x)\, dn + \int_1^x a_2\, x \log(x)\, dn\right) + \int_1^x a_1\, x \log(x)\, dn \ldots}{n\, x}$$

The *Riemann Hypothesis* says that the growth rate of this wave has a square-root amplitude, which is equivalential to saying that all the non-trivial zeros have real part equal to 1/2:

Figure 13. Visualizing the Riemann Hypothesis

I propose that these atomic spiral-waves arise from the gaps there are between the artificial (pseudo-zero) origins and the natural (true-zero) origin in a way that is comparable to way that waves on the surface of a body water arise from disturbances -holes- in that surface.

In other words, I propose that these spiral-waves arise from *atoms*, so that closing these gaps and disintegrating the atoms removes these holes and reduces the spiral to the zero-dimensional point which is/was their point of departure:

Figure 14. Closing the gap and flattening the surface by the removal of the non-trivial zeros

This proposal explains the "Montgomery-Odlyzko law", which states that distribution of the spacing between successive nontrivial zeros of the Riemann zeta function $\zeta(s) := \sum_{n=1}^{\infty} \frac{1}{n^s}$ (suitably normalized) is statistically identical with the distribution of eigenvalue spacings of the random matrices which are used to predict the energy levels of the nuclei of atoms:

Figure 15. Spacing distribution for a billion zeroes of the Riemann zeta function, and the corresponding prediction from random matrix theory

It also explains the connection there is between number theory and quantum field theory. This connection can be simply illustrated by associating the creation operators $b_n^\dagger$ and $f_n^\dagger$ to prime numbers p_n... Now we have identified the unique 'factorization' of a state into creation operators acting on the 'vacuum' with the unique factorization of an integer into prime numbers (and we have a hierarchy of states: |1> is the 'vacuum'; |2> and |3> and |5> are one-particle states; |6> is a two-particle state... and so on). By reference to the Witten index -the number of bosonic minus the number of fermionic zero-energy states- we see that the Mobius inversion function

$$\mu\ \mathrm{n} = \{1 = n \text{ has an even number of distinct factors},$$
$$-1 = n \text{ has an odd number of distinct factors}, 0 = n \text{ has a repeated factor}\}$$

is equivalent to the operator $(-1)^F$ that distinguishes bosonic from fermionic states, with $\mu(n) = 0$ when n has a repeated factor being equivalent to the Pauli exclusion principle.

If we re-express the Mertens function (which sums the 1s and -1s of the Mobius function) as $\sum_{n=1}^{p_x} \mu(n)$, we see that sums of these states give us essentially the same composite spiral-wave as before:

Figure 16. More waves of the non-trivial zeros

Figure 17. A physical visualization of the Riemann Hypothesis

Assuming that there are an equal number of non-zero-energy bosonic and fermionic states, this wave depicts the zero-energy fluctuations of these particles. Now we can go beyond the Montgomery-Odlyzko law and say that the Riemann Hypothesis is the governing principle of a physical theory according to which the superposition arising from these fluctuations possesses a square root growth rate. This is the same thing as saying that a) the non-trivial zeros of the zeta function have real part 1/2 and that b) these zeros are eigenvalues of the operations that on the one hand creates particles and on the other hand creates prime numbers. This wave protects us against the singularities of Relativity, and the infinities of Quantum Field Theory, and by flattening it, we are reducing the composite spiral to a point, but now this is, not merely a numerical but a *physical* operation: as this spiral-wave is flattened, the gaps between artificial point sources and the natural point source are being closed, and given that bosons can exist without any space between them, and fermions cannot, fermions are being annihilated by this operation.

This is what the radiation/dematerialization hypothesis says happens to the body at the moment of resurrection, and it is what light-before-dark theory says happens if and when the universe is reverse-engineered. We have then the foundation of a new mathematical-physical theory in virtue of which the image on the Shroud was formed when the holographic projection that was the human body of the man in the Shroud was withdrawn by the disintegration of the atoms, and the closure of the gaps there are between non-zero dimensional origins the true-zero-dimensional origin, in virtue of which the body of the man in the Shroud existed in space and time and had a mass:

Figure 18. Gap in virtue of which physical forms have mass (the 'Mass Gap').

Narrowing the gap would cause the man's body to take a brighter and less substantial form than a human body, as Jesus' body is recorded as having done in Matthew 17:1–8, Mark 9:2–8, and Luke 9:28–36. Mathew 17: 2:

There he was transfigured before them; his face shining as the sun, and his garments became white as the light.

Figure 19. Narrowing the mass gap

Closing the gap would cause the man to disappear and return to the zero-dimensional realm from which holographic projections arise (conversely, widening the gap brings about an unnatural increase rather than an unnatural decrease in mass, but this need not occupy us for now). The mathematics of the Riemann Hypothesis is essential to understanding this process for a variety of reasons, but most evidently because if the disintegration of the atoms in the body of the man on the Shroud went in the natural direction -the direction of the multiplication of primes to produce integers, and the direction in which prime-density is lost as we count down the number line- this would have resulted in a dramatic and rapid increase in volume during which great amounts of heat and light would be diffused. This is the space-creating/light-diffusing process familiar from Hiroshima and Nagasaki, and from Nuclear testing in the 50s and 60s. In this case, the tomb in the rock, and the whole of Jerusalem would have been destroyed. If however the disintegration went in the *opposite* direction -towards prime-density rather toward than prime-sparsity- then this is a light-concentrating/space-annihilating, process, and is to be accompanied by a *decrease* rather than an increase in volume. All things being equal, if the latter was the form of atomic disintegration undergone by the body in the Shroud, there would have been a small implosion rather than a large explosion at the moment of transformation. This second direction arises from a reversal of the effect produced by the artificial origins, and action of the mass gaps, and so if this was the form of disintegration undergone by the body in the Shroud, the image was impressed upon the fabric by reverse-engineering.

PART III: THE ARROW OF TIME

The Principle of Relativity

In 1632 Galileo observed in the *Dialogue Concerning the Two Chief World Systems* that the laws of physics are the same in a ship traveling at constant velocity on a smooth sea as they are in a ship standing still:

> Shut yourself up with some friend in the main cabin below decks on some large ship, and have with you there some flies, butterflies, and other small flying animals. Have a large bowl of water with some fish in it; hang up a bottle that empties drop by drop into a wide vessel beneath it. With the ship standing still, observe carefully how the little animals fly with equal speed to all sides of the cabin. The fish swim indifferently in all directions; the drops fall into the vessel beneath; and, in throwing something to your friend, you need throw it no more strongly in one direction than another, the distances being equal; jumping with your feet together, you pass equal spaces in every direction... Have the ship proceed with any speed you like, so long as the motion is uniform and not fluctuating this way and that. You will discover not the least change in all the effects named, nor could you tell from any of them whether the ship was moving or standing still.

This observation has formed the basis of a principle known as 'The Principle of Relativity', which states simply that the laws of physics are the same for all observers in "inertial frames of reference", i.e. observers at rest or moving uniformly in a straight line. Einstein discovered a contradiction involving this principle and the principle according to which light is propagated at the velocity *c* regardless of the motion of the emitting body. The figure below depicts a train, and a light source located in the center of a carriage, and an inconsistency between the perception of an observer inside and an observer outside the train:

Figure 20. The train experiment

From the point of view of an observer inside the train, light emitted from the center of the carriage reaches the front and the rear of the carriage simultaneously, but that from the point of view of an observer *outside the train*, the light reaches the front of the carriage first. It follows that at least one of the following principles is false:

- units of space and time are the same for all observers regardless of their states of motion
- the fundamental laws of physics are the same for all observers in inertial frames of reference
- light is propagated at the velocity c regardless of the state of motion of the emitting body

Given that 2 and 3 are *true*, it follows that 1 is false. It follows also that observers traveling at different velocities literally inhabit different spatio-temporal environments, different spaces and times. This is what leads to the famous twin-paradox, and all of the weirdness's of Special Relativity. These paradoxes are due to the contraction of space and the slowing of time slows in the direction of the speed of light, and if *per impossible* one could travel at the speed of light, space and time would effectively vanish.

