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TRAVERSABLE WORMHOLES: SOME IMPLICATIONS
or
CONTACT! A POST-SINGULARITY PHASE CHANGE

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That is often the way it is in physics - our mistake is not that we take our theories too seriously, but that we do not take them seriously enough.
Steven Weinberg

Everything will be accomplished that does not violate known fundamental laws of science
Gerald Feinberg

"You must follow me carefully. I shall have to controvert one or two ideas that are almost universally accepted."
Opening words of the Time Traveler, from _The Time Machine_, by HG Wells

Summary: Traversable wormholes permit FTL travel, within general relativity, but not time travel and associated acausal paradoxes. This article explores some of the implications traversable wormholes have on the expansion of civilisations through the universe. In particular it is found each civilisation, or empire, imposes a local, accessible, region of simultaneity, or empire-time, which differs from the more natural time frame cosmologists use. Distant regions of the universe, and alien civilisations if they exist, can be reached in short periods of empire-time. Expanding empire- time zones fuse, on contact with each other, forming an absolute, but artificial, universal time frame. Finally some information-processing limitations of Euclidean space are contrasted with wormhole connected non-Euclidean space.

0. INTRODUCTION

To establish an interstellar trading civilisation we need faster-than- light (FTL) travel or communication, which the recently proposed traversable wormholes provide. This article is a what-if, and, in the words of Weinberg, takes the idea and its implications seriously. In the spirit of Feinberg I assume that the ultimate limits of technology are best suggested by the laws of physics [1].

The article is structured thus:

0. INTRODUCTION: You're reading it.
1. SLOWER THAN LIGHT: Problems and frustrations of living in a universe without FTL travel, exacerbated by the adoption of nanotechnology.
2. FASTER THAN LIGHT: Other proposals for breaking the light barrier.
3. TRAVERSABLE WORMHOLES: The latest candidate for FTL, and some of their properties.
4. EXPLORING THE UNIVERSE: How to explore the universe with a modified Bussard ramscoop and on-board wormhole.
5. TIME TRAVEL: Why traversable wormholes do not permit time travel, but allow FTL, and remain compatible with relativity
6. EMPIRE-TIME: The differences between the local, or empire, time frame an expanding civilisation imposes on its surroundings and the more conventional conception of time.
7. ALIENS: Contacting aliens. In particular it examines how local empire-time zones fuse together, forming...
8. UNIVERSAL TIME: ... a universal simultaneity, creating a post-Singularity phase change, Contact.
9. BEYOND THE OBSERVABLE UNIVERSE: Implications of exploring beyond the edge of the observable universe.
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1. SLOWER THAN LIGHT

We can colonize the universe at sub-light velocities [2], [3], but the colonies remain separated from each other by the vastness of interstellar space. In the past trading empires have coped with time delays on trade routes of the order of a few years, or decades at most. This suggests that integrated, interstellar economic and cultural zones are limited, at most, to only a few star systems.

Nanotechnology [4] only exacerbates the situation. We expect full- nanotech, uploading, AIs and other self-transformative technology to arrive (over a period of some few years, often dubbed the Singularity) before interstellar travel becomes practical. Assume, for illustrative purposes, that we keep the same dimensions for our brains as at the moment. Once we are uploaded onto, and redesigned on, a decent nanotech platform our mental speeds can be expected to exceed our present rates by the ratio of the speed of electrical impulses to neurochemical impulses - about a million-fold speed-up. Subjective time, in the information world Hans Moravec has called cyberspace [5], speeds up by this factor. Perhaps we can't expect an ultimately materials-based economy (which even cyberspace is, with its need for raw processing power) to speed up by this amount. Economic speed-up of a factor of a thousand, as the geometric mean of one and a million, might be more reasonable and I shall adopt this factor for illustrative purposes. Even so, the doubling time for the economy is reduced from decades to weeks. Trade across more than light weeks is much less economically significant due to the growth and change in markets during a doubling. Although individual stellar systems can form single economic zones, they remain in economic isolation from even their nearest neighbours, including their surrounding Oort cloud or cometary halo.

With full nanotech and nuclear transmutation there is little need to transfer matter. Trade in the distant future is likely to consist of mostly information. Design plans for new products, assembled on receipt. Patterns of uploaded consciousness of intrepid travelers. Gossip and news. But, with communication

delays to Alpha Centauri of the order of millions of subjective years, two-way dialogues are difficult to imagine - even when we are enjoying unlimited life spans. Old news is no news.

Interstellar communication and exploration, without FTL, is a one-way process. If you had a yen to travel to the Alpha Centauri you could. Squirt your encoded engrams down an interstellar modem and decode at Alpha Centauri. Assuming the receiving station hasn't shut down in the intervening millions of years of subjective cultural change and economic transformation. You could leave a copy of your consciousness behind as redundancy or if you wanted to explore both regions, but I suspect many of us will not find this completely satisfactory. The speed of light barrier would limit and cramp our style much more than it does at present.

Trade routes, we have seen, are unlikely to spread beyond single star systems, at least until after the economy has plateaued (maybe never). Information-based cultures are unlikely to spread beyond single planets before time delays cause social fragmentation. Mars, at its closest to Earth, is 4 light-minutes away. After nanotech speed-up the effective communication distance increases to several subjective-light-years. Other planets become as distant to nanotech based societies as the stars are to us. And stars become as distant as present-day galaxies.

2. FASTER THAN LIGHT

Life, on the galactic scale, becomes incredibly dull without FTL. In science fiction a standard plot device is to invent some FTL mechanism, to make stories interesting. As you might expect, there have been a number of efforts to circumvent the light speed barrier in science-fact, as well as science-fiction.

What stops FTL travel? According to relativity as an object accelerates towards the light-speed barrier its mass increases asymptotically, slowing its acceleration with constant thrust. Ship time also slows down, which also reduces thrust (e.g. for a photon drive the frequency of the photon beam red-shifts, reducing apparent thrust to a off-ship, stationary observer). Both effects make the speed of light an insurmountable barrier.

Since the advent of relativity there have been a number of approaches to FTL travel:

1) Tachyons: Tachyons are posited FTL particles, compatible with relativity. They never cross the light speed barrier, which is all that relativity forbids, being superluminal from emission to absorption. Unfortunately there are serious doubts about whether they could be used for transmitting information [6]. However, no tachyons have been detected, so things look bleak either way.

2) Superluminal quantum effects: Einstein-Podolsky-Rosen & quantum 'teleportation' [7]. Relies on an accompanying classical sublight signal, so no FTL. Other quantum schemes (e.g. pure EPR signalling) rely on transmitting information via the posited collapse of the wave function, on which no general consensus exists. Until this is settled we can't expect too much here. No quantum superluminal effect has been demonstrated in the laboratory, either.

3) Spinning black-holes: Things looked hopeful for a while that large spinning or charged black-holes might permit travel into other regions of somewhere. Recent work shows that the passage of anything through a black-hole sets off a gravitational feedback process that crushes the traveler to death. Also infalling radiation blue-shifts to infinity [8], frying the traveler, if tidal forces, which are similarly inflated (no matter how big the black-hole), don't shred her first.

