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Presidential Address

Labnotes from the Jeremiah Experiment: Hope for a Sustainable Transition

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Worries come in two flavors—the bitter lemon of private fears; the sour apples of public concern. Private fears of illness and loneliness, loss and failure, death and purgatory are universal. Public concerns arise and recede, occur, and reoccur. A recurrent set of public concerns revolve around our numbers and our sustenance: are we too many, will there be enough, is there too much, will humankind, indeed, any kind survive?

I am a child of the great depression and a youth of the great second war. I came to adulthood as new public concerns dimmed the bright hopes of the great peace: the cold war, the difficult struggles for independence, hunger and poverty, and, overall, the nuclear holocaust. But amidst these dominant concerns, a specific set of questions arose to set the agenda of many, enough, and too much. Can our population continue to double and redouble within our and our children's lifetimes? Will there be food enough to feed the many, material sufficient for their needs and desires, energy adequate to move them, to raise their food, and to transform the materials that they need? Will the transformation of energy and materials impose incommensurate burdens on human health, habitat, well being, and our life support systems of nature and earth?

I first learned of these questions 37 years ago, in Chicago, the site of our Annual Meeting. Now I want to readdress them by way of some lab notes from an ongoing study. I keep hoping that one day the study will be completed and published as *The Jeremiah Experiment: Hope for a Sustainable World*. But don't count on it quickly because in a sense I have been working on it for all of my professional life.

The Jeremiah Experiment is, if not a social construction, a personal one. It refers only symbolically to Jeremiah and metaphorically to a laboratory experiment. But within the title, I realize, are encapsulated three characteristics of my research: a large central question that matters, a favorite mode of study, and, for want of a better descriptor, a little romance or magic. The question—"Is there hope for a sustainable world?"—is just one of many variants of a lifelong geographic pursuit[1] central to the nature-society tradition: "What is and ought to be the human use of the earth?" (Wagner 1960; Kates 1987). The mode of study is the quasi-natural experiment favored by those sciences, human and natural, that cannot devise truly controlled experiments. And the romance or magic is, in this case, associated with Jeremiah and my long-term fascination with great ideas (Kates 1988).

These great ideas include the universal trinity of nineteenth-century thought—Darwin, Marx, and Freud—or the equally important ones for the social sciences—Smith, Malthus, and Weber. What is so striking about great ideas is how relatively few there are, how powerful are their impacts on both science and society, yet how oversimplified they are in construct and how often wrong in application. For my own work and that of the nature-society tradition, perhaps the seminal thinker is Thomas Robert Malthus (James 1979; Petersen 1979; Wrigley and Souden 1986).

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Malthus

Malthus's principle of population begins with the biological realities of hunger and sex (Malthus 1798 [1965]), and the corollary that the latter can be satisfied with greater ease than the former. Sex in Malthus's time was linked to reproduction and to a more rapid growth in numbers of persons than in the means of subsistence. Because this imbalance cannot continue, growth is reduced by "positive checks" in the form of misery (disease, famine, and war), vice (abortion, adultery, birth control, homosexuality, and prostitution), and in later revisions of the original essay by "preventive checks" such as delayed marriage (Petersen 1979).

As Petersen (1979:58) notes: "If we adopt the cynical definition of a classic, a work that everyone cites and no one reads, then the *Essay on Population* must be designated a super classic. . . ." If read, beyond the original *Essay,* Malthus emerges as an inspired scientific observer who constantly sought and collected new data and who incorporated in seven subsequent editions (Wrigley and Souden 1986) some of the preventive behaviors that would serve to dampen the tendencies he forecast. But discounting contraception and abortion by conviction, he sadly concluded that the most likely outcome for the lower classes would be a life of vice and misery as their numbers pressed against the levels of available subsistence. Yet even within his lifetime, in England and Wales where he eagerly joined the debate on the poor laws and in the rest of Europe where he studied and traveled, Malthus would be proved wrong.

Malthus was born in 1766, a century in which, for the first four decades, the population of England and Wales probably did not grow. But in the decade after his birth, the population grew by 7 percent, by 11 percent in the decade of the publication of the *Essay on Population* and by 18 percent by the time of the fourth edition (Clark 1968: Tables III.11, III.12:99–103). Underlying this population explosion was a rapid decline in deaths. The decline in births would take much longer, almost a century in England and more than a century for all of Europe. In all, the English transition from high births and high deaths to low births and low deaths—a demographic transition that became the classic model for population study—took 150 years to complete (Knodel and van de Walle 1976).

In retrospect, we know that Malthus overestimated the proclivity of population to increase. It dropped steadily through the very preventive checks or vices that he eschewed. He underestimated, moreover, the sustenance base by assuming that it consisted primarily of agricultural land of varying but fixed quality and accessible only to resident populations. He did not foresee that the productivity of agricultural land could be enhanced by major improvements in machinery, cultivation techniques, fertilizer, hybrid seeds, herbicides, and pesticides, nor that Europe would draw on food produced in all corners of the world through trade, transport, and empire.

Nonetheless, Malthus's principle of population persists as social explanation, cautionary tale, or forecast. Despite repeated refutation (see, for example, Barnett and Morse 1963; Burton and Kates 1964; Harvey 1974), the *Essay on Population* seems to arise anew, albeit with a shift in focus, in each successive generation (Figure 1).

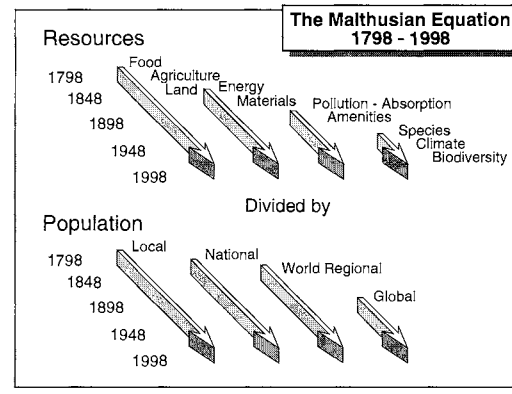

Figure 1. Two centuries of expansion of the Malthusian equation (resources/population) with the numerator expanding from concerns with food to biodiversity and the denominator from local populations in England and Wales to the entire world.

The numerator of the Malthusian equation, originally food and agricultural land, was expanded to include energy and material resources by 1865 (Jevons 1865), pollution-absorbing capacity and amenity resources by the late 1950s (Landsberg, Fischman, and Fisher 1963), and the biosphere, the basic life support systems of biogeochemical cycles (Bolin and Cook 1983), and finally species diversity and genetic information by the 1980s (Wilson 1988). It is also characteristic of the persistence of Malthusian concerns that none of the earlier concerns really disappear. They have simply been renewed in larger contexts as Malthus's population denominator is extended from the local to national, regional, and then to the current global focus.

