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Protection and restoration of the nervous system

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(Transcribed and verified by Burtlancast and Giraffe)

Ray has a PHD in biology and biochemistry, with a specialization in physiology from the University of Oregon. From 1959 to the early eighties, he taught courses in anthropology, biology, physics, nutrition, immunology, metabolism, and psychology at Colleges in Oregon and Mexico. And he also conducts private nutritional counseling. He started his work with progesterone and related hormones in 1968. I don't know if most people realize that John Lee got his material from Ray Peat. Linus Pauling said: "If you're ten years ahead of your time, you get the Nobel Prize. But if you're fifteen years ahead of your time, you're called a quack.". Ray's fifteen years ahead of his time; that was shown with coconut oil, which fifteen years ago, he was promoting, and everybody thought it was poison. And now, every health food store has about six varieties of coconut oil, and everybody's using it. He's been working on the practical and theoretical aspects of… energy and the body's structure are interdependent at every level. He says: "Marketing" of products without understanding just what they do and why they do it seems to be adding confusion, rather than understanding as hundreds of people sell their misconceptions with their products. The very concept of "marketing" is at odds with the real nature of these materials, which has to do with the protection and expansion of our nature and potential. A distorted idea of human nature is sold when people are treated as "the market."

Anyway, I give you Ray Peat.

RP: The reason I was late getting into biology…starting graduate school in 1968 (I graduated from college in 1966)…it was my first experience at biology classes in 1950 and 1953 that made me think that biologists were sort of demented, or doing something completely anti-scientific. Because, in the 1940's, I had read, for example Russian psychologists…I had read in 1948 a [Russian] article that explained the distribution of chromosomes in the population: 46 chromosomes was the normal number. But there were perfectly healthy people who had 47, or 45. And even some with two more, or with two less. But, usually, the further you were from 46 chromosomes, the more likely were they to have some kind of syndrome. But anyway, they looked at it statistically, and 46 was very clearly the most common number in the population. And they looked at lots of people. Then, 3 years later, when I got into high school biology, and the textbooks said: "Humans simply have 48 chromosomes, period." And then, in College biology, same thing: "Humans have 48 chromosomes." Nothing about statistical variability. It was 1956 before American biologists discovered that we have 46 chromosomes.

And the textbooks never made a big thing about why they were 8 years behind other countries [with] relatively backward economies, in something that seems as simple as counting chromosomes. Anyway, when I graduated from college, I had a very bright literature teacher, so I decided that maybe, the real understanding of the world could be by studying literature and philosophies. But when I got to university, this was in the peak of McCarthyism, the English department was basically cowardly closed off, [like other] parts of the university. And I tried several different departments: the psychologists were the best people I could find at the university at that time. So, I almost majored in psychology. But then I found that you had to believe in Watsonian behavior somewhere, at least Skinnerian behavior (to get through the biology department).
Consciousness was not reality at that time. And my professors actually explained why you don't need to use an anesthetic for circumcising babies because they're not conscious. And the fact that they writhe around, and scream and turn red when they are being cut… [they explained that away by claiming:]"That's just a reflex. Consciousness develops at the age of 1,5 years when the myelin is completely deposited. And that's the time at which the brain stops growing." *awes in the audience*

At one time, they said: "Brain cells multiply only up until the sixth month of gestation." Then they gradually expanded it to 1,5 years. But [about] consciousness, at that time [it] was said, "If there's such a thing as consciousness at all, that doesn't begin until maybe it's an 1,5 year old, when there's no longer any division of brain cells."
And remember: at that time, brain cells didn't reproduce. Heart cells didn't reproduce. It was in 1990 when brain cells and heart cells were discovered to be able to reproduce even in adults. But, one of the other people I've read in the 1940's was L.V. Polezhaev, a biologist, who had been demonstrating organ regeneration in the 30's, and all through the 40's. And the brain cells and heart cells can be stimulated to regenerate.
The last ten years or so, [with] the advent of cloning, and stimulated regeneration, and stem cells, and so on, this is causing a lot of turmoil in the biological world. You don't get the sense in the newspapers of what this is doing to professors who have…[For example,] with Dolly, there were still people who were saying Dolly is impossible because, in principle, you can't clone an animal from a somatic cell. You can clone vegetables, because they're different. But people were saying, right in the 1990's: "that's impossible to clone an animal". But a guy named John Gurdon was cloning frogs, and amphibians back in the sixties. And that was impossible too because frogs are animals, and animals can't be cloned from somatic cells.
[Thus,] there's this sort of underground of fad in biology [with] the people that educate medical students, the superstructure mainstream… [And] this reality is something very different from science.
In the 1970's, I think I've heard everyone of my professors, at some point, say something like "Today, hundred thousands of my brain cells died" (at that time, it was a hundred thousand per day; previously, it was ten thousands per day): in 1970, an article in Science took advantage of this background (all biology professors believing that brains were dying massively every day in their lives, and the knowledge that people used to program computers by punching out holes into pieces of card). It explained memory and learning through the lifespan in terms of selective death of brain cells. If we're losing a hundred thousand brain cells every day, just think how this converts to a computer, were you can punch out hundreds of thousands of bits of information on each card.

