PORTHOLES AND PLATE GLASS

Occasionally we feel called upon to justify the fact that we grind portholes of plate glass and not Pyrex.

Portholes and plate glass have been rejected by our assailants usually on one of four counts:

1) Plate glass mirrors are said to be harder to figure because of thermal instability of the soft glass. This is unquestionably true to a small extent. The glass is more easily distorted by the temperature of the water, by the heat generated during polishing, and by the heat from the hands. However, these problems can mostly be obviated by doing most of the polishing upside-down, i.e. with the tool on top (so that the hands do not heat the back of the mirror blank) and by using only lukewarm water on the mirror face in fine-grinding and polishing. Furthermore, these problems show up only as small difficulties, and only in the figuring of the mirror curve, and have no bearing on the final performance of the mirror.

2) Porthole mirrors are said to be thermally unstable in performance due to the distortion of the curve by the more rapid cooling of the front surface on exposure to the night sky. Although theoretically this would be true, our experience is that in almost any situation in which this problem would arise, the turbulence in the tube will be so great as to mask it. If the telescope is kept in a warm place before being exposed to the cool night sky, air currents set up in the tube by this foolishness mask all optical defects (except the diffraction pattern of the spider mount) for most of an hour.

3) Porthole glasses and other plate glass blanks are said to be too thin and therefore subject to bending in the telescope. This is no problem at all if the mirror is properly mounted. We have an 18" telescope in Sacramento only 1 ¼" thick, which on a good night shows clear black sky between each pair of stars in Epsilon Lyrae. It hangs on a strap and rests against a nine point suspension system on the tailgate. The suspension system is mad of thin cardboard, Masonite, and ¼" plywood. Also, thin blanks reach thermal equilibrium more quickly than the thicker Pyrex blanks, both in polishing and in use.

4) Heat-treated portholes are said to gradually change shape on long standing, due to the release of internal strains set up in the heat treatment. We have yet to see this sort of distortion in any of our mirrors. If the glass has been lying around for twenty or forty years

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since its manufacture (as most of our portholes have), it is doubtful if the distortion due to strain release will be detectable within the next 100 years. However, if a mirror is dropped and broken, even slightly, the strain release becomes immediately apparent, and the mirror may require refiguring.

Finally we have this to say to our assailants: Let's handle first problems first! The first problem is, "Shall we or shall we not make our own telescope?" Many of our assailants, through fear, have answered this question in the negative. We have answered it in the affirmative.

The second problem is, "What shall be the aperture of our mirror?" Many of our assailants have settled for very small mirrors, 6" or under, for fear that a larger one would be too costly or too difficult. We prefer the cheaper glass in larger sizes. A 12" porthole will wipe out a Pyrex 8".

The third problem is the turbulence in the tube, which is best handled by using a ventilated tube; by keeping the telescope at near outdoor temperatures; and by turning the tube over from time to time.

All the rest of our optical problems are miniscule compared to the aforementioned four.

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RODS AND CONES

There are two kinds of sensory cells in our eyes – the rods and the cones – and they have very different functions. The cones, which I call ladybird beetle cells, are very sharp about color and detail, but very stupid about dim objects. On the other hand, the rods are totally stupid about color and detail but are fairly smart about very dim objects. And, as you must have noticed, in the daytime, with your cone cells, you can see the leaves on the trees. But at night, with your rod cells, you see only the trees. That's because your cone cells go off duty in the dark.

Now, to do their job nicely your rod cells need some help. Their effectiveness is spoiled by exposure to bright light. That's why you can't see very well at night just after someone shines a flashlight in your eyes. The bright light does two things to your eyes. It closes down the aperture of your pupils which let the light in, and it bleaches out a chemical which the rods use for seeing in the dark. And, although the aperture of the pupil can be quickly readjusted, the replacement of the chemical takes some time.

The eyes produce a light sensitive pigment called rhodopsin. It is also called "visual purple." The rod cells use it to help us see in the dark, and it's made out of Vitamin A. That's why we're told to eat carrots to improve our night vision. However, you can get only about one percent of the Vitamin A out of carrots by munching them down raw. You can get nearly twenty percent by cooking them, and over ninety percent by juicing them. Incidentally, spinach and other thin-green leafy vegetables have lots more Vitamin A than do carrots.

The eyes continually produce rhodopsin, but in the daytime it is continually bleached out by light. And it takes quite a long time for the rhodopsin to build up to full capacity. That is why when someone shines a bright light in your eyes at night it takes quite a while before you can see as well as you could see in the dark before. You may have noticed that sometimes, when you wake up very late at night, the room looks a lot brighter than it did whey you went to bed. And, although there may have been no change in the actual brightness of the room, it appears brighter because the rhodopsin has accumulated in your eyes and increased your ability to see in dim light. We say that your eyes have become "dark adapted." It has been pointed out that total adaptation to the dark may take some forty-eight hours.