Neo-Malthusians descend from a long tradition, traced by some to Cassandra—the prophetess destined not to be believed (Ehrlich and Holden 1988). But for my own part, tradition traces to the old testament prophets, and most especially to the archetypal figure of Jeremiah.

Jeremiah

The prophet Jeremiah is the archetype of those who warn of future woes, hence the term *jeremiad* as a tale of woe. Jeremiah may have begun to preach and prophesy in 626 B.C. Imprisoned several times and once almost starved to death, he nevertheless continued to challenge priests, other prophets, and ruling kings. Among his many writings, there is this on the fate of the earth:

> I looked upon the earth, and lo, it was waste and void; and to the heavens, and they had no light. I looked on the mountains, and lo, they were quaking, and all the hills moved to and fro. I looked, and lo, there was no man, and all the birds of the air had fled. I looked, and lo, the fruitful land was a desert, and all its cities were laid in ruins. . . . Jeremiah 4:23–26

For the status quo, Jeremiahs are always unsettling, as much or more in A.D. 1995 as in 626 B.C. If today we have secular religions alongside traditional ones, science surely qualifies as such a pursuit. To extend the metaphor scientific knowledge offers us new dogmas and scientists serve as both priests and priestly critics—the Jeremiahs of our time.[2]

For these Jeremiahs, the name and noun have acquired a pejorative tone that ridicules these conveyors of bad thoughts in the age of progress. While I do not share that negative view of Jeremiahs, I am often troubled by the excesses of language or selectivity of evidence that are found in many jeremiads. And I am troubled, as was Jeremiah himself, with false prophets: who, in seeming to provide early warning, provide only early anxiety.

Jeremiahs of Our Time

The scientific Jeremiahs of my time begin with William Vogt. While the demographic transition was virtually completed in Western Europe by the 1930s, most of the world was still experiencing slow growth due to both high births and high deaths. But parts of Latin America were already in the midst of the demographic transition and growing rapidly with high birth rates and rapidly falling death rates. Thus it is not surprising that Vogt, the first of the post-war population Jeremiahs, worked in Latin America as an ornithologist and then chief of the conservation section of the Pan American Union. In his major work *Road to Survival* (1948), he began his chapter on Latin America by noting that:

> All Latin American countries except three or four are overpopulated. They are able to feed and shelter their citizens and supply water for their many needs, only by progressive and accelerating destruction of natural resources; biological bankruptcy hangs over their heads like a shaking avalanche. (Vogt 1948:152)

Drawing on his Latin American experience, Vogt develops his neo-Malthusian prophecy: Much of the world is already overpopulated; all of the world bears evidence of the progressive destruction of natural resources; some of the world is already starving; and matters will get much worse unless profound changes are made.

Road to Survival was translated into nine languages and sold worldwide. Bernard Baruch's introduction to the volume notes that this "is no dry-as-dust study." Indeed, it is not. Despite Vogt's early scientific experience, the volume is not dispassionate science. It is a polemic, a work of advocacy, passion, and summary judgment, written in the language of a victorious

post-war America, savior of the western world, and fearful of the threatening Asian hordes.

A very different prophesy is that of Harrison Brown (1954), a geochemist responsible for much of our understanding of the age of the earth and its minerals (Smith, Fesharaki, and Holdren 1986). He too had observed demographic change, beginning in 1949 but in Jamaica rather than Latin America. In *The Challenge of Man's Future,* published some six years after *Road to Survival,* Brown creates the first integrated synthesis of neo-Malthusian concerns. His chapters on population, food, energy, and things anticipate decades of environmental concern. He clearly understands the demographic transition currently underway.

> One-third of humanity . . . has yet to start the transition from one extreme pattern of births and deaths to the other. A second third is lowering mortality rates, but family limitation techniques have not yet been introduced on an appreciable scale. The remaining third of the population is approaching stability, but the equilibrium level in the present cycle will be considerably higher than the existing population. (Brown 1954:95–96)

He tried to estimate the population of the world a century hence, cautioning, however, that his assumptions were little better than guesses. Given his assumptions, world population would reach 4.8 billion by 2000 and 6.7 billion by 2050, bracketed by the expectation of "at least 5 billion persons and perhaps 10 billion persons by the time another 100 years have passed" (Brown 1954:99).

Unlike Vogt, Brown did not doubt that the earth could readily support these numbers and even much larger ones. What he did doubt was the feasibility of a "world-wide free industrial society in which human beings can live in reasonable harmony with their environment." He saw instead the likelihood of a grim Malthusian future, a reversion to an agrarian society capable of supporting no more than 5 billion people worldwide. He saw as less likely but still possible an industrialized society that abolished war, made the transition to new energy sources, and stabilized population, albeit by creating "the completely controlled, collectivized industrial society." But it too was a society that Brown would not want to be a part of. Least likely, for him, was the evolution of a world community within which people were well fed and could lead free, abundant, and creative lives. As citizen, he exhorted us to work for such a world; as scientist, he regarded it as unlikely. Thus there was room in Brown's prophesy for maneuver but it was small and probably unattainable.

For Vogt, for whom the world of 1948 was already overcrowded, the decades ahead would reap a bitter harvest, at best, of lower living standards, and at worst, of the miseries of hunger, illness, and social discontent. But Vogt's prophecy was never realized. Forty-five years later, world population (as compared to 1950) had more than doubled, but food supply had risen even faster, energy had more than quadrupled, and the economy had quintupled (Table 1).

Brown's cautious scholarship fares better. The reduction in death rates and birth rates had proceeded according to his forecast, but at a faster pace and in different places than he envisioned. World population reached 4.8 billion in 1985, 15 years earlier than Brown projected, and it is projected to reach 6.7 billion in 2005 rather than in 2050. Other expert projections in the 1950s underestimated, as did Brown, the speed with which both births and deaths would drop (United Nations 1958).

At the time that Vogt and Brown wrote, as

Table 1. Change in World Population, Food, Energy, and Economy 1950–1993.

	1950	1993	1993 to 1950 Increase
Population	2.555 (billion)	5.557 (billion)	2.17
Food (Grain)	631 (million tons)	1682 (million tons)	2.66
Energy (Fossil Fuels)	1570 (million tons oil equivilant)	6965 (million tons oil equivilant)	4.43
Economy	3.8 (trillion $)	19.3 (trillion $)	5.07

Source: Brown, Kane and Roodman 1994.

shown in Figure 2, the global average of children born per woman was 5—more than twice the 2.1 births required to achieve eventual zero population growth. Today, the global average of 3.1 is more than halfway in the transition required for a stable population. The death transition has been more rapid, of course; today's life expectancy of 66 years is about two-thirds of the way in the transition between the 1950 life expectancy (at birth) of 40 years to the stable population life expectancy of 75 years (Population Reference Bureau 1995).

