

HEALTH AND STRESS

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COULD TINY DOSES OF STRESS ACTUALLY BE GOOD FOR YOU?

KEYWORDS: Mithridate, anaphylaxis, botox, The "Radium Girls", Eben Byers, atom bomb, nanopharmacology, hologram, pheromones, energy communication pathways.

About 40 years ago, scientists became interested in discovering why certain trees were resistant to fungi that usually caused decay. They extracted a chemical from bark that inhibited the growth of fungi in the laboratory and since this had commercial potential, they wanted to determine the least amount that would be effective. To their surprise, they found that extremely weak concentrations of their extract produced the greatest inhibition and that much higher doses provided little benefit. They called this response "hormesis," and defined it as "the stimulatory effect of subinhibitory concentrations of any toxic substance on any organism."

Hormesis was derived from hormone, a word coined in 1904 by Ernest Starling, to designate any substance produced in small amounts at one site but carried via the blood to affect some distant location. Since then,

hormone has become essentially synonymous with secretions from endocrine glands like the adrenal, pituitary, thyroid and gonads.

Hormone is derived from the Greek *hormōn*, meaning "to excite." Hormesis refers to anything not originating in the body but with general stimulating or excitatory effects when given in very small doses. Two decades ago, researchers found that fish died when exposed to cadmium but that this could be prevented by prior administration of tiny doses of this toxic element. They also called this hormesis and the term now usually refers to the observation that exposure to tiny amounts of a poison or toxin can subsequently provide protection from what would normally be a lethal dose.

This is hardly a new concept. Around 2100 years ago, Mithridates, King of Pontus (Turkey), gave different poisons to condemned criminals to study their lethal effects so he could learn how to avoid or treat them. He found that taking minute daily doses of these poisons would provide protection. Shakespeare used mithridate in *King Lear* to describe a shielding dose of a poison and we still refer to this protective phenomenon as mithridatism. The Greeks and Romans used hemlock, arsenic and cyanide. Poisoning at the dinner table was

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not uncommon in Nero's time and this became a common practice during the Middle Ages and Renaissance. The infamous Lucrezia Borgia, who allegedly killed hundreds by serving them poisoned wine also took small amounts of certain poisons prophylactically as a precaution to prevent injury in the event that someone surreptitiously switched glasses.

Hormesis And Antibiotic Resistant Bugs

Farmers and agricultural chemists became interested in antibiotics because of the thousands of lives saved by penicillin during World War II and the subsequent spectacular success of streptomycin in treating tuberculosis. Some were fearful that feeding antibiotics to livestock might suppress normal intestinal flora and reduce their production of vital nutrients from food that promote growth and bolster immune system resistance to infection. However, when chicks were fed small amounts of streptomycin they grew faster and larger than controls. Similar effects were demonstrated with various antibiotics in other animals and by 1960, feeding antibiotics to farm animals had become standard practice all over the world. This has steadily increased and **25 million pounds of all antibiotics produced in the U.S. annually are now fed to healthy chickens, cows and pigs to promote growth. That's eight times more than the 3 million pounds used to treat infections in humans.**

While livestock on a steady antibiotic diet allows farmers to bring them to market sooner, there is concern that this practice has had harmful repercussions for humans, particularly with respect to the growing problem of drug resistant "superbugs".

When consumers eat foods containing drug resistant coliform, salmonella and other bacteria, serious infections can surface, especially in the elderly or others with impaired immune systems. In addition, antibiotic fed cattle, hogs and poultry are increasingly being raised under confined conditions in the least expensive rural areas where there are few sanitary controls. An estimated 50-75 percent of feed antibiotics pass unchanged into manure, which causes additional problems.

