Time: the view from ordinary shoulders.

Peter A Cunningham Nov. 2008.

Time

I am interested in what the non scientist has to say on difficult matters like the nature of time. Actress Shirley MacLaine once wrote: 'I had the same fascination with [time] the future and the presence of other worlds inhabited by beings that I also had a familiarity with. So to me, the past and the future were part of me now. There was nothing wacky or preposterous about knowing the lines of time such as I understood them to be. They just were like nature or the sky. I felt that time existed in me rather than that I existed in time. In effect, science had freed itself from the domination of the church, only to become the modern dominator of the truth today. The chains simply changed hands. The new enslaver of truth is science, and we are seeing its effect on human behaviour everywhere. Without the recognition of the soul's journey within us, we are lost and only part of what we were intended to be.' Novelist, Michael Crichton explores deeper meaning for time on page 136 of his story *Sphere* (1998). Beth asks Harry why anyone would want to send a space craft through a black hole. "Because of gravity," Harry said. "You see, black holes have so much gravity in them they distort space and time. You remember how Ted was saying that planets make dents in the fabric of space-time? Well black holes make tears in the fabric. And some people think it is possible to fly through those tears into another universe, or another part of our universe; or to another time." These mysteries are in common parlance.

Still, the nature of time is an age-old conundrum that preoccupies not just the physicist and philospher but all of science and the layity. Everyone has a gut-feeling about time if not an opinion. To broaden our earthbound concept of time, it is useful to ask, as Paul Davies did: 'What is happpening on Mars now?' There is no definite answer in terms of our clocks. Earth and Mars are about 20 light minutes apart. But since Einstein and the proposition that information cannot travel faster than the speed of light, the observer on Earth realises that it is impossible to know the exact situation on Mars though he may infer the answer." And it also goes without saying that different observers of the moment in question, moving at different velocities, have different perceptions and projections of what the present moment is, was or might be. I shall argue that Time is innocent in the face of subtle robotics, the pre-programmed theatre of receptor and ligand for example, the drama of the sperm and the egg, a milder yet equally miraculous version of the big bang.

Estimates of the speed of light at about 299,792.58 km per second and one light year measuring 9,460,730,472,580 km or that the Earth orbits the sun at 107,200 km per hour expresses not only the enormity of the space time concept but the work done by positivist (quantitative) scientists who perceive reality through their senses, a something that is out there and independent of mind. This reality is governed by natural and unchangeable laws. On the other hand there is the interpretive (qualitative) perspective whose theorists believe that reality is experienced internally and that it is socially constructed through interaction and is based on the definitions that people attach to it. Mathematics offers a more certain reality than our

y, space-time, equations, radiation.

unpredictable one. Nevertheless to approach the nature of time in an organised fashion a framework for thought and action is required.

Researching the nature of time comes down to perspectives adopted and the various paradigms, methodologies and mehods that are available to the investigator. Settling on a guiding set of beliefs and values that provides a guide or map to the kinds of problems that should be addressed and the types of explanations that are acceptable to a researcher is a reasonable first step. Positivism or interpretivism are paradigms accepted by social scientists although philosophical bases wrought from phenomenology, symbolic interactionism, existentialism, Marxism, feminism, ethnography , hermeneutics and socio-linguistics are also considered paradigms. It is convenient to consider methodologies under the headings of quantitative (positivist) or qualitative (interpretivist). Methods such as observations, interviews, experiments or content analysis can be used in any methodology.

Lay perception of time rests with its forward flow and variable viscosity, its potential for reverse flow and journeys through time. Science on the other hand has little to say about this perceived flow. General relativity depicts time as a coordinate to describe a space-time event. Nothing actually flows. Thus Time has been squeezed into a positivist mindset with its underlying assumption that people, through their senses, can capture the world around them and time is not part of it. Except to say that there is a contemporary theory that space-time assumes e form at Plank scale i.e. 10 to the -35 meters. This theory attempts to combine quantum mechanics with general relativity. The most spectacular feature of this theory called Loop Quantum Gravity is that it predicts the existence of space-time ‘atoms’. What may these do to human viability? This thought gives time a suggestion of substance and relates back to the notion of particles called ‘chronons’ that penetrate and harass all matter. Perhaps the ‘no can see no can be’ school of physics has finally loosened its grip in fright at the ever burgeoning sub-atomic physical world and its likely relationship to ageing.