In order to make sense of the concept of projection -and to avoid a circumstance in which there is an infinite concentration and a zero diffusion of light- it is necessary to work with artificial point sources. These are all tied to a solitary *natural* point source, from whose perspective light *is* infinitely concentrated. It follows that while it is possible to regard light as in motion against a background of space or vice versa in environments in which there is a balance of concentrated and diffused light (classical environments in keeping the Riemann Hypothesis), light is -absolutely speaking- at rest, and acquires the well-founded illusion of having a speed from the absolute motion of space. We must therefore revise the Theory of Relativity in terms of the principle that -absolutely speaking- it is light that is at rest, and it is space that expands equally in all directions at the minimum speed of c. The idea that light in a vacuum is propagated in straight lines at the velocity c is replaced by the idea that a vacuum expands in straight lines at the velocity c. Rather than

- light is propagated at the velocity c regardless of the state of motion of the emitting body

we have

- space expands at the velocity c regardless of the state of motion of the body in space

The curvilinear propagation of light in a gravitational field is replaced by the idea of the curvilinear propagation of space in a field of concentrated light. To apply this principle, take any situation in which we would be inclined to say that light is moving in respect of space and ask how space must be moving in respect of light to account for this impression. A symmetry arising from the balance of light and space, and prime density and sparsity, allows us to look at it in the former way (this is a well-founded illusion), but latter is what is really happening.

The Expansion of the Universe

The principles which emerged originally from the Special Theory of Relativity are these:

- the fundamental laws of physics are the same for all observers in inertial frames of reference
- light propagates at the velocity c regardless of the of the state of motion of the emitting body
- therefore units of space and time differ from observer to observer

From these principles we get the idea that units of space and time shrink in the direction of accelerated motion (equivalently, space and time shrink in the direction of the origin of a gravitational field, i.e. an artificial point source), so that as this motion approaches that of the speed of light (as the natural point source is approached), space and time tend to vanish. But since light is absolutely *at rest*, these principles are misleading, and the *correct* way to express them is this:

- the fundamental laws of physics are the same for all observers in inertial frames of reference
- *space expands* at the velocity c regardless of the state of motion of the body in space
- therefore units of space and time differ from observer to observer

But we know both from maths and from experiment that, while the expansion of mathematical and physical space may be regarded as *locally uniform*, this expansion is accelerating from a global point of view, and so we can revise 2 in this way:

- *space expands locally* at the velocity c regardless of the state of motion of the body in space, but there is a global expansion which is greater than c and which is accelerating

Richard Feynman in *The Character of Physical Law* invited us to imagine that atoms are divided into blue-coloured and white-coloured varieties, and separated into compartments. If the separation is removed, then just as blue dye turns water a luke-blue colour, the atoms form a luke-blue mixture. He observes that individual collisions provide no clue as to the irreversibility of the mixing process, but that studying a film of the mixing played in reverse reveals that

> ...every one of the collisions is absolutely reversible, and yet the whole moving picture shows something absurd, which is that in the reverse picture the molecules start in the mixed condition... and as time goes on, through all the collisions, the blue separates from the white...

He went on to say that

.

> ...it is not natural that the accidents of life should be such that the blues will separate themselves from the whites...

.

The one-way nature of this process is reflected by from the experiment in which a gas is confined to one of two compartments. If the separation between the compartments is removed, then the gas spontaneously distributes itself in a uniform manner throughout the two compartments, but it does not spontaneously revert to the separated state. More

familiar still, is the breaking of an egg. We never see a broken egg spontaneously reassemble, and there is no way to reassemble an egg after it has been broken ("All the kings horses and all the kings men couldn't put Humpty together again."). But although both these processes involve a one-way direction when viewed from a sufficiently global perspective, they can go either way when viewed from a sufficiently local perspective: the individual atoms comprising the gas molecules might just as well go from compartment B to compartment A as from compartment A to compartment B, and if we study the individual atoms comprising Humpty Dumpty we get no clue as to the fact that Humpty cannot be reassembled. Feynman's answer that it is not natural is the sort of answer that can be legitimately given only when no deeper explanation is possible, when the thing standing in need of explanation is a self-explanatory or is a brute fact has been reached, and the irreversibility of classical phenomena is very far from being a brute fact. To explain it, we consider instead of blue and white coloured atoms that eventually form a luke-blue mixture, bosons (which can all pile up in a single zero-dimensional location) and fermions (and fermions that must be separated in space): in its fundamental light state, the universe involves no space, and no fermions, and the birth of the matter involves the introduction of space and fermions that produces a mixture of light and darkness. Again, the individual interactions between these particles provide no clue as to the irreversibility of the mixing process, but recalling the correspondence we earlier set up between the creation operators $b_n^\dagger$ and $f_n^\dagger$ to prime numbers (p_n)... and that the Mobius inversion function $(\mu(n))$

$$\mu(n) = \{1 = n \text{ has an even number of distinct factors},$$
$$-1 = n \text{ has an odd number of distinct factors}, 0 = n \text{ has a repeated factor}\}$$

is equivalent to the operator $(-1)^F$ that distinguishes bosonic from fermionic states

Figure 17. A physical visualization of the Riemann Hypothesis

we can see *exactly* why this mixture of light and darkness appears balanced form a local perspective but why there is an irreversible trend toward the loss of light from a global perspective - reversing it and turning darkness back to light means that the Prime Number Theorem (no non trivial zeros with real part of 1) and the Riemann Hypothesis (no non-trivial zeros with real part other than 1/2) are false, and if they are false, then the primes die-off rather than spread out, i.e. there are a finite number of primes.

To the naked eye the the distribution of the stars in the night sky seems to be random, but looking through a telescope we realize that galaxies have a spiral shape, light-dense toward the center of the galaxy, and increasingly dark at distance further away from the center. Same thing with the primes in the number line:

Figure 21. The loss of density exhibited by the stars and by the prime numbers

It is only by considering a sufficiently large group of stars and primes, and a sufficiently large group of particles, that the loss of energy-density known as 'entropy' is found to involve a one-way direction known as the arrow time. In fact there are multiple arrows of time. Well known are the thermodynamic arrow arising from the loss of heat, the cosmological arrow arising from the expansion of the universe, the radiative arrow arising from the expansion of waves outwards from their source, the causal arrow arising form the fact that effects follows causes rather than precede them, the quantum arrow arising from the collapse of the wave-function, and the psychological arrow of consciousness arising the fact that we remember the past and the future is unknown... Less well-known is the *genetic arrow*, which arises from the loss of mutability of DNA with generation, a consideration that explains anomalous results such as the

apparent mismatch between Y-DNA extracted in 2014 from the skeleton of the English King Richard III and his contemporary paternal relatives, and points to the falsity of the Theory of Evolution (which depends on symmetrical DNA mutation rates). But the arrow that contains and explains all the others is the *arithmetic* arrow: if we play a film depicting the un-breaking of an egg or the increase of the density of the prime numbers in the number line, we see something that looks absurd, and Feynman had no better explanation for this impression of absurdity in the first case other than 'the accidents of life,' But the impression of absurdity attached to the loss of density of the prime numbers as we count down the line isn't an 'accident' at all - it is mathematically *necessary* that the repetition of a unit be accompanied by a global decrease in prime-density. The Riemann Hypothesis is an extension of the Prime Number Theorem: it says, not merely that the primes thin out, but that local changes in prime-density are equally likely to involve an increase as a decrease in density, and that they cannot exceed the upper and lower bounds marked in red and blue in the graphs below:

Figure 22. The Loss of Prime-Density

$$\text{Density} = \frac{\pi(x)}{x}$$

$$\text{Min Density} = \frac{\sum_{n=2}^{x} \frac{1}{\log(n)} - 2\,\text{Re}\left(\sum_{n=1}^{\infty} \text{Ei}(\rho_{-n} \log(x))\right)}{x}$$

$$\text{Max Density} = \frac{\sum_{n=2}^{x} \frac{1}{H_n} - 2\,\text{Re}\left(\sum_{n=1}^{\infty} \text{Ei}(\rho_{-n} \log(x))\right)}{x}$$

We can now extend the earlier principles:

- the fundamental laws of *arithmetic* are the same for all observers in inertial (arithmetically continuous) frames of reference
- there is a local balance of prime-density and prime sparsity which accounts for the apparent constancy of the speed of light, and allows for either light or space to be assumed to be a rest, there is a global loss of prime-density which accounts for the red-shifted nature of the light from distant stars
- therefore units of space and time and units number differ from observer to observer

We know from Euler's thought-experiment that if prime-density were to increase sufficiently, there would be no units of number whatever, and what we would can say is that every observer has there own individual number line, each of which differs from that of every other observer. We can get at these different but interconnected number lines from Dirichlet's observation that, so long as q and n have no common factor greater than 1, the progression $q\,n + a$ involves infinite primes and that it is associated with an L-function (defined by the series $\sum_{n=1}^{\infty} a_n\, n^{-s}$). All of these L-functions involve a local balance of prime-density and prime-sparsity (as dictated by the Generalized Riemann Hypothesis), and therefore fit the experimental data. But all involve different notions of unity and zero -different sets of primes and zeros because of different sets of artificial point sources- and a global and irreversible loss of prime-density. Correspondingly, *energy-density* is also dropping off in an irreversible manner, meaning that as the number line is turning irreversibly from number into space, the universe is turning irreversibly from light into darkness. "E = MC^2" now becomes "Energy = Mass times the expansion of space squared", "M = E/C^2" becomes "Matter = Energy divided by the expansion of space squared." But the two equations -one which describes the conversion of mass into energy and the other which describes the conversion of energy into mass- *cannot* as has been imagined be equivalent, because the expansion of space is, not constant, but is *growing* as a function of time (if C = 3 × 10^8 m/sec at time t_1 and 3 × 10^9 m/sec at t_2, then by multiplying M by 3 × 10^8 m/sec at t_2 you obviously do not recapture E, and if the expansion of the universe is allowed to go on until a sufficiently late time t_n , you will recapture only a *small proportion* of E).

By way of illustration, we can imagine Alice of *Alice's Adventures In Wonderland* attempting to counter-act of expansive effects of a cake marked "Eat Me" by drinking potion from a bottle marked "Drink Me' which results in contraction. Suppose that the cake caused her size to *increase* by halves so that first she was twice her original size, then a four times, then sixteen times, and so on...

Figure 23. Alice expanded

It might seem that she can counter-act the expanding effect simply by taking a potion that iteratively halves her size until it returns to 1, but no. Alice *can* in some sense regain her original size in this way, but we know from the globally accelerated nature of the expansion of space that, regardless of any relative expansion or contraction, she and everything around her has undergone an absolute and dramatic *to-scale* expansion, and that this expansion is irreversible. From a global point of view, prime-density *never* increases with the repetition of an arithmetic unit, and equivalently, energy-density *never* increases with the repetition of a unit of space-time. And with this expansion and the accompany-

ing loss of energy-density comes death. If Jackson's hypothesis about the formation of the image on the Shroud is broadly the right one, then it was against this must fundamental of forces -the force that drives the universe from light into darkness, and everyman from life to death- that the man in the Shroud successfully pitted himself.

P versus NP and the Computational Arrow of Time

There is a deep problem on the borderland of computer science, logic, maths and physics known as 'P versus NP', which concerns the question of whether the class of decision problems whose solutions are quickly verifiable (NP) by a computer is the same as the class of problems that are *quickly solvable* by computer (P). Historically the problem arose because certain problems seem to be hard to solve. More particularly, they seem to require a lot of *time* -an exponentially growing amount of time- to solve. An example of a NP problem that seeming takes exponential time is Factoring. While it doesn't take long to factor 15 or 21, imagine trying to factor the 200 digit integer

27 997 833 911 221 327 870 829 467 638 722 601 621 070 446 786 955 428 537 560 009 929 326 128 400 107 609 345 671 052 - 955 360 856 061 822 351 910 951 365 788 637 105 954 482 006 576 775 098 580 557 613 579 098 734 950 144 178 863 178 - 946 295 187 237 869 221 823 983

You can easily check that it divides evenly into the primes

3 532 461 934 402 770 121 272 604 978 198 464 368 671 197 400 197 625 023 649 303 468 776 121 253 679 423 200 058 547 - 956 528 088 349

and

7 925 869 954 478 333 033 347 085 841 480 059 687 737 975 857 364 219 960 734 330 341 455 767 872 818 152 135 381 409 - 304 740 185 467

Although it takes a pocket calculator a spit second to do the multiplication, it would take a single 2.2 GHz computer roughly *75 years* to do the division. Factoring is one is one of numerous (NP) problems that are easy in the one direction, and seem to be hard in the other. Here we have a further -computational- arrow of time. We can argue for the conclusion that this arrow really is asymmetric by considering the Travelling Salesman Problem, which is he problem of whether a salesman can visit a number of cities exactly once and return to a home-city for a certain cost.

Figure 24. The Travelling Salesman Problem

First we transform it into a problem of whether a computer (salesman) can execute some number of instructions (visit some number of cities) which executes every instruction exactly once (visits every city exactly once) before returning to a halt state (home-city) for some maximum cost:

Figure 25. The Travelling Salesman Problem in graphical form

An arbitrary computer is therefore working on the problem of whether an arbitrary computer will halt when run with an arbitrary set of instructions, and thus the point will be reached when the evaluation is a *self-evaluation*, i.e. the point will be reached such that the computer is attempting to determine of itself if it will halt. If we associate to every city an instruction, this self-evaluative point will be reached when the number cities on the tour is not less than the number of instructions in the program. This leads to a contradiction in the case that the number cities is *greater* than the number of instructions, and by appeal to this contradiction, it follows that TSP involves a limit on the number of cities. This proves that TSP differs from polynomial-time problems, which aren't sensitive to the size of the input, and that P and NP are not equal. More particularly... associate each atomic instruction in some finite set of instructions with some n-SAT formula (such as $(\neg A \vee \neg B \vee C) \wedge (\neg A \vee \neg B \vee D)$), associate each of these formulas to the vertices of a complete graph other than the start/stop vertex. Associate the halt state with this start/stop vertex. Let v be the number of variables per clause, and if the instruction doesn't result in the machine going into an infinite loop, weight the vertex as $\frac{1}{v} + \frac{v-1}{v}$. If the instruction *does* result in the machine going into an infinite loop, weight the offending vertex as $0 + 1$. Weight the halt vertex as 1. $\frac{n-1}{v}$ gives the minimum truth-density, $\frac{(n-1)(v-1)}{v}$ gives the maximum falsity-density of a satisfiable n-SAT instance, $\frac{n-1}{v} + \frac{(n-1)(v-1)}{v} + 1 = n$ gives the maximum imbalance between the truth and falsity-density corresponding to a Travelling Salesman's circuit that is within budget.