Some 575 billion pounds of animal manure waste containing these deadly microbes are generated annually at such sites. Since manure is too expensive to transport it is usually stored in open or covered pits and later spread or sprayed on nearby crops or farmland. Runoff from such manure-applied fields can carry human pathogens into rivers and ponds that are often sources of drinking water. Several outbreaks of serious infections due to drug resistant bacteria have been linked to livestock waste. In one study, the intestinal flora of chickens fed tetracycline-supplemented feed consisted almost entirely of organisms resistant to the drug after only ten days. Within five months, one third of fecal samples from inhabitants of the farm contained more than 80 per cent of tetracycline resistant bacteria compared to only 6.8 per cent for their neighbors.

Antibiotic residues in meat, poultry and eggs are not believed to be hazardous based on USDA assays for this and hormone content. Although levels above those considered to be "safe" are rarely found, it is not known if trace amounts of antibiotics could still have a hormesis effect and only a small fraction of these foods are inspected. In 1998, the European Union banned antibiotics deemed important for humans as growth promoters in livestock and Germany has banned all antibiotics used for this purpose. Attempts to impose similar restrictions here by the FDA and Congress have repeatedly failed due to powerful farming interests. The only way to presently avoid ingesting unwanted antibiotics and hormones is to buy meat that is certified as being "organic" or devoid of any such supplements from a specialty supermarket or butcher.

Why The Hormesis Concept Is Confusing

Antibiotics make livestock grow faster but also create drug resistant bugs that have dire repercussions for humans. Minute doses of chemicals that mimic hormones can also wreak havoc. Receptors in DNA for hormones allow them to produce their specific effects. However, there can be as many as 500 synthetic chemicals that masquerade as hormones by occupying these receptor sites and alter gene activity,

often with different results. The total number of receptor sites is fixed and if there are 1,000, then 1,000 molecules of a mimicking chemical will fill all of them. Since even small amounts of these chemicals contain several hundred thousand molecules, this blockage often persists and subsequent hormone administration is ineffective.

Allergy and anaphylaxis pose other problems. In the late 1800's, the French physiologist Charles Richet was studying the effects of injecting poison obtained from sea anemones. He found that within a few days his experimental dogs had allergic reactions including vomiting, shock and loss of consciousness and while some died, others made full recovery. Weeks later, because the recovered dogs seemed completely normal, he included them along with others who were given much smaller doses of anemone poison. To his surprise, the recovered dogs developed the same symptoms within minutes but they were more severe and many dogs died within hours.

He later proved there was a physiological state he called anaphylaxis that was the antithesis of prophylaxis. When allergic subjects are exposed to an allergen a second time they are even more sensitive to its effects than the first time. **Instead of building immunity to the substance through exposure (prophylaxis), the immunity becomes greatly reduced and death can occur due to anaphylactic shock.** This can be demonstrated in people allergic to insect stings or penicillin who suffer severe reactions even if exposed to minute amounts of these or even chemically related substances. Richet received a Nobel Prize in 1913 for discovering anaphylaxis and delineating various allergic reactions and diseases.

Minute doses of a poison can also provide benefits locally as well as at distant sites. An outbreak of food poisoning during the Napoleonic Wars led to the discovery of botulinum toxin, an extremely lethal chemical. Victims experienced a progressive paralysis from the head down that caused death by suffocation due to difficulties in breathing. Smoked sausages seemed to be the problem and the bacterium responsible for the toxin in sausage poisoning was later identified and named *Bacillus botulinus*, from

the Latin *botulus*, meaning sausage. Botulinum toxin was purified in the early 1920's and a crystallized version was developed two decades later that is now available as botox.

Researchers showed how minuscule amounts could paralyze muscles and it has been used for several decades to correct blepharospasm, a condition in which patients blink so incessantly that they can't open their eye. A tiny dose of botox into the affected muscle brings immediate relief. Other disorders that respond to this include strabismus, spasmodic torticollis (wry neck) and even hyperhidrosis (excessive sweating). Injecting botox in the armpits, soles of the feet or palms of the hand, and in some cases all three, paralyzes the sweat glands and stops the wetness.