It has often been suggested that when you are looking through a telescope at very dim objects you should go to very low power to make the image as bright as possible. But this advice is extremely misleading. It completely overlooks the fact that very dim objects can be seen only with the rod cells. And it overlooks the fact that the rod cells are stupid about detail. If the object is too dim to be seen by the cone cells, it is hopeless to go to low power. Try it yourself.

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SENTIENCY

When we consider the origin of what we see in time and space as this Universe, the first question that arises is this: did the Universe come out of existence or could it have come out of non-existence? Shall we, like the mystics, take existence for granted, or shall we, like the Big Bang cosmologists, take non-existence for granted? The mystics take existence for granted and want to get from here to There, and that will wash. But the Big Bang cosmologists take non-existence for granted and want to get from There to here and that will not wash. There is no laundry that will take it. So let us, on observational grounds, take existence for granted and ask what might exist in the absence of the Universe and in the absence of time and space.

If what exists in the absence of time and space is not nothing (not zero), then it must be changeless - not in time, and infinite and undivided - not in space. But the question still remains: why do we see it in time and space? And what is the origin of our concept of time and space?

Einstein was very concerned with this problem and he concluded, "...that the formation of the concept of the material object must precede our concepts of time and space." It would seem then that it is our "genetic programming" that imposes on us the concept of the material object through our identification with a material organism.

So then it must be our "genetic programming" that veils the Changeless, the Infinite, and the Undivided and projects the changing, the finite, and the divided in its place – in which we nevertheless see the Changeless as inertia, the Infinite as electricity, and the Undivided as gravity. But if it is our "genetic programming" that pulls the wool over our eyes we shouldn't complain. After all, the eyes themselves are genetic, and the eye invented the brain.

In the long history of genetic evolution our brain was invented by our eyes. Among the *protists* (the single-celled organisms with a nucleus, which the bacteria lacked), the *Euglena* has a little orange spot to tell it where the light is, and flagella to get it there. Long later, when the eyes became more complicated, they need an organ to interpret what they saw and they made it out of flagella. That is the brain, and that's why flagella protein occurs in the brain. So cheer up! The genes that pull the wool over our eyes made the eyes themselves, and then the brain.

Now the European physicists and philosophers took for granted that matter is both insentient and inert. The Sankhyans in India took for granted that matter is insentient but "ert" (active). The Vedantins in India took for granted that matter is both sentient and ert. How could anyone who lives in an earthquake zone take for granted that matter is inert? We don't push those mountains

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around; they push each other around. And if the stone didn't know where the Earth is, it would certainly not fall *toward* it.

Now the Vedantins say that in order to mistake a rope for a snake, you must fail to see the rope rightly through the *veiling power* of *tamas*, and you must jump to the wrong conclusion through the *projecting power* of *rajas*. But you must have seen the rope in the first place through the *revealing power* of *sattva*, or the mistake might have taken some other form.

Now the interesting thing is this: our "genetic programming" appears to have *veiled* the Changeless, the Infinite, and the Undivided and *projected* the changing, the finite, and the divided in its place. So we see that the veiling and projecting powers are native to our "genetic programming." But the revealing power is native to sentiency itself. It is the sentiency inherent in matter and ourselves that allows us to see the Changeless showing through as inertia in matter and as the search for peace and security in ourselves. It is that sentiency that allows us to see the Infinite showing through as the electrical charge on the miniscule particles of matter and as the search for freedom in ourselves. Finally it is the sentiency that allows us to see the Undivided showing through as gravity in matter and as love in ourselves. And sentiency is native to existence itself.

Bravo, the genes! But keep your eyes open! That which is beyond the genes is really what you are.

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1991

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SHADOW OF THE MOON

The tidal effects of the Earth on the Moon have long since stopped the spin of the Moon with respect to the Earth, so the Moon now keeps the same face toward us. But the Moon still spins once a month with respect to the Sun. And we can watch that from the Earth. In a little over two weeks the Moon waxes from new to full and then, in a little over two weeks, it wanes from full to new. If you lived on the Moon, the Sun would come up only once a month and stay up for two weeks at a stretch, and the rocks get hotter than boiling water. And, although on the Earth when the Sun sets over the mountains, you can still find your campsite, on the Moon, when the Sun sets over the mountains, all you could see would be stars.

Now the plane of the Moon's orbit around the Earth is not in the plane of the Earth's equator, so, as seen from the Earth, the Moon goes north and south once a month. Sometimes it crosses through the shadow of the Earth and we have what is known in the trade as an eclipse of the Moon. But the Earth is much bigger than the Moon, so the total shadow of the Earth (the umbra) more than covers the whole face of the Moon. If you were an astronaut on the Moon at that time you would see sunset light all around the edge of the Earth. That is why, as seen from the Earth, there is that lovely reddish glow on the face of an eclipsed Moon.