Let n be the number of instructions/vertices, and we can conclude that

- If and only if it is possible to visit every vertex exactly once before returning to a halt vertex for a cost n without upsetting the balance of minimum truth-density/maximum falsity density $\frac{n-1}{v} + \frac{(n-1)(v-1)}{v} + 1 = n$, there is some Turing machine that will not infinite loop when run with some input.

From here we get the equation $\frac{p_n-1}{v} + \frac{(v-1)(p_n-1)}{v} + 1 = p_n$ and the idea that we can create any TSP circuit out of prime-circuits. Recalling the association of the creation operators $b_n^\dagger$ and $f_n^\dagger$ to prime numbers (p_n)... we can immediately associate these same operators to TSP circuits by reference to this equation:

$$\frac{p_n - 1}{v} + \frac{(v-1)(p_n-1)}{v} + 1 = p_n$$

From the observations above, every TSP circuit, and every bosonic and fermionic state, can be assigned a place in a hierarchy of circuits/states based on the complexity of that circuit/state, and depending on where in that hierarchy that circuit/state appears, it can be determined whether or not some creation operator can complete some operation or whether or not some computer can complete some circuit under budget by appeal to the Mobius inversion function $\mu(n)$

$$\mu(n) = \{1 = n \text{ has an even number of distinct factors},$$
$$-1 = n \text{ has an odd number of distinct factors}, 0 = n \text{ has a repeated factor}\}$$

By this line of argument, TSP problems can be identified with Factoring problems, and since the former are hard, so are the latter, as it is with the former, so it is with the latter. We can go one step further and identify the problem of computing the permanent of a square matrix (to compute the amplitude of n identical bosons to go from are an input to an output state is to compute the permanent of a square matrix)

$$A \text{ Per} = \sum_{\sigma \in P_n} \prod_{i=1}^{n} a_{i,\sigma(i)}$$

with Factoring. All of the differences between bosons and fermions arise from the difference between the computation of the permanent and the determinant

$$A \text{ Det} = \sum_{\sigma \in P_n} (-1)^{\text{sgn}(\sigma)} \prod_{i=1}^{n} a_{i,\sigma(i)}$$

where the former is hard and the latter easy. A fast algorithm for Factoring, as a fast algorithm for the computation of the permanent, would collapse this hierarchy, and in 1994, Peter Shor introduced an algorithm which shows that *quantum* computers can factor integers in polynomial time, meaning that quantum computers can solve NP-Complete problems and compute the permanent of a square matrix, in polynomial time. Alan Turing conceived of an “oracle”, a computer able solve decision problems in a single operation. If it is possible for a program to run an input without any paying any computational time, the mathematical constraint on the computer which underpins the inequality of P and NP can be removed, and the program of such an all-powerful oracle is free to run inputs of any imaginable complexity. In a world without such a limit, P = NP, but the complexity of the inputs that can be run by real-world programs *is* limited because a program cannot in a finite period of time run an input whose complexity is equal to or greater than its own. In regard to these real-world limits, computer scientist Scott Aaronson has observed that the inequality of P and NP protects certain physical laws. Suppose, he says, you set your computer working on an exponentially hard NP problem while you board a rocket ship that accelerates up to the speed of light and returns to earth only after the calculation has been completed. In space-time this might be an hour or so, but in earth time it might be millions of years. Trouble is that, while the time to make the computation has artificially become polynomial, the energy requirements of the rocket ship are exponential. Or suppose that you have a computer whose first operation is performed in 1 second, the next operation in 1/2 a second, the next in 1/4 of a second... and so on. Theoretically this computer has within 2 minutes performed an infinity of operations. Trouble is that the energy requirements of the cooling required to run a computer chip at this speed are exponentially great. Conversely, the equality and P and NP *unprotects* these laws... We can be more precise by arguing that the equality of P and NP implies that seemingly asymmetric direction of the loss of prime and energy-density governed by the Riemann Hypothesis is actually symmetric. In that case, a quantum computer has the ability to reverse the naturally irreversible, to reverse the direction of the arrow of time.... Isn’t this mathematically, and hence physically impossible, and so don’t we have a proof, not of the possibility of reversing the arrow of time, but of the impossibility of quantum computers? Not quite: the Riemann Hypothesis doesn’t say that prime-density and sparsity must involve the balance associated with the non-trivial zeros of real part 1/2, it says that in so far as a progression is *arithmetically continuous* it must involve this balance, i.e. it says that this balance is a necessary condition of arithmetic continuity). The impossibility proof there is here concerns “scalable” quantum computers, i.e. for quantum computers inhabiting the arithmetically continuous classical domain.

Reversing the Arrow of Time

Classically speaking, the solving NP-complete problems in polynomial time, and the reversal constituted by the resurrection, is *impossible* - skeptics are in a sense quite right to doubt that the dead ever come back to life on theoreti-

cal as well as empirical grounds. But it must always be remembered that the creation of the universe itself is an event that is classically impossible, a consideration that proves that non-classical events are in some sense necessary for the existence of classical events. We can therefore look upon the resurrection as a *new creation*. Otherwise put, we cannot place limits on what can come out of the natural point source that lies at root of the universe (where light is infinitely concentrated). The most that we can do -and I have attempted to show how this is to be done here- is to place limits on the *classical things* that can come out of this point source, but all the while knowing from the undeniable existence of this point source, and the undeniable fact of creation, that the non-classical is real, and that it is a precondition of the classical. Are these really undeniable? Do we really need any un-caused creative origin of our universe? Any denial will almost certainly proceed along the lines of Bertrand Russell's denial in his 1948 debate with F. C. Copleston on BBC radio. During the course of this debate, Russell maintained over-and-against Copleston that "If anything can exist without a cause it may as well be the world as God". If the world is a plurality (which it is), and God a singularity (which he is), then to say 'If anything can exist without a cause it may as well be a plurality as a singularity'. But Russell -who knew little to nothing of quantum mechanics, the distinction between bosons and fermions, and the Pauli Exclusion principle, and nothing at all of the connection of physics to number theory - made a logical blunder, the logical blunder made every day by atheists: if God be pure light, then the claim that "If anything can exist without a cause it may as well be the world as God." is equivalent to the claim that "If the number 1 can exist without the composites, then composites can exist without the number 1." The number 1 *can* exist without the composites in the form of the singularity of concentrated light at root of Einstein's universe, and at root of Euler's extraction of all groups of primes and their powers from the harmonic series, but the converse is trivially false: otherwise put, matter is dependent on energy, but energy -whilst its presence is felt throughout the world- is independent of matter. Similarly, the world is dependent on God, but God -whilst his presence is felt throughout the world- is independent of that world (whilst the non-classical is present throughout the world, it is *prior* to the classical).

Normally, the human body exists in a state of relatively low and ever-diminishing energy-density. If the one-way direction of time were somehow *turned back*, and a body were to take on a sufficiently high state of energy-density, it would vanish. As early as 1989, physicist Thomas J. Phillips proposed that some of the features of the image on the Shroud, and the youthful radiocarbon date of 1988, could be explained by a thing called “thermal neutron flux”. According to this model, the sudden disintegration of the nuclei of the atoms in virtue of which the body of the man in the shroud possessed mass -which is akin to what would happen if the gaps between an artificial point sources and a natural point source governing teh projection of the body in the Shroud were to close- would result a low-energy radiation signal such as could have both created the image on the Shroud and skewed the radiocarbon date. This proposal was met with the response that this possibility had been considered by the laboratories participating in the carbon-dating of the Shroud, but dismissed because “No plausible physical mechanism has been proposed to explain how resurrection was accompanied by a significant neutron flux.”

