Ray Peat's Newsletter

We must strive to become good ancestors. Ralph Nader

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Particles in Context

There have been, since the development of good microscopes, occasional descriptions of microscopic food-derived particles in the blood and urine of people and animals (Herbst, 1844; Hirsch, 1905; Volkheimer, 1961). Preconceived ideas about the structure and function of the body have caused those observations to be ignored or denied. Volkheimer immediately recognized that the presence of food particles in the blood and cerebrospinal fluid needed to be investigated, because of the circulatory and immunological implications.

In the 1960s, a North Korean researcher, Bonghan Kim, reported the discovery of what he called a "third vascular system," in addition to the blood and lymph vessels, in which particles containing DNA were circulating. He suggested that they constituted a repair system for all the body's organs. For various reasons, his reports were almost completely ignored; a few acupuncturists in the US circulated one of his publications.

Just a few years ago, a few "western" researchers discovered that very fine particles circulating in the blood and other body fluids, which they had considered to be insignificant "dirt," actually contained DNA, RNA, proteins, lipids, and hormones, and that their composition varied with age and the state of health. There were also lengths of DNA molecules circulating in the blood as free particles, and these particles, like the more complex "microvesicles," were readily taken up by other cells. It's now well established that these microparticles provide communication between cells, changing the function and structure of the recipient cells. This communication constitutes part of the "epigenetic" process of adaptation.

These discoveries have coincided with the development of "nanotechnology," in which, for example, drug companies embed their drugs in small particles, and clothing manufacturers embed silver or copper nanoparticles into garments as deodorants, and cosmetics manufactures use nanoparticles to modify the texture and color of their products, and supplement manufacturers use them as "lubricants," to make the ingredients flow nicely in their machines. The quantity of nanoparticles and microparticles in air and water from pollution has increased greatly.

Our institutions continue to be based on old biological models that were adopted for reasons other than their scientific validity, and those models are blind to the immense harm being done by new technologies.

Volkheimer was concerned about the health implications of the persorption of alien particles even before our endogenous particulate regulatory system had been recognized. Recently, corporations and government officials have been publicizing their belief that there is no danger from particles except when they are inhaled.

In the first several decades following the discovery of the danger of asbestos, industry prevented governmental regulation by saying that the harm hadn't been proven conclusively. When it became common knowledge that asbestos causes lung fibrosis and lung cancer, and that forms of silica other than asbestos also caused

lung fibrosis, the industry argument shifted to saying that, although particulate matter has been conclusively shown to damage the lungs, we have to assume that it's safe for the rest of the body, because damage hasn't been conclusively shown except in the lungs. (The International Agency for Research on Cancer, IARC, lists inhaled particulates unambiguously as a Group 1 carcinogen.)

Biologists have occasionally noticed that something they do to an individual organism, that doesn't immediately cause major changes in its development and functions, will produce serious effects in its offspring, and then in the next generation, lethal effects. A group in Russia fed Monsanto-tainted foods to hamsters, and found that the effects appearing in the first generation were more extreme in the second generation, including infertility, and that only a few survived in the third generation (Baranov, et al., 2010; Surov, et al., 2010; Maligin & Ermakova, 2009; Ermakova, 2008). The doctrine that cells are controlled by genes, that acquired changes aren't inherited, has made many people think that it would be unreasonable to continue toxicity studies beyond the life span of an individual animal. **The fact that epigenetic changes and transgenerational effects are now well documented, requires that environmental pollution be interpreted in new ways.**

Many things that are now considered nontoxic and noncarcinogenic are likely to be harmful when exposure is extended transgenerationally. Impaired infant brain development, allergy, and autoimmune diseases are known to result from a great variety of causes, ranging from radiation to mild chronic stress.

The dogma that our being is determined by our "genetic blue print" has guided social policy very broadly. Doctors and public health officials, not long ago, were saying that a pregnant woman's malnutrition had no effect on her baby, if it managed to be born alive. If a substance didn't produce genetic mutations when cells were briefly exposed to it, it couldn't be carcinogenic. If a certain dose of radiation didn't produce mutations, it was said to be harmless. The genetic dogma was highly political; people who challenged it were excluded from the discussion. Despite the institutional power behind the dogma, the implications of epigenesis are now coming to be recognized.

Life is adaptation, every adaptation involves epigenetic modifications of the state of differentiation, and every epigenetic change has transgenerational repercussions. The Weismann Barrier, the doctrine of a "germ line" absolutely isolated from the "soma," is as extinct as the Central Dogma of molecular biology. The publications that purported to demonstrate the embryological isolation of a "germ plasm" were, when I was a student, a shibboleth of mindless gene centrism.

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Every cause has effects, but those effects in organisms are constrained by the purposeful flow of energy. V.I. Vernadsky's and Norbert Wiener's work provides a context for a non-Weismannian approach to the problems of a toxic environment. James A. Shapiro and Guenter Albrecht-Buehler have discussed some of these purposeful biological processes on the molecular level.