In 1962–1963, the growth of world population may have peaked at an estimated 2.2 percent (Brown, Kane, and Roodman 1994:99). Although unrecognized at the time, this achievement was both unique and unprecedented. Never before has and perhaps never again will the world's population grow so rapidly. If we must choose a time to record the subtle shift in the perception of the population crisis—the tilt in the constant tension between optimism and pessimism—then this might have been such a moment. What tipped the balance to the optimists was the assurance that the end of the population explosion was in sight, not merely in the theoretical models of the demographers, but in the bottom-line summations of life and death.

To be in the midst of change yet oblivious to it is characteristic of the human condition. Thus did Malthus's contemporaries debate whether the population of England was growing or declining until the first census of 1801 proved that this had been a period of extraordinary growth (Petersen 1979). Similarly, in the early 1970s, a leading demographer, Ansley Coale (1973), found little evidence of a fertility decline despite the fact that births in that decade (1965–1975) had declined in 127 countries (Population Reference Bureau 1976). With hindsight, we now know that on the eve of the World Population Conference in Bucharest in 1974,

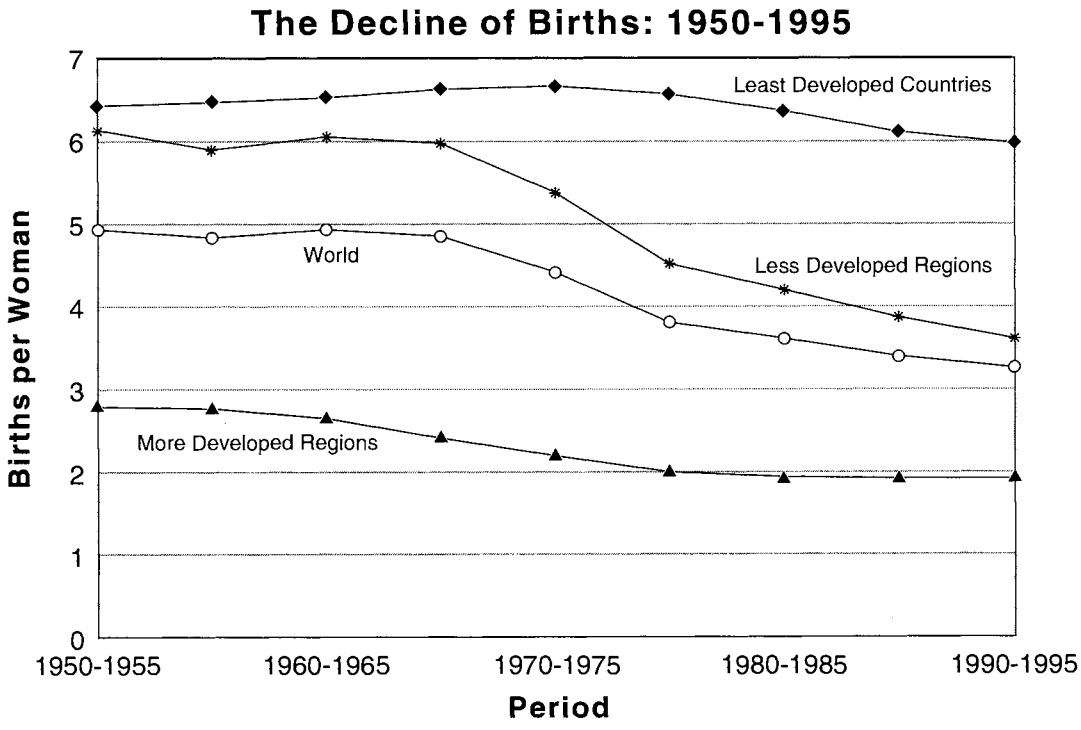

Figure 2. The decline in total fertility rates between 1950–1955 and 1990–1995 in the world, in more developed and less-developed regions, and in the 47 least-developed countries. Source: United Nations, Department for Economic and Social Information and Policy Analysis 1993:23.

the birth decline phase of the demographic transition was well underway.

The polite consensus of that conference's final statements belied the profound split between the First World of industrialized countries and the Third World of developing countries joined with the Second World of socialist countries (Finkle and Crane 1975). All agreed on the need for a decline in population but split in their assessment of the transition's requirements. Third-World representatives and their Second-World allies argued that "development is the best contraceptive" because it was the lack of development that had encouraged large family sizes. Representatives of industrialized countries argued, meanwhile, for government-led efforts to reduce fertility; successful efforts there they maintained would lead to development. Essentially these several "worlds" differed over the explanations for the rates and the timing of the population transition—was fertility reduction caused by development or by access to modern knowledge and techniques of contraception?

Unmentioned in Bucharest was a third explanatory factor—culture and ethnicity—for such differences, whether real or not, were not discussible within the confines of the United Nations. Equally unrecognized at the Conference was the impact that education, employment, and the changing roles of women would play in reducing fertility.

The Global Demographic Transition

Today, we know that development, family planning, and culture all contribute to a fertility decline, even though there is much we still do not understand and culture is still understudied. More than 100 national and international studies (Sherris 1985) have used a variety of statistical and analytical methods to estimate the relative contributions of economic and social development and organized family-planning programs to the decline in births. Trying to control for interactions between fertility reduction and development, studies covering most of the developing countries (Maudlin and Berelson 1978; Lapham and Maudlin 1984) have reported that about two-thirds of the fertility decline is associated with increases in development, with family-planning programs contributing another 15–20 percent in fertility reduction.[3] Some analysts disagree, however, arguing that even this fraction gives too much credit to the efficacy of such programs (Hernandez 1981; Pritchett 1994).

As for culture and ethnicity, only a few studies have included such factors in the analysis of fertility decline. My own examinations, focusing on East and Southeast Asia, small and crowded island or city states, or those of Chinese extraction, suggest that when socioeconomic development and substantial family-planning programs are carried out, the most rapid declines took place.[4]

If, as these studies seem to show, "development is the best contraceptive," it is not clear which aspects of development are most influential. Analysts argue variously that development reduces the need or desire for more children because more children survive, there is less need for child labor, more need for educated children, less time for child bearing and rearing, as there is more opportunity for women to have education and salaried work, and finally more access to birth control technology. Advocates of a particular policy often single out one of these themes to justify their programs, but it is clear that greater child survival, changing needs for labor, improved opportunities for women, and access to birth control all proceed together in the course of development.

Neo-Malthusian concerns, though never realized, never quite disappear; but they persist, albeit transformed. In recent years, the balance between pessimism and optimism has begun to shift again with renewed concern over population growth and its impact on the global environment. While the lifetime average number of children born to women dropped by 14 percent in the 1970s, that average improved by only 6 percent in the 1980s (Sadik 1991:2). Birth rates remained very high in Africa and in the Near East. Countries in Asia and Latin America that had made considerable progress in fertility reduction appeared to reach a plateau with little further progress (Horiuchi 1992).

