On The Nature of Things as Seen in the Late 20th Century

Our general understanding of nature in the late 20th century is discussed here in the time-honored style of Lucretius (50 B.C.). The author has research experience in many different fields of science such as chemistry, biology, astronomy and physics, and hence is able to survey all of those fields from a broad perspective, without any bias toward a particular school of thought.

The field of chemistry is fairly well advanced today, and is perhaps the most useful of all Earthly sciences. Yet biology has become so over-reviewed and intensely competitive, that one can hardly expect more than incremental progress from most of the workers in the field.

Astronomy is in great confusion today, because the vast majority of professional astronomers believe in things which are probably not true: for example, the Big Bang and dark matter. New data from 1996, which concern the time it takes a supernova to explode in a distant galaxy, show that the Hubble redshift is due entirely to the slower rate at which particles counted time in the distant past, rather than to fast receding velocity after some ancient explosion. It seems possible that the high redshifts of quasars might be due to a similar effect, as locally reduced rates of counting time in small regions of space, again without any fast receding velocities from Earth.

Perhaps a deeper understanding of these scientific and philosophical issues will encourage a few biologists, physicists and astronomers to set out on a different course, as we enter the 21st century.

1. The Limits of Knowledge in a Very Short Life

> *"I have planted in your hearts an element of compassion, to let you assist one another in supporting life. Do not extinguish that element, do not corrupt it, learn that it is divine; and do not substitute wretched scholastic feuds for the voice of nature." —Essay on Tolerance*, Voltaire (1763).

We do not live very long. By the time a man has lived 20 years, he may have begun to learn some of what was done in previous centuries. By the time a man has lived 30 years, he may have begun to do something himself, which was not done before. Yet by the time a man has lived 40 years, he begins to doubt whether any of what was done before, including his own work, is of any real value!

If we lived much longer, say for 100 or 200 years in good health, some people would continue to learn and think and do original things all through their lifetimes. Those long-lived men and women would then go far beyond us in their thinking and knowledge. Indeed, the simple-minded ideas which we follow in our philosophy and science and religion today, might look meager and infantile to such superior beings.

How would Shakespeare judge the quality of modern drama on television? What would Tolstoy say about the airport novel? What would Newton think of modern physics and astronomy, for example of dark matter and the Big Bang?

Once we see the limitations of our knowledge in such broad perspective, it becomes a little easier to contemplate the imperfections of science and culture and religion, as they exist in the late 20th century. It was no different in Roman times: why else would Marcus Aurelius write an entire book on the virtues of stoicism? In his words, when contemplating the decline of Roman culture and religion, "All these things are necessary."

In the field of science, how many Roman scientists were convinced by the atomistic philosophy of Epicurus and Lucretius, after reading *De Rerum Natura*? It took another 1900 years for man to believe in atoms after Rome fell. And even Lucretius, a great believer in truth through observation, had the wrong model for astronomy in the Solar System. He thought that the Moon and Sun and stars must all somehow be circling the Earth, at various speeds and on various paths, for unknown reasons.

Here I would like to discuss the nature of things as seen in the late 20th century. The governments of most large countries in North America and Europe have spent massive amounts of money on science in this century, in a quest to learn more about nature. So we might be able to say more today about scientific matters than men could say previously, or at least a little more than what Lucretius could say in 50 B.C. Of course, the underlying character and intelligence of man has remained basically unchanged for the past two thousand years; so we are no smarter individually than Lucretius or Epicurus (far from it). Yet there are many more of us alive today than then, and also we have scientific instruments which are much more well developed, so that we can see things which are very small or very far away.

In order to conduct this survey of human knowledge effectively, it will be useful to summarize first what is known about the two most well-established sciences on Earth in the late 20th century, namely chemistry and biology, since not many readers of this journal will know about those fields. After we look closely at chemistry and biology to see what is happening there, we may proceed to physics and astronomy with a more open mind than before. Thus, we may usefully experience the errors of others firsthand, even in fields of knowledge that are well understood, without any embarassment to ourselves.

One thing should be made clear from the start: most physicists and astronomers in the late 20th century seem to be no smarter than the majority of chemists and biologists, at least in the view of this independent, unbiased observer who knows a great many of them. So if chemists and biologists can make large errors as a group, then so can physicists and astronomers. "If the blind lead the blind, surely they both shall fall into a ditch," as so well illustrated in the famous painting by Peter van Bruegel. Any belief that physicists and astronomers are somehow better than the rest, and so far advanced they cannot err, is a wishful delusion—as we shall see below.

2. Chemistry

Because chemistry is such a practical science, its theories are usually tied closely to observation and experiment. It is indeed the most predictive and useful of all Earthly sciences, since from the chemical structure of a molecule one can predict many of its functional properties. Conversely, one can synthesize by organic reaction in a test tube an enormous variety of chemical compounds, in pure form and large amount, for use in industry or medicine. The world as we know it would stop without chemistry, yet it could go on quite nicely without quantum electrodynamics or cosmology.