Occasionally when the Moon crosses it goes between us and the Sun, so that then we see only its shady side, and in the darkness of the sky around the unlit face of the Moon we see the Sun's corona. And great excitement ensues.

The Moon is much smaller than the Earth, so sometimes, when the Moon is a little too far away in its elliptical orbit, the tip of the Moon's total shadow (the umbra) doesn't quite reach the Earth surface, and so we see the disk of the Moon not quite covering the disk of the Sun. We see a little rim of the Sun's disk around the Moon. This is known in the trade not as a total eclipse of the Sun, but as an annular eclipse. If the Moon when it crosses between us and the Sun is a little closer to the Earth then the tip of the Moon's shadow moves across the face of the Earth as a shadow in the sunlight a few miles wide. This August the path of the Moon's shadow crosses Europe where, if the weather is clear, many people will have the opportunity to bask in the shadow of the Moon.

But wait! The tidal effect of the Moon on the Earth is slowing the daily spin of the Earth and our days are getting longer. The "Exterior Decorator" has rules. You can't get rid of angular momentum. You can push it around or cancel it with an equal and opposite angular momentum, but you can't just make it disappear. So the angular momentum of the Earth's spin is being transferred to the Moon's orbit and the Moon is going further away. So after some time (and I won't say

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how long) we won't see any more total eclipses of the Sun because the Moon will be too far away to let the tip of its shadow move across the face of the Earth.

So, COME BASK IN THE SHADOW OF THE MOON WHILE YET YOU CAN!

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SOME SUNNY THOUGHTS

When you burn a log in the fireplace it burns to carbon dioxide and water, and a bit of ash. It was originally carbon dioxide and water in the forest, and, with the help of sunlight, the tree made it into wood. It threw the oxygen out as waste and left the sunlight inside. Then you, with the help of the oxygen in the air, burn it back to carbon dioxide and water, and that sunlight heats your house.

The many things we think we do, we really don't. They are all driven by the energy of sunlight. When you watch a football game, it's just sunlight recycling itself on the football field.

My steps, when I walk the Golden Gate Bridge, are similarly driven by the energy of sunlight. They are driven by the oxidation of the reducing agents made, with the energy of sunlight, by the plants in the wheat fields of Kansas, in the vineyards and pastures of California, and in the pineapple plantations of the Philippines. They are driven by the sunlight on the orange groves of Florida and California, on the cane fields of Hawaii and Brazil, and partly by sunlight that fell on the ocean off Cape Cod.

Although the reducing agents which we eat may have come from far and near, they were made by plants in the recent past, whereas the oxygen which we breathe has been thrown out as waste by all those green leafy things over the past hundred million years.

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STRUTS AND WRAPPERS

Telescopes come in different types, some in tubes and some in struts and wrappers. Struts and wrappers come apart and pack in little spaces, and therefore win in transportation. But tubes win out in viewing because they're dark inside with thermal insulation.

However, the tubes are harder to get around. The tube of our old twenty-four incher (Delphinium) is thirty inches in diameter and twelve feet long, and it doesn't pack in little spaces. (But it sleeps two, end to end, and you can't roll out of bed.) Although it's hard to get around, the tube makes it easy to set up the telescope. The box goes in the rocker, and the tube goes in the box.

Struts take longer to put together (some assembly required), but they have the big advantage in making it easy to get the telescopes out for public use. And, after all, that is what matters. The struts require wrappers, or shrouds, to keep out the turbulence of the air near the ground, and to keep out stray light. Therein lies the problem. Most shrouded telescopes wipe out to their shrouds because of thermal conductivity. The upper surfaces of the shrouds cool off by exchanging infrared radiation with the night sky, while the bellies or lower surfaces stay warm by exchanging infrared radiation with the ground. Then, if the wrappers or shrouds are not thermally opaque they transfer these temperatures to the air column inside and seriously disturb the viewing.

It is a usual thing at Star Parties, even on good nights when the atmospheric turbulence is low, to see oversized star images in these shrouded telescopes. When you throw the eyepiece out of focus you can see the eddies of the cold air coming down from the ceiling and the warm air coming up from the floor. This internal disturbance can be largely controlled by wrapping the shroud in some lightweight, thermally insulating wrapper like a Space Blanket. The collar that holds the diagonal and any light shield beyond it have the same problem. They should be thermally opaque.

Years ago in Alberta, Canada, I was asked to check an eighteen-incher f/6 in struts and wrapper, and with a lightweight extra collar beyond the eyepiece to control stray light. The problem was in the telescope, not in the night sky. One third of the problem was in the extra collar, and another third was in the shroud. Only one third was in the eyepiece collar and the rest.