[So,]I could name probably twenty completely insane ideas that were current in the biological community. For example, probably half of my biology professors at one time cited a study by August Weismann, who in 1889 or 1890 cut the tails of 1500 mice over a period of 22 mouse generations. And said this disproves* Lamarckian and Darwinian inheritance, or evolution of acquired traits.
*[Weismann embarked on the experiment to disprove Darwin's « Law of use and disuse » which claimed that the body sheds through generations those parts he has no use of anymore]

Even when I was eight, and read this in an encyclopedia, that was obvious that Weismann was making propaganda. Because Lamarck said :"Animals that strive and adapt, and acquire new traits by this striving adaptation, pass some of these traits on the next generation".
And my parents had some books, including Darwin's first editions, like « The descent of men » : [it] had an introduction in which Darwin said « People are saying that I base evolution on the Malthusian idea of the survival of the fittest and elimination of unfit, and so on ». He said "No! Here are the things that I believe account for evolution » : and he named the things that Lamarck and Darwin's grandfather, Erasmus Darwin, an evolutionist in the 18th century, [wrote] - that sexual selection, and adaptation, and inheritance acquire traits – (at the very end of the 18th century, Erasmus Darwin would say exactly the same things that Lamarck said).
[So,] Darwin, as late as the 1860's, said, "You're distorting me. I agree with Erasmus Darwin and Lamarck on these points."

But, by the end of the century, Weismann, the typical Social Darwinist, said : "Malthus had the right idea ; that weak people are eliminated".
And so, the human species is improved by misery. Poverty, disease and war are improving the human species. A literary critic wrote that he had seen evidence that the King hired Malthus specifically to help put down the revolutionary spirit. Because the monarchy was realizing that they were in danger, because people were impoverished, diseased and heading to be killed in pointless wars. So he had Malthus say, "It's good to suffer. Poverty, disease and war are creative. They eliminate the bad stuff."
And Weismann's mouse tail experiment was just one wildly, propagandistic thing that he had to knock down Darwin and Lamarck.
Weissman's main work was counting chromosomes (even though he had such bad vision that he couldn't use a microscope). In 1890 he determined that the development of an individual from an ovum is possible because the genetic material, such as Mendel identified, is all there in the ovum. And when that fertilized egg divides, each of these subsequent divisions loses some genetic information. And obviously you couldn't clone from a somatic cell, because not all of the genetic information is there. So he said, "The germ-line is immortal - the body, the soma, is mortal." And he said, "Each time you differentiate to a new tissue or organ, that's because you've lost some of the genetic information that was in the ovum." And remember, this was 60 years before Americans learned to even count the average number of chromosomes in people. A guy who couldn't use a microscope because of bad eyes created a doctrine of the deletion of information to explain the expansion of complexity from a fertilized egg to an adult organism. Weismann said that "Since the body is mortal, it doesn't have everything it needs to create itself (if you take only one part). So it's gonna wear out" (the « wear and tear » theory started there, at the same time). But the mortal tissues

of the body are now there, and they're eventually just going to wear out. Programmed aging essentially derives from this idea of the deletion of information.

The whole trend of 20th century biology was building on this idea of « increasing complexity by deleting information ». And so the guy that said, "learning is because our brain is dying", he was exactly analogous to Weismann's "The organism develops because it loses information." And in the 50's there were people who said that you can x-ray bacteria and cause them to mutate into new forms by destroying their genes with x-rays. And this was weird: bacteria that had lost their genetic information were said to have given rise to the next higher complexity in evolution. And all of the [inaudible] of complex organisms were believed by the Weismann principle to have derived from bacteria that had lost information.

That picture of progress through loss, I think traces back to the times that Erasmus Darwin ... He had a slogan even on the side of his carriage : "From Seashells Everything Comes" (the Latin phrase). But that got him in trouble. So he had it painted out fairly quickly, because people realized that evolution was contrary to the creationist doctrine. For example, well into the 19th century, to graduate, or even to study at British universities, you had to essentially sign a loyalty oath that you believed all of the tenets of the Church of England. People like Shelley weren't welcome at the English universities. Earlier censorship was tightening up all through the 18th century. And people like Darwin, instead of writing scientific treatises about evolution, as Lamarck did in France (which was relatively loose)... Darwin wrote a poem about the nature of life and put [in it] these ideas of "acquired, adapted from sexual selection", creating evolutionary progress.

The deists, remember, didn't want to deal with church officials entering, for example, the investment market, and saying that "God can intervene at any time". To have anything secure, the Deists wanted sort of a mechanical clockwork universe that was predictable. So that they could start projects and have confidence that they could finish them without God intervening.

And so, they said "God was like a clockmaker" who started the world running. And he was such a perfect creator, that he made it so that it would run all by itself forever. But it was like a clock that he was winding up and setting in motion, and then staying out of it. So, that physicists, and engineers, and anyone could count on [a] certain reliability of the world. But, as people started working on steam engines, and understanding what happens to the energy and the fuel, the laws of thermodynamics were eventually extracted from understanding how steam engines work. And they said "Well, the nature of reality is that everything's running down. And a closed system can't do anything but run down". So, physics set on the same kind of path that "nothing can be added to the world, because that's God's province". The only thing that can be done to the world is for it to get poorer, losing information or losing organization, losing energy (different gains in entropy). I think this historical picture accounts for why biologists, at the time i was first taking biology courses, why they could believe such impossible to believe things.

In studying literature, the only person that really appealed to me, in English literature, was William Blake, who, in many different places, had physiological descriptions. For example, the number of nerves in the optic nerve: his count was closer than any count until the electron microscope was

developed about 180 years later, or so. And Blake described evolution; which, obviously, he was getting these ideas from the culture. Erasmus Darwin was contemporary with Blake and was a very famous intellectual. And so, there was this oral culture in London and other big cities, in which 200 years advanced ideas in physiology, biology, evolution, development...For example, at the same time, i think it was from Swedenborg, the religious leader, who was also an engineer and biological experimenter. Swedenborg, i think is where Blake got the idea that showed up in his book that the nerves develop and invade the other tissues. This wasn't demonstrated until i think 1911, how the embryo innervates the tissues; that the nerves come from the top and go down into the various tissues. And at late stages of development, innervate the muscles, skin, and so on...