Several diseases that used to mainly affect older people are now, in the last 15-20 years, becoming more common in young people. Things that happened to their parents and grandparents have probably contributed to their early susceptibility to those diseases, and if exposure to those factors continues, the cumulative effects can be expected to get worse. The increased incidence of degenerative disease in young people is bad for those individuals, but it suggests (to people who aren't genetic determinists) that the outlook for a subsequent generation is even worse.

The decrease of fertility with aging is well known; for example, starting in middle age a man's sperm count tends to decrease steadily, along with decreased sperm motility and increased abnormality of shape. The recent trend, in most countries, has been for a progressive reduction in sperm quality even in younger men.

"Multiple studies over the past 15 years have reported median sperm concentrations of 41-55 × 10^6/ml in young men (mean age 18-21 years) from the general population, suggesting that many of them have suboptimal semen quality" (Virtanen, et al., 2017). "During recent years, an increasing percentage of male infertility has to be attributed to an array of environmental, health and lifestyle factors" (Kesari, et al., 2018).

The living state isn't an "all-or-nothing" matter; there are different degrees of vitality.

In effect, there is a premature aging or atrophy of the seminiferous tissue. Things that cause tissue atrophy are likely to also cause cancer, so it isn't surprising that the rate of testicular cancer is increasing: "Rapid increases in testicular cancer incidence have marked the second half of the last century" (Znaor, et al., 2015); "Forecasts predict that the incidence of testicular cancer will increase by 25% in Europe by 2025" (Kudjawu, et al., 2018).

A recent report from the Centers of Disease Control and Prevention indicates that between 2014 and 2015, age-adjusted death rates in the United States increased for 8 of 10 leading causes of death, including cardiovascular disease rates (Xu, et al., 2015).

A study of the incidence of cancer in England between 1976 and 1997 in young people, between the ages of 15 and 25 (Birch, et al., 2002), found that the incidence increased by an average of 1.5% per year during that period. "Significant increases were seen in non-Hodgkins lymphoma (2.3%), astrocytoma (2.3%), germ-cell tumours (2.3%), melanoma (5.1%) and carcinoma of the thyroid (3.5%) and ovary (3.0%)."

In the US, metastatic breast cancer in 25 to 39-year-old women increased from 1.53 per 100,000 to 2.90 per 100,000. Since these women seldom have mammograms, and since there is no tendency to over-diagnose metastatic cancer, that was a real increase (Johnson, et al., 2013).

Cancers of the tongue and tonsil in young people have been increasing in recent decades (Atula, et al., 1996; Schantz and Yu, 2002; Shiboski, et al., 2005).

A new epidemic among young people is inflammatory bowel disease (Malmborg and Hildebrand, 2016; Molodecky, et al., 2012). Suicides among teenagers have increased (Pirani, 2018; BCBS Health Index).

Inflammation is involved in the chronic degenerative conditions, especially atrophy and cancer, and even in depression (Miller and Raison, 2016; Udina, et al., 2012; Raison, et al., 2010). The incidence of several inflammatory diseases, including atopic dermatitis and systemic lupus erythematosus, has been increasing in many countries (Rees, et al., 2017; Kiadaliri, et al., 2018).

The "bystander effect" that occurs when irradiation of one tissue causes similar damage in other tissues, or throughout the organism, is a general phenomenon that occurs with injuries other than ionizing radiation. When a lung is damaged with silica particles, cells removed from that lung, when cultured outside the organism, secrete into the culture fluid substances that produce similar injury, fibrosis, when cells from a different organism are exposed to that fluid.

The finely ordered structure of the living state is maintained by the flow of energy. That flow can be damaged not only by deprivation of metabolic fuel or oxygen, but also by things that distort the structure.

When particles of dust or smoke are inhaled, the smallest particles (less than 1/10 the size of bacteria) pass into the lungs, causing damage there, but some pass through into the blood, and are distributed to the heart, brain, kidneys, liver, gonads, etc., damaging those organs, activating inflammatory processes. The larger particles, including bacteria, are mostly trapped on the mucous membranes before they reach the lungs, and are swept up by the mucus, and swallowed, where they reach the intestine, with potential persorption into the bloodstream.

There are macrophage-like cells in the intestine that ingest particles such as silica, and, being unable to digest them, are likely to be inactivated, but in the process communicate an inflammatory reaction through the body. If the intestine itself becomes inflamed, the weakened barrier function allows bacterial endotoxin to enter the bloodstream, amplifying the inflammatory and immunosuppressive effects. Macrophages damaged by particles and endotoxin can lead to immunosuppression (Keller, 1976; Radić, et al., 1988; Huaux, 2009; Kumagai-Takei, et al., 2011; Kim, et al., 2014;Freire, et al., 2013; Lotzová and Ritchie, 1977) while promoting inflammation.

The process of inflammation and fibrosis is initiated in response to anything that blocks the adequate production of energy.