As I write, still another shift may be underway with a renewed momentum to limit births in China (Peng 1993), promising changes in fertility decisionmaking in South India (Caldwell, Reddy, and Caldwell 1988), and

with the first significant drops in fertility in several Southern and Eastern African countries (Caldwell 1994). With the slowing of the fertility decline in the 1980s, the optimistic median projections of a 10-billion-person world were revised upward to 11–12 billion for 2100.[5] At the same time, the emergence of a new set of human-induced regional and global environmental change problems reopened the issues of resource adequacy and environmental degradation. And in the developed world, concern shifted to the rapid growth of an aging population whose care would make extraordinary demands on smaller and younger populations (Lutz 1994).

Thus while there seems to be little question about the continuation of the global demographic transition, much depends on its pace. A doubling of population would seriously challenge our hopes for a sustainable future; and, given further stagnation in the transition, a trebling of population could overwhelm us.

The Sustainability Transition

To meet the needs of a doubled world population, some project a 2–4–6–8 scenario—a need for a fourfold increase in agriculture, a sixfold rise in energy use, and an eightfold increase in the value of the global economy (Anderberg 1989).[6] The environmental changes caused by such enormous intensification of production and consumption could have adverse consequences for human health, habitat, and well-being, and for the life-support systems of nature and the earth.

Thus the demographic transition is only a prelude to the sustainability transition in which our essential resources and life-support systems would need to sustain the well-being of a doubled or trebled global population. In an extraordinarily short period of time, a matter of decades, human society will need to feed, house, nurture, educate, and employ at least as many more people as already live on earth. If in this warmer and more crowded world environmental catastrophe is to be postponed, it can only be done either by maintaining great inequities in human welfare or by adopting very different trajectories for technology and development. For geographers, as Tom Wilbanks (1994) so thoughtfully informed us in last year's presidential address, these are central and pressing issues.

There are many good reasons to question humankind's ability to negotiate a sustainability transition. Currently there are three contrasting and archetypal visions of such a transition. These visions are rooted in great ideas of eighteenth- and nineteenth-century figures—Robert Malthus, Adam Smith, and John Stuart Mill—but they are as current as today's book and magazine racks.

The Coming Anarchy

Malthus, as noted above, thought that there were three checks to population: moral restraint, vice, and misery:

> . . . all the causes which tend in any way prematurely to shorten the duration of human life, such as unwholesome occupations, severe labor and exposure to the seasons, bad and insufficient food and clothing arising from poverty, bad nursing of children, excesses of all kinds, great towns and manufactories, the whole train of common diseases and epidemics, wars, infanticide, plague and famine. (Malthus 1798[1965]:39)

Malthus's dismal sketch accords with the recent one drawn by Robert Kaplan (1994) and described on the cover of the *Atlantic Monthly* as "The Coming Anarchy.":

> Nations break up under the tidal flow of refugees from environmental and social disaster. As borders crumble, another type of boundary is erected—a wall of disease. Wars are fought over scarce resources, especially water, and war itself becomes continuous with crime, as armed bands of stateless marauders clash with the private security forces of the elites. A preview of the first decades of the twenty-first century. (Kaplan 1994:cover)

Thus the first of the visions of the sustainable transition is one of misery, of population numbers and consumption checked by the four horsemen of the apocalypse.

Beyond the Limits

As Mill wrote in 1848 and Meadows, Meadows, and Randers (1992) quoted in their recent book:

> I cannot . . . regard the stationary state of capital and wealth with the unaffected aversion so generally manifested towards it by political economists of the old school. I am inclined to believe that it

would be, on the whole, a very considerable improvement on our present condition. I confess that I am not charmed with the ideal of life held out by those who think that the normal state of human beings is that of struggling to get on; that the trampling, crashing, elbowing, and treading on each other's heels . . . are the most desirable lot of humankind. . . . It is scarcely necessary to remark that a stationary condition of capital and population implies no stationary state of human improvement. There would be as much scope as ever for all kinds of mental culture and moral and social progress; as much room for improving the Art of Living and much more likelihood of it being improved. (p. 211)

In the update of their earlier work *The Limits to Growth* Meadows et al. (1972) describe in *Beyond the Limits* a sustainability transition. Using their world model, they simulate a sustainable world with deliberate constraints on growth:

> . . . the model world . . . decides on an average family size of two children beginning in 1995, has perfect birth control effectiveness, and has decided to aim for an average consumer goods per capita of 1968, $350 per person, per year, about the equivalent of that in South Korea, or about twice the level of Brazil in 1990. Furthermore, starting in 1995, it begins to employ technologies [that] increase the efficiency of resource use, decrease pollution emissions per unit of industrial output, control land erosion, and increase land yields until food per capita reaches its desired level. The resulting society sustains 7.7 billion people at a comfortable standard of living with high life expectancy and declining pollution until at least the year 2100. (p. 198)

> [Such a sustainable society] does not necessarily mean the population and economy are static or stagnant. They stay roughly constant the way a river is roughly constant, though new water is already running through it. In an equilibrium society . . . people are being born while others are dying; new factories, roads, buildings, machines are being built awhile old ones are being demolished (and recycled). Technologies are improving, and the steady flow of material output per person would almost certainly be changing and diversifying in content. As a river may have ups and downs around some average flow, so could an equilibrium society vary, either by deliberate human choice or by unforeseen opportunities or disasters. (p. 200)

Thus for them, a sustainability transition is a transition to an equilibrium society provided there are constraints on the growth of population and material output but not on human development.

The Ultimate Resource

A final vision of the sustainability transition is of a continuous transition, one guided by Adam Smith's invisible hand. Simon (1981) presents Smith's view in its most extreme form as:

> The standard of living has risen along with the size of the world's population since the beginning of recorded time. And with increases in income and population have come less severe shortages, lower costs, and an increased availability of resources, including a cleaner environment and greater access to natural recreation areas. And there is no convincing economic reason why these trends towards a better life, and toward lower prices for raw materials (including food and energy), should not continue indefinitely . . .
>
> There is no physical or economic reason why human resourcefulness and enterprise cannot forever continue to respond to impending shortages and existing problems with new expedients, that after an adjustment period, leave us better off than before the problem arose. Adding more people will cause us more problems, but at the same time there will be more people to solve these problems and leave us with a bonus of lower costs and less scarcity in the long run. The bonus applies to such desirable resources as better health, more wilderness, cheaper energy, and a cleaner environment. (pp. 345–346)

Simon's faith in the forever is extreme, but many economists and technologists share in his vision that the invisible hand of rising prices will curb consumption and encourage materials and energy substitution and invention. They are confident that human creativity can overcome all limits.

I am not much of a purist in anything and thus I find it difficult to accept the solitary likelihood of any of the archetypal transitions. While fascinated by great ideas and ideals, be they Smith, Malthus, or Mills, I fear that the actual pathway of a successful transition—indeed if we can succeed—will probably follow that path of decision and action that Lindblom (1959) called "muddling through," or, perhaps more appropriately, "lurching through."[7] And to do so will surely embody some elements of all three visions.