Remember: Malthus wasn't censored. But everyone who had an alternative idea of what's going on in society and evolution was likely to get hanged if they were too blatant in their description of things the King didn't like. And Blake was tried for sedition in 1804. After that, he was much more circumspect in the way he described his evolutionary and physiological ideas. He became very hard to interpret. But that was the general situation that there was this amazingly rich scientific culture that was like a piece of the 20th century set therein in 18th century London.

And people that did get published, like Malthus, were the people who were put up to the task for political reasons. When contemporary textbooks write the history of their science, they look at who got published: and physicists, and engineers, and biologists who held the right ideas were the ones who got published.
But the really good ideas were things that people talked about in secret. So, the idea of being ahead of your time, it's really more like being under your time. Because there's this 200 years of more or less contemporary thinking.

Other people that I've read in the 1940's, in the time that i was 8 to 12 years old: J. C. Bose was one of the interesting people, who around 1900 had been very popular and exciting as a physics, biological and radio researcher in England. But after 2 or 3 of his lectures, people started thinking about the meaning... that he was showing crystals, and metals, and vegetables, and animals all had sensitivity and reactivity. And you can fatigue a piece of metal, for example, and let it rest and it would recover, just the same way a fatigued muscle recovers. And when the British biologists started realizing the implications of what Bose was saying, they went back to more abstract kind of biology. And he didn't give anymore seminars. But he went back to India. And Marconi sent his men to try to get Bose to be involved in the Marconi radio company, because Bose had invented the sensor for Radio detection. Ordinary sensors at that time...the sensor would pass a current which would turn a current into a bell that would ring the bell and activate a hammer that would knock the sensor back into a starting position. So, they were, sort of like a Rube Goldberg apparatus; you could only detect a signal as fast as your hammer could re-sensitize the thing that.... Bose, by understanding the fatigability and recover ability of material, used metal particles, and mercury coatings, and pressure and such. So that he could tune up his radio sensor and it would spontaneously recover it's sensitivities. So you could keep sending a signal and do practical radio communication. And that was one of the devices if you used it too much, too fast, too long, it lost sensitivity, just the way an overworked muscle or brain loses sensitivity. So he would let her rest, and that would come back and work like a freshman, just like resting your brain or muscle.

One of my next newsletter is going to be on this idea of fatigue, and what it has to do with inflammation, excitation and eventually damage and atrophy of the tissue. And as far as I know, the people like Polezhaev, they didn't make any special reference or connection to Jagadish Chandra Bose. But these ideas of material substance being sensitive and responsive the same way living substance is, these were in the culture. And Alexander Ivanovich Oparin, who is considered to be one of the founders of the study of the origin of live…in 1924, Oparin's book explained a jelly conception of the origin of life; that organic materials would coalesce spontaneously. And Oparin got his ideas from this Dutch chemist, Bungenberg de Jong, who wrote in 1932 a book he called "auto-complex coacervation", which is like a colloid that reestablishes new equilibria, until you get several phases that are all stable with one another. Some of them love oily materials; some are more water-loving. Even though there were [other] people who realized that the cytoplasm is a jell, and that the membrane isn't a necessary component, Oparin and Bungenberg de Jong were the [true] pioneers of the "jell-conception" of cytoplasm, and did the thinking and the experimenting that showed how a jell can establish itself, remain in equilibrium, have preference for certain types of material that would dissolve (oily materials preferentially over watery materials). And that certain salts would be concentrated just passively, just in a physical arrangement of materials, without any pumps or energy being involved with that stage.

Le Chatelier was another contemporary. Vernandsky, the Russian, went around the world hoping to get an appointment in the United States; but no one wanted to have a geo-biologist or a bio-geologist on their faculty. So he was mostly working in France and Russia. And he recognized [and showed] in Le Chatelier's principle, which chemists all know about, but don't really apply it very far (Le Chaterlier's principle is that when you disturb a system of substance, the substance responds at to reduce the stress) that any energy impinging on any substance creates order of a certain kind, depending on the nature of the energy and pinching on the substance. And so, sunlight running through air, or seawater, or whatever, organizes that in a certain way. And the energy, by Le Chatelier's principle, minimizes the disturbance. So, a continuous flow of energy is going to continuously restructure and reorganize, adding information to the system. When you flow energy through any substance that has any capacity for memory, it's going to remember that. Now, this is the second passage of energy, so it's never the same as the first passage. The substance remembers by changing its structure. In the 1930's and 40's, water was already being realized to have intrinsic memory and to have long range ordering processes that made water near a surface different from the water at a great distance from the surface. The water that had been near a surface will remember some of that structuring-effect that it had. For example, where a body of water, or a drop, meets the air, it forms a film that's tough enough for a bug to walk on. That's the sort of structuring that happens anytime something different is introduced in the water.

Vernadski, by applying this principle showed that all substances - especially wet gelatinous substances - are able to store experience, or store the record of energy that has passed through them. A lot of people were thinking about the origin of life in terms of a "warm soup". That's how a lot of American biologists described it. Sydney W. Fox, who was a student of Operin and understood de Jong's work, suggested that maybe life didn't start in the soup. He thought, possibly, about condensing amino acids (formed in the clouds, or wherever) might have condensed on the hot volcanic rocks. So he just threw some powdered amino acids on hot volcanic rocks and sprinkled a

little bit of water, just enough to make a very viscous gel. And then he scraped the stuff up an hour or two later, put it in water, and looked at it under the microscope. And it had formed something much more specific than the complex coacervates that Bungenberg de Jong had studied.