On the other hand, qualitative investigation using Phenomenology advances the idea that people are active creators of their own world and have a consciousness that communicates to them everyday experiences and knowledge. I can understand the perception of flow of time and like all the others I believe in it. The earth has been shown to travel around the sun producing a cycle of night and day, darkness and light that in turn conducts a suite of activities and rests, consciousness and sleep, a rhythm for life. This is most noticeable in the expression of body chemistry especially the variation of cortisol and melatonin levels in the blood of human subjects during the approximately 24-hour cycle.

Within this circadian cycle, a person usually sleeps approximately 8 hours and is awake 16. During the wakeful hours, mental and physical functions are most active and tissue-cell growth increases. During sleep, voluntary muscle activities nearly disappear and there is a decrease in metabolic rate, respiration, heart rate, body temperature, and blood pressure. The activity of the digestive system increases during the resting period, but that of the urinary system decreases. Hormones secreted by the body, such as the stimulant epinephrine (adrenaline), are released in maximal amounts about two hours before awakening so that the body is prepared for activity. The controlling mechanism for these cyclical activities is thought to be a region of the brain known as the hypothalamus which seems to be the master centre for integrating rhythmic information and establishing patterns. Body temperature patterns vary at different hours of the circadian cycle. The natural time signal for the circadian pattern is the change from darkness to light. Where daylight patterns are not consistent, as in outer space, regimented cycles are

established to simulate the 24-hour day. If one tries to break the circadian rhythm by ignoring sleep for a number of days, psychological disorders are sure to ensue. Any shift in the circadian cycle requires a certain period for readjustment. Each individual reacts to these changes differently. Travel across a number of time zones is commonly accompanied by circadian rhythm stress, sometimes called “jet lag.” Melatonin is a hormone secreted by the pineal gland, a tiny endocrine gland situated at the centre of the brain. Fifty or so years ago we had no idea what this tiny polypoid mass on the under-surface of the brain did. Then investigation prevailed and knowledge advanced. Melatonin, a derivative of the amino acid tryptophan, is produced in humans, other mammals, birds, reptiles, and amphibians. It plays an important role in the regulation of sleep cycles. The pineal gland's production of melatonin varies both with the time of day and with age; production of melatonin is dramatically increased during the night hours and falls off during the day, and melatonin levels at night are higher in children than in adults. It is thought that the increased production of melatonin coincident with nightfall acts as a fundamental mechanism for making people sleepy. With dawn the pineal gland stops producing melatonin, resulting in wakefulness and alertness. The high level of melatonin production in young children may explain their tendency to increased sleep time.

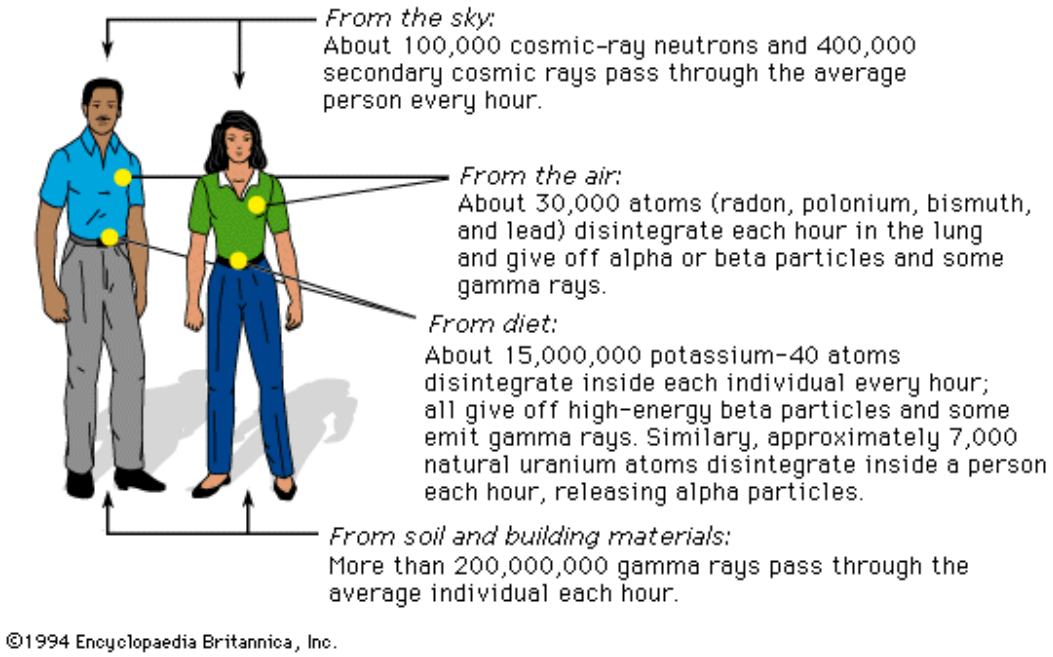
The proof of the pudding may be in the eating according to positivist enquiry, but scientist and philosopher Roger Penrose cautiously points out that, “It is our apparent experiences that tempt us to bias our computational models of the world in terms of time evolutions while the physical laws themselves do not contain such compelling inbuilt bias”. The fact is we feel we cannot affect the past or the future, simply because it cannot be done. Are things then predetermined? Perhaps. What is predetermined is human genetic structure that controls manufacture of a vast variety of protein molecules that govern function of the animal body and mind. It turns out to be a perfect blueprint but for a measured outcome of age and death.

