

Rachel's Environment & Health News

#752 - The Latest Hormone Science, Part 3

September 18, 2002

In this series we are asking whether mainstream scientists still believe that industrial chemicals released into the environment can interfere with hormones in wildlife and humans, causing widespread harm. The NEW YORK TIMES in August said most scientists don't. (See RACHEL'S #750, #751.) We have tried to answer the question by examining the most recent 24 monthly issues of ENVIRONMENTAL HEALTH PERSPECTIVES (EHP), a peer-reviewed journal published by the federal National Institutes of Health.

In RACHEL'S #751 we reported on seven studies linking hormone-disrupting chemicals to human illnesses. This week, we continue reporting on human studies, then turn to animal studies (wildlife and laboratory animals).

** Background (meaning "normal" or everyday) exposure of healthy Dutch pre-school children to PCBs and dioxins (potent hormone-disrupting chemicals) via breast feeding is related to a diminished number of immune system cells and increased middle ear infections, coughing, and chest congestion, persisting at least to the age of 42 months. Previously, immune system damage had been observed in laboratory animals exposed to PCBs and dioxins in their diet (see RACHEL'S #414).

(Dioxins are extremely toxic chemicals created as by-products of many industrial processes, such as incinerators, where chlorine combines with carbon at high temperatures. PCBs are dioxin-like industrial chemicals manufactured by Monsanto between 1929 and 1976 and now found almost everywhere on the planet. See RACHEL'S #237.)

An earlier study of Inuit children had found an increase in otitis media (ear infections) among those exposed to hormone-disrupting chlorinated chemicals through their mother's milk. The Inuit live in the extreme northern part of the planet, about as far away from industrial sources as anyone can get, but many organochlorine chemicals march steadily northward as time passes because cool weather "distills" them out of the atmosphere. (This distillation process was described eloquently in the book OUR STOLEN FUTURE -- see RACHEL'S #486 and see www.ourstolenfuture.org.)

The authors of the Dutch study point out that the proper response to their findings would be to reduce the discharge of hormone-disrupting chemicals into the environment, not curtail breast feeding. EHP Vol. 108, No. 12 (December 2000), pgs. 1203-1207.

** A pilot study of 29 men in Massachusetts showed an association between levels of PCBs and DDE in their blood and reduced sperm count, reduced sperm motility (ability to move), and sperm shape. (DDE is a breakdown byproduct of the pesticide DDT.) Based on the findings of the pilot study, a larger study has begun. EHP Vol. 110, No. 3 (March, 2002), pgs. 229-233.

In 1992, an analysis of 62 published studies reported that American men today produce only half as much sperm as their grandfather's did. In 1997, a re-analysis of the original 62 studies, using a different statistical technique, confirmed the finding -- 50% average sperm loss among U.S. and European/Australian men, 1938-1990, though no evident decline among non-Western males. Within the U.S., regional variations occur, but the average decline is 50% nationwide.

Now a third analysis has been published, which includes an additional 47 English-language studies, and extends the time-period slightly, from 1934 to 1996. The basic finding remains unchanged: a 50% reduction in sperm count among U.S. and European/Australian men but not among non-Western men. EHP Vol. 108, No. 10 (October 2000), pgs. 961-966.

** A new study shows that the common plasticizer, DEHP

[Di(2-ethylhexyl) phthalate], blocks the normal action of male sex hormone (androgen) and disrupts the normal growth of penis, testicles, prostate, and semen tubes (seminal vesicles) in male rats. (A plasticizer is a chemical added to hard plastics, such as vinyl or PVC, to make them soft.) Furthermore, DEHP caused malformed penises and caused male rats to lose interest in female rats. The authors report that, at lower doses than were used in this study, DEHP diminished the size of rats' testicles. The authors conclude, "These results imply that the acceptable daily intake for DEHP is only 3 micrograms of DEHP per kilogram of body weight per day." They report that typical exposure to DEHP in the U.S. ranges from 4 micrograms to 30 micrograms per kilogram of body weight per day. Thus typical human exposures in the U.S. far exceed the level of DEHP thought to be safe. The authors also point out that DEHP may produce additive effects when combined with other chemicals that behave in a similar manner. EHP Vol. 109, No. 3 (March 2001), pgs. 229-237.

** Diesel exhaust is a complex mixture of hydrocarbons and metals. In young rats, exposure to diesel exhaust has been shown to reduce the levels of certain hormones in the blood and to diminish the production of sperm. A new study exposed 90 female rats (72 pregnant, 18 not pregnant) to diesel exhaust for 13 days (from day 7 to day 20 of pregnancy). In the offspring of the pregnant rats, the development of testicles, ovaries and the thymus gland (an important part of the immune system in mammals) was "delayed and disturbed," the authors say. They go on, "Our study provides evidence for the first time that inhalation of diesel exhaust during pregnancy masculinizes fetuses through accumulation of testosterone in mother rats." The authors wonder what effects diesel exhaust might have on the immune system in later life. (EHP Vol. 109, No. 2 [February 2001], pgs. 111-119.) Immune disorders such as asthma and diabetes are rapidly increasing in industrialized nations.