Sidney Fox' mixture of amino acids had spontaneously, and almost immediately, formed little bacteria-like particles, very uniform in size and shape. And when he added amino acids to the watery solution that these were floating in, the things would grow, incorporating amino acids into their structure, and even produced offsprings (they would reach a certain size and a bud would form). In the absence of water, slightly moist, hot amino acids polymerize spontaneously into proteins. And those proteins spontaneously form little bacteria-like particles that brake up. Following the coacervation principle, they are more stable at a certain small size. The proteins that make up those particles can catalyze reactions incorporating new amino acids into new proteins, allowing them to grow. So, in an hour or two, Sidney Fox demonstrated something very much like the origin of life that Operin and Bungenberg de Jong had just postulated as possible; he demonstrated real growing organisms, like things with real proteins, spontaneously synthesized.

The inflammatory process that causes atrophy and inflammation, tumor formation, aging, tissue loss and so on, is structurally just like fatigue. And if you start thinking of the living stuff as substance rather than information… if you imagine you're a chemist or an engineer with a gob of stuff to analyze, when you look at it under different conditions (of temperature and pressure, and saltiness, and wetness, the amount of water versus salts,…)… when you look at the living organism, or at its cells, in this way, as substance, everything gets infinitely simpler.

When you look at it from the Weissman's-influenced kind of biology, you have the God-created, infinitely complex genome, which is being torn down to create the greatest structures. But it's an essentially infinitely complex process that ...it's so complicated that you can't calculate it.
But when you look at it from Vernandsky's, Le Chatelier's and Sidney Fox' perspective, you see that physical processes influence the behavior. And when you look at any condition, such as dementia, cancer, arthritis, epilepsy, paralysis, migraines, emphysema, all of these are physical processes, as well as biological processes. And a common feature that they have is that the cells get too wet. The gel that's put into a watery solution without enough salt or sugar, or things dissolved in water, swells up, and can eventually decompose, just from getting too wet. All of the fatiguing, inflaming, tumor-forming, atrophy-producing biological processes involve this accumulation of water out of control. The gel is no longer in control and excluding watery stuff; the gel is forced to take up too much water. And along with the water, it's forced to take up random amounts of proteins and fats and salts that shouldn't be there. For example, the healthy cell excludes calcium and takes up magnesium; if you immerse it in too much water, without enough sodium, that alone will cause the cell to take up calcium; and calcium and the water excite the cell. So, for example, to apply this to epilepsy, if you make a person drink too much plain water, it can bring on a seizure. Another way that neurologists can test for epilepsy – they used to do this – is actually have the person drink a pint of water; and if they had a seizure, that proved they had epilepsy. Or they would have them hyperventilate; and if they had a seizure from hyperventilating, that proved they had epilepsy. When you hyperventilate, you reduce the amount of carbon dioxide in your blood. That allows water from the blood to move out into the cells, such as the brain cells, causing them to swell, get excited and, in the case of epilepsy it can cause a seizure, or in another situation it can cause cramping pain.

Are there any questions or comments on this point ?

Q: *A lot of what William Blake wrote was poetry and what I got from his readings, at medical school, he seemed profoundly religious: was that a cover, or was that him ?*

RP: Yea. He referred to god as "old nobodaddy aloft". He came from a sect that used language in a particular way. And when you look at the conflicts between two different poems, one where he's sounding like an atheist, ridiculing a beastly, cruel God: he basically says: "That (God) doesn't exists ; the only God is man-like". So, he was a humanist speaking a very old fashioned religious language.

Q: *You make some analogies as what [inaudible] today. I know, for instance, germaphobes that [inaudible] and I swear it's like going to a religious meeting. There's just a way of thinking that is acceptable and, say, to talk about nutrients is unacceptable, and everything has to be named by the drug companies, the FDA, and they really suppress knowledge.*

RP: Yea. I'm trying to avoid taking any genetic courses; i think i did take one. But I've read the textbooks they were using in other genetics courses; and one of them was called "classical papers in genetics". And I've read that, just to see what they consider their history to be. Were there some really good genetics ideas that were, apart from this Weismann-Mendell organ religion? And all of the papers in that book of classical papers, that supposedly are the foundation of modern genetics, all of them said: "This data are consistent with the idea that...etc". There was no confirmation of the idea; it was simply "it could happen". *chuckles*
And, that's surprisingly how science has been working in the 20th century: consistent with not "Disprove all of the alternatives and leave something that is very convincing" but, basically just saying "It could happen" in line with this evidence.
And often, the conclusions in science magazines have often nothing to do with the data. As if the editor didn't read them. *chuckles*

Q: *Could you talk a little bit about hydration effects involved with, let's say, blood hydration versus extracellular hydration, intracellular hydration also, and how hydration may relate to developmental cycles, in terms of gestation and the evolution of organisms?*

