During the past six years, evidence has accumulated indicating that humans and wildlife may be affected by industrial chemicals that interfere with hormones. (See REHW #263, #264). Hormones are chemical messengers that travel through the blood stream, turning on and off bodily processes, thus regulating reproduction, growth, development (including mental development), and health. The general term for chemicals that interfere with hormones is "endocrine disrupting chemicals." About 50 chemicals have so far been identified as endocrine disruptors, but roughly 70,000 chemicals now in commercial use have not yet been tested for such effects.

Because we are all now exposed daily to hundreds (if not thousands) of chemicals in our air, water, and food, it is worrisome (to say the least) that some of these chemicals might be permanently altering our development as humans (and the development of our offspring) -- not to mention our health.

The new report, which we will refer to as the Weybridge Report, contains some important conclusions, such as these:

** "It is evident that there are adverse health trends affecting the reproductive organs of both men and women. Thus, the incidence of testicular cancer has increased quite dramatically in countries with cancer registries[,] including Scandinavia, the countries around the Baltic Sea, Germany, UK [England], USA and New Zealand. Similarly there has been an increase in the incidence of breast cancer in many countries and the incidence of prostate cancer also appears to have risen. While changes in the incidence of prostate cancer may have been influenced by better reporting and better diagnostics, this can not explain the bulk of the increase in testis cancer. Similarly, the reported increase in breast cancer incidence seems real."[1,pg.13]

** The apparent decline in male sperm counts in some countries is likely to be genuine, and not attributable to confounding factors or methodological variables;[1,pg.6]

** However, there is "insufficient evidence to definitely establish a causal link" between the health effects seen in humans and exposure to chemicals;[1,pg.6]

** Summarizing: "Although our present knowledge about environmental [endocrine-disrupting] agents and reproduction is extremely limited, we know enough about adverse trends in reproductive health to be concerned," the Weybridge Report concludes.[1,pg.14]

** In wildlife, the following kinds of effects have been noted in relation to endocrine-disrupting chemicals:

** Female molluscs (e.g., snails, mussels) have turned into males as a result of exposure to endocrine-disrupting chemicals (a condition called imposex);[1,pg.14]

** In fish, males have been observed producing vitellogenin (a protein that gives rise to the yolk of eggs, and which is ordinarily only found in females). Furthermore, hermaphroditism has been observed in fish (a single fish having both male and female sex organs).[1,pg.14]

** Some reptiles (turtles and alligators), have reduced fertility due to undeveloped male sex organs (small penises).

** In birds, abnormal nesting behavior has been observed, namely female-female pairing.

** In mammals: disturbed fertility has been observed in common seals, grey seals, and Florida panthers.

In laboratory animals, the following endocrine-disruptor effects have been observed:

** Rats and hamsters exposed to dioxin prior to birth and shortly after birth have reduced sperm counts when they become adults. The timing of the exposure determines the effects that ensue.[1,pg.28] There is also evidence that permanent exposure to low levels of dioxin can cause endometriosis in monkeys.[1,pg.28] Endometriosis is a painful disease of the tissues lining the uterus, which often results in sterility; it presently afflicts an estimated 5 to 9 million American women.

** Rats exposed to PCBs prior to birth have disturbed thyroid hormones; as a side-effect, these rats have small testicles and reduced sperm counts as adults.[1,pg.28]

** Exposure of rodents to endocrine-disrupting chemicals can cause them to undergo puberty at an early age and can cause persistent estrus (meaning, being "in heat" for an abnormal, prolonged time).

** Male rodents exposed to chemicals that interfere with androgens (male sex hormones) can be born with hypospadias (a birth defect of the penis) and cryptorchidism (undescended testicles).[1,pg.29] The Weybridge Report notes that, in humans, "there are indications that, in some countries at least... the incidence of undescended testis and hypospadias has increased."[1,pg.13] The Weybridge Report specifically associates these effects (in rodents) with exposure to Vinclolozin, a powerful anti-androgenic pesticide. (In the U.S. today, Vinclolozin is legal for use on cucumbers, grapes, lettuce, onions, bell peppers, raspberries, strawberries, tomatoes, and Belgian endive. U.S. Environmental Protection Agency (EPA) has no published plans for banning Vinclolozin.)

** There is evidence from a number of animal species that sex steroids (for example, estrogen, testosterone) exert long-term effects on the size of the thymus and "on the immune system in general."[1,pg.29] In humans, the thymus is an organ, just above the heart, that produces T cells, which are crucial actors in the immune system.

