Toward Tomorrow Foundational Document

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"The modern world, and by this I mean the world which is dying before our very eyes, has not been the world of the harmony of wisdom, but that of the conflict of wisdom and the sciences and of the victory of science over wisdom."

-- Jacques Maritain (1935)

“I began as a chemist, then chose biochemistry, then the biochemistry of cancer, then the biochemistry of one kind of cancer, and am presently interested in special aspects of that biochemistry. It is only recently--the last 10 years--that I have taken the time to look around me.”

--V. R. Potter, Bioethics: Bridge to the Future (1971)

The individual and collective changes . . . are so different in magnitude, scale, and kind from past changes that even our best records and models offer little guidance concerning the scale or even the character of likely responses to these challenges. The future is quite likely to involve increasing rates of change; greater variance in system parameters; greater uncertainty about responses of complex biological, ecological, social, and political systems; and more surprises.

-- Jane Lubchenco, Science (1998)

People have lived on earth for only a brief time during three and a half billion years of evolution. But, in recent centuries, we have created a world that is essentially new and different from what we inherited. The pace of profound changes that have occurred in just the past fifty years is rapidly accelerating. Depletion of natural resources, climate change, degraded soil and water quality, rapidly declining biodiversity, and widespread destruction of habitats are unequivocally linked to population growth and the ways that people live. Although the health and well-being of many people have dramatically improved as a result of technological achievements and social development, these benefits are not universally enjoyed. Unprecedented numbers of people are living in poverty, primarily in rapidly growing urban slums, while the gaps between the rich and poor grow dramatically larger. These truths make clear the need for fundamental transformation in human behavior when planning for the future, while taking care of today’s needs.

[1] This paper is a result of extensive discussions among numerous participants in the “Toward Tomorrow” project of UMassLowell’s School of Health and Environment. Ted Schettler (Science and Environmental Health Network), Polly Hoppin, Molly Jacobs, David Kriebel, Joel Tickner, Melissa Coffin, and Cathy Crumbley have made important contributions. Melissa Coffin, Molly Jacobs, and Yve Torrie are authors of the vignettes that appear as sidebars.

Acknowledging a past that is rich with human accomplishments and shortcomings, our goal is to help create a future that is healthy, beautiful, just, abundant, productive, and sustainable over time. To accomplish this, we must first ask what brought us here. What assumptions, drives, and desires?

The need for food and shelter, environmental circumstances, culture, social and economic organization, art, religion, science, and human conflicts collectively influence how people live. Although each of these is important, science and technology have played an increasingly dominant role in the past several centuries. But, scientific research and the application of scientific knowledge have not always been undertaken with an understanding of consequences. Conflicts between science and wisdom are all too frequent. This paper offers a perspective on the ecological and health threats that we face. It calls for reassessment of what we study and how we seek to learn and understand. It concludes that a healthy future requires transformation in how we apply knowledge about the world. And it acknowledges the moral dimensions of these concerns. We offer this perspective in hopes that it will be helpful to people gathered at White Oak to begin to craft a Common Agenda that articulates a vision and identifies goals that reflect our responsibilities to current and future generations of people and other inhabitants of the earth.

Getting Here

During the past several hundred years, the form of science that came to dominate in much of the world progressed by systematically attempting to remove faith, values, and emotions from rational thought and to separate humanity from nature, while relentlessly attempting to conquer it for human purposes. This science tends to break the world up into smaller and smaller objects of study. It views the world as a collection of individual things. It de-emphasizes the importance of context: of interconnectedness and interdependence among different parts of wholes; of relationships within complex systems like a forest, a city, a wetland, or a person in a community.

This dominant scientific approach has enabled us to understand many important features of the natural world and is undeniably useful. It has laid the foundation for technical advances that are now deeply embedded in modern industrial society. Many of these have improved the quality and length of some human lives. But they have come at a cost.