The Continuing Experiment

Clues to what those elements might be can be sought in the past. For me, the Jeremiah experiment is one such effort,[8] and it is a con-

tinuing one. These notes report on only the first of a series of perceived crisis—the rise, fall, and renewal of concern with the growth of population. In the future, I plan to address similar crises involving shortages of materials, food, and energy, the burden of pollution, and their interactive effects on the biosphere. What is common to all the case studies is an early (post-war) forecast of crisis that is well-publicized in a landmark book or article—prophesies that are never realized.[9]

As illustrated by the population case, each case study would begin with the emergence of concern in the form of early warnings and follow with an explanatory sketch of the forces that seemed to drive the crisis. Ideally, I would like to document the ameliorative actions that were taken, the effort that was expended, the effectiveness of these efforts, the easing of the crisis, the discrediting of the failed prophesy, and finally, the persistence or renewal of concern. What I hope to learn from each is something about the social and scientific[10] role of Jeremiahs but more importantly about societal response. What can be learned from this post-war experience that will illuminate a pathway for the sustainability transition?

Role of Jeremiahs

I begin with my earlier question about Jeremiahs. If the crisis they foretell does not occur, if doom is forestalled, are they then false prophets? If the crisis is not real, if they have manipulated our perception of crisis with their passion, argument, and eloquence, then they have obviously misled us and the failure of their prophecy is rooted in the falsity of their assumptions. Indeed, that is the argument made in such volumes as John Maddox's (1972) *The Doomsday Syndrome,* Julian Simon's (1981) *The Ultimate Resource,* and Ronald Bailey's (1993) *Eco-Scam.*

But if the crisis is real and society heeds the warning, then doom may be forestalled and the crisis may be abated. Thus the failure of the prophecy to materialize is not by itself evidence of its falsity (Meadows 1988). Counter to our intuition, accuracy may not be a fair test of the prophecy. Instead, we can only ask if the prophets' concerns were reasonable for their time and knowledge. Would a jury of their peers, knowing what they knew, share their concerns at least, if not their passion? With the hindsight of history, does their prophesy of crisis appear reasonable?

It does appear reasonable in their concern with rapid population growth. To sum up the population case: the perception of a population crisis was clearly based on the reality of the unprecedented post-World War II growth in population. The crisis seemed to subside subsequently with the mounting evidence that a transition from many births and low life expectancy to fewer births and longer life was well underway in the world. Population growth peaked in 1962–1963, perhaps for all time, and then began a slow decline with absolute numbers of population peaking in 1989 (Brown, Kane, and Roodman 1994). Intentional effort to control births were widespread, their costs small compared to other social expenditures.[11] The efficacy of the effort was also small in comparison to the influence of larger social and economic development trends. As for the influences of the population Jeremiahs and the institutions and individuals that took up their cause, these were large in the industrialized countries, significant in some developing countries, and completely absent in others, including the most important one, China. And in a tradition, ever since Malthus, the concern with population growth persists, fueled by recent evidence for a slowing of the transition and increased concern with the environment.

Societal Response

The focus on Jeremiahs may be novel, but the approach is not. Societal responses to perceived resource or environmental crisis are strands in the larger web of human adjustment to natural environments that 72 years ago a previous President of the Association saw as central to geographic inquiry (Barrows 1922). His student, Gilbert White, would elaborate this theme into one of the great "geographical ideas that have changed the world" (Hanson n.d.) beginning first with geographical inquiry into human adjustment to floods (White 1945).

Twenty years later, Gilbert White, Ian Burton, myself, and collaborators in 23 countries (White 1974) would explore commonalities in human adjustment to natural hazards (Burton, Kates, and White 1978; 1993). We found that people everywhere undertake six classes of purposeful actions (as shown in Figure 3): they bear or share hazard losses, try to modify haz-

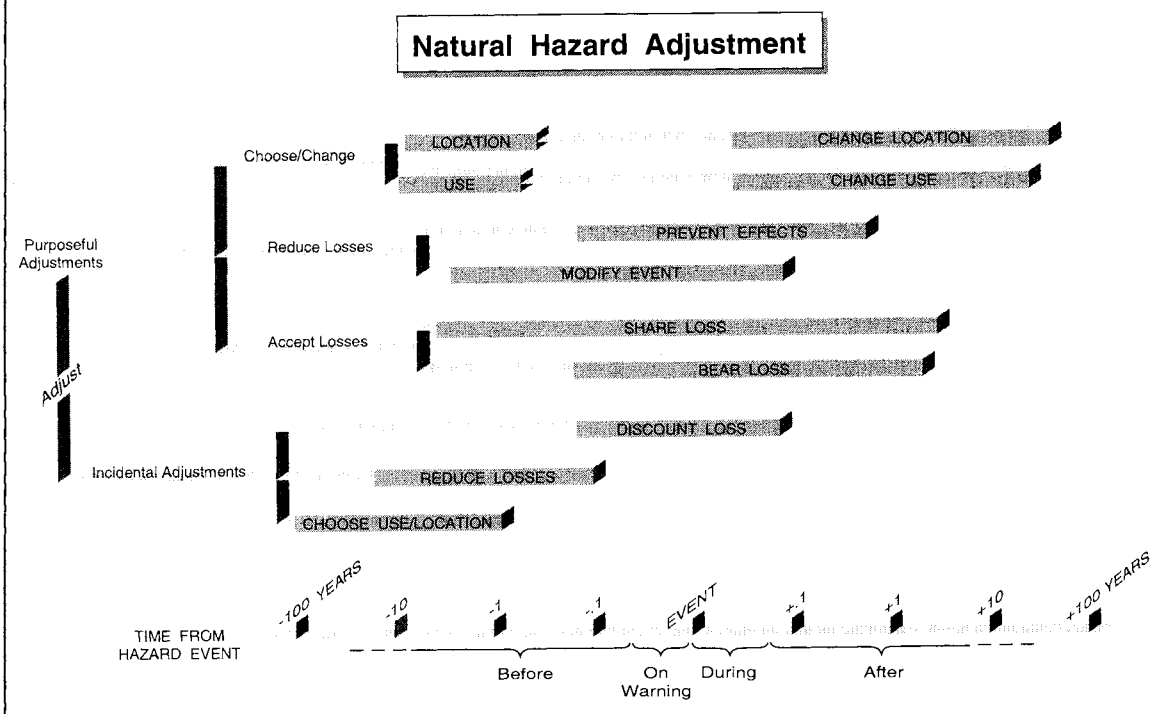

Figure 3. Purposeful and incidental adjustments to natural hazard by period of employment in years from hazard event. Source: Burton, Kates, and White 1978:46.

ard events or prevent their effects, or change their resource use and move to new locations. But besides these purposeful adjustments, all societies seemed to have adjustments that have the effect of reducing or mitigating the hazard but are not consciously invoked for that purpose. Rather, these adjustments are incidental to some other activity with another intended function. For example, the choice of constructing a brick rather than wooden house, a cultural style in the midwest, reduces the potential for tornado damage. Similarly, the universal diffusion of television and radio vastly improved hazard warning.