In the sixties the telescopes one saw at the Star Parties were small, like sheep grazing on the knolls. But now we see eighteen and twenty-inchers running over the hills like cattle. Most of these larger telescopes are in struts and wrappers. Now these larger telescopes are much more beset by turbulence problems than are the smaller ones. This is because if you consider the large aperture as made up of many smaller apertures you can see two things. First,

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the effect of the turbulence on the smaller apertures is twofold. It blurs them a little and it makes them dance. Second, in the image from the full aperture, they dance out of step. It is the dancing out of step that blurs the image in these larger telescopes. That is why it is so important that the shrouds and the collars on the larger telescopes with struts and wrappers should be thermally opaque.

That is also why, when the atmospheric turbulence is obstructive, we use aperture masks on our larger telescopes to give us unobstructed reflectors with smaller apertures and longer focal ratios.

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THE BIG BANG

Is it possible to get a child *to go along with the notion that the Universe arose out of nothing, that is, that nothing made everything out of nothing?*

It may be *impossible* to get anyone who has not been through high school to go along with such a notion, and I'm pretty sure that all the Big Bang cosmologists went through high school first. So let's put the Big Bang cosmology in the subjunctive.

If we can get nothing to make everything out of nothing, we could get started. But shucks, our fire-ball would be in a black hole.

Oh, *if* we can hold off on the physics of black holes, we can get our little fire-ball to expand and cool off to material particles. But shucks, it would be fifty-fifty matter and anti-matter. So how can we get rid of the anti-matter?

Aha, *if* we can invent two radioactive particles, one that makes anti-matter out of matter, and one that makes matter out of anti-matter, then we can get rid of the anti-matter because the particle that makes matter decays more slowly and leaves this Universe as the residue. But shucks, the particle that makes matter out of anti-matter and decays more slowly, decays to magnetic monopoles and leaves us a Universe billions of times denser than the Universe which we actually see. So how to get rid of the monopoles?

Well, *if* we can get the protons to decay, we can have a grand unified theory, and *if* we have a grand unified theory we can have an inflationary model and get rid of the monopoles. How? We simply allow a pimple at the edge of the expanding fire-ball to inflate to the Universe we see, and leave the monopoles behind. But again shucks. The inflationary models require that the present cosmological expansion rate should be on the escape velocity, and that requires that there should be at least 10 times as much matter in the Universe as we thought was there. That would mean that the observed cosmological helium abundance, on which we based our Big Bang model, would be wrong for our model unless all that extra matter, the so called "dark matter", responds only to gravity and to no other force.

But there is still a problem. *If* the dark matter responds only to gravity, why didn't it all fall into the galaxies? Oh no, it can't fall into the galaxies because it can't get rid of its gravitational energy.

Then it wouldn't be in the haloes of the galaxies either, and that's where it is.

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But however much one may doubt the Big Bang model, it isn't fair to make fun of it without replacing it with something which one feels to be more likely.

So let's stick to the observations. When we look out toward the border of the observable Universe, imposed on us by the cosmological expansion, what we see is that the radiation from there is gravely redshifted. That would mean that, as seen by us, the energy of the particles, and therefore their mass, is gravely reduced. Remember, we're sticking to the observations. *Observationally* the mass is reduced, and that has two very interesting consequences. First, all radiation running through such a field of low mass particles would be so often picked up and reradiated that it would be thermalized to 3^0K and give rise to the cosmic background radiation discovered by Penzias and Wilson in 1965. Second, the particles could recycle from the border. That is because if the mass of the particles is small, their momentum must also be small. And, if the momentum approaches zero at that border, our uncertainty in that momentum must also approach zero. Then, by Heisenberg's Uncertainty Principle, our uncertainty in their position must approach totality, and the particles can recycle back in.

Is there any observational evidence that particles are thus recycling back in by tunneling? Yes, indeed there is. Measurements by the Hubble Telescope indicate that there are some 9 to 12 clouds of hydrogen between the Quasar 3C273 and ourselves. According to the Big Bang model, there shouldn't be such clouds since there is no way to put new hydrogen in there, and no way to have such clouds hanging around for 15 billion years without condensing into something we could see. Measurements by the Hubble Telescope also indicate that there is more than enough hydrogen in the great intergalactic voids to make all the known galaxies. Where did all that hydrogen come from if it didn't recycle from the border?

The driving mechanism for the cosmological expansion in this Bang Free model is simply the loss of energy by the redshifting of the radiation. If the radiation looses its energy by redshift because of the expansion, it drives the expansion. The mechanism for the cosmological expansion in the Big Bang model stands without explanation.

It may be asked, what does this "Bang Free" cosmological model predict? Since it is a steady state model, it predicts that the Universe must have frustration built in or it couldn't go on like this.

The ocean is trying to fall to the center of the Earth but the rocks are in the way, and it gets frustrated. And the rocks are trying to fall to the center of the Earth but the iron of the Earth's core is in the way, and it gets frustrated. And the Earth is trying to fall into the Sun but its inertia frustrates it, and it goes round and round. And the Sun is trying to fall into the center of the Galaxy and it goes round and round. The Galaxy itself is trying to merge with all the rest of the matter in

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the Universe but the cosmological expansion frustrates it. But even the expansion can't succeed because it recycles the particles back from the border. *If the Universe didn't have frustration built in, it couldn't go on like this.* And if it couldn't go on like this, all the steady state models would be dead.