Failures to predict or avoid diffuse, systemic impacts of individual activities or technologies have caused fragmentation and widespread destruction of ecosystems. In some cases, stresses have pushed local, regional, and planetary ecosystems close to or beyond thresholds where surprising changes in system operating conditions occur. Many ecosystem benefits, such as provision of food, fuel, and fiber, water purification, air cleansing, climate control, and pollination of crops, are threatened. Greenhouse gases emitted into the atmosphere from

fossil fuel combustion in hundreds of millions of vehicles and industrial facilities are causing planetary climate change that has become self perpetuating. Loss of species is rapidly accelerating in all ecosystems, and if present trends continue, one-third to two-thirds of all species of plants, animals, and other organisms will be lost during the second half of this century. Industrialized fishing has already reduced large predatory fish in the world's oceans to about one-tenth of their earlier numbers. Some over-exploited marine fisheries show no evidence of recovery years after fishing bans, and the changes in species diversity and distribution may be permanent.

The deemphasis of context and the failure to anticipate systemic impacts of human activity—and the resulting degredation of ecosystems—have also resulted in new patterns of human disease that have emerged in recent decades. The US and many other countries throughout the world are experiencing increases in asthma, mental illness, some birth defects, some kinds of cancer, and infectious diseases. Worldwide increases in diabetes and obesity are linked in varying degrees to dietary changes, industrial agriculture, processed food marketing, decreased exercise, changes in the built environment, and industrial chemicals that contaminate most organisms and ecosystems. Increasing disparities in economic status within and between countries support and magnify these trends.

If our approaches to understanding the natural world have limited our ability to anticipate systemic impacts, other aspects of human behavior—particularly population growth and the way we have constructed our social, political, and economic institutions—have played important roles in eroding the benefits that humans derive

The Necessariness Principle

What kind of odor fighting workout gear is best for you? Will it be the fabric that contains tiny capsules that break open and release fragrance molecules with friction…so you can always smell like roses? Will it be the gear that is treated with activated carbon to absorb your sweat…the way a paper towel absorbs a spill? Or will you chose the workout gear infused with silver which works as an anti-microbial to retard the growth of bacteria…on your clothes. Or will a healthy workout, which leaves your clothes soaked, simply prompt you to throw them in the washer?

The odor fighting additions to workout clothes don't change their performance, but they may make them more convenient. It is also possible that the odor-fighting additions themselves, or their manufacture, pose health or environmental risks. But are odor-fighting additions really necessary? This question is rarely asked.

Some will argue that they are not, and that their necessity should be considered in decisions about whether or not to authorize the use of hazardous chemicals in their manufacture. Others will argue that they have a right to choose what is most convenient to their lifestyle, regardless of unproven risks to themselves or to others associated with the new convenience. So when might consideration of necessity be appropriate, and who decides what is necessary and what is not?

Increasing options among a wide range of products and services behoove us to start asking what is necessary and what is not, and what criteria may help to make the distinction. Do we know the environmental, health and safety impacts of products for example? As consumers, should we have access to this kind of information? If so, how should it be communicated? Most people believe that the products they buy have been thoroughly tested and demonstrated to be safe, but actually many have not and are assumed safe until proven dangerous.

A necessariness principle finds itself on a fine line between a goal of safeguarding human and environmental health and safety on one hand, and a consumer's right to choose on the other. However it is a principle that can easily be justified. Establishing criteria will be far more difficult.

from intact ecosystems . Often, activities that will predictably damage relatively healthy ecosystems are admired and rewarded. Although people living in poverty may have few choices, much ecosystem degradation is the result of greed, ignorance, shortsightedness, and confusion between wants and needs (see the sidebar on the Necessariness Principle above).

People frequently fail to consider the consequences of their actions in the future or at remote distances. Moreover, a system that relies on sustained material throughput and continuous growth as a measure of economic health is virtually certain to continue to deplete natural resources, degrade habitat, and contaminate ecosystems and their inhabitants with industrial chemicals and waste. Advocates for the status quo continue to have faith that perpetual growth on a finite planet is not only possible but also desirable and that technical solutions will solve current and future problems as they arise.

Despite improvements in the quality of life for many, the fruits of modern technology are not available to the vast majority of people living on the planet. While far less than one percent of the world's population controls one quarter of the world's assets, most people live on less than two dollars a day. Poverty causes increasing stress, daily threats of illness, insecurity, despair, and loss of social connectedness. In today's world, where communication and travel are easily accessible, vast and growing numbers of people live in poverty, many in sprawling urban slums, and increasing gaps between the rich and poor within and between countries increase the risks of social unrest, violent conflict, and environmentally related disease for all.