Applying this distinction to the perceived population crisis, intentional actions are those collective ones taken consciously to ameliorate or forestall the crisis—in this case family-planning programs, research on the technology of contraception, and the social provision of incentives and disincentives for fewer children. The incidental ones are those that do not address the specifics of population; rather they are actions or activities that in retrospect act to ameliorate the crisis even though they are driven by quite different intentions. Economic growth and social improvement clearly function in this way. They have the major role in encouraging the population transition, but no one consciously pursued development specifically for the purpose of reducing births. For social activists of the population crisis, there may be some discouragement in the fact that the most efficacious actions arose from the incidental.

But reducing fertility may be a case of that class of actions sometimes called "win-win situations" and sometimes called "no-regret policies" which, rather than requiring painful tradeoffs, achieve several desired ends. A case in point is the recent Cairo conference, successor to Bucharest and Mexico City, which, under the banner of women's rights, combined an action plan to accelerate women's education, work opportunities, access to contraception, and survival of their children (Chen, Fitzgerald, and Bates 1995).

Progress can indeed come by "swimming

with the tide" and geographers can help identify the tides. The search for such tides was stimulated for Ian, Gilbert, and me by what we came to call "The Kew Garden Effect" (Auliciems and Burton 1973). Britain's Clean Air Act of 1956, passed in response to the famous London Smog episode of 1952 that paralyzed the city and caused thousands of deaths, was intended to get rid of smoke and seemed to do so with remarkable success—smoke emissions in London fell by 5/6ths in the course of a dozen years (Figure 4a). However, when placed in the context of longer-term observations such as those available from Kew Gardens in London beginning in 1922 (Figure 4b), the sharp decrease in pollution following the passage of the Clean Air Act appears only as a continuation of a long-term trend. Much of the improvement of air quality was due to the displacement of coal by oil and other fuels in industry and the replacement of the coal fire by gas and electricity in the home.

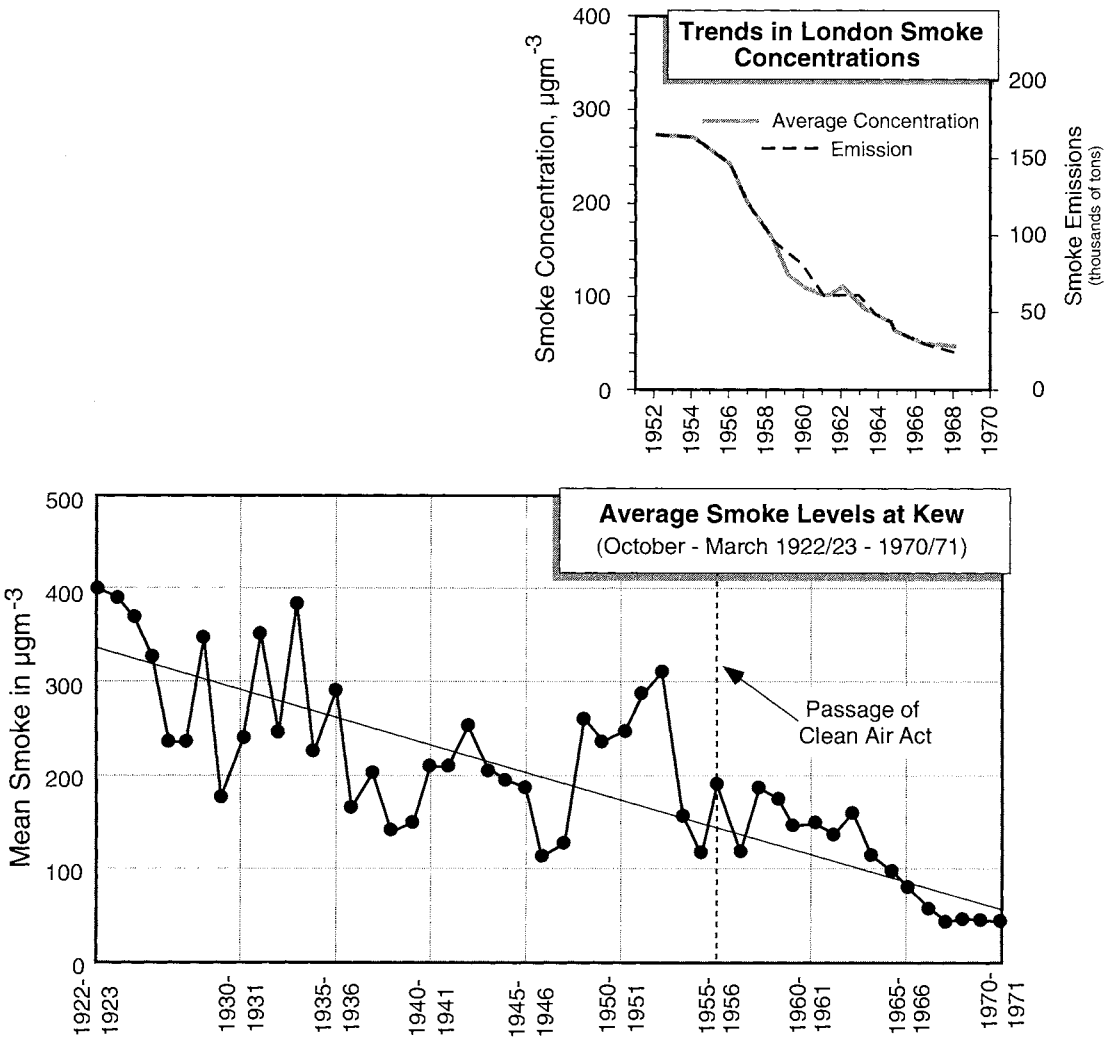

Figure 4. Trends in smoke concentrations and emissions (a) in London 1952 to 1968 and (b) within London in Kew Observatory 1922–23 to 1970–71. Source: Auliciems and Burton 1973.

We also now know that The Kew Gardens Effect is part of a longer term trend in using less carbon to produce energy and less materials to make things. Since the mid-1800s, the amount of carbon used in producing a unit of output has decreased by 1.3 percent per year by a combination of using less carbon-rich fuels (0.3 percent) to produce energy as seen in Figure 5 and using less energy overall per unit of production (1 percent) (Nakicenovic n.d.).

Figure 6 reveals a similar but more complicated trend towards dematerialization—using less materials by weight and volume per unit of production. Thus we are clearly using less wood, steel, lead, copper, and cement but more plastic, aluminum, and fertilizers (although these also have peaked and are beginning to lessen). Surprisingly, despite the computer and television revolutions, the use of paper remains constant (Wernick and Ausubel n.d.).