What we tend to forget in our individualism is that as it is with birth, growing, lusting, falling in love, fighting off disease or suiciding, so it is with living. One has little say other than to make a choice here and there depending on how one feels at the time. Drunk or sober, asleep or fully conscious, your genetically-coded-for proteins are in control. The system takes care of everything. If this raises doubts, think of the other ductless glands like the pineal gland that regulate body processes by their secretion of hormones that are carried to specific target organs and tissues by the bloodstream. Diseases of the endocrine system result from too much or too little hormone secretion or from the inability of the body to utilize a hormone effectively, as in a certain type of diabetes mellitus. The ancient Chinese diagnosed some endocrine disorders and were able to provide effective treatments. Seaweed, for example, which is rich in the element iodine, was prescribed for the treatment of goitre (enlargement of the thyroid gland). Castration of males curtailed a large part of the male testosterone production and stands as an early demonstration of direct intervention to safeguard the chastity of harem women to say nothing of preserving the treble voice in altered males.

Pre-programmed control by the genome permits the prime functions of living organisms—growth, development, and reproduction—to proceed in an orderly, stable fashion. It is exquisitely self-regulating so that any disruption of the normal internal environment by internal or external events is resisted by powerful countermeasures. The questions then shift and become: What are the triggers and the triggers of the triggers other than time duration that manipulate gene activity to produce unpleasant results over a lifetime? Remember, the endocrine system, the nervous system and the immune system, regulate the body's internal activities and external

interactions to preserve homeostasis without any help from the owner. The clincher is that everything animal, vegetable and mineral is subjected to a variety of radio-activity through mineral isotopes and such emissions can cause mutation in genes. The following diagram names the main offenders.

Figure 1 tells part of the story of radiation activity the average person experiences in a lifetime.



From the National Radiological Protection Board, Living with Radiation, 3rd ed., Reading, Eng

Table 1 gives yet another presentation of radioactive elements in the body.

THE RADIOACTIVITY OF THE NORMAL ADULT BODY

Radio ACTIVE ELEMENTS IN THE HUMAN BODY

Radioactive Isotope	Half Life (years)	Isotope Mass in the Body (grams)	Element Mass in the Body (grams)	Activity within the Body (Disintegrations/sec)

Potassium 40	1.26×10^{9}	0.0165	140	4,340
Carbon 14	5,730	1.6×10^{-8}	16,000	3,080
Rubidium 87	4.9×10^{10}	0.19	0.7	600
Lead 210	22.3	5.4×10^{-10}	0.12	15
Tritium (^{3}H)	12.43	2×10^{-14}	7,000	7
Uranium 238	4.46×10^{9}	1×10^{-4}	1×10^{-4}	3 – 5
Radium 228	5.76	4.6×10^{-14}	3.6×10^{-11}	5
Radium 226	1,620	3.6×10^{-11}	3.6×10^{-11}	3

This table lists those radio-elements that produce most of the radioactive decays that take place within the adult body. Uranium-238 (^{238}U), Potassium-40 (^{40}K) and Rubidium-87 (^{87}Rb) are primordial radioisotopes, that is to say they have been present from the time the earth was formed. That they are still present in the environment is due to the fact that their half lives are comparable to the age of the earth, and thus they have not yet decayed into stable elements. Lead-210 (^{210}Pb), and the radium isotopes ^{226}Ra and ^{228}Ra are present today because they have primordial parents; ^{232}Th, with a half life of 1.41×10^{10} years, is the parent of ^{228}Ra, while both ^{226}Ra and ^{210}Pb are daughters of ^{238}U. The remaining two isotopes, Tritium (^{3}H) and Carbon-14 (^{14}C) are both continuously being created by cosmic rays in the earth's upper atmosphere. Today, much of the Tritium in the atmosphere is man made in nuclear reactors, but prior to the nuclear era the only source of ^{3}H was cosmic ray bombardment of carbon.