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Shroud irradiated with neutrons?

Sir — If the shroud of Turin is in fact the burial cloth of Christ, contrary to its recent carbon-dated age of about 670 years (*Nature* **335**, 663; 1988 and **337**, 611; 1989), then according to the Bible it was present at a unique physical event: the resurrection of a dead body. Unfortunately, this event is not accessible to direct scientific scrutiny, but the image on the shroud, which still cannot be duplicated, appears to be a scorch, indicating that the body radiated light and/or heat. It may also have radiated neutrons, which would have irradiated the shroud and changed some of the nuclei to different isotopes by neutron capture. In particular, some ^{14}C could have been generated from ^{13}C. If we assume that the shroud is 1,950 years old and that the neutrons were emitted thermally, then an integrated flux of 2×10^{16} neutrons cm^{-2} would have converted enough ^{13}C to ^{14}C to give an apparent carbon-dated age of 670 years.

This flux of neutrons should have other measurable consequences. The neutron irradiation would probably not have been uniform, for example, so the $^{14}C/^{13}C$ ratio should vary in different parts of the shroud. In addition, other unstable isotopes should have been formed. Several of these isotopes have half-lives long enough that they would still be present, yet short enough that they are not found naturally.

The unstable isotopes most likely to be found in the shroud are ^{36}Cl and ^{41}Ca. The presence of either would confirm that the shroud had been irridated with neutrons. An accurate measurement of the ratio of either ^{36}Cl to ^{35}Cl or ^{41}Ca to ^{40}Ca (see table) would test the prediction of an integrated neutron flux of 2×10^{16} neutrons cm^{-2}. This may not be possible, however, because contamination with new sources of chlorine or calcium may have occurred from washings or other sources since the irridation took place.

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HEDGES REPLIES—The processes suggested by Phillips were considered by the participating laboratories. However, for the reasons given below, the likelihood that they influenced the date in the way proposed is in my view so exceedingly remote that it beggars scientific credulity.

(1) No plausible physical mechanism has been proposed to explain how the resurrection was accompanied by a significant neutron flux. If a supernatural explanation is to be proposed, it seems pointless to make any scientific measurement on the shroud at all.

(2) Assuming a ‘scientific’ (but not yet articulated) explanation for the neutron flux, it is an amazing coincidence that the neutron dose should be so exactly appropriate to give the most likely date on historical grounds. (Arguably a total of 10^{28} neutrons (the number in a human body) would be available. Using Phillips' figures, this would be sufficient to impart a date of 100,000 years into the future. To produce a date within 100 years of the first recorded history of the shroud implies that the dose has been ‘fine-tuned’ to better than one part in a hundred million.)

(3) In fact, the dose proposed by Phillips is much too high, as he has not included the neutron capture by nitrogen in the cloth. A not untypical N content in linen is 1,000 p.p.m., for which a thermal neutron flux of 2×10^{15} cm^{-2} (that is, 1,000 times less) would be appropriate. This does not

Figure 26. 1989 Correspondence in *Nature* between T.J. Phillips and a critic of his neutron flux theory

Studies performed by Jean-Baptiste Rinaudo (1998) showed that a proton irradiated linen cloth is very similar in appearance to the body-image area on the Shroud

Figure 27. Comparison of a section of the Shroud (insert) and a proton irradiated linen cloth by Rinaudo

but, again, the problem is, as Philip's critic argued, the apparent absence of any physical mechanism. Or as STURP member Alan Adler, has said of Jackson's theory, it is not generally accepted as scientific because it runs counter to the laws of physics. But Adler is talking about the laws of physics accepted by him and his contemporaries, and these 'laws' arise in a context of a theory that is at best a low-energy approximation of the true theory. Jackson has pre-empted and diffused this objection by his thesis that the explanation of the image on the Shroud requires extension and revision of the accepted physical laws. This takes me to the conclusion to which I have been working throughout this note: the mathematical-physical framework outlined above, together with the oracular ability of a quantum computer running Shor's algorithm, shows that a natural quantum computer is physical mechanism in full accordance with the laws of physics able to bring brought about the resurrection in a manner that accounts for image features of the Shroud.

Jackson and others have proposed that the body image on the Shroud was produced by the effect radiation on a cloth collapsing through a disappearing body, but there is something *insufficient* about cloth-collapse theories, and critics of the authenticity of the Shroud (such as David Kyle Johnson Ph. D who writes a *Psychology Today* blog ironically called *A Logical Take*) have mixed in with the usual pseudo-historical and pseudo-scientific objections some legitimate observations pertaining to this insufficiency:

Just looking at the Shroud also establishes that it is not legitimate. First, the image in the shroud looks nothing like what Jesus would have actually looked like; first century Palestinians were not that tall (false, the vagaries of the cloth make it impossible to determine the exact height of man in the Shroud, but based on excavations in Galilee, this was not unnaturally far beyond the average for that time and place of 5'9), did not have that kind of hair or beard, or even that kind of nose. Instead, the image is more typical of how Jesus came to be depicted in art in the 14th century (false, the image is typical of how Jesus was depicted since the 6th or 7th century AD because these images were *based* on the image on the Shroud).

And speaking of the hair, the long hair seen in the shroud defies gravity. It is parallel with the man's body, as if he is standing, instead of falling to the back of the head as it would if was the body were lying flat (true)...

Shroud enthusiasts—"shroudies," as they like to be called—insist that the image on the shroud was produced by some kind of energy (like radiation) emitted by Jesus's body as he rose. But the image on the shroud could not be produced by such an event. (A) Radiation can't leave an image in cloth (false). (B) Even if it could, since radiation emits in all directions, at best it would just leave a blurry silhouette, not a clear cut face with features (false, high frequency radiation is capable of producing a clear image). (C) Even if it could produce a clear cut face with features, that face would be distorted. A cloth wrapped around someone's head lays flat against their nose, eye sockets and ears. If someone's face somehow 'radiated' and recorded an image on such a cloth, when flattened out the cloth would depict whole representations of each part—nose, eye socket, and ears—all pointing in the same direction (true, assuming the presence of gravity)...

Cloth-collapse models simply can't account for phenomena -such as the lack of any side image, and the undistorted nature of the frontal and dorsal images- suggestive of an absence of gravity, but the late artist Isobel Piczeg provided the hint of a theory that can. She noted:

- The lack of anatomical distortion of the naked Body projected on the Shroud.
- It is clearly visible on the Shroud Images, especially on the Dorsal Image, that the muscles of the Body are not crushed and flattened against the stone bench of the tomb.
- The Body is hovering between the upper and the lower sheet and there is NO TRACE OF GRAVITY.
- The lack of gravity is also further proven by the Shroud linen. The linen does not fall on top of the Body, but remains in its unnaturally stretched condition at some distance from the body.