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THE BIG BANG:
"A Thing of Rags and Patches"

Looking out at the Universe at large, what we see is that all the distant galaxies appear to be running away from us in such a way that the farther away they appear to be from us, the faster they appear to be running away. Thus, at some 15 billion light years from us they would be receding at the speed of light. It is this so-called "expansion" that imposes a border to our observable Universe because no message, whether electrical (electromagnetic) or gravitational could be received from something receding at the speed of light.

Actually what we see is that the spectral lines of those distant galaxies are redshifted toward the low energy end of the spectrum, and that is usually taken to mean that those galaxies are going away. But the border is imposed on us by the redshift itself.

If this apparent expansion rate could be doubled the resulting border would be closer because those distant galaxies would reach the speed of light at only 7.5 billion light years away instead of 15.

Now the simplest and most straightforward explanation for this apparent expansion is that long ago there was this great explosion which has been dubbed the Big Bang (you must have heard of it), and that is why all the distant galaxies are seen to be running away. Now you must not suppose that this Big Bang model was invented out of whole cloth. It was not. Like the Steady State model that followed it, it was invented to explain this apparent expansion. But now the old Steady State model is dead, and the Big Bang is "a thing of rags and patches."

THE DEATH OF THE EARLY BIG BANG MODELS

The Big Bang models in their early days faced some very interesting problems. If the explosion had gone off at greater than the escape velocity, so that gravity could never have halted the expansion, then nothing in the Universe could ever have run into anything else in the Universe ever again. We could have never gotten any galaxies and stars out of it. (If a hand grenade explodes in mid-air the pieces of the hand grenade do not run into each other.) But cosmological models which do not allow for galaxies and stars are considered to be flawed. So those old models have been laid to rest with headstones in the graveyard.

Even if the explosion had gone off at less than the escape velocity, it would still have been no better because then the Universe would have long since

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collapsed to what is known in the trade as the "Big Crunch". So those models, too, have been laid to rest.

That left us with this problem: why should this accidental explosion have gone off at just the escape velocity with such very tight constraints? This problem was patched with the "Anthropic Principle". Since we know from Quantum Mechanics that there is no longer any talk of a Universe without an observer, and since we see no way to get observers without galaxies and stars, the explosion had to come out exactly at the escape velocity in order that we could be here to worry about it. It had to come out at the escape velocity in order that the Universe could exist at all.

On quite independent considerations, the early Big Bang models had another problem: why is the Universe made of matter rather than half matter and half anti-matter? It had long been known that radiation cooling off to material particles cools off to 50% matter and 50% anti-matter. And it was known that when these particles find each other once again, they disappear into radiation. So the problem is: how could the fire-ball, which was too hot to be anything but radiation, cool off to a preponderance of matter over anti-matter? That is, cool off to more protons than anti-protons and to more electrons than positrons?

This problem was then patched with the X particles, which make matter into anti-matter, and the anti-X particles, which make anti-matter into matter. Then, since the X particles decay more rapidly that the anti-X particles, we are left with a preponderance of matter over anti-matter. Splendid solution! But the anti-X particles, which decay more slowly, decay into magnetic monopoles, which we do not find. Too bad! That is known in the trade as the "monopole problem". OK, so how can we now get rid of the monopoles?

The patch on this repair job is perhaps the most ingenious of them all. We allow a little bubble on the side of the monopole Universe suddenly to inflate into the Universe which we see. In addition to leaving the monopoles behind, these inflationary models automatically yield a Universe expanding at the escape velocity so we don't need the "Anthropic Principle" anymore. Good! But that lands us in what is known in the trade as the "dark matter" problem. Most of the matter in the observable Universe would have to be something which we have never discovered, something invisible which responds only to gravity. Otherwise the Helium prediction would be wrong.

One of the early predictions of the Big Bang model was the cosmic abundance ratio of hydrogen to the two isotopes of helium and to deuterium and lithium. This was long ago confirmed observationally, and was one of the strong arguments against the Steady State. But that early prediction would hold true only if not more than 10% of the matter in the observable Universe predicted by the inflationary models is ordinary matter out of which those substances can be made. Consequently, the inflationary models predict that some 90% of the

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matter in the observable Universe must respond only to gravity and not to nuclear forces or to any other force such as electricity or magnetism which might allow us to detect it. Vera Rubin, among others, found that most of the "dark matter" is not in the visible portions of the galaxies, but in their haloes.[1] The question then is this: why is the "dark matter" found in the haloes of the galaxies and not in the galaxies themselves? Why doesn't it all fall in? (It should be noted here that this is a problem only for the Big Bang models. The Steady State models predict that most of the matter in the galactic haloes should be ordinary matter blown out by the galactic winds.[2] That, as I see it, is where the patchwork now stands.