It didn't take long for surgeons to realize that injecting botox close to the eye to treat blepharospasm or strabismus not only relaxed the muscles responsible for these disorders but also those that form facial wrinkles. A pinch of botox can make you look 20 years younger but how long this effect lasts remains to be seen. Another interesting spin-off from the current botox rejuvenation craze is that many patients suffering from migraine reported that their attacks were much less frequent, did not last as long, and headaches were much milder.

Botox is the most powerful poison known. One gram can kill a million people, which is why it is the most feared biological weapon. If minute amounts of this or other poisons provide benefits because of hormesis, could minimal exposure to other types of toxic agents like radium and x-rays have similar effects? The answer seems to be yes.

The Remarkable Radium "Liquid Sunshine" Fad And Its Deadly Consequences

In the early 1900's, radium was considered to be much more valuable than either gold or platinum. Radium or radon laced water was called "liquid sunshine" because it was believed to be a magical elixir that could promote health and prolong life by rejuvenating effects that provided a host of widespread benefits. **Radium was added to toothpaste, hair tonic and candy** and incorporated as part of the brand name of

numerous items whether they contained it or not. Radioactive drinking water was readily available as an elixir and panacea and its presence was a selling point for spas and hot springs in Arkansas, New York and Massachusetts. Diverse types of radioactive products, appliances and medical devices were available for the relief of fatigue, arthritic and other pains or to increase vitality, potency and retard the ravages of the aging process.



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From left to right above are the (1) Cosmos Bag, a cloth bag containing cotton and low grade radioactive ore to be applied to rheumatic and arthritic joints. Radioactive water and especially (2) Radithor were popular with physicians and patients as a tonic and crocks lined with radioactive ore were used to produce radioactive water at home. Water left in the (3) Revigator crock overnight was about five times as radioactive as the maximum recommended for well water today. The (4) Radiendocrinator, available from American Endocrine Laboratories for \$150, was intended to be placed over the endocrine glands and could be worn in an athletic strap adapter under the scrotum. The top of the box in the last photo (5) reads "The Best Radium Finest Seamless Male Pouches (Male pouch was the term used for condom). There were also radioactive suppositories, bath salts, lotions, cigarette holders, comforters, heating pads, refrigerator deodorizers and bread.

The first public inkling of any problem with radium came as a result of a 1927 lawsuit filed by Grace Fryer. Grace started working at the U.S. Radium Corporation's factory in New Jersey in 1917, where she learned to paint a glow-in-the-dark compound on the numbers of watch, clock, altimeter and various instrument dials. She and 70 other women sat at long tables in a dusty room mixing up glue, water and radium powder into a glowing greenish-white concoction that was painstakingly applied with a camel hair brush. After several strokes the brushes would lose their shape and they were instructed to point them with their lips. As she later stated, "I think I pointed mine with my lips about six times to every watch dial. It didn't taste funny. It didn't have any taste, and I didn't know it was harmful." **She did think it was strange that when she blew her nose, her handkerchief glowed in the dark but everyone knew the stuff was harmless and many even painted their nails and their teeth to surprise their boyfriends when the lights went out.** She quit the factory in 1920 for a better job as a bank teller but about two years later, her teeth started falling out, she developed a painful abscess in her jaw, and x-rays showed severe bone decay. She was joined in the suit by four fellow workers with similar problems and the trial attracted international attention since all of them were pursuing such a rapid downhill course that death seemed likely before a verdict could be reached. The company denied any wrongdoing despite evidence that their own documents indicated they were aware of this potential problem. The "Five Radium Girls", as they were known, all suffered horrible deaths in the next few years and although they won the suit, the company got off with paying a paltry pittance, even in those days.

Can Small Doses Of Radium Or X-Rays Promote Health By Radiation Hormesis?

