Ray Peat's Newsletter

Szent-Györgyi's Energy

A few years ago someone found that yellowing deciduous leaves in the fall were in the state of protein catabolism. I have discussed how this parallels the "toxic" effect of night and winter on animals; the darkness damages mitochondria, and red light seems to be the most effective frequency in restoring their function. The observation that cortisone begins to rise (in humans) when lights are turned out, rather than when people begin to sleep, nicely fits with the rabbit mitochondria studies, and the autumn leaves: either the cortisone causes the damage, or, more probably, the mitochondrial inefficiency wastes glucose, and increased adrenalin, cortisone – and dreaming – are responses to hypoglycemia.

At the moment I am working on the idea that potato plants, which do not normally produce seeds, can be induced to do so by blue (and other high frequency) light – at least when grown in acidic soil which provides iron or other heavy metals which tend to generate free radicals. This idea is a kind of generalization of the idea I first heard around 1953, from an old forester who knew that a coneless pine tree could be caused to produce a heavy crop of seed by injuring it with an ax. There are many other examples of the same process, such as grass which produces seed early when the weather is dry. The many toxic effects of estrogen caused me to interpret its effects (for example, rapid cell division in the uterus) as another example of the same process. In the 1940s, people often talked about famine causing extremely early fertility in girls; although it wasn't much discussed at that time, starvation (and other stress) does cause an elevation of estrogen.

Since Albert Szent-Györgyi died I have been thinking about his idea that the "Hopkins electron pool," stored in cellular proteins provides the energy for cell division. Around 1972, someone reported that sunlight shining on dark hair induces free radicals, and that these free radicals persist for hours in darkness. But exposure to red light "quenches" the free radicals within seconds.[1]

My idea of the "toxicity" of darkness is that free radicals (produced by metabolism, or maybe by cosmic rays) accumulate with time, but that the red component of light normally quenches them. In darkness, the excess of excited electrons would begin to spread beyond their safe storage system, and to cause toxic effects, such as oxygen wastage.[2] Many toxins and stressors are known to act through a common pathway of free-radical damage;[3] this accounts for the generalized protective effects of certain substances, such as vitamin E (as discussed by Meyerson in *Ray Peat's Newsletter* #29).

One of the most sensitive tests for estrogen's effect is the reduction of a dye (called TTC) by tissue and whole cells;[4] it is reduced (theoretically) by various "dehydrogenases." (The Hopkins electron pool was called by E. Racker "nothing dehydrogenase"). Progesterone blocks estrogen's effects on this dye. Since a similar dye has been used to measure the activity of superoxide dismutase (SOD), it seems that the superoxide radical can reduce the dye. Whatever the source of the electrons, estrogen and progesterone act in different directions on their availability.

Progesterone is known to inhibit cell division in various situations: in the uterine endometrium, in cancer, and in frogs' eggs. Several years ago, someone found that the progesterone in frogs' eggs was bound to the melanin – whose function in the eggs was never understood. (Though Szent-Györgyi for many years emphasized that pigments often exist invisibly inside organisms, and probably have electronic-metabolic functions, rather than the decorative function usually associated with pigments). Melanin generally exists as a complex with proteins. If the energy for cell division is stored in proteins, and if progesterone is acting on the eggs to inhibit cell division, and is bound to the melanin – which is known to store electronic excitation – then maybe progesterone is acting to prevent the escape of energy from the protein-melanin system.[5] If it does this generally, that could explain its very general "catatoxic" effects.

Szent-Györgyi's Energy

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It was around 1954 that I first found some potato fruits, and hoped to get viable seeds with which to grow new strains of potato.[6] Around that time, John Ott found that squash plants he was photographing with pink artificial light produced only male flowers. The next season he used bluish artificial lights, and his plant produced only female flowers. Later, he found that night blooming plants such as the Morning Glory, could keep blooming if exposed to blue light, but when they were exposed to pinkish light their blooms collapsed.

All of this seems to be converging on the idea that the female reproductive tissues are activated by a free-radical or excited electron promitotic system. But beyond that it seems to have clear implications for aging, stress, toxicity, energy, tissue repair, regeneration, etc. The key idea is that biological structure and biological energy are delicately linked and balanced even at the finest – molecular and submolecular – levels.[7]

Notes:

1. Some people now consider melanin to be an anti-oxidant. It is important not to confuse melanin with lipofuscin, which is produced under oxidative stress and is able to accelerate the wastage of oxygen and energy.
2. Oxygen wastage itself will block respiration, disrupt mitochondrial function, and allow intracellular calcium to increase. There is clear evidence that many types of cell damage lead to cell death by a common "calcium path." Tissue stress has many self-promoting loops: enzyme release, formation of carbon monoxide and probably cyanide, retention of iron, etc. Sulfur, especially as the sulfane and sulfhydryl forms, is involved in many protective processes: see *Ray Peat's Newsletter* #5, 6 and 50. Deposition of calcium and iron are closely associated, and in oxygen deficiency iron becomes a major source of free-radicals, as discussed in *Newsletter* #41.
3. This pathway, according to Meyerson, is closely linked with the calcium-cell-death pathway; supplemental magnesium and vitamin E closely interact in protecting against stress.
4. Disruption of the cell destroys the ability to reduce the dye, suggesting that something more than ordinary enzymatic reduction is involved. At least, the phenomenon would involve an extreme sensitivity to concentration. This violates the basic assumption of conventional (and stupid) "test-tube biochemistry," namely, that reactions in the test-tube meaningfully reflect what occurs in the cell. Le Chatelier's principle "when a balanced system is disturbed, the equilibrium will shift in a way to restore the original condition," shows how complex enzymes can change activity upon dilution, but this is not generally thought to apply to the dehydrogenases.
5. In "A biophysical approach to altered consciousness" (*J. of Orthomolecular Psychiatry*, 1975) I proposed that a "leak" from this system could cause mental symptoms. Substances such as progesterone might have their beneficial psychological and neurological effects by stopping the leak.
6. In the winter of 1954-55 I experimented with growing algae under various lights – red, blue, and ultraviolet – to compare with algae grown in daylight, but I didn't have facilities for growing larger plants under those lights, and it has taken more than 30 years to get back to it.
7. Szent-Györgyi invented this field, called submolecular biology. It shades into Selye's "supra-molecular" biology through the work of many people, such as Gilbert N. Ling, F.Z. Meerson, and Otto Warburg.

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