HOW WRONG COULD WE BE?

Just because the Big Bang still has problems doesn't mean that the Steady State is right. And just because the Steady State had problems doesn't mean that the Big Bang is right. The fact that we can think of only two models does not prove that one of them is right.

THE DEATH OF THE OLD STEADY STATE

Back in the 50's and the 60's the Big Bang theories faced a competing cosmological suggestion by Bondy, Gold, and Hoyle called the Steady State model. And it too can now be found in the graveyard along with the older Big Bang models. But unlike them, the Steady State model died without descendents. The descendents of the old Big Bangs, though heavily patched, still live in the halls of academia while the old Steady State has succumbed. This was partly due to the difficulty, pointed out by Fred Hoyle himself, that it could not account for the cosmic abundance of the light elements.[3] And partly to Penzias and Wilson's discovery of the 3^0K microwave background radiation which was taken to be the proof of the Big Bang and the tombstone of the Steady State.

THE RAISIN PROBLEM

The Big Bang models have been compared to a raisin pudding in the oven. As this pudding gets larger and larger, the raisins get lonelier and lonelier so that if you come too late for dinner, there may not be any raisins in your spoon. But the Steady State people suggested that as the raisins get lonelier and lonelier, new raisins might spring up in between, so "it don't make no nevermind" how late you come for dinner, there might be 5 or 6 raisins to a spoon. Well, the Big Bang people didn't like that one bit, and so they asked, "Where did you get those new raisins?" And the Steady State people replied, "Where did you get yours?"

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Now I have problems with all these models. They don't have a raisin store. They all have the Universe coming out of *nothing*, and with no driving mechanism for the observed cosmological expansion. For the Big Bang models, the energy of the fire-ball explosion is simply thrown in.

THE RAISIN STORE AT 3RD & K (THE BORDER)

So let's take a careful look at the border conditions in the light of Relativity Theory and Quantum Mechanics to see if we can come up with a new model. As mentioned earlier, the observable Universe has a border, some 15 billion light years away, imposed on us by the redshift of the spectral lines of the apparently receding galaxies. (If the energy of the spectral lines is redshifted to zero, no messages, either electrical or gravitational, can be received by us.)

But what do we see near the border? We see that if the energy of the radiation approaches zero, so does the energy of the particles giving rise to that radiation. Yet we also know from Einstein's Special Theory of Relativity (1905) that if the energy goes to zero, the mass also goes to zero. (What we see as matter is just potential energy by E=m.) Now there are two very interesting consequences if the mass near the border approaches zero.

First: it is well known that radiation going through a field of low mass particles will be so often picked up and re-radiated that it would come out thermalized to 3^0K. The amount of background radiation predicted by this model is what we actually measure, whereas the amount predicted by the Big Bang models is some two orders of magnitude too high.

The second consequence is that the particles themselves must recycle from the border. We know from Heisenberg's Uncertainly Principle (1925) that the product of our uncertainty in a particle's position and our uncertainty in its momentum can never be less than Planck's constant over 2 pi. But if the mass of the particles approaches zero, so does their momentum and our uncertainty in that momentum as well. (You can not have a very large uncertainty about a very small quantity.) Then, from Heisenberg's Uncertainty Principle, our uncertainty in where the particles are must approach totality. Hence, the particles simply "tunnel" back in.

[You must remember that electrons and protons are not things like tables and chairs. They do what "things" cannot do. They are like dollars in the bank. There is no "this one," no "that one." When an electron goes from one energy level in an atom to another it does not slide down the wall. It simply disappears from the one and reappears in the other, and the physicists even have a name for it. It is called "tunneling". If someone writes a check on a bank in Santa Barbara to a bank in Portland, no one goes down in a truck to get the money. It

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just disappears in Santa Barbara and reappears in Portland. You must have noticed. Electrons and protons are like that.]

So the particles tunnel back into our observable Universe with all their negative entropy intact. And curiously enough this is also required even in the Big Bang models. Heisenberg's Uncertainty Principle requires it. There can be no Maxwell's Demon, and there is no subjunctive clause in Heisenberg which allows you to say, "If I were at the border the particles would be fine." The observer is *always* at the center of the observable Universe. [He can't get to the border.]

LET'S HAVE A LOOK

Now you might ask, "Is there any observational evidence that the particles might recycle from the border?" Yes there is. It has recently been determined that there are huge clouds of hydrogen in what were previously thought to be the voids between the great walls of galaxies.[4] These clouds contain enough hydrogen to make all the known galaxies. Also, the Hubble Telescope's measurements of the Lyman Alpha Forest (the hydrogen absorption lines) between the Quasar 3C273 and ourselves indicate that there are some 9 to 12 hydrogen clouds between us and it.[5] The Big Bang has trouble explaining such clouds, whether of new hydrogen or of old hydrogen uncondensed to galaxies and stars in 15 billion years.