An avalanche of similar horror stories subsequently revealed the hazards of other radioactive products considered to be beneficial. The most famous was the case of Eben Byers, a millionaire steel tycoon, strapping sportsman and U.S. amateur golf champion whose physician urged him to take Radithor. Byers was so convinced it gave him "zip" that he often drank a few of the 2.2 ounce bottles daily. He consumed close to 1400 bottles at \$1.00 each between 1928 and 1930 before dying in 1932 of radium poisoning at the age of 51. By then he had not only lost his zip but most of his teeth from bone decay, his body was covered with abscesses and he weighed 92 lbs. The *Wall Street Journal's* headline "*The Radium Water Worked Fine Until His Jaw Came Off*" was essentially the death knell for such radium products. However, bathing in radon water is still popular. Some 75,000 people a year seek treatment for arthritic and other complaints at a dozen radon spas in Germany and the government pays for therapy at one facility. There are several in Austria, the Czech Republic and Japan. There are also numerous mines around the world including the U.S. where people flock to inhale radon. Many are repeat patrons with countless testimonials of miraculous cures. It seems unlikely that these are all placebo effects based on arthritic pets that could hardly walk or had to be carried in but could be seen running and jumping weeks later.

Such low-level radiation is now under intense investigation in Japan, where it has been successfully used to suppress cancer by strengthening immune system defenses and promoting DNA repair. There is good evidence that there is stimulation of superoxide dismutase, a powerful antioxidant that blocks free radical damage, and ATP, the source of energy for all cells. Scientists at several top medical centers reported increased levels of insulin, endorphin and enkephalins, which may explain "rejuvenating" effects, such as increased brain cell membrane permeability, improvement in hypertension and diabetes. Double blind studies performed on patients at Japan's Misasa Radon Springs have confirmed the ability of its radioactive water

to relieve rheumatism, neuralgia and other complaints. Similar results were obtained in studies conducted in conjunction with Radon Therapy Hospital specialists at Austria's Bad Gastein spa.



Radon Therapy in abandoned Montana mines



Atomic bomb researchers were very concerned about the possible dangers of generating large amounts of radioactive isotopes but found that mice exposed to modest amounts of uranium dust lived longer than controls. In 1963, the Atomic Energy Commission confirmed that morbidity rates were lower and longevity was greater in mice, rats, guinea pigs and hamsters that had received low dose irradiation. The following year, cows that had been accidentally exposed to small amounts of radiation after an A-Bomb test 18 years previously had to be put to sleep because of extreme old age, but there was little mention of this in the press. The vast majority of dairy and beef cattle rarely live longer than 15 years. No newspaper featured a 30-year follow-up of 1155 low-dose radium dial

painters showing that they had significantly fewer cancers than the general population and also lived much longer. Most people are also unaware of long term studies showing that **Hiroshima and Nagasaki survivors with a low exposure to nuclear radiation are now healthier and living longer than controls who resided in unaffected Japanese cities.** About a million patients are treated annually with low dose radiation at Russian hospitals and this is now also officially endorsed in Japan, presumably because it is cost effective as well as safe. Radiation hormesis may have a tough road to hoe in the U.S. but it has strong and growing scientific support.

Is Hormesis A Form Of Homeopathy?

Homeopathy is also based on the belief that infinitely small concentrations of drugs as well as other substances can have significant biological effects that are opposite to those seen with conventional doses. This is based on the premise that "like cures like", a concept that dates back 28 centuries to Hippocrates. The term is derived from the Greek "*homoios*" (similar) and "*pathos*" (suffering) and was introduced around 200 years ago by the German physician Samuel Hahnemann. He proposed that a high dilution of a substance could "cure" the same symptoms it would normally induce in much larger doses. If hay fever caused sniffles and teary eyes similar to that experienced while peeling onions then a homeopathic onion remedy might be beneficial. This "law of similars" is based on the belief that these dilutions have biological activities that are specific for a given substance. Hahnemann administered drugs, plant and other extracts to healthy people and recorded the symptoms they produced so he could select the appropriate therapy for his patients.

His followers also recorded their own experiences. Today's homeopath can consult a number of homeopathic materia medica texts to identify a substance that has been reported to induce in healthy individuals the same symptoms experienced by a patient. That substance is then prescribed in very low doses to produce an opposite effect. There are numerous examples to support this. Conventional doses of aspirin delay blood clotting but an eight-year study of a homeopathic preparation showed it shortened bleeding time. Large amounts of sodium sulfate

cause diarrhea while a homeopathic dose can be effective for treating intractable diarrhea. Various allergens are used to desensitize patients whose symptoms are due to these specific substances.