Hope for a Sustainable Transition

For me, there is much curiosity and some mystery about such long-term trends as development, decarbonization, or dematerialization. What is there about development that actually reduces births? What has encouraged us to use less carbon, half a century before anyone even queried the role of carbon in the potential warming of the atmosphere (Arrhenius 1896)? Why is lighter better when heavier is sturdier? One hypothesis is that of scale shifts, in which the incidental becomes purposeful following a change of scale to a higher order of social organization or complexity or to the attainment of a greater goal. Another perhaps related hypothesis is an evolutionary one that sees such trends as a kind of natural selection, e.g., Boulding's (1981) arguments for viewing technologies as species and artifacts as evolving in ways similar to organisms. Explanations for specific trends might then be found in some combination of human aspiration and inspiration, technological evolution, and competitive efficiency.

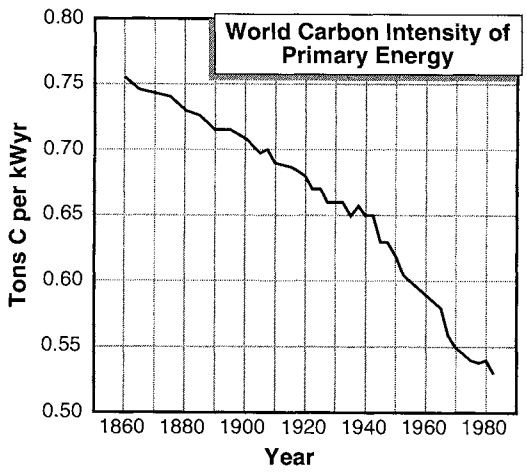

Figure 5. Trends in world carbon intensity (the ratio of the carbon content in tons of all fuels: wood, coal, oil, and gas to the energy content in kilowatt years of all primary energy sources) from 1860 to 1982. Source: Nakicenovic n.d.

Whatever the underlying causation for these trends, we should not conclude that purposeful action is neither needed nor desired. The lesson of the modern demographic transition is that development, family planning, and culture is a far more effective combination than solely relying on an amorphous trickle down of developmental change. And development that brings together the elements of women's opportunity, access to contraception and reproductive health, and child survival can be accelerated by concrete purposeful action.

There is also great potential to accelerate trends to reduce the energy and materials required per unit of economic output. Simple interventions include the recent competition to build a low-energy consuming, non-ozone depleting refrigerator which will soon be on the market in the United States or to move immediately to next-generation refrigeration in India. Longer-term, the emergent field of industrial ecology promises to use the market mechanisms of competition and efficiency to minimize the throughput of energy and materials and the output of wastes from industrial processes. Still longer-term, there is great opportunity to increase human sustenance without increasing environmental burdens through the science and engineering of biological processes, new energy sources and transmission, new materials, and the substitution of information for energy and materials. Most promising

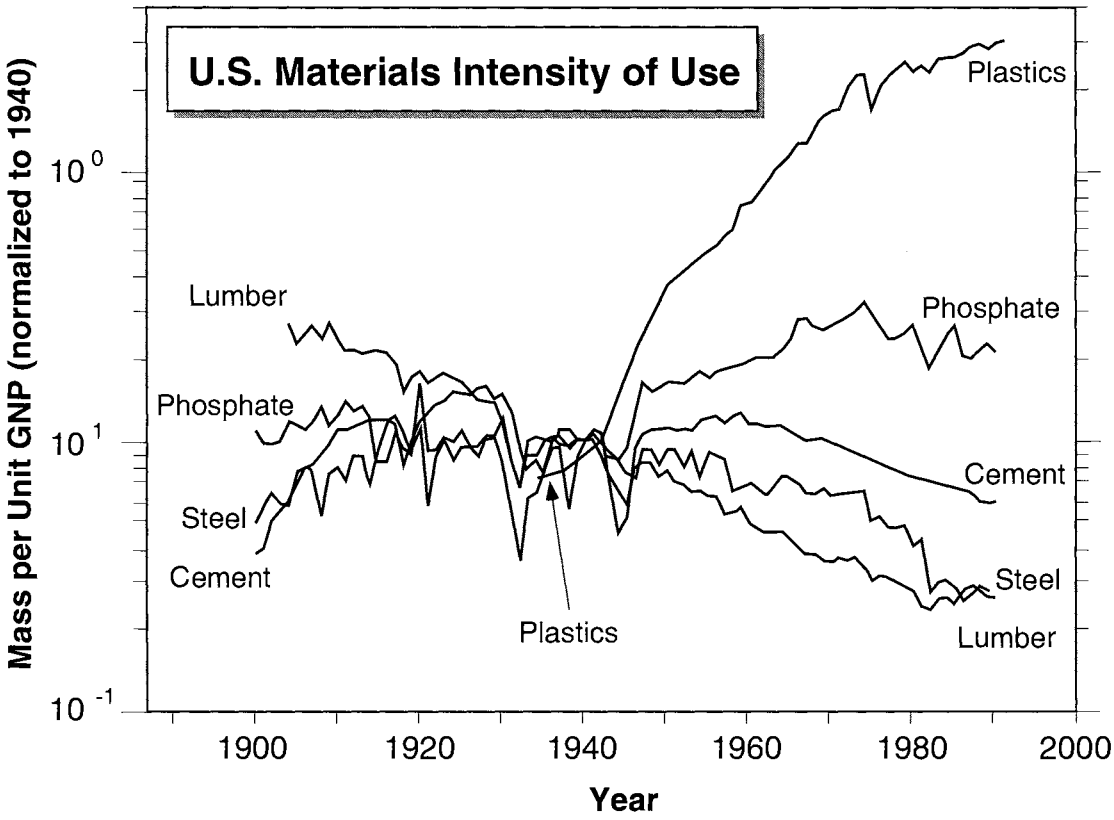

Figure 6. Trends in U.S. materials intensity (the ratio of the mass of material production to each unit of U.S. gross national product) with the 1940 ratio set to 1.0. Source: Wernick and Ausubel n.d.

in the long run, however, may be work on the molecular and sub-molecular technologies: micro-electronics, biotechnology, and nanotechnology materials.

A Jeremiah Parable

As I try to understand what this experiment writ large means, I imagine spaceship earth as a kind of fortunate Titanic. On the ship's prow in the middle of the night, Jeremiah Jones peers into the dimness. Faintly perceiving some ominous shapes ahead, he cries out lustily "icebergs ahead." Unsure if he is heard, he cries out again and again. On the ship's bridge, the captain, hearing Jeremiah only after some time, turns to the navigator and asks for a course correction to avoid a collision. Ten degrees to the starboard she says. The Captain, thinking "What luck that I have already started to turn because of the bad weather ahead," orders a five degree correction. The helmsman looks at his compass and suddenly realizes that he has been dozing for a few minutes and that the ship has actually been drifting, fortunately though, in the right direction. Without saying anything, he then corrects the course by two degrees. Up ahead, alone and in the cold, Jeremiah awaits a hard starboard course correction, maybe even a reversal of engines. Sensing none, he mutters to himself "they never listen to me" and prepares for the worst.[12]

With you I wonder, if there is so much fortune in the evasion of doom, from whence is such good fortune derived, and for how long will it continue?