You might also ask, "Does this new model have a driving mechanism for the observed cosmological expansion?" Yes it does. If the redshift of the stellar radiation caused by the cosmological expansion robs that radiation of its energy, then that robbed energy must drive the expansion. You can't get rid of energy any more than you can get it out of nothing. As the German physicist Rudolf Clausius said, "Die Energie der Welt bleibt constant; die Entropie strebt einem Maximum zu." (The energy of the Universe remains constant, the entropy [the scrambledness of the energy] strives to a maximum.) However, if the particles recycle from the border as hydrogen, and perhaps some Helium, even the entropy may not go up.

MAY THEY REST IN PEACE

One of the problems of the early Big Bangs was that the explosion had no targets because the whole Universe was in the explosion. (Bombs are dangerous because the pieces run into buildings.) Then we had the Inflationary models that did have targets. But the Inflationary models require that the Grand Unified Theories (GUT) should succeed. That is, that it can be shown that the Strong Nuclear Force (which I don't think is a force at all) and the Electroweak Force are aspects of a single force. The difficulty here is the Grand Unified

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Theories require that the protons should decay and there is no evidence that they do. As H. M. Georgi says in "The New Physics," "Experimental physicists have not seen evidence for proton decay, despite a heroic effort." It appears that both the electrons and the protons are stable. But if the protons don't decay, the Grand Unified Theories may – and if they decay, the patched up Big Bang may finally go.

Now if our long cherished modern Big Bang joins its elders in the graveyard, alongside the old Steady State, will we have anyone left alive?

RAISINS

You might still ask, "Of what are the raisins made in your new model? And why are there any raisins at all?"

All our old models have gone to the graveyard by suggesting Universes which could not possibly exist. Perhaps that is because non-existence was the stuff out of which those Universes were made. Our models took non-existence for granted. The Big Bang models got their fire-balls out of nothing. I quote: "through random fluctuations in nothingness." And the old Steady State got its hydrogen out of nothing. That is known in this office as "the raisin problem." Where did the raisin store at 3rd & K get the raisins in the first place? "Aus Nichts wirt Nichts, das merke whohl." (Out of nothing comes nothing, mark it well). All of our models have taken non-existence for granted. But why?

So let us ask, "What remains if, on observational grounds, we take existence for granted instead, but leave out space and time?" Can we get a new cosmological model that does not end up in the graveyard? Can we get the Universe which we actually see?

If we take existence for granted, but ask what would remain in the absence of the Universe and in the absence of space and time, what is immediately obvious is this: in the absence of time we would have the absence of change. In the absence of space we would have the absence of the divided and the finite. Is it the Changeless that shows in our physics as inertia? (Matter fights every change in its state of motion). Is it the Infinite that shows in our physics as the electrical charge on the miniscule particles? (The electrical energy of the Universe would go to zero if the size of the particles went to infinity. It is in our physics as a number.) And is it the Undivided that shows in our physics as gravity and the attraction between opposites like plus and minus charges, and spin-up and spin-down? (The gravitational energy of the Universe would go to zero if and only if the dividedness of the Universe went to zero.)

As I see it, our raisins are made of gravity, electricity, and inertia simply because the Changeless, the Infinite, and the Undivided must show through as

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what we see in space and time, like the length and diameter of a rope showing through in the snake for which it has been mistaken. Is that why the particles are not "things", and can recycle from the border?

For the details of this new model please see "The Equations of Maya" in "Cosmic Beginnings and Human Ends, pages 259 to 287, 1995 (reference #2).

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[3] Sir Fred Hoyle, "The Intelligent Universe," (New York: Holt, Rinehart, & Winston. 1983, p 175).
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THE BIG BANG
"A Thing of Rags and Patches"

Looking out at the universe at large, what we see is that all the distant galaxies appear to be running away from us in such a way that the farther away they appear to be from us, the faster they appear to be running away. Thus, at some fifteen billion light years from us they would be receding at the speed of light. It is this so-called "expansion" that imposes a border to our observable universe because no message, whether electrical or gravitational, could be received from something receding at the speed of light. (Actually what we see is that the spectral lines of those distant galaxies are redshifted toward the low energy end of the spectrum, and that is usually taken to mean that those galaxies are going away. But the border is imposed on us by the redshift itself.) And if this apparent expansion rate could be doubled, the resulting border would be closer because those distant galaxies would reach the speed of light at only seven and a half billion light years away instead of fifteen.

Now the simplest and most straightforward explanation for this apparent expansion is that long ago there was this great explosion which has been dubbed the Big Bang (you must have heard of it), and that that is why all the distant galaxies are seen to be running away. Now you must not suppose that this Big Bang model was invented out of whole cloth. It was not. Like the Steady State model that followed it, it was invented to explain this apparent expansion. But by now the old Steady State is dead, and the Big Bang is "a thing of rags and patches."