Drugs like nitroglycerin and digoxin that are effective for treating angina or atrial fibrillation can induce or aggravate these disorders when given in large doses. Aspirin is often used to lower an elevated body temperature but can cause life threatening hyperthermia if too much is taken.

Hahnemann's approach was revolutionary at a time when bleeding and purging were used to treat most diseases and prescriptions could contain dozens of drugs in the hope that a few might be effective. **In some respects, homeopathy forecast the development of vaccines as well as certain current concepts of how immunity develops.** It fell out of favor following the advent of antibiotics and medications more consistently effective for specific disorders or symptoms. Since homeopathy had no scientific rationale and the dilutions used were often so great that no molecules of the active substance were detectable, it was assumed that any "cures" were placebo effects.

Nevertheless, as with acupuncture, which was similarly derided by Western physicians, the efficacy of certain homeopathic approaches has been proven. Sales of homeopathic medicines in the U.S and Europe have increased by 20% to 30% annually for the past 2 decades. France's equivalent of the A.M.A. has called for official recognition of homeopathy, inclusion of homeopathy training in the undergraduate medical curriculum and the creation of a postgraduate degree. Similar efforts are being implemented in Great Britain and elsewhere. There is growing evidence that the benefits of both homeopathy and acupuncture as well as proven electromagnetic field therapies are achieved via subtle energy pathways. A homeopathic remedy is prepared by diluting a substance and shaking it vigorously (succussion). This process is repeated over and over until the desired dilution is achieved.

Homeopaths maintain that although the physical molecules of the original substance may be gone, dilution and succussion leaves an imprint of its energy pattern that provides a kind of healing

charge that is not achieved with either dilution or succussion alone. Each process builds sequentially upon the other, causing the power to be retained and progressively intensified. It is not the chemical content but the "vibrational pattern" of the remedy that stimulates healing. Benveniste has shown that such "memory in water" exists and can have biological effects. This appears to be different than hormesis. More about this to follow.

Stress, Homeostasis And Hormesis

Most studies show that chronic stress reduces the immune system's ability to resist infection and impairs immune responses to vaccines so that they provide less protection. This is particularly true for the prolonged and persistent stress experienced by caregivers for spouses or loved ones suffering from Alzheimer's disease and other chronic debilitating disorders. However, acute stress bolsters immune system function and repeated bursts of mild stress enhance the memory of dangerous challenges and appropriate coping responses that may provide future protection.

Stress occurs whenever the stability of the body's internal environment (homeostasis) is threatened. Good health requires that blood pressure, heart rate, body temperature and the blood concentration of glucose, sodium, potassium, oxygen and a host of other physiologic and biochemical parameters are maintained within fairly narrow limits. This is accomplished by automatic responses that have been exquisitely honed over the lengthy course of human evolution. If a cell's environment changes significantly, a master protein called heat shock factor immediately turns on the genes that express "molecular chaperones" to help appropriate proteins to restore normalcy.

Proteins are basic components of all living cells but to function properly, each protein first must fold itself into its correct shape. Molecular chaperones assist in this process by preventing misfolding, or, in the case of already misfolded proteins, to detect them and prevent their further accumulation, which can lead to Huntington's, Parkinson's, Alzheimer's and other neurodegenerative diseases.

This heat shock factor response is present in all living cells and can be elicited and increased by repeated exposure to mild

stressors. A recent study confirms that when this master gene is underexpressed lifespan is shortened and that longevity is increased in animals in which there is overexpression. Further support comes from animal studies showing that **short bouts of stress increase the immune system's ability to ward off infections and promote wound healing.**

When rats and mice were gently restrained for two hours there was a rise in heart rate, blood pressure and circulating levels of stress hormones. These are all characteristics of a normal response to psychological stress and subsided within a few hours after the experiment ended. When a chemical or protein antigen was then applied to the skin, these animals had a much stronger immune response than non-stressed litter mates. The magnitude of the immune response was assessed by measuring the degree of inflammation at the site of antigen administration and the types and amounts of cells and proteins indicative of immune system activity that were present.