** Hypospadias is arrested development of the penis, and it occurs in about 1 out of every 125 live male births in the U.S. With hypospadias, the normal opening of the penis occurs not at the tip but on the underside, sometimes as far back as the scrotum. In the most extreme cases, hypospadias can make it difficult to tell whether a newborn is a boy or a girl. The problem can only be corrected surgically. The cause of hypospadias is unknown.

The important discovery in 1995, that some environmental chemicals act as anti-androgens,[1] meaning they disrupt the normal function of male sex hormones, has led researchers to ask whether environmental anti-androgens may contribute to the occurrence of hypospadias.

Four pesticides (or pesticide breakdown byproducts) are now classified as anti-androgens: DDE (a breakdown byproduct of DDT), Vinclozolin, Procymidone, and Linuron. In addition, two phthalates, widely used in plastics and personal care products --DBP [dibutyl phthalate] and DEHP [Di(2-ethylhexyl) phthalate] --are anti-androgens. And dioxin and PCBs have anti-androgenic properties. These eight chemicals have all been shown to cause hypospadias in laboratory animals.

Hypospadias and other genital abnormalities were recently reported in mink and river otters on the Columbia River, and among populations of black bears and polar bears. With the exception of the black bears, which were not monitored for chemicals, all the abnormal animals had elevated levels of organochlorine chemicals in their bodies. EHP Vol. 109, No. 11 (November 2001), pgs. 1175-1183.

** Although chlorinated chemical discharges from pulp (paper) mills have decreased substantially during the past decade with the adoption of nonchlorine bleaching systems (especially outside the U.S.), harmful effects on fish downstream are still regularly observed, including depression of hormone levels in blood, delayed maturation, smaller gonad size, and confusion of sexual

characteristics -- for example, females developing an elongated anal fin that is characteristic of males. This study took advantage of a "natural experiment" -- a pulp mill closed for a period of time, then started up again. Researchers examined the ratio of male to female eels hatched in waters below pulp mills that were operating, then when the mills closed temporarily. While the mill was operating, the sex ratio was significantly altered (only 42% males instead of the usual 50%) but returned to normal when the mill temporarily closed. EHP Vol. 110, No. 8 (August 2002), pgs. 739-742.

** The salmon populations of the northwestern U.S. have been declining for decades, some to the point where they have already gone extinct; others are listed as endangered. This study examined female salmon on the Hanford Reach of the Columbia River and found that an astonishing 84% of them had a genetic marker that is normally only found in male salmon. The long-term effect of this sex reversal would be to reduce the number of females in each successive generation, eventually driving the species to extinction. The researchers do not know what has caused the sex shift in such a large proportion of wild salmon on the Columbia River. They point out that some pesticides (atrazine, carbofuran, lindane, methyl parathion, and dieldrin) are known to behave like estrogen in rainbow trout and are present in the Columbia River, though at levels considered too low to create this problem. Thus the mystery remains unsolved. EHP Vol. 109, No. 1 (January 2001), pgs. 67-69.

** Among male tadpoles exposed to dibutyl phthalate (DBP) at low levels, about 7% of the males developed ovaries, thus confirming previous studies showing that DBP is a hormone disrupter. DBP is widely used in PVC pipe. The authors conclude that DBP is "an environmentally dangerous hormone" that disrupts the development of testicles in male animals. EHP Vol. 108, No. 12 (December 2000), pgs. 1189-1193.

** A survey of bullfrogs and green frogs in New Hampshire found deformed frogs at 13 of 16 sites that were checked. Examination of hormone levels in deformed and normal frogs revealed that normal frogs have 3 times as much male sex hormone (androgen) in their blood, compared to the deformed frogs. Normal frogs also had three times as much of a hormone called gonadotropin-releasing hormone (GnRH) which is produced by the brain. This study suggests that hormone-disrupting chemicals may be one of multiple causes that are producing malformed frogs, and declines in frog populations, at many locations around the world. EHP Vol. 108, No. 11 (November 2000), pgs. 1085-1090.

>From this brief examination of one peer-reviewed journal over the past two years, the conclusion seems inescapable that industrial chemicals in the environment can and do interfere with the hormones of wildlife and humans, causing widespread harm. Furthermore, it is clear that large numbers of scientists agree that this is so because they are spending their lives researching these problems instead of pursuing more lucrative opportunities. Unfortunately, the full extent of these problems remains unknown, and unknowable, for practical reasons that will become clear in RACHEL'S #753.

[To be continued.] -- Peter Montague

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[1] W.R. Kelce and others, "Persistent DDT metabolite p-p'-DDE is a potent androgen receptor antagonist," NATURE Vol. 375, No. 6532 (1995), pgs. 581-585.