People in many countries of the world aspire to Western styles and standards of living, where necessity and sufficiency are given short shrift. But that trajectory is stressing earth's biophysical systems beyond the capacity to support human lives of quality. Collectively, these observations are context for planning for tomorrow.

Moving Ahead: Differences and Agreements

In order to decide how to proceed in helping to shape the future, it is important to acknowledge differences in the ways that people perceive, interpret, and interact with the world. Differing ethical frameworks often underlie worldviews, each with its own particular emphasis on the rights of individuals, the community, and justice. World views influence how we acquire, assimilate, and apply knowledge in our daily lives, including our opinions about how societies function best, and appropriate roles for civil society, corporations, and government.

Approaches to medicine and public health are illustrative. A focus on the health of individuals rather than communities has produced a medical model of disease that emphasizes pathology, biochemistry, and physiology at the tissue, cellular, and sub-cellular levels. This model, which dominates in the United States, emphasizes the immediate causes of disease more than structural factors with health-related mechanisms of action that may be indirect, circuitous, and difficult

to study. The social, built, and natural environments, and how we manage them, create a structural context that profoundly influences disease risk. Models that emphasize the medical or structural origins of health and disease are not inherently mutually exclusive, but economic forces that create opportunities for professional enrichment, product development, and profitability strongly favor the medical model of disease. Multiple demands on resources also influence their relative emphasis.

Large, sprawling, highly-technical medical facilities that concentrate on treatment of illnesses, molecular biology, biochemistry, genetics, and pharmaceuticals now account for 16% of the US gross domestic product. In many circumstances, this approach has resulted in spectacular successes in treating injuries or diseases once they occur. Yet, although the US accounts for more than half of all money spent on medical care on earth, these expenditures have not resulted in generally superior health status. For example, a recent study concluded that late middle-aged US residents are much less healthy than their counterparts in Great Britain for diabetes, hypertension, heart disease, myocardial infarction, stroke, lung disease, and cancer. These differences exist at all points of socioeconomic status, despite the US spending more than twice that of Great Britain per capita on medical care.

In the US, far fewer resources are allocated for research and public policy focusing on disease prevention and protection of life-supporting communities than on diagnosis and cure of specific illnesses. Moreover, when prevention is addressed, individual behavioral factors such as smoking cessation, diet, and exercise are usually emphasized. Support is often lacking for modification of social and community factors that will benefit entire populations, such as ensuring access to nutritious food, building neighborhoods in which it is safe to walk, and providing mass transit to reduce air pollution.

Truths to underlie decision-making

Despite differing opinions about what to study and how to allocate resources, it may be possible to agree on certain truths, which can be a foundation for future directions in how we learn and apply knowledge. We propose the following:

- While changes in natural systems occur apart from human activity, humans are the dominant force behind major planetary and regional ecological changes in the past century.
- Complex biologic and ecologic systems, with richly interactive, interdependent parts, behave in ways that are often not predictable by examining individual components.
    - Sometimes, changes within complex systems cause surprisingly new behavior of the entire system.
    - When complex systems begin to behave in new ways, they often resist returning to previous operating conditions. For example, as increasing carbon dioxide from fossil fuel combustion dissolves in the oceans, the

resultant acidification, already detectable, appears likely to fundamentally disrupt the entire marine food-web, beginning with zooplankton that rely on current conditions for skeletal formation. These changes are likely to cause permanent changes in species diversity and distribution in the world's oceans, even if atmospheric carbon dioxide were to return to earlier levels.

- Changes may enhance or reduce a system's capacity for self-renewal and resilience—the capacity to absorb and adapt to stresses while maintaining essential functions.

- Beauty and aesthetic experiences, including contemplation of nature or creative human intervention in the natural world, provide numerous health benefits.
- World-views, scientific research agendas, study designs, and individual and public policy choices are value-laden.