Figure 28. The body in the Shroud at the moment of resurrection

And while her theory doesn't make sense in terms of the space-centric Theory of Relativity that has come down to us from Einstein, it *does* make sense in terms of the energy-centric theory outlined above according to which the initial condition of the universe is pure energy, that light therefore has zero speed, and so that the expansion of the universe against this background of light is the basis of the apparent speed of light, and of the tension between the dark energy that increasingly pulls the universe apart and the 'light energy' that holds it together: gravity is on this account, not a true force, but an epiphenomenon of the action of the force causing the acceleration of the expansion of the universe, and so the suspension of this expansion required to raise the body in the Shroud from the dead would indeed be accompanied by the seeming suspension of gravity (conversely, if the balance of light and dark-energy is tipped in the forward rather than the reverse direction, then the pseudo-force of gravity takes on the crushing proportions of the black hole which as the name itself suggest lies in the opposite direction of the singularity of light). That this suspension is possible for a quantum computer is *not* to say that any man-made mechanism or any mechanism of terrestrial origin can do such things, for *all* such mechanisms inhabit the classical domain, and are thus limited by the problem known as 'quantum decoherence', i.e. the collapse of a quantum superposition (the wave-function) by the interaction of the quantum computer/system with its environment. The central experiment quantum mechanics - the experiment from which all quantum weirdness arises- involves the shooting of particles through 2 narrow slits and measuring their arrival on a screen behind the slits. If detectors are attached to the slits, a pair of Gaussians appears on the screen, one between each slits, but otherwise an interference pattern such as would be produced by a wave appears. This leads to the thought that a superposition of waves known as a 'wave-function' describes the particle as it is independently of measurement, a superposition that implies that the particle traveled through both slits at once and interfered with itself. This leads to the paradox of Schrodinger's Cat, a thought-experiment concerning a cat is imprisoned in chamber into which a poisonous gas will be released dependent on the behavior of a qauntum system: the 2-slit experiment has seemed to some to imply that the cat is in a joint state of alive + dead until the system is measured.

Figure 29. Schrodinger's Cat

The flaw in all of the conventional interpretations of the 2-slit experiment -most especially the 'many worlds' interpretation which would have us believe that the universe breaks into independent branches whenever a quantum system is measured- is the failure to appreciate that classical systems are themselves superpositions - they are the long-ranged

symmetric superposition that arise from the waves associated to the non-trivial zeros of L-functions that we have considered above. Schrodinger's cat is such a classical system, and is thus at all times either alive or dead, and not both, regardless of what the quantum system in the thought-experiment does. But this is not true of a quantum systems, which are the short-ranged asymmetric superposition associated to the *sources* of these long-ranged superpositions. According to these conventional interpretations of quantum mechanics, the act of measurement -such as the act a of measuring device attached to the slits- collapses the superposition, but this is the wrong way to look at it. Another way to characterize the essence of this kind of interpretation is to say that, according to such interpretations, the presence of the 2-path information of arithmetic consciousness collapses the superposition, and this is the reverse of the truth. Rather, it is the collapse of the qauntum superposition that produces the 2-path information of arithmetic consciousness. This follows from the nature of the connection between number theory and qauntum field theory and complexity theory outlined above: given the association of the creation operators $b_n^\dagger$ and $f_n^\dagger$ to prime numbers (p_n)... we can associate these same operators to Travelling Salesman circuits by reference to the equation:

$$\frac{p_n - 1}{v} + \frac{(v-1)(p_n - 1)}{v} + 1 = p_n$$

Every TSP circuit can we know be assigned a place in a hierarchy of circuits such that there is a point at which the complexity of a computational problem is as great as the complexity of the means of solution, a point that marks a collapse, the end of one program and the beginning of another. Assuming that there are an equal number of non-zero-energy bosonic and fermionic states, the imbalance in the sum

$$\sum_{n=1}^{p_x} \mu(n) + 2$$

concerns the *zero states*, which are the mass gaps in virtue of which light is diffused. These correspond to the differences between TSP inputs and programs, and the point at which these are in balance, which is the point at which there is a balance of concentration and diffusion represented by the intersections of the x-axis by the wave below is a limit that marks a collapse, the end of one mass gap and the beginning of another:

Figure 17. A physical visualization of the Riemann Hypothesis

These limits coincide with the prime numbers which form the basis of all arithmetic progressions, and with the atomic quantum superpositions that form the basis of all classical superpositions. The meaning of the 2-slit experiment is this: the light/dark symmetric classical universe is a projection arising from light-dominant asymmetric non-classical projective sources. There is then no sense in trying build scalable quantum computers, i.e. qauntum computers that inhabit the classical domain. A billion dollar industry has grown up built around the quest to *build* these machines (and toy quantum computers that can factor very small numbers no faster than a pocket calculator have *already* been built, but toy quantum computers are the only quantum computers will ever be built), but the quest is based on a misconception of the relationship between the classical and the quantum domains. This misconception is that quantum systems are the building blocks of classical systems in the same sense in which bricks are the building blocks of brick walls, which implies that a classical system (a brick wall) is merely a scaled up version of quantum systems (bricks). This is a more or less unanimously accepted picture of the universe, but a false one - if you follow a classical system back in time as far as possible, you will not come to a pile of very little quantum brick, but to a maximally energy-dense

classical system that appeared at the moment of creation in an instant. The *true* picture can be formed by using the projection/projector metaphor. In the light of this metaphor, physics since the time of ancient Greek atomists has been based on an category mistake that equivocates between the projection (classical) and the projector (non-classical): projected (classical) domains possess a particular balance of concentrated light and diffused light governed by the Riemann Hypothesis, whereas the domains of the projectors (non-classical) possesses an imbalance in favour of concentrated light. More particularly, the projectors (the artificial point sources of which we spoke earlier) produce Riemann Hypothesis-friendly balances of light and space in the form of projections - more precisely, they produce spiral-waves associated to the non-trivial zeros of L-functions- but are themselves light-dominant. When the proto-arithmetic system which is the projector approaches the balance at which it can itself function as an arithmetic system which is the projection -the balance at which at which the gap between the projector and the projection becomes very small- it loses the properties that made it computationally powerful in its quantum state (the wave-function of that system must collapse). Like all the arrows of time, the quantum arrow is a form of the arithmetic arrow, the action of a natural quantum computer is able to *reverse* the destructive direction of this arrow, but this not the action of a classical device or object, but of something that *transcends* the classical domain.

The bible is full of accounts of events that involve such reversals: the parting of the red sea to allow the children of Israel to escape from Egypt, the collapse of the walls of Jericho, the ascent into heaven by the prophet Elijah, and so on and so on. But -along with the creation itself- the greatest of these stories by far is that of the resurrection of Jesus -Yeshua ben Yosef- who identified himself as the Jewish Messiah and the son of God, and from all accounts rose from the dead by his own power. According to the bible, Yeshua was, like you and I, in the sense that he was a part of the classical universe, and he bled, suffered terribly, and died. But it says also that he rose form the dead within three to four days, and so that these experiences were for him unnecessary: that he had it within his power to overcome death itself, shows that he had it within his power *not* to bled, suffer, and die. His story is that of someone who had it within his power to reverse the to defeat the dark energy, and to reverse the arrow of time and the reason that all of kings horses and all the kings men could not put Humpty Dumpty together again, and that Alice could not by use of a shrinking potion restore herself to her original size. Less poetically, he had it within his power to cross to the high-energy side of the divide signified by the balance of prime and energy-density given by the Riemann Hypothesis as a condition of arithmetic consciousness. This is the ability possessed someone whose origin is in the realm beyond the smallest mass gap -a realm *outside* of our classical universe- and it is an ability that accounts for his virgin birth, his miraculous powers (powers unparalleled by any other biblical figure or by any figure in human history), the transfiguration, the resurrection, and for the ascension. It is also accounts for the mysterious image upon the cloth we call the Shroud of Turin (and for the incorrect carbon-dating of the cloth).

APPENDIX A: A SUMMARY OF STURPS CONCLUSIONS

No pigments, paints, dyes or stains have been found on the fibrils. X-ray, fluorescence and microchemistry on the fibrils preclude the possibility of paint being used as a method for creating the image. Ultra Violet and infrared evaluation confirm these studies. Computer image enhancement and analysis by a device known as a VP-8 image analyzer show that the image has unique, three-dimensional information encoded in it. Microchemical evaluation has indicated no evidence of any spices, oils, or any biochemicals known to be produced by the body in life or in death. It is clear that there has been a direct contact of the Shroud with a body, which explains certain features such as scourge marks, as well as the blood. However, while this type of contact might explain some of the features of the torso, it is totally incapable of explaining the image of the face with the high resolution that has been amply demonstrated by photography.