The most remarkable success of modern chemistry is perhaps its ability to produce in large amounts the molecules of biology: namely proteins, RNA and DNA. All of those molecules of biological origin, when synthesized chemically, usually seem just as active when introduced to living cells, as the ones isolated originally from a biological source. Thus, many biotechnology companies are now able to make small peptides or proteins in large amounts, through the use of organic or enzymatic chemistry; and then those small peptides or proteins may later be used as growth hormones in agriculture, or as pharmaceuticals in human medicine. Also, simple machines which quickly and easily synthesize DNA or RNA of long chain length and defined sequence, are present now in most biology laboratories worldwide. Those chemically synthesized molecules of DNA or RNA can then be used by laboratory workers in a routine fashion, for the engineering of novel genes, or for the discovery of novel devices for gene control.

In fact, while this essay is being written, the author has within a few weeks made six different molecules of DNA, each of length near 50 nucleotides; and then has cloned those molecules into part of a gene which grows in the bacterium *E. coli*, in order to modify gene function at the level of RNA. No large team of scientists is needed to carry out such research; the methods and technology are simple yet advanced, and can be carried out by just a few skilled workers in a short time.

Thus, it seems as if modern chemistry may have progressed very far in the last two centuries. First, it achieved the simple organic synthesis of foodstuffs and dyes, as exemplified by the German chemists of the 19th century; and later, it achieved the complex organic synthesis of biomolecules, as exemplified by the American and European chemists of the 20th century.

The present limitations of chemistry are roughly as follows:

(a) Some of its theories, for example the sigma-pi model of single versus double bonds, appear quite doubtful. For example, there has always been a good case for double bonds that consist of two bent single bonds, and not of a special pi type.

(b) Chemists have had great success at predicting from first principles the properties of simple polymers such as nylon or perspex, but have not yet succeeded at manipulating or predicting from first principles, the structures of complex polymers such as proteins or RNA or DNA.

(c) There is still no good way to catalyze the formation of any specific chemical bond, using specific frequencies of light or sound.

One could discuss these and other chemical subjects further, but for brevity let us proceed to biology.

3. Biology

The great advances of biology came in the 1950's and 1960's, when it was found that:

(a) DNA is the chemical substance of genes;

(b) DNA is a double helix, the base sequence of which can be inherited stably from generation to generation, so as to explain Mendel's rules of inheritance, found much earlier in 1860;

(c) the base sequence of DNA can specify the amino-acid sequence of proteins, where any triplet of bases in the DNA stands for one amino acid in a protein, according to the well-known Genetic Code.

There are no dissidents in biology today, as seem rampant in physics, who openly doubt any of those well-tested experimental facts. Still, a few workers such as Ted Steele and John Cairns have expressed doubts as to whether the usual mechanism of evolution might be correct, when applied to the evolution of DNA sequences in living cells. For example, are all mutations in the DNA really generated at random, or might some mutations be induced somehow, by the environment in which a cell or organism finds itself? Perhaps there might exist a mechanism in certain kinds of cell, for a change of DNA sequence as induced by the environment, through the copying of RNA back into DNA?

Other workers, for example John Griffith (who found the A-T and G-C base pairs of DNA but was never credited with it), have long suggested that in certain cases, a protein rather than RNA or DNA may be the infectious agent for some disease. Indeed, we have seen his hypothesis verified recently with the "mad cow disease" in Britain, where cattle that eat certain proteins from sheep, later pass on those proteins to humans in ordinary beef; and such proteins, once ingested in humans, sometimes cause brain degeneration by mechanisms which are not yet clearly understood.

Nor is it understood yet how the HIV virus, which is thought to cause AIDS, manages to kill so many cells without directly infecting them. Many of the human cells which are killed in the terminal stages of an AIDS infection seem not to contain HIV DNA or RNA; so a few workers have argued that factors other than HIV virus cause AIDS. Others believe that the HIV virus might excrete into the blood certain cell-killing proteins, which could kill cells elsewhere without infection by HIV DNA or RNA. Perhaps that is true; but if so, why do those same proteins not kill cells in species such as the chimpanzee, which can be infected by HIV virus yet not die from it?

All of the questions listed above are really side issues to the main problems in biology. No matter how the answers to such difficult questions turn out, they will not alter the central role of DNA and the Genetic Code, as the primary means by which chemical information is controlled in all living cells on Earth.

What might be the main issues in biology, on which scientists will still be working well into the 21st century? Some of these are:

(a) As any organism grows from a single cell to a mature adult, it may contain eventually thousands, millions or even billions of different cells, whether it be worm, fly, frog or human. How do all of those different cells know when and where to form the correct body tissues and parts? Much effort has already been devoted to this difficult problem, called "cell development", with few useful results to date.

(b) How can we slow or stop the growth of cancer cells, which are often normal cells that have escaped control of their reproduction? Similarly, how can we stop the growth of antibiotic-resistant bacteria and viruses, which may once again plague mankind in the 21st century?

(c) How did life start on Earth? Was it seeded from space (as suggested by Arrhenius, Crick and Hoyle), or did the lifeless atoms spontaneously join together to form simple cells (as suggested by Oparin, Miller and Bernal), perhaps in the early atmosphere of Earth that had no oxygen? This highly philosophical topic has attracted much fanatical support recently for one theory or another: say for the "RNA World", or "life on clay", or "life in a warm pond". It resembles closely modern astronomy in that regard, since there are few hard facts available which might constrain extended speculation.