Toward a Common Agenda for Present and Future Generations

If a common goal is to help create a future that is healthy, beautiful, just, productive, and sustainable over time, it is essential that we transform the ways that we think about, seek to understand, and act in the world. This will require acknowledgement of legitimate ethical dilemmas and choices, new agendas, as well as new resolve in confronting current institutional arrangements that support the status quo.

In order to meet current human needs while leaving future generations a planet where they may live lives of quality, we believe that science and policy must finally and firmly reject a view of humans standing apart from nature. Required changes have moral dimensions. People must consider their responsibilities not only to current generations but also for those yet to come. As noted by the philosopher Herschel Elliott, any viable system of ethics is contingent on its ability to preserve the ecosystems that sustain it. Any moral code consistent with long-term human survival must be informed by current ecological realities. Put another way, the rules of ethics must conform to the rules of nature. Although all people share a responsibility to learn and live in ways that are sustainable over the long-term, the obligation is greatest for those who now disproportionately use, benefit from, and degrade the earth's resources.

A systems approach to understanding and acting in the world is essential. This approach explicitly acknowledges relationships among parts and wholes wherein each changes the others. Parts and wholes co-evolve. System behavior cannot be predicted simply from knowledge about individual parts. Systems not only adapt to changing circumstances, but their behavior may be fundamentally transformed by changes in some parts. A systems approach does not preclude or underestimate the value of studying component parts as long as information is reassembled and continuously put back into a larger context.

Below, we attempt to capture these ideas in lists of principles and actions to guide scientific research, individual actions, and institutional policies that follow from a common goal: a need and desire to sustain the health of our planet for future generations. Sidebars illustrate several of them. These principles and actions may be useful as we draft the Common Agenda.

General Principles for Scientific Research

Research principles in the interest of current and future generations should be linked to policy choices and be adaptable to changing observations:

- First, do no harm.
- Scientific research agendas should be based on the contract between science and the supporting public. Scientists and their work benefit in numerous ways from public support and resources. Scientists, therefore, have a reciprocal obligation to engage in activities that are in the public interest.
- Research should consider the impacts of interventions at short and long distances as well as the short and long term. What, for example, are the implications of current farm subsidy programs on environmental quality in the US and abroad over the long term? What will be the long term impacts of large scale biofuel production from corn or other feedstocks? How are human and wildlife health likely to be affected? Recently, for example, the demand for corn for ethanol production has caused a dramatic increase in the price of tortillas in Mexico, affecting primarily people who are poor.
- Research should consider how the scale of an intervention (size and duration) in a system influences its impacts. For example, farmers may develop ways to handle animal excrement but when those practices are employed at a large factory-farming scale their impacts can differ dramatically from smaller-scale applications. Air and water pollution and soil degradation are often extensive and reach far beyond the borders of the farm.
- Understanding and predicting the behavior of complex adaptive systems is notoriously difficult. Scientific uncertainty is common and resistant to resolution. Uncertainty does not, however, absolve us of the responsibility to act, based on the best available information, with clearly stated goals and ethical responsibilities in mind. When there are significant threats of harm to human health and ecosystems, precautionary action—based on the best available information—should be taken, even if some cause and effect relationships are not fully understood. (see Kaiser sidebar next page)

General Principles for Decision-making

Decision-making should:

- Routinely consider the natural, built, and social environments
- Build community resilience—the capacity to absorb stresses and adapt without losing essential identity and functions
- Foster justice/fairness

- Consider the needs of future generations and our responsibility to them

Kaiser Permanente

Kaiser Permanente was founded in 1945 as the largest nonprofit health care plan in the US, and in 2001 reported an almost $20 billion operating revenue. In recent years, Kaiser has recognized what it calls an environmental paradox for healthcare: chemicals and materials used to treat patients are often toxic and cause harm to the environment and the public. Kaiser realized that their choice of medical products had to be, if not beneficial to the larger public, at least be benign, because the healthcare industry should not contribute to ill-health. The company began with several notable hazards: IV bags and tubing used in the hospital were made of vinyl plastic and created dioxin when incinerated; many vinyl products contain a plasticizer (diethyl-hexyl phthalate), a known reproductive and developmental toxicant, that leached out during use, directly exposing patients; heavy metals were used in various medical devices, such as blood pressure gauges; some chemicals used in operations and maintenance were toxic; and the hospitals generated large quantities of waste. Since these issues were raised, Kaiser has become a model for the healthcare sector with environmentally friendly purchasing programs, building hospitals to be green buildings, reorganizing hospital operations to be more sustainable (such as green janitorial supplies), promoting the use of alternative transportation for employees to get to and from work, and planning future initiatives for hospital food sources to come from sustainable agricultural practices.[1] Kaiser has also adopted the precautionary principle as an overarching guide to their decision making.