RP: In early stage, when the cells are growing fast, like the fertilized ovum, and early cell divisions, they're about 92% water. And in an older organism, the water content gets way down to around 70%. But, in 1920, someone found that just putting cells in a hypotonic solution forced mitoses to start. So, when the cell is rapidly dividing, and forming a new organism, the high content of water stimulates the certain kind of activity that, in context, creates increased mass and complexity. And when the organism is mature, and doesn't want tumors popping out everywhere...the body's fluids cells – intracellular and extracellular – are relatively dehydrated. But you can stimulate regeneration just by increasing the moistness. In the 1950's, some magazine described someone who had the end of their finger cut-off at the base of the fingernail: and they kept it sealed and moist: and, from the finger, regenerated it. Remembering that, 30 years later, i knew 2 people; a little kid, who cut off the end of his finger the same way (right at the base of the nail), and a carpenter, who sawed off the end

of his finger. The kid's mother put his finger into a ballpoint pen case, so it wasn't touching anything; but the atmosphere was sealed around it. And the carpenter used an aluminum cigar tube to put over his finger. And they now both have perfect normal length fingers; the fingernail looks perfectly, even though there's no fingernail visible after they cut it off. So, adults can regenerate nicely formed tissue, in very visible ways: bone, and skin, everything… takes on a normal shape. When the conditions are right… I think, besides the humidity, the carbon dioxide (that's kept present in equilibrium with the metabolizing tissue) is a factor that prevents that "going wild" in the mere scar formation (or tumor formation). I think that's the main function of carbon dioxide. When sugar is fully metabolized, it all turns into carbon dioxide; and the carbon dioxide can - but doesn't necessarily – be turned into carbonic acid by combining with water. And so, sugar constantly streaming into the cell means that water and carbon dioxide are going to be constantly streaming out of the cell. And just in terms of binding with water and leaving the cell, that's one way that carbon dioxide, as it's formed, tends to remove water from a certain compartment.

But carbon dioxide, in itself, before it forms carbonic acid, is acidic. And this is another thing where the mainstream culture talks about hydrogen ions as how you conceive acidity. The whole way of talking about it is typically in terms of the concentration of hydrogen ions. That's what pH means. But the real theory of acidity is just the opposite. It's the binding of electrons rather than the releasing of protons (or hydrogen ions). And Lewis was the person who explained the correct general theory of acidity. And so, these are called Lewis acids. And a Lewis acid doesn't necessarily contain any hydrogen, or protons. So there's no pH involved. But it still has all the properties of acidity because it is binding electrons. And when you bind electrons, you tend to liberate protons, anyway. And carbon dioxide, then, in itself, when it binds to a protein, is acidifying the protein just by pulling electrons away from the protein. And when you acidify a gel, it tends to contract (the gel being acidic proteins; most biological gels (and most gels, in general) are made with acid polymers). And if you add alkali to it, it expands and swells. So, the acidifying function of carbon dioxide tends to squeeze water out of the cells, just by what the carbon dioxide is doing to the proteins. And so, carbon dioxide is a stabilizing and shaping factor.

Q: *Is there any difference in this effect between sugars and fats ?*

RP: Yah, sugar makes more carbon dioxide per unit of energy. In the presence of extra carbon dioxide (or at high altitude*) the cell's ability to resist fatigue [is increased] - fatigue being seen as the same as inflammation, swelling, uptake of too much water - . You can work harder or longer without getting fatigued. I think that's entirely the effect of carbon dioxide on the water.

*(At high altitude, where there is less oxygen pressure , you retain your own carbon dioxide produced in your tissues because it isn't being competed against by the excess of atmospheric oxygen: it's as if you have an enriched atmosphere of carbon dioxide)

But there are effects on the ATP too. The equation for making ATP is to dehydrate the precursors. And when you destroy ATP by de-energizing it, you add water - hydrolyze it - . And if you look at the equation, if you can just pull water molecules out of the environment, ATP would spontaneously form. It wouldn't take any fancy machinery. Just dehydrating a compartment should cause spontaneous phosphorylation.

And I think carbon dioxide, by its effect on gel, and by taking water out in the form of carbonic acid, I think that's how the carbon dioxide contributes to raising the energy and endurance of cells.

In Nepal (high altitude) there's a study (I think it was with 67,000 households) looking for different diseases; they didn't find any cases of Alzheimer's, or other dementias. They were extremely deficient in brain diseases in general. But the absence of aging dementia was remarquable. And that's something that's been known for over a hundred years, that high altitude populations are very resistant to the diseases of aging, cancer and heart disease, for example. Insurance companies have known that cancer is relatively scarce in Nepal and Bolivia, and all of the high altitude places.

In New Mexico alone, which is a relatively small population, the figures are very clear that for every 15,000 feet, you get 5 or 10% reduction in mortality from heart disease. The same with cancer around the world.

Q: *inaudible*

RP: Well, carbon dioxide is retained. It has an anti-oxidant function. There's less oxygen, but I think carbon dioxide is really what oxygen is being used for. It undergoes chemical reactions, but the production of carbon dioxide, I think, is what really creates the structure of the cell, maintains the gel in the living state and makes the energy hard to deplete. Just all kinds of muscle and nerve tests… [for example] grip strength is stronger at high altitude, even though the oxygen is lower. It's an example of the toxicity of oxygen, or the anti-toxicity of carbon dioxide.

Q: *inaudible*

RP: It's tending to damage their lungs and make their emphysema worse.

Q: *How do you explain the people with emphysema are walking around with oxygen, and apparently thinking they are improving it? But from what you're saying, they are getting worse ?*

RP: I think it's a similar thing to altitude sickness. Many places are still treating altitude sickness with oxygen; but someone noticed that a device they were taking up on Mount Everest, a plastic bag, that they would put the sick person in, let it sit in, and blow it up with oxygen, they would get better, [and] recovered from their mountain sickness. But someone analyzed the air, and they were concentrating their own carbon dioxide in this plastic bag. And so someone tested just having them breathe carbon dioxide at high altitude. And it worked.