(d) How are genes controlled in chromosomes, and what decides the complex structures of chromosomes as seen in a microscope? The first part of that problem is known as "transcription", and it produces many research papers each week; most of those have a shelf-life of less than one year.

Modern biology, like modern chemistry before it, is rapidly becoming an industrial pursuit, driven by patents and egos and money. Some researchers in large medical centers actually no longer care if they cure a disease, or find a new mechanism of nature. Most modern biologists are willful members of a highly competitive peer-review system, that is based on status and hierarchy rather than on true scientific achievement. Here is what Lucretius had to say about those men long ago, in 50 B.C. in ancient Rome: "Wandering aimlessly in a vain search for the way of life, pitting their wits one against another, disputing for precedence, struggling night and day with unstinted effort to scale the pinnacles of wealth and power. O joyless hearts of men! O minds without vision!"

If this current trend in biology continues, where status and hierarchy take precedence over productivity and creativeness, one might expect most real progress to cease, or at least to become very inefficient. Already some universities are using computers to decide which assistant professors should get tenure or research money. The computer adds up the total number of papers written per year by each professor, and then weights the sum according to which journals the professor has published in, and how prestigious they might be. This procedure of course cannot select for research quality, since the apparent prestige of a biological journal often has little relation to the quality of scientific papers published within it.

How would Einstein have fared in the modern university system by publishing in *Annalen der Physik*, or Mendel in his little Austrian journal? What about Darwin, who only published the occasional book on earthworms or barnacles? Or Barbara *Mc*Clintock, who stopped publishing altogether in 1953, having no real audience? We need not think about Alfred Wegener, who never published in academic journals at all. What incentive is there to make new medical inventions in such a system, that demands constant if meaningless results?

Thus, the progress of biology today appears severely in doubt. Much progress was made in the recent past, but mostly by mature workers such as Avery, Crick, Perutz or Sanger, who were not constantly being reviewed as to their status and political standing in a research hierarchy, month by month, as they attempted to solve important problems. Of course, one may ask whether biology is alone in that regard, as an overcompetitive and distorted science. How much of the biology that you read in newspapers or journals today can be believed, as compared to articles dealing with astronomy and physics? Some news items such as the “NASA Mars Rock” combine both biology and astronomy, and so are doubly believable on that account.

4. Astronomy in the Milky Way

Having completed our brief survey of chemistry and biology, let us proceed now to what might be considered the least well-determined of all physical sciences, namely astronomy. In the close neighborhood of Earth, the current state of knowledge in astronomy is pretty good, especially when compared with what Lucretius or Ptolemy thought 2000 years ago. We know that the Moon goes around the Earth, while the Earth goes around the Sun; and that even the closest star such as Alpha Centauri (a bright double) lies four light-years away through almost empty space.

But once we proceed further from Earth, and begin to consider the structure and dynamics of the Milky Way, trouble sets in. It is commonly believed that the Milky Way galaxy might be rotating very fast about its center, or by about 300 km s^{-1} in its outer parts. Since the Earth and Sun are located near an outer edge of the Milky Way on the Orion Arm, they must also be travelling at nearly 300 km s^{-1} through empty space, in a very fast orbit about the center, according to that standard view.

Two serious problems plague that belief. First, a high speed of rotation such as 300 km s^{-1} should in principle fling the Earth and Sun far out into intergalactic space, or far beyond the limits of the galaxy itself, unless the gravitational mass of the Milky Way is somehow much larger than what we can see. Could there be some kind of invisible “dark matter” at the galactic center, which holds the Earth and Sun in a very fast orbit by its strong gravity? The amount of dark matter at the galactic center would have to exceed what is now observed in terms of ordinary, visible stars and gas by perhaps two orders of magnitude, for this high-gravity explanation to be viable.

Second, a high speed of rotation near 300 km s^{-1}, as seen in the outer parts of many spiral galaxies that resemble the Milky Way, can sometimes appear to persist for up to ten galaxy diameters away from an outer edge, through dilute gas in almost empty intergalactic space. Meanwhile, the apparent speed of rotation in those galaxies often decreases from 300 to 200 to 100 to 0 km s^{-1}, as we examine stars and gas which lie closer to the galactic center. It is almost as if any spiral galaxy might be rotating as a “rigid body”, where the speed of rotation seems to increase linearly with distance from the center.

Those various interpretations in terms of rotational velocity, seem completely contrary to the laws of Kepler and Newton for planetary motions in the Solar System, where Pluto orbits the Sun more slowly than Mercury, and not vice-versa. If the Milky Way galaxy were analogous to a Solar System but on a larger scale, one would expect its outer parts to rotate about the center more slowly than its inner parts, and not vice-versa, under the influence of high gravity. Furthermore, the speed of rotation should fall off measurably with increased distance from the center, and not remain constant at some high value far out into intergalactic space!

Some workers, for example T. Van Flandern, have suggested that the force of gravity might be modified on a large scale, so as to explain the strange rotational speeds of stars within galaxies. Thus, the force of gravity between any two distant objects might be weakened somewhat on a large scale of several thousand light years, if some of the gravity waves which pass between those two objects are absorbed by intervening material. Hence, stars in the outer parts of galaxies might be attracted to the center strongly, since they lie in a region of space where stars are spread far from one another; whereas stars in the inner parts of galaxies might be attracted to the center weakly, since they lie in a region of space where stars are packed closely together. Perhaps that explanation can account for the apparent speeds of rotation within galaxies, as fast on the outside but slow on the inside; but it seems doubtful whether such modified gravity can explain why the apparent speeds of rotation usually remain constant at some high value, in dilute gas which lies far beyond any galaxy itself.