Implementing Principles for Research & Decision-making

Bearing in mind these principles, we suggest the following actions as high priorities for consideration in a Common Agenda.

- Establish a public interest research agenda. Public interest research develops knowledge and/or technologies that increase the well-being of the public, the commons, and the common good. It requires complex problem-solving and requires attention to economic, social, cultural, and environmental dimensions. It is not used to develop knowledge or technologies that further injustice, poverty, and maldistribution of wealth and resources. Public interest research requires insights from different ways of knowing and active citizen participation. The research agenda should encourage scientists to:
  - Address multiple stressors and cumulative impacts of interventions on complex systems, including:
    - Devising innovative research methods for analyzing the cumulative and interactive effects of various hazards to which ecosystems and people are exposed;
    - Analyzing impacts on vulnerable sub-populations and disproportionately affected communities (human and non-human)
  - Consider feedback loops in complex systems and how interventions might affect their intensity and direction. As an example, there is now considerable evidence that global climate change is self-perpetuating and accelerating. Releases of methane, a potent greenhouse gas, from peat bogs that were once frozen contribute to warming trends. Further thawing will contribute even more methane which will, in turn, contribute to further warming.

- Use interdisciplinary approaches, including developing and using new techniques for determining which system variables to study and how to combine them in new statistical models; include better integration of qualitative and quantitative data; integrate public and private sources of knowledge.
- Structure participation so that policy-relevance, scientific credibility, and legitimacy of the scientific process are maintained. Community based, participatory research can result in information that is informed by inherent community wisdom, multidisciplinary, highly credible, and directly applicable to community needs.
- Emphasize and expand research on primary prevention of harm, safer technological options, and restoration of damaged communities and ecological systems.
- Devise more comprehensive techniques for communicating potential hazards and uncertainties. More standardized techniques to identify what is known, not known, and can be known is needed.

- Develop programs that address structural and often indirect causes of disease and disabilities as well as more immediate and direct causes. Examples of such programs include current urban design strategies that address multiple contributors to disease and environmental degradation simultaneously. (see urban design sidebar below)

Sustainable Urban Design

The layout of our workplaces relative to where we live has an enormous impact on our daily lives, and on the planet. The US Green Building Council estimates that built structures account for nearly two thirds of the electricity used, and is responsible for thirty per cent of greenhouse gasses produced each year in the United States.[2] The built environment has dramatic environmental impacts. To address these impacts, cities have begun to integrate green design into their development strategies through: 1) minimizing the extraneous; 2) designing for multiple functions; 3) designing for local climate; 4) designing for durability and longevity; 5) selecting materials made most efficiently; 6) preferentially using local/regional materials; 7) using recycled and recyclable materials; and 8) looking for the least toxic materials and manufacturing processes.[3]

Not just an architectural issue, these principles are also being used in urban planning initiatives:

- *Scottsdale, AZ is in the process of its first comprehensive review of the city's transportation system since the 1980s, and expects to update or design new plans for bike paths, pedestrian traffic, streets, and public transit.[4]*
- *Bellingham, WA has redesigned the downtown area around the Whatcom Creek. By replacing invasive plant species along the riverbank with native grasses, retrofitting city buildings with basins to collect and filter rain water run off, and starting a community campaign to buy goods locally in an effort combat urban sprawl.[5]*
- *Vancouver, Canada has drafted a 100 year plan which anticipates issues, such as global warming, waste disposal, and contaminated air and water, which accompany population growth. The plan sees energy and water conservation as important strategies in making Vancouver a livable city in the century to come.[5]*

- Develop programs that intervene in systems in ways that address multiple problems without creating new ones. Models emerging from local sustainable food production programs offer examples of systemic benefits to communities of people suffering from malnutrition, poverty,

unemployment, environmental degradation, and associated illnesses (see sustainable urban agriculture sidebar below).