Q : *question about aging and getting excess ions out of the cell.*

RP: I think that's related to the fact that aging involves a plugging up of all kinds of sensitive points on macromolecules in the cell. Glycation is something that's identified with diabetes, and Alzheimer's disease, and so on...It means the attachment of sugar-like fragments to proteins, and especially to receptors, or regulatory points in the cell. And they call it glycation, as if it's caused by glucose. But actually, the oxidized products of polyunsaturated fatty acids are many times more active than causing glycation. And the glycation happens mainly on lysine amino groups of proteins. But you can glycate any molecule that has an amino group. And that pretty well inactivates it. But the normal function of a good concentration of carbon dioxide is to bind to Lysine groups in

hemoglobin. That's how oxygen is released in the tissues where you need it. Because carbon dioxide comes out of the cells, binds to the lysine, forming a carbamino-group on the hemoglobin, acidifying the hemoglobin and making the oxygen available for the cell to get. Then when you get into the lungs, with a high oxygen concentration, the oxygen displaces the carbon dioxide. But the carbon dioxide binds that way to insulin receptors, nerve receptors, anything that has a lysine group, carbon dioxide is normally there protecting it, and acidifying it, and stabilizing the structure in sensitive positions or conditions. And so, just hyperventilating, i think, is contributing to the aging process, in which things tend to get glued together by glycation.

Q: *Do you know if anybody's ever measured this competing effect between carbon dioxide interfering with glycation reactions and the fact that glycation reactions themselves are dehydrations and therefore would be enhanced by a dryer environment? Therefore, you predicted they would go the other direction. In terms of aging itself, becoming dehydrated.*

RP: I think some of the dehydrations with aging is a normal defensive process. In extracts of tissue, slices and cell cultures, and old animals, and organ treatments, if you inject a hyper-tonic solution (remember, the hypo-tonic causes tissue swelling, excitation, inflammation), like sea water, instead of isotonic saline (seawater is about 7-10 times stronger than the salt solution of the blood) but a lot of hospitals are using the concentration of seawater 7 times normal strength to revive people. And it works better than isotonic saline. And in individual cells, and tissue cultures, and so on, it has an anti-oxidant effect that protects against oxidation, free radical damage. All kinds of damages are protected by not just concentrated salt, sodium chloride, but concentrated sugar and urea have similar effects in protecting cells. So i think the dehydration of the fluids with aging, part of that is a defensive reaction. During a seminar, once in 1991, one of my professors said (he knew i had read, (chuckle) unlike the other people at the university): "You think that it's true that all of these different tissues of the organism are isotonic with the blood?". And so i went down, and in about an hour, i found an experiment which took out very fresh snips of tissue and dropped them in isotonic, dull concentration, triple concentration, and so on, solutions, and found that most tissues from an adult organism are stable only at about a triple osmolarity; 2 or 3 times more concentrated than the bloodstream. And so, there seems to be something special about the blood that makes us able to handle it at the isotonic, but hypo-tonic to our functioning tissue cells. And i think that's a barrier of fibrin; largely fibrin on the inside of capillaries interacting with the movement of carbon dioxide out of the cells.

Do you have comments ?

Q: *Is there any correlation between your comment on these stories of how high altitude populations age slowly and the fact that runners from Kenya and Ethiopia set world records on a regular basis? Also, is there relation between and caloric restrictions on the--*

RP: Yea. Caloric restriction reduces the amount of damage to the mitochondria energy producing system. So that the cells are actually metabolizing at a higher rate than animals that are eating lots of vegetables, and such. The toxins from a freely chosen diet quickly slow down the metabolic rate. And in calves, which are born with very saturated brains, because they're basically getting butterfat

incorporated into their brains, rather then vegetable oil, their mitochondrias slow down in proportion to the linoleic acid getting incorporated into the mitochondria, in the cardiolipin that regulates the mitochondrial energy production.
And there's a paper you can find on the internet called "Uncoupled and surviving"; it's about a mouse that's naturally very hyper metabolic; it burns energy at a tremendous rate; lives much, much longer than ordinary mice. And that's a general rule: that the high metabolizers live longer than the low metabolizers. And they tend to have bigger brains. And the biggest skull fossil ever found was on Mount Kilimanjaro. And i always thought that [it] was probably a combination of some kind of a good diet plus the high altitude. Because when you do the opposite, when you increase the oxygen tension, or do any of these things such as disturbing the amount of water the tissue can handle, the brain gets smaller. Radiation causes the tissues to swell and take up water. And the chronic effect is to cause the offspring to get smaller brains.

I think all of these things, polyunsaturated fatty acids, radiation, estrogen, and too much oxygen are all doing exactly the same thing, which is overexciting the tissue and keeping it from going along the normal path of complexification and adaptive complexity.

Q: *Ray, do you drink your 8 glasses of water a day?*

RP: No. I've always thought Heraclitus had something when he said "dry souls are best". He also said you can't step into the same river twice. *chuckles*

Q: **Question about Gilbert Ling**

RP: When I went to graduate school, I was intending to become a nerve biologist, primarily. And the professor would refer us to articles and journals that seemed pretty irrelevant to the actual problem it was supposed to be solving. But I would look through the same journal and found that there were articles published the same year, that were much better solutions than the professor had referred us to. And eventually, over a period of three or four weeks (first term in graduate school), I saw that Gilbert Ling was turning out more and more often as a person who had solved the problems that were being not solved by the conventional mainline biologists. So I wrote to him and he answered nicely. He said: "You just don't understand what science is; science is about money and prestige and power". * chuckles *

He is the one that developed the glass microelectrode (which used to be called the Ling-Gerard microelectrode). He not only developed it, but he decided that it wasn't measuring the membrane potential, which everyone since him has claimed that it does. He says that there is no membrane potential. In my lab, with that same nerve biologist, I was using a Ling electrode in a muscle cell on an oscilloscope. And with a micromanipulator, I would move it into the cell and back, at different places in the cell. And a professor came by and was watching what I was doing and I said, "Look: each place in the cell has its own distinct electrical potential", and he turned so fast. *chuckles*. He couldn't look at the evidence because, if there's a membrane which is creating the potential, everything inside is a dilute solution: you can't have regional potentials. But Gilbert Ling explains why a cell is analogous to a water softener, which retains ions passively; it doesn't expend energy to do that. You can take hair, clean all of the ions out of it, dip it into blood serum, and it will take up magnesium and potassium just like a living cell. But people are still talking about membrane pumps.