The basic problem from a scientific point of view is that some explanations which might be tenable from a chemical point of view, are precluded by physics. Contrariwise, certain physical explanations which may be attractive are completely precluded by the chemistry. For an adequate explanation for the image of the Shroud, one must have an explanation which is scientifically sound, from a physical, chemical, biological and medical viewpoint. At the present, this type of solution does not appear to be obtainable by the best efforts of the members of the Shroud Team. Furthermore, experiments in physics and chemistry with old linen have failed to reproduce adequately the phenomenon presented by the Shroud of Turin. The scientific concensus is that the image was produced by something which resulted in oxidation, dehydration and conjugation of the polysaccharide structure of the microfibrils of the linen itself. Such changes can be duplicated in the laboratory by certain chemical and physical processes. A similar type of change in linen can be obtained by sulfuric acid or heat. However, there are no chemical or physical methods known which can account for the totality of the image, nor can any combination of physical, chemical, biological or medical circumstances explain the image adequately.

Thus, the answer to the question of how the image was produced or what produced the image remains, now, as it has in the past, a mystery.

We can conclude for now that the Shroud image is that of a real human form of a scourged, crucified man. It is not the product of an artist. The blood stains are composed of hemoglobin and also give a positive test for serum albumin. The image is an ongoing mystery and until further chemical studies are made, perhaps by this group of scientists, or perhaps by some scientists in the future, the problem remains unsolved.

APPENDIX B: ON THE ALLEGED CONFLICT BETWEEN THE SHROUD AND THE GOSPELS

The Synoptic Gospels (Mathew, Mark, Luke) all confirm that Jesus was wrapped in a linen cloth, a 'sindon':

Mathew 27: 59 Joseph took the body, wrapped it in a clean linen cloth.

Mark 15:46 So Joseph bought some linen cloth, took down the body, wrapped it in the linen, and placed it in a tomb cut out of rock. Then he rolled a stone against the entrance of the tomb.

Luke 23:53 Then he took it down, wrapped it in linen cloth and placed it in a tomb cut in the rock, one in which no one had yet been laid.

The meaning of ‘sindon’ is

linen cloth, esp. that which was fine and costly, in which the bodies of the dead were wrapped

The word is used in the singular: Mark describes the piece of material in which Jesus’ body was wrapped as a ‘sindon’ (Mark 15:46) and he describes the garment worn by the young man who fled naked on the night of Jesus’s arrest as a ‘sindon’ (Mark 15:51). The Shroud *of Turin* is a sindon, a fine linen cloth, whose 3 over 1 herringbone weave is particularly elegant and rare. The gospel of John however seems to contradict the synoptic gospels, saying

John 19:40 Taking Jesus’ body, the two of them wrapped it, with the spices, in strips of linen. This was in accordance with Jewish burial customs.

And later

John 20: 5-7 He bent over and looked in at the strips of linen lying there but did not go in. Then Simon Peter came along behind him and went straight into the tomb. He saw the strips of linen lying there, as well as the cloth that had been wrapped around Jesus’ head. The cloth was still lying in its place, separate from the linen.

But the word from which the English expression ‘strips of linen’ supposedly translates is ‘othonia’, when the latter actually refers to cloth of all sizes and shapes. The Greek writer Dioskorides not only used ‘orthonia’ to mean a sheet but coupled it with the verb ‘enelein’, which is the verb Mark used to describe the wrapping of Jesus’ body in linen (‘eneilisenti sindoni’). Evidence that John did not intend the meaning ‘strips of linen’ comes from a passage in Luke (Luke 24:12) where Luke describes what he has previously described in Luke 23:53 as a ‘sindon’ (a single cloth) as ‘orthonia’:

Luke 23: 53 Then he took it down, wrapped it in linen cloth and placed it in a tomb cut in the rock, one in which no one had yet been laid.

Luke 24:12 Peter, however, got up and ran to the tomb. Bending over, he saw the strips of linen lying by themselves, and he went away, wondering to himself what had happened.

John also says that Jesus was buried according to Jewish burial customs, and unlike the Egyptians, the Jews did not mummify their dead. Lazarus was bound hand and foot, but the word used by John to describe this is, not ‘othonia’, but ‘keiriai’. It is clear that John has been mistranslated, and that what he and Simon Peter saw lying in the tomb were,

not ‘strips of linen’, but the single fine linen cloth or ‘sindon’ that according to the synoptic gospels was used by Joseph of Arimathea to wrap the body of Jesus after the crucifixion. Separate from this was the cloth that had been wrapped around Jesus’ head. It is arguable that both of these cloths have survived to this day, the first as the Shroud of Turin, and the second as the Sudarium of Oviedo.

APPENDIX C: SHROUD-DENIAL

The Mystery of the Shroud

The central mystery of the Shroud of Turin is, and always has been, how the image was imposed upon the cloth. Numerous attempts have been made to duplicate it, and all have failed, and we see now why there will never be any successful duplication. It may very well be true, as historian Antonio Lombatti maintains, that the Shroud was one of 40 supposed burial cloths of Jesus in circulation during the middle ages, but so what? That there are 40 forgeries of Vermeer’s *Girl With a Pearl Earring* in circulation does nothing to cast doubt on the existence of an original painting... Moreover, if all our considerable efforts and ingenuity -the Shroud is by far the most analyzed artifact in history- have proven insufficient to unambiguously expose a fake made using primitive technology, then either our analytical methods are unreliable or the Shroud is genuine. And not only have we been unable to unambiguously expose the Shroud as a fake, the consensus amongst those scholars who conducted the longest and deepest investigations into this matter is that it is *genuine*. In the words of the Shroud of Turin Research Project (STURP):

> We can conclude for now that the Shroud image is that of a *real* human form of a scourged, crucified man. It is *not* the product of an artist (my emphasis).

The authenticity of the Shroud, it can be argued, is a condition of the reliability of our present scientific methods for understanding the universe.

The Psychology of Shroud-Denial versus Shroud-Affirmation

There is -it can not be reasonably denied- a considerable weight of evidence in favor of the authenticity of the Shroud: scientific theories have gained world-wide acceptance on a basis of less evidence; people -not least of all Jesus himself- have been sentenced to death on the basis of less evidence (believers in the authenticity of the Shroud are often called ‘the faithful’ as if they believe in spite of the great amount of evidence revealing it to be a fake, but it might be objected that in the light of the overwhelming amount of evidence for the authenticity of the Shroud it is the disbelievers in the authenticity of the Shroud that are ‘the faithful’). The barrier to belief is, not the weight of eveidence to the contrary -there is really one a single contrary and easily disposable contra-indication- but the implications of the Shroud for the nature of the universe and man’s role in it. These are so unwanted at the psychological level that many apply to it higher standards of proof than would normally be applied, and seize upon every possible sign that it is a fake. But surely, it might we objected, the pro-Shroud brigade are no less liable to bias than are the con-Shroud brigade; surely they apply *lower* standards of proof than would normally be applied, and seize upon every possible sign that it as *genuine* (Many Shroud skeptics argue for example that the STURP team were biased, but in fact many were initially agnostic or skeptical). There is an important difference. Non-Christian Shroud-deniers are more likely to be negatively biased because the authenticity of the Shroud coheres with and therefore is evidence in favor of the central element of Christianity (Jesus' death and resurrection), whereas for a Christian its in-authenticity is irrelevant. Elaborating, if one disbelieves the central tenet of Christianity, then one expects that there is nothing extraordinary about Jesus' burial Shroud, and if a claimed burial Shroud exists that *does* posses extraordinary properties, then one expects that it is inauthentic. If by contrast one *believes* the central tenet of Christianity, then one need have no expectations regarding the nature of Jesus' burial Shroud whatever. Certainly, a Christians's belief structure is not in the least impacted by the existence of a fake Shroud. Perhaps the paradigmatically dispassionate attitude to the Shroud belongs to Barrie Schwortz. An orthodox Jew, and a reluctant and skeptical member of the original STURP team, Schwortz's later role as perhaps world's foremost proponent of the Shroud's authenticity appears to be based solely on the strength of the historical and scientific evidence.