These immune responses remained strong several months later when the animals were re-exposed to the irritant even though there had been no further restraint stress in the interim. Control animals had normal heightened immune responses upon re-exposure but reactions were up to four times higher than these in the group that had been stressed. Learning how immune responses are increased during stress could help create more effective vaccines. One author noted, "The whole point of vaccination is to generate more memory cells. The way the stressed animals' immune systems responded to the antigen the second time around suggests that acute stress may help generate more of these 'memory' cells."

Repeated brief starvation may act as a mild stressor to increase human longevity rather than reducing metabolism and free radical damage. The immune enhancing effects of low-calorie diets in fruit flies pops up within 48 hours and disappears just as quickly when the diet stops. A fly that starts dieting in middle age is just as well off as one that always dieted and a fly that diets until middle age and stops is no different from one that never dieted.

Vigorous exercise increases free radical damage and lowers immune system resistance to infection. However, low level exercise stress

acts much like intermittent fasting in animals. Both increase the production of brain nerve growth factor that bolsters immune system function, which could explain their ability to reduce cancer and thus prolong life.

What And Where Is "Memory" And Do Good Things Come In Really Small Packages?

We are protected from various infections and challenges to health by the body's ability to "remember" and respond appropriately to prior threats of a similar nature. The brain and the immune system are generally thought to be the only parts of the body that have this capability and they appear to work in concert via hard wired and humoral connections. However, there may also be poorly understood "energy" pathway connections and there is evidence of memory at a cellular level. It was previously believed that memory was stored in specific parts of the cortex, like furniture in different rooms of a house. However, extensive ablation studies reveal that memory is stored throughout the brain like a hologram. As I noted in *Science News* almost two decades ago, "In a hologram, every element of the subject is distributed throughout the photographic plate, making it possible to reconstruct the entire original image from any portion of the picture. In this paradigm, the brain stores memory and deals with interactions by interpreting and integrating frequencies, retaining the data not in a localized area but dispersed throughout its substance." This is consistent with **an emerging model of "energy" medicine that views biology not in terms of measurable physiologic and biochemical parameters but "vibrational" characteristics that are difficult to quantify.** This could help to explain how acupuncture, homeopathy and electromagnetic fields produce biologic changes without any

detectable caloric exchange as well as the ability of a strong faith or placebos to promote health and influence the course of an illness. Bill Tiller has shown how "intentionality" can change the pH of a solution and influence the maturation of larvae and how this energy can be stored on a computer chip to achieve the same results at a different location and time. These observations defy the laws of thermodynamics but are consistent with quantum physics and quantum holographic theories proposed by Edgar Mitchell and others.

Nanopharmacologic studies also demonstrate the powerful effects of infinitesimally small amounts of hormones that support the validity of hormesis and energy medicine. *Nano* is Latin for dwarf, but the prefix is now used to refer to technologies or substances that are extremely small, at least one-billionth of a unit, designated as 10^{-9} . Beta-endorphins are known to modulate natural killer-cell activity in dilutions of 10^{-18} and interleukin-1, another important immune system component, has been found to exhibit increased T-cell clone proliferation at 10^{-19} or less than half a billionth of a unit. Although thyroid hormone is present in our blood at only 1 part per 10 billion, this is enough to regulate the rate of our entire metabolism. Pheromones are powerful aromatic hormone-like substances that creatures secrete to attract one another. One molecule of moth pheromone is so potent it will attract another moth from miles away and trigger a cascade of physical reactions, although how this is accomplished is still a mystery. Nor do we understand what is responsible for the diurnal and other rhythms that govern hormonal secretions and immune system function and the effects of medications. It is clear that our current concept of communication needs to be expanded to include subtle energy pathways - so stay tuned for more!

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