And at Gilbert Ling's site on the internet, you can read a lot of his papers on how, basically, silly and corrupt mainline biology and medicine are. He is following up on… A. S. Troshin was, more or less, a contemporary of Gilbert Ling, who wrote a very good book ("Problems of Cell Permeability"), you can find it in one of the big science libraries here, on the behavior of ions in cells.

Q: **question about how to measure the PH in cells**

RP: A guy named Richard L. Veech, at the National Institute of Alcoholism, has demonstrated that even [In Vivo Magnetic Resonance Spectroscopy (MRS)] can measure intracellular PH distinct from the extracellular [one]. And he was the first one I know of who demonstrated that tumors have higher intracellular PH; it's the extra-cellular acidity that lactic acid causes. But the tumor itself, intracellularly, is excited and alkaline relative to normal cells. And excitation of any sort will eventually produce an alkaline field around the nerve or the muscle, as well as swelling. It's just like any gel that gets alkaline will swell up.

Q: *Is it necessary to make the body alkaline if it's acidic ?*

RP: Well, acid, basically, is protective, as long as it's involving carbon dioxide: carbon dioxide is oil soluble. And if you added 1% or so to the air here, we would add it to our blood and soft tissues; it would concentrate inside cells more than in the water. But it would go on increasing for months; just breathing the same concentration, it finally builds itself into the bones, strengthens them as calcium carbonate, before the calcium phosphate form. So we're as if we've been deprived of carbon dioxide chronically. And I think that's one of the things that causes the tendency to enflame and tumefy and atrophy with aging.

Q: *Will carbon dioxide help with osteoporosis ?*

RP: Yea. And that's how Vit K works; Vit K activates carbon dioxide and helps to integrate it into the bones.

Q: *We should walk around with a bag over our heads ?*

RP: Yea. Wear it while watching television. *chuckles*

Q: **question about acidity in the body inducting pathological germs**

RP: The carbon dioxide, while it acidifies the inside of cells and stabilizes them, it's regulating, it's hauling calcium outside cells and helping deposit it into the bones or [sends them out of] the kidneys. It's ability to combine with water and become a counter-ion to metals accounts for, I think, all of the so-called active transport of metals (the active streaming of metals out of cells, or in the cells). People used the idea of pumps to account for those kidney movements (and so on). Gilbert Ling, several times, just calculated that the cell, just to operate one or two of it's pumps would need fifteen times more energy that it could possibly derive from the energy available as food and oxygen. But the blood is alkaline because of the movement of carbon dioxide, keeping the alkaline metals in motion.

Q: *We only have a few minutes left; could you summarize ?*

RP: About 30 years ago, i was thinking about this carbon dioxide thing, and i had mentioned how it regulates brain circulation to one of my nutrition classes. And i had said "soda" (meaning soda pop, as a carbon dioxide source). And next week, a girl said that she had given her paralyzed mother, who was hemiplegic from a stroke (6 months she had been half-paralyzed) a spoonful of baking soda in a glass of water; and in 15 minutes, the paralysis lifted. So, then i started trying it every time i heard of someone who had a stroke. Recently in Mexico, a guy had been, basically, just a wad on his bed for three weeks after a stroke. And a guy gave him a spoonful of baking soda in a glass of water; within a few minutes, he could move his hand. And the next day, he could walk across the room with...[but] not very well. And dementia; i think I've told you before about the woman who had had epilepsy for 20 years. And her neurologist had documented her IQ decline (that was all they did on his annual check-ups) and said she was not to go out of the house by herself (she was so demented, she couldn't find her way home). And she took progesterone; and 3 or 4 days later, she came back all by herself. And when she was recovered, and able to do everything on her own, she went to graduate school, got a masters degree – straight A's – and...*chuckles*

Q: *And did she fire her doctor ? *chuckles**

RP: Her doctor fired her (laughter). I've tried to get her to go back and talk to him; but in general, these people who have these sudden, total recoveries, embarrass their doctors i think. The doctor just doesn't want to...Like a guy with Lou Gehrig disease (ALS) had a doctor that said he would work with him, but that involved just watching him, rather than actually participating and prescribing. But anyway, this guy was declining along with the other patients in the waiting room, that he saw every week. And when he started using niacin, progesterone, infra-red light on his head for a couple of hours every day, after a few months of declining, [he] started improving. And i think it was 6 or 8 months after he started. He sent his toilet equipment, wheelchair, and all these things back to the store (laughter) and showed off that he could do light lifts, went back to work at his company and had no more Lou Gehrig disease (awe in the audience). And sugar is another thing. Sugar stops the excitotoxic process; it works with niacin to stop the lipolysis that produces the fatty acids that activate the excitotoxic process. And so, sugar and salt, and baking soda, and breathing in a paper bag, and getting a lot of light, and taking thyroid and progesterone...The only thing wrong with it is that some of the people recover so fast that no one believes it *chuckles*. [They say]"It couldn't have been terminal...".