4) Einstein-Rosen bridges: An Einstein-Rosen bridge connects two otherwise widely separated regions of space, with a bridge, throat or tunnel of space, whose length is independent of the conventional separation. Unfortunately the throat is very short-lived, pinching off so quickly that only tachyons (if they existed) could travel through them and get out the other end, [9]. But if you could travel FTL you wouldn't need a wormhole- Catch-22! Einstein-Rosen bridges are non-traversable wormholes.

As each attempt has failed the conventional wisdom has strengthened that FTL travel is the 20th century's analogue of the alchemist's dream of transmuting lead into gold or flying to the moon. Or living forever. They seemed impossible dreams at the time....

3. TRAVERSABLE WORMHOLES

In 1985 Carl Sagan appealed to theoretical physicists for plausible methods of FTL travel to include in his forthcoming book, _Contact_. Stimulated by this request, amongst others, were Kip Thorne and his graduate students at Caltech. Instead of looking at how different forms of matter distort space they turned the problem around and asked, what states of matter are required to hold a wormhole open permanently, so no pinch off occurs? The answer is 'exotic' states, a highly stressed state, with enormous tensile strengths. The tension or pressure of 'exotic' states exceeds the local energy density. We have no familiarity with substantial 'exotic' states today, but it existed under conditions of extraordinary pressure in the early universe and exists in very tenuous forms today. Carl Sagan published _Contact_ in 1985 [10], incorporating the Caltech team's early work on traversable wormholes in the novel. Thorne et al published their conclusions in 1988 [11], including a recommendation for students to read _Contact_ as a light introduction to traversable wormholes and 'exotic' states!

In 1989 Matt Visser showed how more general traversable wormholes could be constructed [12] or, more precisely, gave the material requirements for wormhole stability. A Visser-style wormhole requires 'exotic' states confined to the edges of a three-dimensional volume, for example the edges of a cube. Although there is only one cube of material, it appears at two locations to the external observer. The cube links the two 'ends' of a wormhole together. The cube has no interior, but merely facilitates passage from 'one' cube to the 'other'. Each face of the cube, instead of showing the interior of the cube, opens onto the view from the corresponding face of the other cube. A traveler, passing between the edges of 'one' cube, emerges from between the edges of the 'other' cube, unaware of anything special about the journey.

The 'exotic' nature of the edge material requires negative energy density and tension/pressure. But the laws of physics do not forbid such materials. The energy density of the vacuum may be negative, as is the Casimir field generated in the empty space between two plate conductors or in the particle creating region around a black-hole. Negative pressure fields, according to standard astrophysics, drove the expansion of the universe during its 'inflationary' phase. Cosmic string has negative tension. Clearly 'exotic' states are not barred by physics.

The negative energy of a wormhole has equal magnitude to the energy of a black-hole, where the wormhole throat radius equals the black-hole Schwarzschild radius. A traversable wormhole can be thought of as the negative energy counterpart to a black-hole. The energy of a traversable wormhole, like a black-hole, scales with its linear dimensions. A one meter cube entrance requires a negative mass of roughly 10^27 kg. A planck-scale wormhole, throat diameter of 10^-33 m, has a negative mass of 10^-8 kg.

Negative energies, though they exist in nature, have so far only been seen in association with other positive energies, yielding systems with total positive mass. The negative Casimir energies observed are confined between metal conductors whose mass gives the total system of conductor plus vacuum a positive, overall energy. Similarly the particle creating region of an event horizon is energetically dwarfed by the associated black-hole mass. Being conservative in my induction I'll assume that the total mass of a wormhole is positive, of the same order as the core's negative energy, which is suggested by some other recent work [13], although only a conjecture.

Construction of 'exotic' cubes is, of course, far, far beyond our present day engineering capabilities. I would seriously doubt the possibility of achieving such capability were it not for the self- transformative technologies mentioned earlier. With AIs and nanotech combined we expect the limits on intelligences to be governed by physics, not biology [1], [4]. Our brain's processing capacity is conventionally assessed

between 10^15 - 10^18 bit/sec. A comparably sized nanoelectronic brain would have processing power of 10^32 - 10^36 bit/sec [14]. The 6 orders of magnitude absorbed by nanotech speed-up, mentioned in the opening paragraphs, still leaves 8 - 15 orders of magnitude expansion for complexity, or depth of thought, of our brains as we switch from biology to nanotechnology. So we should not blithely assume construction and manipulation of the exotic states required will long remain beyond the grasp of future, post-Singularity, civilisations, populated by such super-intelligences, or cyberminds [5], unless prohibited by physical law [1]. The remainder of the article will assume the mass production of wormholes is economically achievable by future civilisations.

Leaving aside the problems of construction, let's look at the properties of wormholes. A wormhole collapses, or throat pinches off, when the amount of mass passing through its throat's vicinity approaches the same order as the amount of negative mass confined to its edges, threatening to form a black-hole. Surprisingly, the maximum rate of mass flow through a wormhole is independent of size. As the diameter of the throat expands so does the time taken to pass into and beyond the hole's Schwarzschild radius, giving a maximum rate of mass flow through the hole of c^3 / 2G, or approximately 2.10^35 kg/s, where G is Newton's constant, c the speed of light.

Wormholes can be viewed as communication channels with enormous potential bandwidth. According to Shannon [15] and others [14], [16], information has a minimum energy of kTlog2 per bit associated with it, where T is the absolute ambient temperature. The gravitational field of the hole will impose a size-dependent lower bound on the Hawking temperature of the wormhole, giving a channel capacity that scales with hole size, of 10^52 bits/sec * mass (in kg). This suggests it will usually be more economic to squirt the design of an object down a wormhole channel rather than the object itself. This bandwidth, or channel capacity, is the upper limit possible through a hole, but doesn't, in itself, give any clues as to how to achieve it.

These two properties of wormholes, fixed matter-throughput versus bandwidth scaling with mass or radius, suggest that large, cold wormholes will be used primarily for communications, rather than matter transference. Some exceptions might be unless the object is unusually information-rich or can't be reduced to classical information (e.g. a quantum correlated EPR state [7]), without destroying the object. Another other class of objects that will need direct physical transference, rather than being transmitted as information, are wormholes themselves. Having laboriously dragged one end of a wormhole somewhere, later wormholes are transferred via the first, to increase the connections between the two distant regions.

An object swallowed by the mouth of a wormhole leaves its electric charge, momentum and mass associated with the mouth, in an analogous manner with the no-hair theorem for black-holes. The no-hair theorem for black-holes says that a black-hole only remembers the total charge, mass and momentum (linear and angular) of objects swallowed. Correspondingly, when an object is disgorged from a wormhole the mass and charge of the wormhole end is reduced, by the disgorged object's mass and charge. Matter and charge flows through a wormhole have to be balanced in either direction to prevent gravitational and electric flux lines being trapped and distorting the hole. To the external observer, who may not know a wormhole is involved, mass and charge appear locally conserved. Over the long term the wormhole is forced to act as a matter exchange, rather than a source or sink for matter. I'll return to this point when discussing the Bussard ramscoop idea.

4. EXPLORING THE UNIVERSE

Wormholes enable travel from one mouth to the other. To travel to distant parts of the universe one wormhole end stays at home and the other is carted away, at sublight velocities, to the destination.