There are many other radioisotopes in the body in addition to those listed above. Most of those omitted contribute very few decays per second, and are thus trivial compared to those in the table. These include familiar isotopes that are found in the fallout from nuclear weapons, such as Cesium-137 and Strontium-90. Other primordial radioelements may be present, such as ^{232}Th, and radionuclides used in diagnostic procedures by the medical profession may also be present in some persons. Radon, in the form ^{222}Rn, is always present in the air we breathe. The hourly rate of assault from space, the atmosphere and the products of human activity are staggering; all the more so when we realise that the time of exposure of these particles to the human genetic material, organelles and cells can be cumulatively damaging. Life on earth is a sort of slow death by bombardment from within and without over time.

Paradoxically, one could live forever but for the genetic errors and mutations.

Mutation

Wikipedia, the free encyclopedia says it well. It is not time that alters gene structure but mutation. Mutations have varying effects on health depending on where they occur and whether they alter the function of essential proteins.

Mutations can be classified as:

- 1 Classification
  - 1.1 Change on structure

Harmful mutations are the ones of most common interest. Changes in DNA caused by mutation can cause errors in protein sequence, creating partially or completely non-functional proteins. To function correctly, each cell depends on thousands of proteins to function in the right places at the right times. When a mutation alters a protein that plays a critical role in the body, a medical condition can result. A condition caused by mutations in one or more genes is called a genetic disorder. Some mutations alter a gene's DNA base sequence but do not change the function of the protein made by the gene. Studies in the fruit fly show that if a mutation does change a protein, this will probably be harmful, with about 70 percent of these mutations having damaging effects, and the remainder being either neutral or weakly beneficial.

If a mutation is present in a germ cell, it can give rise to offspring that carries the mutation in all of its cells. This is the case in hereditary diseases. On the other hand, a mutation can occur in a somatic cell of an organism. Such mutations will be present in all descendants of this cell, and certain mutations can cause the cell to become malignant.

Often, gene mutations that could cause a genetic disorder are repaired by the DNA repair system of the cell. Each cell has a number of pathways through which enzymes recognize and repair mistakes in DNA. Because DNA can be damaged or mutated in many ways, the process of DNA repair is an important way in which the body protects itself from disease.

In biology, mutations are changes to the nucleotide sequence of the genetic material of an organism. Mutations can be caused by copying errors in the genetic material during cell division, by exposure to ultraviolet or ionizing radiation, chemical mutagens, or viruses, or can occur deliberately under cellular control during processes such as hypermutation. In multicellular organisms, mutations can be subdivided into germ line mutations, which can be passed on to descendants, and somatic mutations, which are not transmitted to descendants in animals. Plants sometimes can transmit somatic mutations to their descendants asexually or sexually (in cases where flower buds develop in somatically mutated parts of plants). A new mutation that was not inherited from either parent is called a *de novo* mutation. The source of the mutation is unrelated to the consequence, although the consequences are related to which cells are affected.

Mutations create variation within the gene pool. Less favorable (or *deleterious*) mutations can be reduced in frequency in the gene pool by natural selection, while more favorable (*beneficial* or *advantageous*) mutations may accumulate and result in adaptive evolutionary changes. For example, a butterfly may produce offspring with new mutations. The majority of these mutations will have no effect; but one might change the color of one of the butterfly's offspring, making it harder (or easier) for predators to see. If this color change is advantageous, the chance of this butterfly surviving and producing its own offspring are a little better, and over time the number of butterflies with this mutation may form a larger percentage of the population.

Potassium-40 is the most radioactive of the normal body radioelements, and enters the body within all the food we eat. Potassium is an abundant element, is an essential constituent for plant growth, is found in most soils, and is thus incorporated in growing plants. It is also an essential part of the human diet. The level of potassium in the body is maintained by a homeostatic process. The average adult consumes about 2.5 grams of potassium each day. There are three different potassium isotopes: ^{39}K, a stable isotope, is the most abundant, at 93.26 % of the total; ^{41}K is next in abundance at 6.73 % and is also a stable isotope. The potassium isotope of interest is ^{40}K. It is primordial radioisotope present in all potassium at a very low concentration, 0.0118 %.