Alternatively, now that our minds are free of prejudice and open to new ideas, we can ask whether the whole concept might be wrong. How do we know for certain, that the Milky Way galaxy is really rotating about its center at a fast 300 km s^{-1}, and also rotating much more rapidly in its outer parts than in its inner parts? The only evidence for such fast rotation depends on a rather peculiar interpretation of the spectroscopic data, where altered frequencies of light as seen in many distant parts of the Milky Way are always interpreted as Doppler shifts, due to receding or approaching motions from Earth.

For example, light from the Large Magellanic Cloud shows a lower frequency than expected in its spectral lines by $f'/f = (1 + v/c) = 0.999$, which gives $v/c = -0.001$ or $v = -300$ km s^{-1} by a velocity interpretation, where $c = 300{,}000$ km s^{-1}. According to that velocity interpretation, the Earth and Sun are being carried away from the Large Magellanic Cloud at about 300 km s^{-1}, by an overall fast rotation of the Milky Way. In another case, light from Andromeda M31 shows a higher frequency than expected by $f'/f = (1 + v/c) = 1.001$, which gives $v/c = +0.001$ or $v = +300$ km s^{-1} if interpreted as due to motion. Here an overall fast rotation of the Milky Way is supposed to be carrying us toward Andromeda at nearly 300 km s^{-1}.

Yet all interpretations of that kind must remain extremely doubtful, since we cannot see for certain whether the Large Magellanic Cloud or Andromeda, or indeed any other distant part of our galaxy, is really moving across the sky with true or “proper” motion, as for a planet circling the Sun. It remains only an interpretation, and not a fact, to believe that such tiny changes of light frequency as seen across the width of the Milky Way, and across the widths of many other spiral galaxies, by typically 1 part in 1000 or just 0.1%, must represent very fast motion about the center as for a Doppler shift.

The whole idea seems unlikely. For example, in certain cases we can see distant spiral galaxies face-on rather than edge-on, yet still we can see in some of those galaxies (such as M101) a strong gradient of light frequency across the width of the galaxy, even when the plane of spin lies 90° away from our viewing direction. Also, it would seem impossible even in principle to confirm the strange nature of such rotation by a study of proper motions through the sky, since no proper motion of any outer part relative to any inner part should be detectable, for a spiral galaxy that spins as a rigid body. Indeed, current studies of the proper motion of stars in the outer parts of our galaxy seem confusing, and do not yet yield any clear model for the dynamics: see Figure 6 of Majewski (1993) cited below.

There is good evidence for fast rotation of stars within the small, central parts of spiral galaxies such as Andromeda or the Milky Way. Within those small central regions, stars have been seen to orbit the center very rapidly, as judged from the altered frequencies of light which they emit or absorb, and also from studies of their proper motions relative to one another. But such fast stellar velocities fall off quickly with increased distance from the center, just as expected from the laws of Kepler and Newton for planetary motions in the Solar System. Hence, the outer parts of any spiral galaxy should show only slow velocities of rotation, since the influence of the central gravity well does not seem to extend far outward into the spiral arms with any significant strength.

Many other data lead one to doubt whether the outer parts of galaxies are really spinning as rapidly as might be indicated by an interpretation of their light frequencies in terms of motion. For example, judging from their light frequencies alone, some galaxies seem to be spinning at two different speeds for any given distance from the center, or even in two different directions at once. Why do the stars and gas on different tracks then not collide, so as to create a disturbance which might be seen through any telescope? In other cases, a local variation of light frequency as seen at the center of any galaxy, often correlates with a global variation of light frequency as seen edge-to-edge. How can the speeds of stars at the center of any galaxy, possibly determine the speeds of stars on either edge, or 10,000 light years away, by some long-range correlation of velocities? In still other cases, a variation in the frequency of light as absorbed by stars across the width of any galaxy, may be quite different from a variation in the frequency of light as emitted by hot gas between those stars. How can the light-absorbing stars be rotating differently from the light-emitting gas, which lies between those stars?

In summary, we are compelled to ask: could those slightly altered frequencies of light, as seen in the outer parts of the Milky Way and other galaxies, indicate some physical effect other than true motion? As a completely different kind of explanation, let us ask whether the masses m of particles might be 0.1% different on either edge of the Milky Way than at its center, across a distance of 10,000 light years. If that hypothesis is true, then particles should count time differently by 0.1% on either edge of the Milky Way than at its center, since the clock rate f of any particle varies in proportion to its mass as $f = 2mc^2/h$.

Such a gradient of energy or frequency is well-known in biology, and is usually called a "developmental gradient", as seen across the widths of growing embryos. In other words, any highly-organized system of matter might be expected to show a gradient of energy across its width, whether it be a fly, frog or young growing galaxy. That slight gradient of energy then seems to coordinate the overall growth of an organism, by mechanisms which are still poorly understood.