Sustainable Urban Agriculture

Urban Agriculture has come onto the scene as important for community development and urban design because of the assets it provides to residents

Goleta, California is home to the Fairview Gardens, a 100 year old organic farm and an island in a sea of suburbia, feeds 500 families with the fruits and vegetables grown on twelve and a half acres. Beyond just providing food, the farm offers apprenticeships for aspiring organic farmers, gardening classes, farm festivals, and other events fostering interest in agricultural stewardship.[6]

From 1971 through 1991, the New Alchemy Institute looked into methods of food production which would maximize crop yields while minimizing impact on the environment. The Institute found that an integrated approach to farming— including raised vegetable beds, small scale aquaculture, and small ecosystems grown under greenhouses known as bioshelters—resulted in greater individual access to food and could contribute to societal transformation toward a more sustainable way of life.[7]

A community group known as the Dudley Street Neighborhood Initiative (DSNI) in the Roxbury neighborhood of Boston put these techniques into practice in the 1990s with an urban agriculture project. DSNI began a community garden on formerly abandoned lots, began holding farmer's markets, and started plans for a bioshelter covering plots of vegetables and some small aquaculture projects.[8] In 2005 residents began selling garlic bulbs grown within a 10,000 foot greenhouse to area restaurants. The cost of outfitting the greenhouse with the materials needed for commercial growing was paid by the Massachusetts Highway Department (as restitution for polluting the area with road salt and oil years before), while the proceeds from the operation will go to DSNI for reinvestment.[9]

Other benefits of urban agriculture include greater social cohesion and reduction in rates of crime. The community of Victoria Hills in Kitchener, Ontario, Canada reported a 30% drop in crime after the first summer their community garden was established, and a 56% drop overall by the third summer. Residents felt safer, as well, citing that they came to know their neighbors and liked seeing people working in the garden late into the evening.[10]

In urban areas where access to fresh and high quality produce may be limited, urban agriculture is a viable alternative. Rooftop gardens, for example, provide low income families with an affordable way of complementing existing nutritional resources, and can be a source of renewed dignity as families grow their own food, rather than having it provided to them.[10]

- Use adaptive management techniques, including designing and applying system interventions on a scale that is "safe to fail". Integrate techniques into the design, management, and monitoring of programs in order to systematically test assumptions in order to adapt and learn. Modify interventions based on monitoring and learning.
- Change economic incentives that reward behavior damaging to public environmental health. Current economic incentives favor treatment once illness occurs or damage is done. Ecological economics is an alternative framework that addresses the interdependence and co-evolution between human economies and natural ecosystems. Ecological economics emphasizes natural and social capital rather than the monetary value of goods and services as important indicators of economic health.

Conclusion

In order to increase the prospects for lives of quality for people and other inhabitants of the earth, and for the protection and restoration of ecological systems that support life, people must not only modify, but in many cases, radically transform the way that they seek to understand and decide how to live in the world.

Despite the inevitability of valuable, robust debate about optimal ways forward, basic starting points around which considerable agreement will be necessary and may be achievable are:

- A human future that is healthy, beautiful, just, abundant, productive, and sustainable over time must embrace a view of humans as intimately interconnected to and interdependent with the natural world.
- The long term welfare of humans is irrevocably intertwined with the conditions of ecological systems that support life.
- A human future with lives of quality will depend on actions that link science to wisdom. They will be deeply influenced by humility that comes from the limits of our capacity to understand and the extent of our power.

Acting wisely means turning away from ecosystem degradation toward restoration; constraining actions that are not sustainable over time and moving toward those that are in harmony with natural systems, meeting our needs sufficiently but not beyond, and firmly rejecting the goal of continuous growth on a finite planet.

Without pretending to know all that the future will bring, we can begin to shape it by systematically applying knowledge more wisely while continuing to address how we attempt to understand the world. We confront the inescapable need to transform how we organize ourselves, structure industry and economic institutions, and our patterns of consumption while living lives of material sufficiency and social and cultural abundance.

Citations

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