Carbon-14, produces almost as many disintegrations per second in the body as does ^{40}K. The 16,000 grams of carbon in our bodies is exceeded by only one other element, the 43,000 grams of oxygen. Since one out of every 10^{18}th carbon atoms is ^{14}C, that results in a large number of radioactive ^{14}C atoms in every person on earth. This radioactive tracer in all carbon is the result of the continual bombardment of the earth's atmosphere by cosmic radiation. These cosmic rays contain neutrons, which produce ^{14}C in the upper atmosphere by hitting nitrogen atoms and transmuting them to ^{14}C. This process has been going on for as long as the earth has had an atmosphere, with the result that about one out of every 10^{18}th carbon atoms is now ^{14}C. All living things, trees, plants, animals or fish, as they grow and consume food, continue to add and replace carbon in their structures. However, after death, no new carbon atoms are added, so their ^{14}C content slowly decreases as the ^{14}C decays and thus allows their age to be determined by ^{14C} dating. Similarly, ^{40}K and ^{87}Rb can also be used for dating, but only over much longer time periods.

Lead-210 enters the human body primarily through the diet, but some fraction is inhaled from the air (from the decay of ^{222}Rn), and some enters as a consequence of smoking cigarettes. Polonium-210 (not considered separately in the table above) also may enter the body by these routes, but a much larger fraction of its intake is from the smoking of cigarettes. Thus in smokers ^{210}Po can contribute a significant fraction of the total radioactivity in the body. It was not considered in the table for it is not a "normal" constituent of the body, and because the body content is variable, depending on both the number of cigarettes smoked per day and the length of time the individual has smoked. The decay rate given in the table above for ^{210}Pb includes its two radioactive daughters, ^{210}Bi and ^{210}Po.

Uranium-238 is also found in all humans, entering the body as a contaminant with various foods. This heavy element is the first radioisotope in a long chain of radioisotopes which includes ^{226}Ra.

However, the ^{226}Ra in the table above does not originate from the ^{238}U in the body, for after two prompt daughter products of ^{238}U the decay process is effectively halted while the third daughter, ^{234}U grows in, for it has a long half life, 2.4×10^5 years. The calculated decay rate, 4.6 disintegrations per second, includes only the two prompt daughters which may stay in the body after the decaying atom is transformed from uranium into Thorium-234 and then into Protactinium-234.

The two radium atoms listed in the table enter the body incorporated in all the foods we eat, and in some areas, in the water we drink. Radium is found rather uniformly distributed in all soils, and thus in the products grown on these soils. From our studies of radium in the human body it has been observed that a representative 70kg man contains about 32 pCi of ^{226}Ra in the skeleton and 4 pCi in the soft tissues. The values for ^{228}Ra are not as well known; a value of 18 pCi in the skeleton has been assumed for this isotope.

In spite of the frequently stated phrases that "all radiation is harmful" and that "there is no safe dose of radiation", we humans contain, survive, and thrive with rather remarkable quantities of radioactive materials in our bodies.

Does this imply that every time a radioactive atom decays in the body a cancer results? Or does it mean that once in a while such an event may cause a cancer? The statement is meaningless without an estimate of the risk per event. No attempt has been made to express the dose that might be delivered to the body by the isotopes incorporated within the body. There are two reasons for this. First, dose is defined as the energy delivered to a sensitive organ or tissue, divided by the mass of that tissue or organ. It is this author's belief that we do not know the target we should use to calculate dose for any of these radioelements. Consider the radium in the body. We do know that radium mimics calcium within the body, and thus most of it is found in bone. Historically, such doses have been expressed as the total energy emitted by the radium and its daughters divided by the mass of bone in the body. Since many of the radium daughters emit alpha particles, which can produce a lot of damage, this alpha energy is multiplied by a factor to account for this increased damage. In actuality, most of the alpha particles never reach a sensitive tissue, such as a cell, and thus most of this energy is wasted. Indeed, most of the times that an alpha particle does hit a cell, it kills the cell and dead cells don't give rise to malignancies.

For the purpose of this essay I have shown the paradoxical nature of time in that it is a parameter that lends rhythm and consequence to a past, present and future while not really existing at all. It is DNA (deoxyribonucleic acid) with its multitude of information tasks, its regulatory and repair capacity and its vulnerability to subversion that limits the sum of meaningful time i.e. our moments on earth. Time itself is blameless. The evidence for this is overwhelming. Court dismissed. The environment is guilty. This is not to say that 'Time' is not personal and everywhere. It's just that destructive radiation is also personal and everywhere. Although forward directional Time is the guest of all biological processes, particularly that of ageing, we cannot find time a destructive force. We're born, we die and for the greater part all we are aware of is the passage of time and the not so subtle changes of the flesh. Decline and fall is not as quick as it could be by virtue of such mitigating factors as programmed repair and tissue replacement. People are living longer so the effects of radiation appear to be being ameliorated the opposite: good for you. Perhaps death will disappear off the radar.

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