To sustain high accelerations a space probe with an on-board, small, light, wormhole could be powered from base. The fuel (perhaps antimatter, in the form of super-heavy anti-particles) is uploaded through the base end of the wormhole to the on-board end of the wormhole, powering a photon drive. A corresponding mass (ballast) has to be exchanged to maintain the two-way mass balance, as I mentioned

earlier. This matter has to be collected by the probe from its environment, which naturally leads to the suggestion that the probe should be a Bussard ramscoop [17], collecting ballast/fuel from interstellar gas with a magnetic 'trawl'. Half the collected matter is exchanged for antimatter via the wormhole, which is combined with the remaining matter to power the photon drive. A Bussard ramscoop gains in thrust as it reaches higher and higher relativistic speeds (the Lorentz-Fitzgerald contraction increases the density of oncoming interstellar plasma). To protect against relativistic dust impact damage some of the extra energy and mass could be used for the construction of a heat shield (whose mass would partially off-set the gain in thrust with speed). At different velocities different designs are optimal, so the probe would have to effect in-flight redesign.

At the relativistic speeds time dilation becomes a major factor. Time dilation reduces trip times for relativistic travelers. A probe accelerating at one-gee approaches light speed within a year. As it speeds up probe time dilates more and more. I have given flight times assuming 1-gee acceleration, after the original plans [18], based on a hydrogen fusion motor. I've also included a higher 1000-gee flight time plot, based on the greater accelerations a nanotech ramscoop construction could withstand, and an antimatter drive could deliver. Probe or journey time to various locations, are, not allowing for slow-down:

Destination	Distance in light years	Trip time at various gees	1-g	1000-g
Alpha Centauri	4.3		2.3 years	3.3 days
Centre of Milky Way	30,000		11 years	6.5 days
Andromeda Galaxy	2,250,000		15 years	8 days
Nearest Alien Civilisation?	100 M		19 years	9.5 days
Edge of observable universe	10,000 M		24 years	11 days
Edge of inflationary bubble?	10^30		70 years	28 days

The probe remains in communication with the home base, throughout the trip. As a drop point approaches another wormhole plus deceleration rig is uploaded through, detaching itself from the mother craft. Deceleration is quicker and less expensive than acceleration: the daughter craft brakes itself against interstellar/galactic gas, dust and magnetic fields, or even reflects the oncoming gas forwards to double the braking force. Transfer of colonists begins when deceleration is complete. The colonists transfer through the daughter hole, whilst the main probe continues its outward voyage. One of the first tasks is to secure the connections with home by increasing the local wormhole presence, transporting more wormholes from base via existing wormholes. Initial supplies, plant and machinery are transported as needed from base. Transport of manufacturing plants continues until local nanotech factories become more competitive than transport of finished product and local industries reach critical mass. After this the wormholes become increasingly used for communications rather than materials transport.

An analogy with the cloud chamber springs to mind here. Charged particles are tracked through cloud chambers. Each particle is invisible, but its presence is revealed by the expanding wake of droplets left behind. Similarly the space probe is all but invisible, lost in the immensity of deep space. The burgeoning colonies left behind mark its passage. The colonies send out further wormhole probes. >From a distance the whole affair resembles a growing 3-D snowflake, with Earth at the centre. The tips of the snowflake indicate the positions of colony-probes.

Road, sea and air routes allow the creation and operation of global markets. With the growth of transportation once isolated economic zones are now forming more tightly integrated global trading blocs. Similarly wormhole connections enable galactic and intergalactic economic blocs or zones to form.

5. TIME TRAVEL

As we have seen, wormholes are constrained by relativity to travel at sublight speeds, being time-dilated as normal. Clocks placed at the two mouths of a wormhole always remain in synchronisation with each other [19]. If I look through one end of a wormhole and compare the near clock with the far clock they'll

always agree, even if one end of the wormhole is traveling at relativistic speeds, many light-years away. We observe the two clocks keeping time with each other, yet relativity says the 'distant', traveling clock, is running slowly. How do we reconcile this? Only by concluding that the receding clock is being displaced in space _and time_ [19]. A wormhole connects different regions of space and time. If a wormhole enables someone to travel from Alpha Centauri 2996 to Sol 2993, and vice versa, then no paradox results because they can't travel back to Alpha Centauri (through conventional space, a distance of about 4.3 light-years) and arrive before they left (to cause a paradox).

Paradoxes result if a wormhole connects, say, Alpha Centauri 3000 to Sol 2993. Now a traveler can travel, through the wormhole, from Alpha Centauri 3000 to Sol 2993 and then make the return journey, through normal space within 5 years, at sublight speeds, arriving before her own departure. This is a problem because we can always time dilate one end of a wormhole and not the other, either by placing one end in a gravitational field or transporting it with great speed. Wormholes, it would seem, can be always transformed into time machines.

Problems begin when the wormhole ends move towards each other, and the time-shifted traveler is able to return, by traveling through conventional space, to visit herself before departure. If a traveler can visit an earlier part of her worldline then the possibility of acausal paradoxes is opened. This conclusion was realised soon after the first articles on traversable wormholes were published [11]. Depending on your view of the plausibility of time travel this is either, if you believe time travel possible, very exciting or, if you scoff at time travel, proof that traversable wormholes can't exist. No general consensus emerged in the pages of various physics journals as the subject was batted back and forth. Elaborate and very interesting papers [20], [19] reconciled time travel with quantum theory, whilst Hawking proposed, and gave plausibility arguments for, a Chronological Protection Conjecture, CPC, which says the Universe Shalt Not Allow Time Travel [21].

One of the time travel sceptics is Matt Visser. Early in 1993 he showed that wormholes do _not_ enable time travel [22], by proposing physical mechanisms that enforce CPC. Visser showed that the mouths of a wormhole, with an induced clock difference, could not be brought close enough together (one wormhole end inside the light cone of the other end) to permit causality violation. Quantum field and gravitational effects build up as the two ends of a wormhole approach each other and either collapse the wormhole or induce a mutual repulsion. Visser's work is not complete, but it seems swarms of virtual particles (including gravitons) disrupt the region around a time machine, just before it would otherwise become operational. The virtual particle fluxes around a nearly chronologically violating region are able, via the uncertainty principle, to form closed space like (superluminal) loops and borrow energy off themselves, becoming more virulent than usual. As traversable wormholes approach being time machines, the energy of the virtual space like particle loops pinch off the throats, preventing formation of paradoxical, real closed time like loops. This mechanism still works even if more than one wormhole is involved. One end of a wormhole is excluded from the light cone of the other end, even if the light cone is transmitted via another wormhole. For the purposes of this article I'll adopt Visser's conclusion that the CPC mechanism is generic and blocks all forms of time travel via wormholes, but permits the operation of wormholes for the purpose of FTL travel.

6. EMPIRE-TIME

Wormholes do have one major trick up their sleeves. We have seen that wormholes don't permit time travel. But they do exhibit some very strange effects. Consider the journey from Earth to Andromeda of a 1- gee exploration probe (with the obligatory on-board wormhole), from the probe's perspective. At launch from Earth, in say the year 3000, the probe's view of Earth matches the view of Earth through the on-board wormhole - both show Earth 3000. After 15 years probe-time travel, at constant 1-gee acceleration, the ship reaches Andromeda. The view of Earth through the wormhole now shows Earth 3015. But the probe can calculate trip duration, using standard Minkowskian geometry, relative to the stationary, Earth-bound observer. This time works out to be 2,250,001 years. So the probe knows that it is 'really' year 2,253,001. We have to conclude that wormholes not only connect widely separated regions,

but also different times, as we said earlier. In this example Earth 3015 is connected with Andromeda 2,253,001.