In any case, an altered mass m and clock rate f of particles on either edge of the Milky Way would explain the altered frequencies of light as observed, without any need for a fast rotation of 300 km s^{-1} in the outer parts, since f (light) is always a well-defined fraction of the clock rate $f = 2mc^2/h$. For example, light emitted or absorbed by a hydrogen atom comes in frequencies which are well-defined fractions of the electron clock rate, as $f = 2mc^2/h = 2.46 \times 10^{20}$ per second, divided by 4×137^2, 16×137^2 or 36×137^2 for the first three shells of a hydrogen atom.

How can we tell whether such a theory of variable mass might be true, and not just wild speculation as seems so common in astronomy today? Here is how that theory could be tested: if the masses and clock rates of particles are truly different on either edge of the Milky Way than at its center, then rates of decay for radioactive atoms, as created by supernovae elsewhere in our galaxy, should be slightly longer or shorter than those measured on Earth, depending on the mass and time-counting rate of the star which has exploded.

For example, supernova SN1987A in the Large Magellanic Cloud would be expected to show slightly longer half-lives of decay by 0.1%, as 77.4 rather than 77.3 days for its cobalt-56 isotope, or 272.1 rather than 271.8 days for its cobalt-57 isotope, if the light frequency there is less by 0.1% relative to Earth. The effect to be measured is quite small, but so was the precise angle by which light bends around the Sun, which nevertheless in 1919 confirmed Einstein's prediction of higher gravity for objects in fast motion. Surely today's astronomers, with their expensive satellites and high-speed computers, could manage to test the variable-mass hypothesis, if it might alter completely their ideas about the nature of galaxy motion, and also eliminate the need for dark matter, which appears not to exist.

In general, altered frequencies of light should be associated with altered rates of counting time in the variable mass model, simply as:

$$f'/f = t/t'$$

so long as a distant light source remains stationary to Earth.

X-ray data of defined frequency were collected for decay of the isotopes cobalt-56, 57 over many months, during the explosion of SN1987A. From a careful study of those data, one might be able to tell whether time-counting rates are really altered by 0.1% in the Large Magellanic Cloud relative to Earth. Unfortunately, the x-ray data from SN1987A have not been made public, so we cannot inspect them for small changes in the rate of radioactive decay. Still, we shall see below how a similar supernova in a distant galaxy provides good evidence for altered time-counting in proportion to altered light frequency, so as to explain the Hubble redshift of distant galaxies.

5. Astronomy in Distant Galaxies

Our understanding of nature tends to become even more confused and uncertain once we leave the vicinity of the Milky Way, and begin to consider the structures and dynamical motions of distant galaxies. Most or all distant galaxies show spectral lines of lower frequency than expected, when compared to spectral measurements for the same kinds of atom here on Earth. To be precise, the frequency of any spectral line as seen in a distant galaxy tends to decrease, in proportion to the apparent distance of that galaxy from Earth, as indicated by its reduced brightness or size. This is the well-known "Hubble redshift", and it has been a matter of controversy for 80 years.

Three different models have been advanced to explain the Hubble redshift. First, many astronomers believe that it indicates an expanding universe, where all distant galaxies are somehow receding from Earth in four dimensions, after an ancient explosion or Big Bang. Other astronomers believe that light from distant galaxies somehow loses some of its frequency during the long travel to Earth, through almost empty space. Still other astronomers believe that the masses or time-counting rates of particles might have been less in the distant past than they are today; so that when we look into the past by observing light from distant galaxies, we see lower frequencies of light due to the lower masses of particles at the source.

Until recently, there was no way to tell by logic and reason which of those three theories might be correct; all was prejudice and academic bias. The experimental data on galaxy shapes, sizes and intensities could not provide any direct evidence as to which of the theories mentioned above might be correct. However, new measurements of clock rate for the light emitted by supernova

SN1995K in a distant galaxy, now seem to favor the last theory mentioned, which invokes altered mass. The experimental observation is as follows: the altered light-frequency $f'/f = 0.676$ as the Hubble redshift for that distant galaxy, is very close to the inverse of the total time $t'/t = 1.479$ that it took supernova SN1995K to explode, relative to a standard light-curve as based on similar supernovae seen near Earth. Hence, it now seems probable from experiment that $f'/f = t/t'$ for the Hubble redshift of distant galaxies.

If the same distant galaxy were receding rapidly from Earth, so as to cause its Hubble redshift, then its receding velocity would have to lie near $v/c = 0.37$, in order to give $f'/f = (1 - v/c) = 0.63$ close to 0.676. The apparent duration of SN1995K would then be increased by only a small factor of $t'/t = 1/\sqrt{(1 - 0.37^2)} = 1.08$ as for ordinary time-dilation in special relativity, or by much less than the factor of 1.48 which is observed. Hence $f'/f = (1 - v/c) \times t'/t = 0.63 \times 1.08 = 0.676$, as the full expression for a Doppler shift that involves high velocities.

Finally, according to the other theory mentioned, light from a distant galaxy might lose some of its frequency during the long travel to Earth, and not at the source. That theory predicts a duration for SN1995K of $t'/t = 1.00$, which is even less in accord with experiment than the receding-velocity model. It is not clear how any travel-path theory for the Hubble redshift, could produce a lengthening of the original light pulse in time by 48%, no matter how far such light travels through space from a distant galaxy to Earth.