The Weybridge Report reaches several other conclusions which hint at the difficulty of the job that lies ahead as researchers try to pin down the relationship between endocrine-disrupting chemicals and normal development in humans and other animals:

** "It is not possible fully to understand the significance of levels found in tissues or blood until the mechanism and timing of action of EDS [endocrine disrupting substances] and their metabolites are better understood."[1,pg.37] In other words, it is not merely endocrine- disrupting chemicals that must be understood. After they are present in the body (of animal or human), they are metabolized and they become different chemicals, which also have effects that must be examined and understood. Furthermore, the timing of exposure is critical. For example, exposing a pregnant rat to dioxin on day 15 of pregnancy causes effects that do not occur if the rat is exposed on day 14 or day 16. This makes laboratory research on endocrine-disruptors a great deal more complex (and therefore more costly) than typical toxic chemical research.
And finally, it will be necessary to test at least 2 generations of animals because effects on offspring are the main concern with endocrine-disrupting chemicals.\[1,pg.43\]

** "...it is not anticipated that any useful SAR relationships will emerge."[1,pg.45] SAR means "structure-activity relationship." Sometimes the unknown toxicity of a chemical can be estimated by examining the molecular structure of a chemical with known toxicity. If this can be done, a structure-activity (really structure-toxicity) relationship can be observed, and the activity (toxicity) of a chemical can be estimated from its chemical structure. Observing a SAR can help scientists decide quickly which chemicals are likely to be bad actors.

Unfortunately, the Weybridge Report concludes, endocrine-disrupting chemicals do not resemble each other structurally. Their structures vary all over the map, so no structure-activity relationships are likely to emerge to help scientists decide which ones are bad actors. This means all chemicals are candidates for testing --which greatly complicates (and boosts the price of) testing to find endocrine disruptors.

** "There was general agreement at the workshop that an endocrine disrupter could only be adequately defined through the testing of chemicals in the intact animal."[1,pg.53] This, too, is bad news. It means that test-tube testing of chemicals will not yield the needed information --tests must be done on living animals, which is expensive (and often cruel).

** The potential interactive effects of exposure to several substances simultaneously needs to be taken into account.[1,pg.41]

In sum, the Weybridge Report says that, to understand the problem of endocrine-disrupting chemicals, we must study the interactions between combinations of chemicals; we must study these interactions on at least two generations of live animals; we must expose these animals at different moments in their lives (different times prior to birth and after birth). And of course, the animals must be exposed to various concentrations of the chemicals to see if a dose-response relationship becomes evident.

The need to test combinations complicates the picture enormously. For example, to test just the commonest 1000 toxic chemicals in unique combinations of 3 would require at least 166 million different experiments (and this disregards the need to study varying doses given to animals at varying times during their lives). If we wanted to conduct the 166 million experiments in just 20 years, we would have to complete 8.3 million tests each year. The U.S. presently has the capacity to conduct only a few hundred such tests each year. Just training sufficient personnel to conduct 8.3 million animal tests each year is beyond our national capacity.

** Remarkably, the Weybridge Report recommends that, until the necessary research is completed to give us full scientific knowledge, consideration should be given to reducing the exposure of wildlife and humans to endocrine disrupting chemicals, in line with the Precautionary Principle.[1,pg.52] (As stated in Principle 15 of the 1992 Rio Declaration on Environment and Development, the precautionary principle says that, "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.")[2]

In sum, the Weybridge Report establishes criteria for understanding the problem of endocrine disrupting chemicals, but it appears that even the wealthiest nations in the world haven't the capacity to do the necessary scientific research. This is a problem like no other we have ever faced. The danger of irreversible damage is real. Therefore, invoking the Precautionary Principle, to limit our exposure to such chemicals even before we have full scientific knowledge, would seem to be the only rational approach to take. In the U.S., this is probably not possible because of the political muscle of the chemical corporations. But perhaps other, more rational, democracies can shame us into precautionary action.

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)


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Descriptor terms: endocrine disruptors; estrogen; testosterone; androgens; vinclozolin; structure-activity relationships; SAR; europe, European environment agency; European Commission; world health organization; who; European Centre for environment and health; oecd; england; sweden; netherlands; germany; cefic; testicular cancer; breast cancer; hypospadias; cryptorchidism; sperm count; imposex; molluscs; shell fish; hermaphroditism; intersex; fish; vitellogenin; fertility; reproductive health; birds; fish; turtles; alligators; dioxin; endometriosis; pcos;