Interference with energy production is fundamental to inflammation. When cellular stimulation increases faster than oxygen can be delivered, there is a shift to glycolytic energy production, with the conversion of glucose and amino acids to lactic acid. Small particles of silica or other inorganic or organic material (such as plastics), can, like radiation, oxygen deprivation, sepsis, or estrogen, increase the production of lactic acid, and this lactate promotes various features of inflammation, including edema, collagen synthesis, and the growth and movement of cells.

Working in a photocopy shop, being exposed to the toner particles in the air, evidence of genetic damage appears in the urine, and exposing cells to the fumes from a laser printer causes DNA breaks (Tang, et al., 2012; Khatri, et al., 2013). All of the known "epigenetic" mechanisms (DNA methylation, histone changes, and non-coding RNA changes), besides the DNA breaks, are known to be caused by nanoparticles (Sierra, et al., 2016).

These changes can be caused by extremely small amounts of invisible airborne particles, but the quantities that people are now exposed to are very large, and are increasing year by year.

Small amounts of nanoparticles can pass into the skin, especially when it's moist from sweat, from fabrics that have been impregnated with them to serve as sun blockers and deodorants, and to make them wrinkle resistant, stain resistant, and antiseptic (Bianco, et al., 2015; Crosera, et al., 2016; Filon, et al., 2011; Miquel-JeanJean, et al., 2012; Tang, et al., 2010). Many perfumes, shampoos, cosmetics, and sunscreens contain them, up to 10% by weight, and are deliberately applied to the skin.

Drugs and nutritional supplements frequently contain microparticulate titanium dioxide (a Group 2 carcinogen, according to IARC) and silica, to make attractive tablets. Those things are sometimes even included in encapsulated vitamins and powdered thyroid, to speed filling and reduce static electric charges. Toothpastes frequently contain titanium dioxide for whiteness and opacity, and fumed silica to give it a thicker consistency.

For many people, "foods" are probably their main source of exposure to industrial particulate matter. The FDA allows up to 1% of the weight of food to be titanium dioxide, and up to 2% fumed silica.

The characteristic diseases of our time . . . involve reductive stress, the inability to maintain cell respiratory energy production, and its associated destructive inflammatory processes.

The FDA recognizes the carcinogenicity of crystalline silica, but they "expect" amorphous silica to be noncarcinogenic. The evidence of the genotoxicity and carcinogenicity of amorphous silica is unambiguous (Guo, et al., 2017; Amre, et al., 1999; Wittig et al., 2017; Seidel, et al., 2017; Fontana, et al., 2017; O'Neill, et al., 1986; Sinks, et al., 1994).

Besides the material that has to be listed on the label, things that are called "processing aids," which get into the food incidentally to their manufacture, don't have to be mentioned on the label. For example, there are "food grade lubricants," kosher and halal lubricants, which can include particles of fluorinated hydrocarbons, identical to the material in Teflon, as well as fumed silica. Silica is widely used in spray drying

foods, including milk, to prevent clumping of the powders.

There are more than 100 different vaccines that contain particulate aluminum hydroxide, intended to create a generalized inflammatory reaction, and since the 1970s, the number of them administered has increased greatly. Word magic is commonly used to obscure the nature and functions of the adjuvant.

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The fact that epigenetic changes and transgenerational effects are now well documented, requires that environmental pollution be interpreted in new ways.

Our so-called "immune system" detects unfavorable changes in the structural-energetic system, and reacts quietly to restore the system, removing abnormal structures, and facilitating the restoration of function. When the organism's situation isn't good, instead of invisible restoration there is inflammation, a process in which crude provisional repairs are made, so that the damaged tissue doesn't continue to demand resources that aren't available. A scar is formed, a relatively inert fibrotic tissue replaces the fully functional tissue. This happens progressively with continued exposure to harmful factors, degrading the lungs, heart, blood vessels, gonads, liver, kidneys, brain . . . .

The process of inflammation and fibrosis is initiated in response to anything that blocks the adequate production of energy. Very different factors can have additive or synergistic effects leading to the same conditions of inflammation and fibrosis. Ionizing radiation, particulate matter, and estrogen excess interfere with the system in different ways, but all produce reductive stress, inflammation, collagen synthesis, and loss of differentiated cellular functions.

The characteristic diseases of our time—cardiomyopathy, pulmonary hypertension, neurological disorders, Parkinson's disease, Alzheimer's disease, insulin resistance and metabolic syndrome, rheumatoid arthritis, kidney diseases, and cancer (Pérez-Torres, et al., 2017)—-as well as trauma, shock, sepsis, and infection, involve reductive stress, the inability to maintain cell respiratory energy production, and its associated destructive inflammatory processes.

Our institutions continue to be based on old biological models that were adopted for reasons other than their scientific validity, and those models are blind to the immense harm being done by new technologies. Our organisms are undergoing continuous processes of adaptive changes in response to our pro-inflammatory environments, involving epigenetic changes that limit our potentials and that threaten to have cumulative effects in following generations. **Now that the effects of the degraded environment are showing up in deadly terminal diseases in younger and younger people, it's important for more people to start rejecting products and practices that contribute to chronic inflammation.**

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