Using the wormhole a traveler can move between Earth 3015 and Andromeda 2,253,001. (Note: CPC prevents paradoxes. Trying to create an _additional_ return wormhole connecting Andromeda 2,253,016 with Earth 4,503,002, say, would enable someone from Earth 4,503,002, to travel to Earth 3030, via Andromeda 2,253,016 to disrupt their own past. But the closed space like loops form, via the CPC mechanism, and block the arrangement.) Whilst a wormhole bridgehead is established, CPC prevents any connections to different times, within the future light cone, even indirectly via other wormhole connections. Because of this strict chronological enforcement it makes sense to define a local time, which I call empire-time, for use within the regions linked up. In this example Earth time is the standard by which clocks can be set.

The time frame being defined by the expansion of wormholes, which I've dubbed empire-time, is not coincident with the cosmological time frame. The cosmological space-time is the space-time frame in which the average background distribution of matter is stationary. The cosmological frame, or co-moving frame, expands with the Hubble expansion of the universe. At each point in cosmological time the averaged distribution of matter, on a large scale, is even, allowing the easiest calculation of dynamics of the expansion of the universe. Relativity says all reference frames are relative, but in truth most astronomers think of the cosmological frame as a natural choice, or Schelling frame, to adopt, even though we are drifting with respect to it.

Wormholes sent to the Andromeda, in our example, at near light speeds arrive in approximately year 2,253,001 cosmological time, but in year 3,015 empire-time. Assuming once wormhole technology is developed we expand at near light speeds then the surface of constant empire-time forms an inverted cone in cosmological space-time, with Earth at the apex. (I use the language of cones to describe what is really a sphere, but this is conventional in relativity texts, because it lends itself to greater ease of visualisation - think of time forming the vertical scale and the spatial dimensions contributing to the horizontal co-ordinates. Later times form surfaces stacked on top of earlier times.) At any particular moment in empire-time the entire surface of the empire-time cone is accessible to the wormhole traveler. Traveling along the wormhole highways away from Earth takes you into the far future in cosmological time, but not in empire-time. Later empire-time zones form inverted cones, open base uppermost, stacked on top of each other.

Empire-time is the time imposed by the wormholes throughout the region they connect up. This region I'll call an empire, although no central authority is implied but is allowed. Clocks within the empire can be synchronised with each other, provided they are close to a wormhole. A traveler within the empire could always set their clock by empire- time, because the wormholes provide a common reference frame, or a background, against which to define position and velocity. Because this reference frame is common to all occupants the empire-time defined can be used to catalogue events in a time-ordered fashion. Attempts to redefine the empire-time already laid down by the wormhole infrastructure are firmly resisted by CPC. To redefine empire-time you have to repopulate a region with holes traveling at a vastly different speed than the original colony probe. The CPC mechanism says, in empire-time terminology, two holes disturb each other as they approach closer than their empire-time difference times the speed of light e.g. two holes with an empire-time difference of a year can't approach closer than a light-year without being both violently disrupted and destroyed [23].

Once the empire-time frame has been defined it becomes increasingly difficult to change it. As the population and economy of a region grow the numbers of holes increases. Once established, to change the relationship between cosmological time and empire-time requires the complete upheaval of the local economy and denizens. Economic growth breeds chronological stability.

Questions about the distant cosmological future of our universe are answered directly by travel. How quickly is the Hubble expansion slowing? Would the natural universe expand forever or re-collapse? Is

the universe spatially closed? Send out a probe at one-gee. From the above table we see that within a century of empire-time it is reporting back from almost inconceivable distances and futurities, answering the questions about the fate of the natural universe. If you wish you can visit the end of the universe, and come back. "Go see the end of the universe" might be a catchy travel company's jingo. (Actually this is only possible in an open, uninhabited universe, as below. In a closed or alien-infested universe there is a limit to how far you can travel before CPC prevents you.)

7. ALIENS

Enrico Fermi said "if aliens existed they would be here" [24], reflecting the increasingly common view that circumstantial evidence indicates alien civilisations are very few and far flung in the universe. The easiest way to explore and colonise the universe is to send out self-replicating space probes, as Tipler has cogently argued [2], [3], which almost any civilisation will do so at some stage in its evolution. Within a cosmologically short period (i.e. millions of years) we could colonise the Milky Way and the rest of the Local Group. The arrival of a colony probe at a star system precludes and supersedes local biological evolution. This hasn't happened to us, otherwise we won't be here. Since life on Earth has evolved over billions of years then we can't expect (statistically speaking) to find civilisations within our local group or, perhaps, anywhere in the universe. This is the Fermi Paradox.

A statistical elaboration of this argument [25] gives grounds for believing that the nearest aliens are currently over a 100 million light-years distant. For illustrative purposes I'll assume the nearest alien civilisation is 100 million light-years distant. In the cosmological frame, without wormholes, we won't make contact with them for over 100 million years. Which makes their existence an object of theoretical speculation, which can't be resolved for millions of years.

With relativistic probes and on-board wormholes, though, we can reach alien colonised regions within decades of empire-time, no matter (almost) how far away they are, although no probe can penetrate into an alien empire. Each empire defines its own empire-time, in conflict with the empire-time of the other. A probe from Earth flying into an alien zone not only crosses alien space, but also alien empire-time zones. As it approaches the alien home world it passes increasingly into the alien empire-time future. CPC forbids such travel by destroying lone wormholes that attempt to interpenetrate each others' empires.

This opens up the possibility of different expansion scenarios.

A well coordinated, centrally controlled species might halt expansion at the boundary of their home galaxy (say) for a few thousand empire- years, building up numbers, armaments etc. When their technology seems to have plateaued they resume expansion relying on technology and numbers to overwhelm aliens. Such a strategy is technology dependent. If wormholes can be booby-trapped to explode on tampering or hostile attack such a strategy fails. Consider what happens as they invade a neighbouring, occupied galaxy. At the first sign of attack the defenders destroy their wormholes in the invasion zone and retreat in a scorched earth policy. The structure of their respective empire-times operates to favour the defenders. The attackers penetrate deeply towards the galactic core and home world within a few years of their empire-time. 'Meanwhile' the defenders retreat, abandoning rim worlds one-by-one, over a period of tens of thousands of years of _their_ empire-time. Each light-year crossed and the defenders' technology and economic power advances by a year (likely to be a large gain with nanotech growth rates), whilst the invaders' technology is in relative stasis. Eventually science, technology and weight of numbers tells and the balance of attack shifts in favour of the defenders. Unless an invader overwhelmed the defenders in some surprise, sneak attack the attack fails. Wars have to be fought on a more subtle level. Enough material here to keep military strategists busy for a while.

A more likely scenario is: Contact is signalled by our leading wormhole probes failing in the overlap of our sphere of influence with the alien empire's sphere, a kind of neutral zone. Finding each other's probes is non-trivial. It might be easier to find the colonies than the original exploration vessels. To push the analogy with a particle zipping through a cloud chamber, search for the tell-tale droplets, rather than the

elusive particle. The easiest way of doing this, at the point where the relativistic wormholes are destroyed, is to send out sub-light, mildly-relativistic survey probes (with on-board wormholes), from the nearest drop points, to establish diplomatic relations. If both sides explore each other with non- or mildly-relativistic probes (relative to the cosmological frame) then their empire-times will realign themselves, meshing together over the locale of the neutral zone, although this may take years, permitting diplomatic contact and, assuming no wars, eventual exchanges of wormholes.

