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Response

AS WE WROTE IN OUR EDITORIAL, THERE ARE great treatises on discovery in science, including its cognitive psychology, and Klahr's rigorous analyses are certainly among them. But we believe that there is still a place for some personal counsel for practicing scientists and, for further reading in this genre, Sir Peter Medawar's *Advice to a Young Scientist* (*1*) should not be missed.

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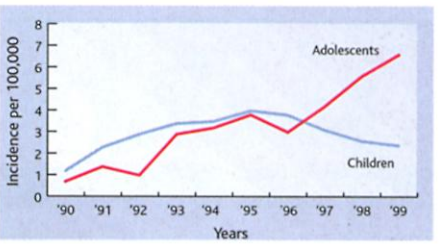
Health Consequences of the Chornobyl Accident

THE NEWS FOCUS ARTICLE "LIVING IN THE shadow of Chornobyl" by Richard Stone (20 Apr., p. 420) serves to remind us that the health consequences of an accident that took place 15 years ago are still occurring. In the article, however, Stone reports that the incidence of thyroid cancer in children rose as early as 1 year after the accident. My colleagues and I were the first to draw the attention of the West to the rise in thyroid cancer, after a visit to Minsk in 1992 (*1*), and we continue to work on the incidence, pathology, and molecular biology of the increase.

The first significant rise in thyroid cancer occurred in 1990, 4 years after the accident in 1986; there was a possible rise in 1989, but only natural variation in the previous years. I do not believe that there was a rise 1 year after the accident, because of the time needed for the acquisition of further mutations after the original exposure, and the time needed for growth of the tumor to a detectable size. The combination of these factors with the growth pattern



Thyroid cancer is one health problem that continues to increase 15 years after the accident at Chornobyl; others need to be monitored as well.

of the thyroid gland, diminishing during childhood to reach very slow growth levels in adult life, accounts for the sensitivity of very young children to this cancer (*2*).

Although Stone says that the risk of health problems in the exposed population is a subject of intense scrutiny, the major international effort has been devoted to thyroid problems. It is not surprising that these were dominant in the early stages, because radioiodines (together with tellurium-132, which decays to iodine-132) formed the greatest proportion of the activity released, excluding the biologically inert xenon. However, it is important to have a coordinated international effort to investigate all the possible consequences. It is particularly important to create a balance sheet of the health risks of conventional and nuclear power generation at a time when the United States is reportedly considering new nuclear power stations. The health risks could then be considered along with the other effects, such as the contribution to global warming. But without full information on Chornobyl, we cannot make a fully informed decision.

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Response

REGARDING THE LAG TIME IN OBSERVED thyroid cancer cases, Williams is correct: The sentence at issue should have read "...the number of childhood thyroid cancer cases began rising within a few years after the accident." My remark that health effects in the exposed population have been subject to intense scrutiny is based in part on efforts by researchers in several countries to reconstruct doses and trace Chornobyl-related health effects of the liquidators (clean-up workers). These studies are alluded to but not discussed in detail in my article. Belarusan, Russian,

CREDIT: (LEFT) EFREM LUKATSKY/AP; (RIGHT) SOURCE: THYROID CANCER CENTRE, RESEARCH AND CLINICAL INSTITUTE OF RADIATION MEDICINE AND ENDOCRINOLOGY, INSTITUTE OF PHYSIOLOGY, MINSK

and Ukrainian scientists have also gathered health data that should provide grist for international studies.

RICHARD STONE

Many Citations Support Global Warming Trend

ARGUING AGAINST CONCLUSIONS ABOUT global warming reached by Donald Kennedy in his Editorial "An unfortunate U-turn on carbon" (30 Mar., p. 2515), S. Fred Singer says, "...the overwhelming balance of evidence shows no appreciable warming trend in the past 60 years; hence, it is unlikely to be significant in the future" (Letters, "Global warming: an insignificant trend?" 11 May, p. 1063). He is wrong on both counts.

The evidence for warming over the last 60 years is unequivocal, even if the direct instrumental record is ignored. The change in temperature has led to a major reduction in the mass of alpine glaciers in almost all parts of the world (*1*), an increase in permafrost thawing at high latitudes (*2*) and at high altitudes (*3*), a reduction in the extent and thickness of Arctic sea-ice (*4*), later

> "...regardless of arguments over instrumental versus satellite-based estimates of [global] warming... there are multiple indicators of warming in the 20th century..."

freeze-up and earlier break-up dates of ice on rivers and lakes (*5*), and an increase in the calving rate of Antarctic ice shelves (*6*). There is no evidence or reason to think that these systems have a lag response to warming of 50 years or more [e.g., (*7*)]. There have also been shifts in the distribution of plant and animal species, both latitudinally and altitudinally (*8*), changes in the phenology of plant leafing and flowering (*9*), and the storage of significant quantities of heat in the near-surface ocean (*10*), as well as an overall rise in sea-level driven by both continental ice melting and a steric change due to the increase in overall ocean temperature (*11*). In addition, there have been remarkable increases in ground temperatures over the last millennium (*12*).

Thus, regardless of arguments over instrumental versus satellite-based estimates of warming in recent decades (*13*), there are multiple indicators of warming in the 20th century that paint a vivid picture of the global-scale environmental consequences of the temperature increase. Going forward in time, the accelerating rate of fossil fuel consumption will drive global temperatures to levels not seen in at least a millennium, and probably higher than for many thousands of years. This scenario will play out in a world whose population will increase by 50% over the next century.

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The Scope of Medieval Warming

HEMISPHERIC MEAN TEMPERATURES THAT have been reconstructed with a wide range of climate proxies indicate that temperatures were warmer in Medieval times than during the subsequent "Little Ice Age" (~1550 to 1850) (*1*). However, all studies of large-scale climate variations reveal some regions that do not follow the global or hemispheric trend [for example, (*2*)], so selecting a few data points, as W. S. Broecker does in his Perspective (*Science*'s Compass, 23 Feb., p. 1497), adds little to resolving the title question he poses: "Was the Medieval Warm Period global?"

Furthermore, Broecker's statement that only borehole temperatures and snowlines can reconstruct temperatures to within 0.5°C is not supported in the literature. Reconstructing global temperature re-