Some cosmologists believe that the Hubble redshifts of distant galaxies are not really Doppler shifts, due to receding velocity after some Big Bang. Instead, they postulate that “space is stretching” everywhere over long periods of time after such an explosion, while the galaxies themselves remain stationary with relative velocity $v/c = 0$ and hence no Doppler shift! Nor is the space within galaxies being stretched, but only the space outside of galaxies. Lastly, as we study other galaxies which lie close to Earth, the Hubble redshifts must at some point revert to normal Doppler shifts, in order to agree with the physics of motion as measured on Earth. An article by G. Galeczki and P. Marquardt in an earlier issue of this journal gives a full account of that strange cosmological theory, which is accepted widely by physicists and astronomers today, despite its flaws. They use it as a means of abstract calculation, without any concern for its logical content or lack thereof.

In summary, the new astronomical data require an increase in the rate of counting time t over billions of years, rather than an increase in the dimensions of space xyz, as a hypothetical stretching of space. That conclusion, however sound, goes contrary to almost all accepted cosmological speculation: if there was really an ancient explosion, then surely most distant galaxies should be receding from Earth? Yet if most distant galaxies are not really receding from Earth, why should there have been an ancient explosion?

It seems possible, therefore, that the Universe may be much older than the 15 billion years which today’s astronomers claim, especially if the masses and clock rates of particles can vary over long periods of time as suggested above. Thus, it would appear that the Hubble redshift can now be interpreted as a measure of reduced clock rate in distant galaxies, rather than as a measure of how fast the Universe might be stretching or expanding. Hence, there is no longer any need for an ancient explosion or Big Bang at some definite time in the past to account for an apparent expansion. On the contrary, the overall structure of our Universe now appears as if it might be largely stationary, while the particles within it are proceeding over long periods of time to states of higher mass or energy.The same idea of variable mass would explain certain anomalous variations of light frequency, as seen in clusters of galaxies such as Stephan’s Quintet or VV172, if some galaxies in those clusters are younger and of lower mass than the others. Typically, spiral galaxies appear younger and of lower light frequency than ellipticals, as if the small spirals might be a younger form of the large ellipticals, in a regular progression of galaxy growth. The periodic light frequencies as reported for some galaxies in clusters, can also be understood in terms of variable mass, if those masses of particles prefer to resonate at certain frequencies or clock rates, as they increase slowly over time.

To conclude, it would seem that modern astronomers may have wandered very far in their beliefs from the true nature of things. A strong skepticism about cosmological redshifts has been with us for many years now, as evidenced by the poem Skeptic written by Robert Frost in 1949:

Far star that tickles for me my sensitive plate
And fries a couple of ebon atoms white,
I don't believe I believe a thing you state.
I put no faith in the seeming facts of light.
I don't believe I believe you're the last in space,
I don't believe you're anywhere near the last,
I don't believe what makes you red in the face
Is after explosion going away so fast.

If the clock rates of particles really do run faster today than in the past, it would appear meaningless to state that the “age of the Earth” is 4 billion years, or that the “age of the Universe” is 15 billion years, since the clock rate by which such huge ages are measured, would not remain constant over long periods of time. Also, it would seem naive in the extreme to associate the estimated age of the Milky Way, as near 15 billion years, with the age of the entire Universe. We might be very much newcomers on the scene, in our little Local Group made of the Milky Way and Andromeda (both small spirals), when compared to the huge, ancient elliptical galaxies as seen in large clusters such as Virgo, Perseus or Coma.

6. The Astronomy of Quasars

If time-counting rates are possibly important to explain altered light frequencies in the Milky Way, and definitely important to explain altered light frequencies as seen in distant galaxies, could those same time-counting rates be important to explain the highly-altered light frequencies of quasars?

The Big Bang astronomers tell us today, that most quasars must lie billions of light-years from Earth, based on an interpretation of their very-low light frequencies in terms of fast receding velocity in an expanding Universe. But we saw above how the idea of an expanding Universe seems highly doubtful, since time-counting rates in a distant galaxy are altered by much more than would be expected from receding velocity: by a factor of $t'/t = 1.48$ rather than by $t'/t = 1.08$.

What other kinds of evidence might be available, to indicate that quasars should lie at huge distances from Earth? If quasars do somehow lie billions of light-years from Earth, then they must be intrinsically brighter than most galaxies by a factor of a thousand to a million, as if they were powered by “ultramassive black holes”. Yet the size of the light-emitting area can be no more than a few light-days across, because we can see short-term fluctuations in quasar intensity over just a few days. Furthermore, we do not see even one ultrabright quasar in the sky near Earth, so we are forced to believe that all quasars must have lived and died long ago like dinosaurs, just after the Big Bang in a “quasar era”!

Apart from their low light frequencies, the only other evidence for very-distant quasars has been the hypothesis of a “gravitational lens” for the quasar pair Q0957+561. Often we can see close pairs of quasars in the sky, just as we see close pairs of stars. Some of those quasar pairs (or triplets or quartets) lie so far apart by their angular separation in space, that they are accepted as true physical pairs of identical light frequency. But other pairs of quasars lie so near one another by their angular separation in space, that they have been interpreted by the cosmological school of astronomers as many different examples of a gravitational lens. Thus, cosmologists believe that the original image of some "very distant" quasar may be split into two identical parts, by an intervening galaxy as the light travels for billions of light-years to Earth.