Empire-times merge as empires merge. Clocks in one empire are synchronised with the clocks in the other. Initially to travel from one empire to another involves wormhole travel to the neutral zone and hopping over to a nearby alien hole, before entering into the alien's wormhole network. As wormholes are exchanged direct travel becomes possible. The wormhole networks merge as more and more direct connections open up. The spheres of colonisation are now available to each other and the two empire-times merge to form a double conical structure. If the alien empire began expansion before us, in cosmological time terms, then traveling to the alien home world would take us back to an era of cosmological time prior to the present.

Given the expansion rates quoted, once the first aliens are contacted the second, third etc. follow soon after. In addition to directly contacting alien empires we'd also make contact indirectly. To begin with we'd make contact with alien empires that had not met very many other aliens - just starting out, so to speak, as we were. This would soon change. As our probes reach further and further into the distant cosmological future we contact larger and larger alien empires, who, in turn, have met more and more other aliens. The crucial point is reached when the average number of civilisations a typical civilisation is in direct contact with reaches three, or thereabouts. In our 1-gee flight scenario this point is reached about 4-5 months after first contact is established, i.e. in under 20 years exploration, plus time to establish diplomatic relations. If we plot the number of aliens contacted, directly _and indirectly_, against empire-time we get an asymptote, bounded only by the total number of alien species in the universe, at this point.

8. UNIVERSAL TIME

This is a symmetrical situation. Not only will we be meeting aliens within an historically short period, but they will be meeting us shortly after their expansions begin. Consequently, all the space-faring species of the universe will be connecting up at about the same stage in their development. This gives us all shared interests and markets in common. We might expect each civilisation to go through two future phase changes, the first individually, the second collectively. The first phase change, the Singularity, is the adoption of full-blown nanotechnology and the consequent uploading from a biological to a nanotech platform. The second phase change, which I'll call Contact, occurs when each civilisation, more or less empire-time-simultaneously, links up with the rest of the universe, tapping the benefits of the near-infinite economies of scale this brings.

After Contact all the local empire-times have merged to form a universal time or simultaneity surface. On a very large scale the sheet of universal time conforms with the cosmological average. On closer inspection (i.e. scales of billions of years and light-years) the universal time surface reveals conical pit-like indentations, marking where each civilisation arose and stamped its own chronological footprint on the surrounding space-time topology, before merging with their neighbours' zones. By saying the universal time surface is indented I reveal my own cosmological time prejudices. From the vantage of point of a future cybermind, post-Contact, it is surfaces of equal, cosmological time that appear bumpy, relative to the planes of constant universal time. To them civilisation birth points appear as the _summits_ of cones in the cosmological time surface, relative to the flat universal time surface. Universal time would be the preferred time for discussing life, history, politics etc. - everything except prehistory before Contact.

Universal time has many similarities with absolute time, as Newton conceived of it [26]. Newton viewed absolute time as deriving from God's immanence, or presence throughout the universe. The universal

time frame defined by wormholes is created by the civilisations within the universe, which is much more satisfactory state of affairs to the modern scientific paradigm.

Roughly half the civilisations we meet are likely to have been around, in cosmological terms, hundreds of millions or even billions of years before us. Gaining access to their empire-time zones will enable our astronomers to observe the expansion of the universe in the distant past (although always further away from here in space than cosmological time). The occurrence of the first civilisation in the universe is the limit before which we could not travel, in cosmological time.

9. BEYOND THE OBSERVABLE UNIVERSE

The expansion of the universe is defined by a parameter called Hubble's constant, which relates the distance of a far galaxy with its velocity of recession. Beyond a certain distance the recession velocity exceeds the speed of light. Objects beyond this are red-shifted to infinity and are unobservable. This distance defines the edge of our observable universe, an event horizon, and lies approximately (subject to experimental error) 15-30 billion light-years away. This is the limit of the astronomers' universe. What lies beyond is left to cosmology to ponder on. Cosmological theories expounded over the last decade (in particular inflationary theories) indicate that the observable universe is just an infinitesimal speck in a greater post-inflationary bubble that extends over distances of 10^30 light-years or more, looking pretty much everywhere as it does here.

Inflationary theories differ about what lies beyond the inflationary bubble. Because these regions are inflating at huge rates, an event horizon prevents any substantial exploration outside the 'bubble'. Unless we make Contact we will never directly observe this since these regions will have changed greatly in the century or two of empire-time (> 10^30 years of cosmological time) it takes to reach them. One possibility is that naturally occurring wormholes, relics of the inflationary period, and inflated to astronomical dimensions [27], may link our post-inflationary, bubble with others, forming an infinitely large chaotic, fractal structure [28], [29].

A couple of paragraphs back I mentioned the phase change, Contact, associated with linking up with the rest of the universe and gaining the benefits of near-infinite economies of scale, access to huge information markets, etc. The present scope of internet, the electronic global communications network, pales into utter insignificance before the size of the pan-universal internet that will form, post-Contact. It's worth while stopping for a moment and considering what this might do to our perception of ourselves and our place in the universe. At the moment we are the only civilisation we know, unique and conceited. If civilisations lie scattered at distances of 100 million light-years, in a universe of radius 10^30 light-years, this still yields over 10^60 alien mother cultures. It is unlikely anyone could ever catalogue all the civilisations and cultures, even if they did have a nanoelectronic brain! No single historian could encompass the sweep of history, no biologist catalogue the species. We would have returned to the medieval world, surrounded by legends of distant lands populated by mythical and fantastic creatures. Construction of a single universal map and travel guide would be impossible. The culture shock of absorbing all the extra data would likely keep us occupied for not far short of eternity.

10. BASEMENT UNIVERSES

Initially, no doubt, wormhole connections would supplement existing architectures, connecting together points in the existing locally Euclidean universe. The next logical step would be to start constructing extensions to the existing topology. The technologies involved in generating artificial inflation to expand the interiors of wormholes into basement, or baby, universes are of the same order of magnitude as creating traversable wormholes. A basement universe is a traversable wormhole with only one end and an inflated interior (rather than two ends and no interior). Rather like the Tardis, in concept, bigger on the inside than the outside. Computer simulated basement universe formation has already been discussed in the literature [30], [31], [32]. The technology to construct traversable wormholes implies the ability to construct basement universes.

We have already mentioned that we expect speed-up of subjective time rates of a million or so with the adoption of full nanotech. If just a factor of a thousand translates into GDP and population growth rates then doubling times drop from decades to weeks. I don't know if these growth rates are sustainable, even in empire-time, but they indicate that any limited resource is likely to be at a premium, within years of empire-time. Since the amount of natural space per civilisation is likely to be limited to roughly 10^24 cubic light-years, space will ultimately be at a premium. The need for living space dictates that eventually wormholes will be used to provide links to artificial basement universes. Or perhaps the possibility of wormhole wars, mentioned earlier, will tempt societies to move wholesale into basement universes for security.