THE DEATH OF THE EARLY BIG BANGS

The Big Bang models, in their early days, faced some very interesting problems. If the explosion had gone off at greater than the escape velocity, so that gravity could never have halted the expansion, then nothing in the universe could ever have run into anything else in the universe ever again. So we could never have gotten galaxies and stars out of it. (If a hand grenade explodes in mid-air, the pieces of the hand grenade do not run into each other.) But cosmological models which do not allow for galaxies and stars are considered to be flawed. So those old models have been laid to rest with headstones in the graveyard.

But even if the explosion had gone off at less than the escape velocity, it would still have been no better because then the universe would long since have collapsed to what is known in the trade as the Big Crunch. So those models, too, have been laid to rest.

That left us with this problem: why should this accidental explosion have gone off at just the escape velocity with such very tight constraints? This problem we patched with the anthropic principle. Since we know from quantum mechanics that there is no longer any talk of a universe without an observer, and since we see no way to get observers without galaxies and stars, the explosion had to come out exactly at the escape velocity in order that we could be here to worry about it. It had to come out at the escape velocity in order that the universe could exist at all.

On quite independent considerations, the early Big Bang models had another problem: why is the universe made of matter rather than half matter and half antimatter? It had long been known that radiation cooling off to material particles cools off to 50 percent matter and 50 percent antimatter. And that when they find each other again, they disappear into radiation. So the problem is: how could the fireball, which was too hot to be anything but radiation, cool off to a preponderance of matter over antimatter, that is, to more protons than antiprotons and to more electrons than positrons?

This problem was patched with the X particles, which make matter into antimatter, and the anti-X particles, which make

antimatter into matter. Then, since the X particles decay more rapidly than the anti-X particles, we are left with a preponderance of matter over antimatter. Splendid! But the anti-X particles, which decay more slowly, decay to magnetic monopoles, which we do not find. Too bad! That is known in the trade as the monopole problem. So then, how can we get rid of the monopoles?

The patch on this repair job is perhaps the most ingenious of all. We allow a little bubble on the side of the monopole universe suddenly to inflate to the universe which we see. In addition to leaving the monopoles behind, these inflationary models automatically yield a universe expanding at the escape velocity, so we don't need the anthropic principle any more. Good! But that lands us in what is known in the trade as the dark matter problem. Most of the matter in the observable universe would have to be something which we have never yet discovered, something invisible which responds only to gravity. Otherwise the helium prediction would be wrong.

One of the early predictions of the Big Bang model was the cosmic abundance ratio of hydrogen to the two isotopes of helium and to deuterium and lithium. This was long ago confirmed observationally, and was one of the strong arguments against the Steady State. But that early prediction would hold true only if not more than 10 percent of the matter in the observable universe predicted by the inflationary models is ordinary matter out of which those substances could be made. Consequently, the inflationary models predict that some 90 percent of the matter in the observable universe must respond only to gravity and not to nuclear forces or to any other forces such as electricity and magnetism which might allow us to detect it. Vera Rubin, among others, found that most of the dark matter is not in the visible portions of the galaxies, but in their haloes.[1] The question then is this: why is the dark matter found in the haloes of the galaxies and not in the galaxies themselves? Why doesn't it all fall in? (It should be noted here that this is a problem only for the Big Bang models. The Steady State models predict that most of the matter in the galactic haloes should be ordinary matter blown out by the galactic winds.[2]) That, as I see it, is where the

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But what do we see near the border? We see that if the energy of the radiation approaches zero, so does the energy of the particles giving rise to that radiation. But we also know from Einstein's special theory of relativity in 1905 that if the energy goes to zero, the mass goes to zero. (What we see as matter is just potential energy: E = m). Now there are two very interesting consequences if the mass near the border approaches zero.

First: it is well known that radiation going through a field of low mass particles will be so often picked up and re-radiated that it would come out thermalized to 3K. And the amount of background radiation predicted by this model is what we actually measure, whereas the amount predicted by the Big Bang models is some two orders of magnitude too high.

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LET'S HAVE A LOOK

Now you might ask, "Is there any observational evidence that the particles do recycle from the border?" Yes, there is. It has recently been determined that there are huge clouds of hydrogen in what were thought to be the voids between the great walls of galaxies.[4] These clouds contain enough hydrogen to make all the known galaxies. Also the Hubble Space Telescope's measurements of the Lyman alpha forest (the hydrogen absorption lines) between the quasar 3C273 and ourselves indicate that there are some nine to twelve hydrogen clouds between us and it.[5] The Big Bang has trouble explaining such clouds, whether of new hydrogen or of old hydrogen uncondensed to galaxies and stars in fifteen billion years.

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