There are several grave difficulties with that hypothesis. For example, the proposed splitting of a single quasar image into two parts is analogous to the splitting of a streetlight image into two parts, by the lens in a pair of eyeglasses. But where will we find an "eyeglass lens" in space, that can extend with perfectly-constant refractive index over tens of thousands of light years, so as to bend the quasar light without divergence? In another case, four identical quasars have been seen at the nearly-opaque center of a distant galaxy, where almost no light passes through from behind: how can that be a lens? Finally, how can one possibly explain by any lens theory the many pairs of quasars which are seen with wide angular separation?

Still, measurements in 1980-1990 for one close pair of quasars, called Q0957+561, showed that one quasar of the pair would vary slightly in intensity over several years, while the other quasar of the pair would seem to follow, with a time delay of about one year. The cosmologists immediately jumped on that observation, to claim that the delayed quasar image might have travelled to Earth more slowly, because it had bent around a distant galaxy. The diffuse, ill-shaped galaxy around which the quasar light was supposed to bend, appeared just as a faint image of low intensity when compared to the two quasars; and it was located far from a direct line between the two quasars, as would be expected for a true lens. Nevertheless, those data were enough to convice most astronomers as to the absolute reality of: (a) the Big Bang, (b) an expanding universe, and (c) quasars as very distant, evolutionary relics of certain high-density fluctuations in the primordial vacuum.

Yet as of 1996, further measurements have shown that the intensities of the two quasars in that same pair can vary independently from one another, on a short time-scale of just several months. The new data seem difficult or impossible to explain by any lens theory. In fact, the astronomer who made the new observations, in order to save his previous hypothesis of a gravitational lens, now proposes that the distant faint galaxy around which the quasar light is supposed to bend, contains billions of fast-moving planets without stars! Those billions of hypothetical planets are then said to wander rapidly through space, so as to make the quasar light fluctuate in intensity on a short time-scale, as it bends due to planetary gravity. The same author suggests that those imaginary objects, which he calls "rogue planet microlenses", make up most of the dark matter in any galaxy, which makes it spin faster on the outside than on the inside.

From another point of view, one might think that each quasar of a close pair could vary in intensity of its own accord, in the space of several months, without the need for any lens on a small scale to explain what is observed. Furthermore, if the two quasars of the pair Q0957+561 lie close together in space, and not so far from Earth as is imagined, then they could influence one another's intensity by a direct interaction through space, on a time-scale of several years, without the need for any lens on a large scale to explain what is observed.

If even one good example of a lensed quasar had been reported in the years 1980-1996, we might take such a lens hypothesis seriously. But how are we supposed to believe in a highly-speculative cosmological theory of "very distant quasars" as "ultramassive black holes" that no longer exist, when such a theory is based on just one or two doubtful interpretations of a close quasar pair, out of hundreds in the sky which do not show the expected behavior? For example, several quasars in the quartet mentioned above, which lies at the center of an opaque galaxy, have been observed to vary in intensity in an uncorrelated way, which seems contrary once again to a lens hypothesis. What indeed are we to make of the logical abilities of most modern astronomers, who accept such a lens theory without question as proof of very distant quasars?

Given all these problems with the conventional astronomy of quasars, one might wish to consider whether the "dissident" astronomers H. C. Arp, G. Burbidge and F. Hoyle could be correct in their alternative theory for quasars. They say that quasars are really small, compact objects of low intrinsic mass per particle, which have been ejected from nearby galaxies such as M87 in the Virgo Cluster. In their view, quasars do not lie so far from Earth as is commonly supposed, nor are they especially bright, nor did they exist only in the distant past. If quasars count time slowly (with low mass) when they are first ejected from the centers of galaxies, and then regain a normal time-counting rate (or normal mass) over billions of years, as they interact with other objects of normal time-counting rate nearby, that would explain most of what is observed. See the books by Arp or Van Flandern cited below for more details of that hypothesis and its supporting data.

Some workers have reported that the light frequencies of quasars and galaxies are not distributed at random, but vary periodically according to certain formulae. Those periodicities would be hard to explain, if all light frequencies were due to true motion. But such periodic light frequencies are easy to explain in terms of altered time-counting or mass.

Thus, the formula for preferred quasar light frequencies is well known to be $f/f' = 1.06 \times (1.228)^n$ where n = 1, 2, 3, 4, 5. The formula for preferred galaxy light frequencies can be written as $f/f' = (1.228)^n/(137 \times 2\pi)$, so as to provide for a similar kind of frequency variation as seen in quasars, but on a smaller scale. By a velocity interpretation, all of those galaxies would have to be receding from Earth with many different speeds that differ by $v = 72$ km s^{-1}, where $v/c = 0.00024 = 0.207/(137 \times 2\pi)$ for the mean value of the series listed above. That makes no sense: why should galaxies be moving at 72 km s^{-1} relative to one another, all across the Universe?