In a sense exponential growth and Euclidean space are natural enemies. The volume enclosed by a Euclidean 3-sphere only increases with the cube of the radius. With exponential growth pressures driving expansion all civilisations confined to Euclidean space will rapidly (in historical terms) hit technological limitations or each other. Wormholes and associated basement universes offer the long term prospect of escaping from this dilemma. An array of basement universes connected by wormholes has the useful property that the volume of habitable space accessible grows exponentially with distance from origin. A civilisation driven by volumetric exponential growth need only grow radially at a constant rate through basement universe space, unlike in Euclidean space, where it must expand radially exponentially.

This might seem somewhat like a subtle and obtuse piece of mathematics, but it's just restating that a tree with continually branching twigs eventually strangles itself, in Euclidean space, whereas it could grow forever through a tangled array of wormholes and basement universes, without the crowding out effect choking off growth. A related limitation of Euclidean space is the amount of information a volume can contain. This limitation, the Bekenstein bound [33], [34], implies that to achieve unlimited information storage a system must spread itself increasingly thinly and operate more slowly [35], in the limit to zero, or else collapse into a black-hole. No such limitation applies to a space of connected basement universes. Each basement universe is shielded from the positive energy contribution of its neighbours, allowing infinitely complex, extended, networked structures to form.

11. CONCLUSION

We have seen that, whilst the construction of wormholes is technically very difficult, the long-term payoffs are very great. A civilisation can expand through the universe, stamping its own chronology on its locality, at a speed only limited by its energy resources. At the very least, problems of construction, theoretical and practical, will exercise the advanced intelligences of the future considerably. In the longer term the possibility of opened-ended, perhaps even infinite, information processing lie before the civilisations which solve the problem of wormhole construction and transport. Without wormholes a civilisation faces certain fragmentation as it expands. With wormholes it can remain integrated. Whether the integration is used or abused is another question.

From a more detached point of view it is interesting that the universal time frame permits a return to the Newtonian conception of an absolute time and simultaneity, previously thought to be incompatible with general relativity. It is especially pleasing that the shape of the universal time surface is a function of the birth place-times of civilisations, rather than divine choice or blind, insensate cosmological processes.

12. ACKNOWLEDGMENTS

My thanks to all the Extropians and Cryonauts for their feedback, including Gregory Benford, Andrew Clifford, Ray Cromwell, Dani Eder, Carl Feynman and Timothy Freeman for filtering out some of my worst errors and most obtuse wording. But most particular thanks to Robin Hanson, for jointly starting and working with me on this project, and specifically for pointing out how empire-time follows from time-dilation. Needless to say none of the above share any responsibility for, or necessarily agree with, some of my conclusions, nor any of my errors.

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14. FURTHER READING

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John Gribbin. In Search of the Edge of Time. Black Swan (1992) ISBN 0552994626. Covers a lot of the relativity background material assumed here, with useful diagrams.

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LETTER BY KEVIN SCHWARTZ

late June, 1993

Rick Rosner
5139 Balboa Blvd # 303
Encino, CA 91316-3430

Dear Rick,

Enclosed: Top Ten list. Don't have a cow. Actually, Rick, I think you should write mathematics articles or pop-sci articles; or do stand-up comedy -- you are VERY funny! Don't blindly pursue fame qua fame; pursue accomplishment, and fame "will follow as the night the day" (Polonius -- see below). **Enclosed**: photocopy of a Table of Contents -- from Chess Life -- featuring yours truly hopeless. **Enclosed**: IQ test spoof (if I find it). Did I remember to send that "Ask Kevyn" gag? Oh, well.

Would you -- as editor or as bouncer, or as both -- be interested in my junior-year Socratic Dialogue on time travel? (It's humorous rather than dull. At least I think so!) I want to revise and expand it into a Godel-Escher-Bach: an Eternal Golden Braid rip-off -- and I figure Megarians should be good critics. Or, better yet, collaborators...

Is Bill Corley (sp?) still in Mega? I want to crack the Sassy / seventeen fiction market, but my knowledge about teenage girls is about nil. If I recall, he has three daughters of roughly the target age. Plus they oughta be smart. Plus he's a writer. So maybe together they could read my stuff and give me pointers, suggestions, what-have-you. (From most girls, the traditional suggestion is: "Get lost, dweeb!")

How can I get my **Multimax** scored? Pat Thomas sent it to me; I "took" it --- takes only about ten seconds! so cool!; I sent it to Clint Williams; he sent it to Harding; months have passed... Do any societies accept MM scores?

Am working on (ie, "inventing") some strategy games and need help with some recalcitrant reticulation programming. Anyone interested in helping? PLEASE?

Idea: why not pool our talents and regularly sell puzzles to Omni, Scientific American, Discover? As a group, puzzle-ability should be our strongest skill. Also: to find new members, I suggest we submit puzzles or place ads in The Mathematical Intelligencer and similar "mathezines". We could also write to noted intellectuals. Wouldn't it be "way cool" 2 1/2 (to have) Bobby Fischer or Judit Polgar or Noam Chomsky or Linus Pauling or Solomon Golomb or Edward Witten or Gerd Faltings -- or whomever -- as a Megarian?

For longer term goals: why not do psychometric / AI research in conjunction with established scientists -- Marvin Minsky, Arthur Jensen... -- and publish in mainstream scientific magazines?

Still in & out of hospital all the time. Not surprising: gettin' on in years. Suhalati checked out at 16; Chatterton croaked at 17; Galois never passed teendom... Not that I'd ever dare to compare myself with geniuses like that --heavens no -- never...

LETTER BY KEVIN SCHWARTZ

Maybe I'm just cranky in my old age, but is anyone else fed up with Hollywood's pervasive **Doogie Hauser Syndrome**? An ancient, highly contagious disease: in most books and in nearly all films and tv programs, anyone presented as a genius is really a a "closet" idiot. Don't get me wrong -- I realize Doogie is not the major conduit of this scourge; he's merely a convenient scapegoat I picked.

For those of you who play too many mind-blowing computer games to remember -- or who read too much to know -- current trashavision: Doogie Hauser, so goes his show's premise, aced the SATs at age **five**. That's a prodigious feat almost of the Pascal / Goethe / Mozart / Mendelssohn level: I think 8, 9, or 10 years old is the current record for acing the math section; for the verbal it's probably in the teens.

Okay, so Doog is this math genius cum linguistic supergenius. He attends Princeton (where else to go? smirk, smirk); becomes a doctor at 13 or 14 or something. So far so logical.

When the show takes place, as Doogie reaches his adolescence, this "genius" acts, aside from his honesty and kindness, like a typical idiotic-but-super-popular teenager. He even wraps up each episode with a tidy fifth-rate-fortune-cookie-moral of a "journal entry" -- say, "Lying is not good. But sometimes the most important part of honesty is knowing when -- and how -- to tell the truth." Okay, admittedly, I fabricated that one; but you get the idea.

As Dr. Leta Hollingsworth asked in her landmark study of gifted children: what can a six year old whose favorite book is Gibbon's The Decline and Fall of the Roman Empire possibly talk about with his or her "peers"? Wouldn't Doogie be a hopeless nerd rather than a member of the "in" crowd?