Q: *Can you talk more about the red light ?*

RP: Ok. At a hardware store, or a chicken store, you can get these things called infra-red light bulbs; they have a cone-shaped, aluminized reflector, and a clear front; they cost about 3 dollars. They're designed to run at 130 Volts; and so, at 120 Volts, they put out a lot of infra-red and red light, compared to ordinary incandescent bulbs. And that's good enough. It saves...3800 dollars than..*chuckles*.

Q: *Can you talk about coconut oil?*

RP: Coconut oil is anti-inflammatory. If you put "EFAD" (essential fatty acid deficiency) into Pubmed search, you'll find that animals that are deficient in the so-called essential fatty acids ([they] will have none of those fats in their diet) are hard to kill with endotoxins, or mechanical trauma, or a variety of poisons. They don't have arthritis, or inflammatory diseases from the normal causes. So, coconut oil, and butter, and the waxes from sugar cane, and bees waxes are being used for the same protective, anti-inflammatory effect. The fats that we make based on palmitic acid, which is found in butter and coconut oil, these are anti-inflammatory things; the mead acid and it's derivatives are powerfully anti-inflammatory. And when we eat vegetables and vegetable oils, we stop making these anti-inflammatory substances, and instead make the prostaglandins and the inflammatory things. And one of the differences between palmitic acid and linoleic acid (besides their effect pro- and anti-thyroid, and pro- and anti-testosterone/progesterone, and so on) [is:] the cell tends to take up more water when it has polyinsaturated fats, just because the double bond tends to associate with water more easily than purely hydrocarbon-saturated fatty acids.

Q: *[inaudible: question about full spectrum light]*

RP: Yep. Full spectrum doesn't stimulate...for example, the ultraviolet stimulates your production of vitamin D. But ultraviolet and blue light are both toxic: for example, to the retina, blue light is destructive to the retina. One of the main things that causes blue light and ultraviolet light to be toxic are the polyinsaturated fatty acids, because they react with high energy radiation.

Q: *[asks a question about why we are constantly told to cut back on salt]*

RP: Well, Gail and Tom Brewer, a man and his wife, wrote a book titled "What Every Pregnant Woman Should Know" about nutrition. And he had two associates, Jay Hodin and Douglas Shanklin, who wrote a book more technical than the Brewers wrote, about the importance of salt in preventing high blood pressure in pregnant women. Salt restriction is pretty sure to cause hypertension in pregnancy. And so, [Hodin ?] made the analogy between premenstrual syndrome and pregnancy, and suggested that women who swell up before their period try eating as much salt as they craved during that time. And usually they craved extra salt, like pregnant women. And when they ate lots of salt, they didn't swell up. So then, my old friends, who were taking high blood pressure pills, i suggested [them] that they try the same thing. And i found that other people had tried that, and saw that a salt-restricted diet raised adrenaline, made them have insomnia, as well as high blood pressure. And when you gave them more salt, you lowered their adrenaline, and generally tended to lower their blood pressure. A man named David McCarron demonstrated that calcium deficiency is more important than sodium excess. But extra-sodium and calcium really will protect you against most high blood pressures [types].

Q : *Is the kind of salt important ?*

RP : It's good to use natural foods like lots of milk for the calcium, lots of fruits for the potassium, and any source you can get sodium (sea water, if you like). To a great extent, one salt can substitute for the other, because it's the ionic strength and the osmolarity that's important.

Q: *question about the source of sodium chlorite: can one use sea salt ?*

RP: Yah, sea salt without additives is a good, practical source. An English woman doctor who went back to her native Mongolia - where they averaged 30 grams of salt per day – gave blood pressure tests to everyone she could find. And she couldn't find a hypertensive person, all the way up into their 90's.*chuckles* She didn't say anything about the rest of their diet. But I think that's an example that even 30 grams is compatible with good health.

Q: *I had a friend who taught chemistry and medicine at a university in Buffalo. He cured himself of cancer by drinking sea salt and saturated, like you talked about, at dinner. Huge amounts of salt, like a liter of water a day, and completely nothing else. He didn't change his diet or anything.*

RP: There have been studies recently of treating ulcers with different concentrations; and ten times isotonic is curative for ulcers. Stomach ulcers included. Sea water tends to be strong enough to help cure stomach ulcers.

Q: *Your opinion about coffee?*

RP: Coffee is our richest nutritional source of magnesium. Caffeine, I think of it as a vitamin, because it so closely fits into our system of uric acid and so on. And, empirically, the people who drink the most coffee tend to have the best health, the lowest cancer, and heart disease, and so on.

Q: *I've heard that Ray Peat recommends eating ice cream.*

RP: For about, I guess 15 years, I had a quart a day. And it did not affect my weight. But when I added about an ounce of coconut oil, my weight went down, in spite of eating the same quart of ice cream plus an ounce of coconut oil. But then, the Peninsula Creamery, over here, got squeezed out of the market by evil distributors. And so, then I went to Breyers, which was the next best thing. But then, Breyers started adding horrible gums, to make the product have a long shelf-live. And so, there's only one or two flavors of Breyers that are still really edible: vanilla and French vanilla.

Audience: *Ray has an excellent website, and a very, very readable newsletter. I went to his website for the first time and it's absolutely excellent. I did not understand some of the things he talked about.*chuckles* But the website is outstanding. Except there's the naked women. *chuckles**

Q: *Is it true that you do counseling for a small fee?*

RP: Yah.

Q: *This is one of the best bargains in the world. It's like Steve Foster who does counseling for a small fee. If you have questions and wanted to get another perspective, call that phone number up there and talk to Ray. Here's a man who's not in science for the money. But on the other hand, he's got bills like everybody else. So, I really think that it would be good for both of you if you get this man a call. So, anyway, thank you very much, Ray.*

RP: Thank you.