Instead, the periodic light frequencies of quasars and galaxies might reflect the preferred rates at which particles count time in those astronomical objects, on two different scales of mass. For quasars, variations in time-counting would amount to a factor of $(1.228)^n$ on a scale of 1 or mc^2; while for galaxies, variations in time-counting would amount to a factor of $(1.228)^n$ on a scale of $1/(137 \times 2\pi)$, which is much smaller than mc^2. The term $1/(137 \times 2\pi)$ is one of the most well-known numbers in physics, as discussed in the second part of this essay. The series $(1.228)^n$ is not so well known, but it could be analogous to the scale of preferred frequencies in music, where $(1.059)^{12} = 2.000$ for any octave. Some data as described elsewhere suggest that $(1.2275)^{24} = 137.036$.

There are too many independent hypotheses in astronomy today. Our modern astronomers have invented one or more hypotheses, to explain each thing that is observed. Rather than postulating: (a) dark matter to explain the variation of light frequency across galaxies; (b) an expanding universe as caused by some ancient explosion, to explain the mean redshifts of galaxies at different distances from Earth; and (c) ultramassive black holes to explain the existence of quasars; one might think more sensibly that we could have made an error, in our assumptions about the physics of the universe on a large scale. In particular, we have assumed with no real justification, that all particles of matter will count time at precisely the same rate wherever we look, over broad expanses of space and time which often extend for billions of light years.

Yet we know from experiments on Earth, that particles can count time at slightly different rates, depending on how fast they move in orbit about the Earth, or how far they lie above the surface of the Earth in a weak gravity field. Therefore, we ought to examine more closely whether similar but larger variations in the rate of counting time might account for: (a) the variation of light frequencies across galaxies, (b) the mean light frequencies of galaxies in proportion to their distances from Earth, and (c) the very low light frequencies of quasars, all by means of a single hypothesis, which removes an assumption which should have never been made.

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Role of Fundamental Astronomy in a Renaissence of Science (History and Contemporaneity)

In his efforts to find regularities in the development of science, V.I. Vernadsky used to appeal to the history of astronomy, paying special attention to the turning point in its advance, *i.e.* to the period known as the Copernican revolution.

According to the conception of Thomas Kuhn, science develops by changing paradigms, *i.e.* world-pictures or disciplinary matrices, which happens by means of revolutions. Modern physicists and philosophers connect the first scientific revolution with the names of Copernicus and Newton, and the begining of the second great scientific revolution with the names of Poincaré, Einstein and Minkowsky. Some believe that the second revolution is not yet completed, whereas others imagine that science is standing on the threshold of the third revolution.

Due to the fashion for revolutions and transformations in the 20th century, the conception of T. Kuhn became popular, and a comparative method, or historical analogy became the prefered method of study, which is productive especially if accompanied by sociological analyses, *i.e.* when science and the scientific community (its morals and ethics) are not separated from the demands and the state of society at large.

The question is whether progress in science is achieved by means of revolutions in knowledge and *Weltanschauung.* An analysis of the work of Copernicus and Newton shows they regarded their accomplishments as part of a succession of great insights rather than a subversion of any doctrine. The expression *in umeris gigantum*, ascribed to Bernard de Chartres (12th century), was widely used at that time. Copernicus even defended Ptolemy from Werner and some Arab scientists. The European Renaissence started with the assimilation of the legacy of Antiquity, and the blossoming of Greek science was a result of mastering Egyptian and Babylonian culture.

Examples from contemporary literature show that original works are often misinterpreted, *e.g.* some important points in Newton's *Weltanschauung* have been distorted. Therefore, a precise understanding of the legacy of grear astronomers and matematicians of the past is no less important than studying Shakespeare, and our activity should not be confined to studying manuals, text-books and commentaries on the classics. We must return to study the originals.

History shows that the corner-stone of a new World-picture within qualitative leaps in natural science is always laid by astronomy. Being "the queen of mathematics" (J. Rheticus) astronomy is at the same time the history of the heavens. However, now it does not occupy the place it deserves in general education; it is not studied in many schools now. As a result, the spatial imagination of scholars remains undeveloped, they adopt a machinelike mode of thinking limited to memorizing codes and "rules of the game". Moreover, the lack of an historical view diminishes the creative potential of scientists. It is impossible to compensate for this by leaps of fantasy, especially if the latter are destructive to logic and common sense ("healthy sense"-in Russian).

The questions raised by H. Poincaré in his papers *On Science* are important for philosophy, and closely connected to the Metrology of the World (systems of coordinates and time). In spite of this, stronomers in the 20th century hold aloof from these questions, which is explained in part by the stagnation of fundamental astronomy and astrometry. It was about 10-20 years before Poincaré that

Simon Newcomb made his well known attempt to overcome the metrological crisis in astronomy.

Unlike Newcomb, Poincaré reconsidered the philosophical categories of Space and Time. Criticism of Poincaré by philosophers, *e.g.* by V.I. Lenin, was confined to accusations of inconsistency and "concessions to idealism".

No answer to the concrete questions advanced by Poincaré has been given up to now. In the second part of the 20^{th} century, with the expanding empirical basis of astrometry (a science of measurements of time and space), problems which once seemed speculative became practical ones. It is inadmissible for astronomers to refrain any longer from discussing the problems raised by Poincare.

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