One symptom of Doogism is that when a chess game is presented --whether on the big or the small screen -- neither party, no matter how "brilliant", will notice a trap until just before checkmate. (See, for instance, Blade Runner.) C'mon! That's like yipping and howling and running right up to a wild, healthy hawk and catching it with your bare hands and breaking its neck.

During his long, long chess career -- from infant to sage -- Capablanca was NEVER checkmated. I don't mean he never lost (although I seem to recall that during a period of twelve years during his world championship he never lost or even drew a game) but he was **never** blindsided by idiocy.

Gene Siskel once complained that all but the smartest Hollywood characters "are dumber than **anyone** in real life." Oscar-winning Silence of the Lambs had the clever Dr. Lecter but compensated with the idiotic Dr. Chilton. (In the **book**, Chilton's no genius, but his fatal flaws are arrogance and ambition -- not stupidity.)

Everything's relative. In Blossom the eponymous teen is "brilliant" because all the other characters are dolts. By contrast, in Hamlet, Rosencrantz, Guildenstern, and Polonius seem like dolts because even the sentry is so much smarter than they. How many people who go around blithely saying "neither a borrower nor a lender be" or "to thine own self be true" remember they are quoting the play's chief fool?

++++++++++++++++++

You don't wanna publish the f'llow'ng fools'**crapnil**[1] -- personal; mean-spirited; un-PC; maudlin -- come t'think of it, why in hell'd you even wanna **read** it? Since you said you need Noesis fluff, I'll try't get aroun' t' sendin' g'rab'age OK4U; UU[2] soon, 'kay? If I find enough energy somehow. By the way, just now I discovered you can temporarily compensate for getting ten (rather than sixteen) hours of sleep by popping three caffeine tablets simultaneously (or drinking three pots of coffee -- but then you'd have to pee a LOT) every hour or so.

(This is an insert several days after the previous paragraph. **Don't** try that trick with the caffeine pills; you'll **seriously** regret it later.)

Believe it or not, I want to hear as much (gossip?) about you and the Mega gang as I can – from cradle to ladle. Aren't there articles on Marilyn and on Chris Harding? Maybe you wish to hear about me. Maybe not. If you do, I can send you truckloads of whiny memoirs. Anyway, I DO wanna hear all about you.

Here's a brief (by my long-winded standards) bio on me:

As the quintessential Appalling (intellectual?) Super-Snob ---- the sort who, from primary school through college, corrects teachers' misquotes; the sort who feels no guilt about "ratting" on his cheating classmates --perhaps, if we might wax psychoanalytic here, because he never felt himself in any way to be "one of the gang", so to him it was more like watching distant enemies than spying on fellow troopers); the sort who tries to discuss Godel and Lasker with a toddling brother (or anyone else with ears); the sort who whines: "You call Glass, Williams, and Sondheim **composers**? What about Schuller; Babbit; Lansky?"; the sort of AiS-S who'd find himself penning a "sentence" longer than a normal newspaper column ---- I am eager to join my "fellows" in Mega; yet as a (nervous twit); the sort who can't look people in the eye; who avoids going out in public except for rehearsals, concerts, grocery shopping, and doctor's appointments; the sort who tends to avoid all human contact except by mail ---- I am anxious that I will fail the cut.

Humans, of course, are not rational. Still, rationally speaking, it should not matter to me whether or not I can get into this society -- especially since I can write in Noesis either way, and since the cutoff is an arbitrary (and apparently unstable) line far above the section of the "curve" where tests correlate with "real stuff". But throughout my childhood I was obsessed with my intelligence -- real or imagined. Maybe I couldn't make friends or catch a baseball, but at least I was a Superbrain! My hubris / megalomania were my self-imposed consolation prize for being hated and miserable. In turn, telling your classmates you have an IQ at least twice as high as theirs only contributes to one's isolation.

When I was young I always assumed kids with super-high IQs were all hopelessly weird, like me, although somehow we'd overcome the odds and achieve Great Things. What a shock to learn of such people as Chris Cole; Keith Ramiere; Marilyn vos Savant – hardly nerds! If anything, they more resemble those "bright-normal" kids who made my life hell than they resemble me. Chris Harding sounds a little like me; but maybe Doogie's the norm for bright folk after all.

---

[1] The ghost of James Joyce will surely exact his revenge for this sorta thing.

[2] Is the appending footnotes to personal letters is the main symptom of a future serial killer? Recently I wrote Hamlet's II, ii soliloquy in dumb rebus. It included a few tubes shaped like the vowel... Anyway, here's a translation into humanspeak of "OK4U; UU": "Okay for you to use".

I don't know the root of my problems, except that my mother's family seems to have lots of artistic and musical talent, and even more phobias, learning difficulties, etc.

My father's side -- including my brother Brandon (Princeton '97) -- is EXTREMELY athletic, although I am a wretched athlete, a miserable klutz. In gym class I was the kid picked last (even after the last girls!); the one neither team captain would accept, even in last place; the one who struggled to lift a two-pound ball bearing off the floor while snickering classmates counted reps at the 120-pound bench-press.

Some teachers called me a genius and lectured me for not paying attention but rather staring out the window; others called me retarded and dismissed my standardized test results as abborations (I see that typo now, but, like Nabakov's H-H, I'll let it be!). Every day, before school, after school, and unless it rained and I could spend recess in the library, during school, I got beaten up. I don't remember ever losing consciousness -- but that's kinda like the cliche, "If you're not here, raise your hand."

Sulking at home, I read historical geniuses and the beatings they took as tykes and said to myself: "Some day I'll show THEM!!" Figuratively, I dusted off a shelf so once I hit my teens, I'd have a place to show off my Nobels and sundry awards. Tah-dah!

It is all the more infuriating to finish school and find myself back where I started: at the dregs of the American caste system. My father has little patience with or tolerance for me; he has excelled in every field he has ever attempted, from games (athletic; strategy; computer) to engineering to toxicology to legal consultation to systems analysis.

One reason I join IQ clubs is that in school I sought the most intellectual (nerdy?) crowd -- only there did I feel safe. Like Norman Bates' libido and his imaginary mother, so kindness and intelligence blurred pathologically in my "teaming brow".

Recently submitted string theory puzzles to The Mathematical Intelligencer. Must finish this letter before my caffeine high bursts. POP!!

Adoringfully yours,

Kevin L. Schwartz

[Editor's comments: Send dialogue on time travel. Here's Harding's address if you wanna write him direct--P.O. Box 5271, Rockhampton Mail Centre, Queensland 4702, Australia.]

AD (?) FROM KEVIN SCHWARTZ

New Test Validation

A hearty thanks to those who submitted solutions to puzzles in previous issues of [redacted]! Your invaluable if unwitting contributions permitted the norming of the Schwartz Noetic Omnivergence Test. Brilliantly fusing AQ, EQ, IQ, creativity, and personality assessment, SNOT infinitely extends the boundaries of psychometrics, rigorously measuring not merely your *present* mental and spiritual state, but also your *once* and *future* states:

have : hold :: heave : ?
pursue, purse, pure : hortatory, oratory, tory :: phenomenon, phenome, no : ?