A number of philosophers, including Wittgenstein, Kuhn, and Quine, have written of a mechanism that helps explain the bias of the Shroud-deniers. These philosophers point out that our belief systems may understood as possessing a loosely hierarchical structure, a structure such that beliefs are arranged according to their logical priority, according to their depth. And they point out that deep-rooted beliefs are not readily abandoned or revised. Since a theory of gravity that differs from that of Newton and Einstein is essential to the physics proposed here to explain the image on the

Shroud, let me give an example concerning the belief in the classical understanding gravity. Belief in the classical law of gravity is deeper than any belief about the behavior of a dropped-cup. If such a cup seemed to float to the ceiling rather than fall to the floor, then maybe it was dropped by someone in a spaceship or in some gravity-diminished environment, or maybe it was a cup-shaped helium balloon... Better these explanations than a revision of the classical law of gravity because when we are confronted with a relatively shallow piece of evidence that apparently conflicts with a deep-rooted belief we will -presumably for reasons of epistemic economy- tend to try and find a way to discount the shallow evidence. Speaking of revising the law of gravity, one of the buzz-topics in physics has been 'dark matter'. The flat rotation curves of galaxies can be regarded as shallow pieces of evidence that conflict with the deep-rooted belief that the law of gravity as it appears in Newtonian physics and in General Relativity is correct. Similarly, the Shroud can be regarded as a shallow piece of evidence that conflicts with the deep-rooted belief of many that the biblical account of Jesus' death is false. Such is their commitment to classical physics, that many physicists would rather believe in the presence of a pervasive, but invisible and undetected substance than accept that the universe is governed by a different set of laws than those proposed by Newton and Einstein. And such is their commitment to an anti-Christian world-view that many skeptics would rather entertain the idea that the image on the Shroud was forged by Leonardo Da Vinci (who was born in 1452, 97 years *after* the first public presentation of the Shroud in 1335) than accept its authenticity. As indicated above, no such conflict exists for the Christian: he or she may find the idea that the Shroud is authentic to be appealing, but there is no tenet of Christianity that implies or even suggests its authenticity, and so no conflict arises from the possibility that it is a fake. Indeed many of the Shroud's most ardent critics are Christians. John Calvin for example asked in his *Treatise on Relics*

How is it possible that those sacred historians, who carefully related all the miracles that took place at Christ's death, should have omitted to mention one so remarkable as the likeness of the body of our Lord remaining on its wrapping sheet?"

For one thing, there is a Jewish taboo cornering the removal of grave-clothes from a tomb, for another, Jesus' disciples were in a vulnerable position at this time, but the simple answer to Calvin's query is that the image is a very faint negative that can only be seen from several meters away, the majority of whose features only became discernible 20 centuries later - it might be said the Shroud is a message that can be properly understood only by those living in the 20th and 21st centuries... Non-Christians are motivated to deny the authenticity of the Shroud in a way that Christians are not motivated to affirm it: if a non-Christian can't deny the authenticity of the Shroud, then they must face the prospect that the gospels offer a true account of the life of Jesus, and this prospect is at very least a disquieting one. In particular, atheists will believe *anything* rather than believe in the resurrection. Their commitment to a world without resurrection runs so deep that they will concoct *any* story no matter how implausible. The most implausible -and the funniest- of these atheistic narratives I know of comes from another art historian, Thomas de Wesselow, who in 2012 published a book claiming that a) the image on the Shroud is an image of Jesus of Nazareth following his death by crucifixion formed by natural chemical processes, but more significantly that b) it was later used to fool the disciples into believing that Jesus had risen from the dead (behold this negative, barely discernible discoloration in the shape of man, for it is the risen Christ):

Figure 30. Thomas is led to belief by an encounter with the resurrected Jesus?

Many physicists may be predisposed to a belief in dark matter for the innocent reason that they can't think of any better theory than General Relativity. One of the pioneers of the discovery of the flat rotation curves -Vera Rubin- inclines to the idea that dark matter is a sign that the traditional $\frac{1}{r^2}$ force law is modified at galactic scales:

If I could have my pick, I would like to learn that Newton's laws must be modified in order to correctly describe gravitational interactions at large distances. That's more appealing than a universe filled with a new kind of sub-nuclear particle.

There are strong indications however that Shroud-skeptics have dismissed the alternative for psychological reasons. Consider some typical responses to a newspaper article describing the work of a team headed by Dr Paolo Di Lazzaro who after a their series of tests decided that the image on the Shroud could only have been created by "some form of

electromagnetic energy" such as a flash of light at short wavelength but that the energy required was too great for contemporary technology. I choose to quote the following comments because of the article's unjustified use of the word 'supernatural' (Di Lazzaro's team did not say that the image on the Shroud was produced by supernatural means, only that the probable means of production were such that it could not have been the work of a medieval forger):

"Has this work been peer-reviewed? Where is it published?"

"And they call these people scientists in Italy, do they? How quaint."

"Galileo must be turning in his grave. I suspect the inquisition got to em."

"Scientists ? hahahahahahaha
Since the Shroud has been radiocarbon dated independently by labs in Arizona, Oxford and Zurich with the result that the Shroud was made between 1260 and 1390 one has to assume that their theory is a tiny bit wrong .....
Or perhaps the fact that radiocarbon dating shows the Shroud to be a fake is another miracle ? Perhaps these "scientists" believe that God was not only using UV lasers but also removed C-14 isotopes from the Shroud ?"

"Sorry, This is junk science. Amazing they published. It is the total dose (intensity X time), not a one off 'flash'.
Further, this rag was carbon dated to well after the time of the supposed death of the mythological son of an mythical construct, based upon Assyrian myths from 4500 years ago.
Probably a timely piece to encourage the decreasing numbers of 'believers'.."

"I just spat out my morning corn flakes reading this tripe!
The corn flakes then formed a perfect image of Virgin and Child on my kitchen table.
It must be true - I'm off to church."

"Meh! What is it with those nutbars? As the irrationality and absurdity of religion becomes increasingly obvious, they try to harness a tailored version of science to impress people. If their sky fairy really existed and wanted to give us a message, I'm sure it would have done so much more directly a long time ago."

"Another story about more Jesus botherers and their pathetic 'evidence' of something that could be mistaken for being an unsupernatural event.....and this indeed was another of those events. I'm sorry, but if you think Jesus was some real supernatural son of some creator of this universe, and that this creator used his magic powers to do this Shroud, then you are simply stupid.
Why should even the slightest bit of respect be given for any simpleton who believes this nonsense?"

The wording on these comments is suggestive, not of dispassionate contemplation, but of hatred and its parent emotion fear, emotions that are directed especially toward the idea of a world governed by quite different principles than the familiar everyday world with which their authors have been deceived into feel comfortable with. Anyway, my purpose here *has not* been so much to argue the case for the authenticity of the Shroud (this is already very strong), as it has been to challenge the deeply-rooted (philosophical) but false assumptions that are blinding people to the hard-evidence constituted by the Shroud.

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