Scores reflect not solutions but thoughts leading to them. In taking the first test to analyze its own analysis, you reach Wahhtnirvana and, with a high enough score, find the Meaning of Life; but as this constitutes cheating, your test is invalidated. SNOT is neither timed nor untimed, but please use only 8-dimensional vector space. SNOT is accepted by all High IQ Societies and most stores. For a free trial copy, just send $ 4 50. (U.S.) to:

The Institute for Superduper Potential
314 Pyahrr Square
Hubris, Ontario I4C - UR0 CANADA

[Editor's comment on next letter: The GRE is a test people take to be considered for admission to graduate school. It's supposed to show your level of something like knowledge compared to other applicants. Only one school that I know of uses it to grant undergraduate credit. Under the semester system, 30 units equal one year of classes; 120 units is the minimum for a BA. Some schools run on trimesters. For them, 45 units equal a year and 180 units are the minimum for a degree.
Under the semester system, a student is (was) expected to take 15 units per semester, which is supposed to equal 15 hours a week spent in class.]

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From: HiQ Systems, P.O. Box 21766, 3001 AT Rotterdam, The Netherlands

Rick Rosner
5139 Balboa Blvd #303
Encino, CA 91316-3430
U.S.A.

Rotterdam, May 22, 1993

Dear Rick:

Please find enclosed a ten-dollar bill --the address label on the April issue of Noesis showed the word LAST in bold letters, and I suspect this has something to do with the upcoming expiration of my Mega membership... (If you're not the one who gets the Money, could you please forward it to whoever acts as our treasurer? Thanks.)

(Side thought: if I.S.P.E. members are "Thousanders", are we "Millionaires"?)

Some time ago, I sent you a copy of my "Old Wor(l)d Test" for inclusion in Noesis --did it ever reach you? If you do print it, please do not print the answers that most of our members will undoubtedly come up with (cf. Quest Test) --as I intend to offer the test to a magazine, I'd like to keep the answers confidential for the moment!

I'm still interested in a Membership Roster, especially now that I'll be going to the U.S. in August --do we have such a list, and if so, could you provide me with a copy?

What exactly is the "status" of a GRE (bloody foreigners! have to explain them everything, don't you?)? Are they the equivalent of a university degree (a BA, an MA)? Does "180 semester units of credit" mean that you've accumulated the equivalent of 90 years in university (or 60 years, if you divide the year into 3 "semesters"...)? Please let me know, I'd love to obtain degrees in subjects I know nothing about! (And there's quite a lot of them around; that's why I am a "consultant"!) Jokes aside, do drop me a line if you can find the time. My address is good until August 1; I'll inform you of my new address A.S.A.P.

Best regards,

Marcel Feenstra

The Old Wor(l)d Test

All IQ-tests, especially the ones that emphasize verbal abilities, contain an element of cultural bias. Since a lot of (high level) tests have been created by Americans, many inhabitants of the Old World must have felt that they were at a distinct disadvantage when they took those tests.

The following test (my thanks to Daryl Inman for his suggestions!) in a way "reverses the situation": the fifty verbal analogies all have something to do with Europe --its literature, religion, science, politics, mythology, etcetera.

I hope that I will be able to present this test to the general American public (through publication in a magazine with a wide circulation). First, however, I'd like to norm it as adequately as possible, and I am asking the members of the Mega Society to help me with this.

I am unable to write to individual participants, but I would like to publish the results of the norming process in Noesis. Therefore, I am asking you to submit, along with your answers, a code of your own invention, consisting of TWO LETTERS followed by FOUR DIGITS (e.g. QT1412). Also, please provide the results of previous IQ or aptitude tests you have taken. (You may include other data such as your name and address, but this is not necessary: you can participate anonymously if you want!)

Please send your anwers, code and IQ-scores (as well as any comments you may have) to:

Marcel Feenstra
P.O. Box 21766
3001 AT Rotterdam
The Netherlands

Also, please mention "Noesis".

Instructions

The Old Wor(l)d Test is an untimed, unsupervised analogies test. (A one month completion time is suggested.) You may use any reference materials, but may not ask other persons for help, or use computers. There is no penalty for guessing.

Provide the word or number that best completes each analogy. For example, in the analogy *American : (is to) Astronaut :: (as) Russian : (is to) ?* the best answer would be *Cosmonaut*.

1. 1 : 12 :: Penny : ?
2. Bull : Swan :: Europa : ?
3. Blavatsky : Steiner :: Theosophical : ?
4. $2^n + 1 : 2^n - 1$ :: Fermat : ?
5. Kypriaki Dimokratia : Kibris Cumhuriyeti :: Greek : ?
6. Offender : Victim :: Verlaine : ?
7. 13 or 15 : 5 or 7 :: Ides : ?

8. Kinshasa : Léopoldville :: Jakarta : ?
9. Parabolic : Elliptic :: Euclid : ?
10. Latin : Greek :: INRI : ?
11. Boulder : Liver :: Sisyphus : ?
12. Dichtung und Wahrheit : Die Geburt der Tragödie aus dem Geiste der Musik :: Goethe : ?
13. Restricted : Unrestricted :: Currency Theory : ?
14. Two wings : Eight legs :: Pegasus : ?
15. Oldest : Youngest :: Wordsworth : ?
16. Constantine : Augustine :: In hoc signo vinces : ?
17. 8/24/1572 : 11/9/1938 :: Massacre of St. Bartholomew : ?
18. The wing wherewith we fly to heaven : The curse of God :: Knowledge : ?
19. Mistral(2) : Fleming :: Mistral(1) : ?
20. Tancrède : Tartuffe :: Arouet : ?
21. Nemean lion : Erymanthic boar :: 1 : ?
22. Hot air : Orbiting rotor :: Stirling : ?
23. Greek : Latin :: Septuaginta : ?
24. U.S.A. : U.K. :: AWACS : ?
25. Amphitrite : Poseidon :: Hera : ?
26. 88 : 90 :: 1898 : ?
27. Kortrijk : Rijsel :: Courtrai : ?
28. Christians : Jews :: Old Testament : ?
29. Zamenhof : Schleyer :: Esperanto : ?
30. Exception : Hypermnestra :: Rule : ?
31. Un sommeil : La vie :: Le rêve : ?
32. Extrovert : Persona :: Introvert : ?
33. English : Portugese :: Spleen : ?
34. International Council of Women : Woman's Social and Political Union :: Anthony : ?
35. Rosetta Stone : Hittite cuneiform :: Champollion : ?
36. Lutetia : Paris :: Stabulum : ?
37. 9,192,631,770 : 1,650,763.73 :: Second : ?
38. Hercule Poirot : Arsène Lupin :: Christie : ?
39. Majorca, Minorca, Ibiza, Formentera : Ibiza, Formentera :: Balearic Islands : ?
40. Honi soit qui mal y pense : Nemo me impune lascessit :: Garter : ?
41. Anglicus : Gallicus :: Rachitis : ?
42. Amsterdam : Rotterdam :: Artis : ?
43. Die Welt als Wille und Vorstellung : Logischer Aufbau der Welt :: Schopenauer : ?
44. 30 : 32:: Gard : ?
45. Rodrigo Diaz de Vivar : Dolores Ibarruri :: El Cid : ?
46. Tasavalta : Népköztársaság :: Finland : ?
47. St.-Aldegonde : Lisle :: Wilhelmus : ?
48. 5 : 1 :: Evaristus : ?
49. First : Second :: Seanad : ?
50. Le soir : Le matin :: Idolâtre : ?

Thanks for helping me norm this test!