Acknowledgments

I am deeply grateful for the close reading and many helpful suggestions of Ian Burton, Ellie Kates, and Tom Wilbanks; for the continuing assistance of Jeanne X. Kasperson in all matters bibliographic, for Jesse Ausubel's insights on technology and the use of Figures 5 and 6, and to Martha Church and Gilbert F. White who made this quest possible.

Notes

1. Lifelong pursuits accumulate an extensive literature and portions of these labnotes have been expressed before, particularly in Burton and Kates 1986; Kates 1983; 1987; 1988; 1994; and n.d.
2. See note 10.
3. For example, in a well-known comparative study of birth rate decline between 1965–1975 (Mauldin and Berelson 1978) that covered 94 developing countries (containing then about 2.8 billion people or 98 percent of the developing world), the analysts employed a stepwise multiple regression to sort out the interactions. Ranking all 94 countries by the size of their reduction in birth rates between 1965 and 1975 and regressing that ranking on a development index, they found that development accounted for about two-thirds of the difference in birth declines among the countries. Adding an additional piece of information—a measure of the existence and effectiveness of the family-planning program—accounted for another 17 percent of the differences between countries. Even more important, the analysts found that development and fertility program effort together accounted for ". . . much more fertility decline than in countries that have one or the other, and far more than those with neither" (Mauldin and Berelson 1978:124).
4. For example, in the Lapham and Maudlin (1984) study of change in birthrates between 1965 and 1980 (noted above), the top twenty countries recorded 20 percent or greater declines in births (compared to the overall world average of 13 percent), and almost half of these were in East or Southeast Asia and a quarter in the Caribbean. Of the top twenty countries, over half were small island or city states. By numbers of population in the top twenty, Chinese speakers in China, Taiwan, Hong Kong, Singapore, and Malaysia overwhelmingly predominate.
5. Demographers generally do not like to use the word *forecasts;* they prefer the word *projections* over *forecasts* which define a range of logical possibilities based on particular assumptions (Frejka 1981). Semantics aside, for almost two decades now the major institutions and individual demographers that make 50–150 year population forecasts have projected a world population of between 8–12 billion with stabilization sometime within the next century. Such agreement needs to be taken with many proverbial grains of salt since all the forecasters seem to use somewhat similar methods and assumptions. The current variants of the major projections forecast a median or central projection by 2100 of 11.0 billion by the World Bank (Bos et al. 1994), 11.2 billion by the United Nations (1993), and 12.6 billion by the International Institute Of Applied Systems Analysis (Lutz 1994) with low-high ranges between 8 and 15 billion. Even this broad range may be too small (McNicoll 1992). Demographers who have examined the accuracy of U.N. forecasts for individual countries and estimated the average errors made in these forecasts would set even wider limits. They argue that there is a 2–1 chance that in the year 2100, global population will fall somewhere between 5 and 20 billion people (Keyfitz 1981; Lee 1991; Stoto 1983).
6. Scenario-building exercises generally follow two alternative paths. The most common one projects current trends into the future under certain assumptions. This is the basic approach of the population projections used in this paper. An alternative approach identifies certain endpoints (usually desirable) at some future time, and asks what trends are required to achieve it. In 1989, an International Institute of Applied Systems Analysis summer study (Toth, Hizsnyik, and Clark 1989) found that "current trends" or "business as usual" projections for a doubling of population required a quadrupling of agriculture, a sextupling of energy, and an octupling of the economy, if varied and nutritious diets, industrial products, and regular jobs are to be in reach of most of the ten billion people (Anderberg 1989). The IIASA study utilized both approaches, choosing optimistic projections (but well within the range of the "conventional wisdom") of the demographic transition and the subsequent growth in agriculture, energy, and economy needed to provide for minimal necessities and a lessening of global inequities. The resulting "2–4–6–8" scenario has not changed much in the ensuing years according to the organizers of the study (Clark 1995; Toth 1995). By way of contrast to such an optimistic or desired scenario, a recent climate change impact study employed a current-trends scenario using a set of linked national agricultural models, and projected, that with a doubling of population by 2060 there would be an increase in agriculture of 2.2 times and an increase in world economy of 4.4 times, along with a rising number of undernourished people, 641 million in 2060 (Fisher et al. 1994; Rosenzweig and Parry 1994).
7. Suggested to me by W. C. Clark (1995). He reminded me that the institutional response of "muddling through" described a process of small incremental changes in governance actions. Responses to perceived crises may involve large shifts, symbolized by "lurching," in directions different from current trends, and overreaction as common as underreaction or appropriately adaptive response. See use by Baskerville (1995).
8. There are others, of course, such as the study of social learning for sustainability in the Columbia

River Basin (Lee 1993), six regional ecosystems in North America (Gunderson, Holling, and Light 1995), and in eight nations attempting to address problems of acid rain, stratospheric ozone, and climate warming (Parson and Clark 1995).

9. Examples of such forecasts and their landmark publications include Brown (1954) on materials; Borgstrom (1965) and Paddock and Paddock (1967) on food; Hubbert (1949; 1962) on energy; Carson (1962) and Commoner (1971) on pollution; and Meadows, Meadows, Randers and Behrens (1972) on interactive effects.
10. Somewhat to my surprise in searching for these landmark publications, all were written by scientists with the exception of one of the Paddock brothers who was a diplomat. I came across no examples of important works by non-scientists (journalists, writers, politicians) that pre-date these key documents.
11. Since Sweden's first grant in 1968 through 1982, foreign donors gave $7 billion in resources representing about one percent of industrialized-country aid to the Third World. Forty percent came from U.S. government and private sources, with Japan the next most generous donor. Canada, the Federal Republic of Germany, Netherlands, Norway, and Sweden gave over $10 million per year. By the end of 1975, 65 developing countries had population and family-planning programs underway. Their expenditures more than matched the external assistance for the same period. The two largest countries in the world, China and India, used little or no external assistance. By 1980, an estimated $2 billion was being spent annually on population activities in developing countries, with only a fifth coming from foreign donors, a fifth from the affected populations purchasing private services, and three-fifths from the governments themselves (World Bank 1984:148–151).
12. The metaphor of the Titanic is a common one—note the description of not acting in the face of crisis as "rearranging the deck chairs on the Titanic." In one important way the metaphor does not capture the realities of the earth's people. As Ian Burton reminded me, on spaceship earth there are many captains on the ship; a crew with myriad, overlapping skills; and passengers, not at all complacent, indeed, many well-organized. To which can be added the intentional class structure of the Titanic. Indeed, the Titanic survivors came primarily from the upper-deck classes.

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Kates, Robert W. 1995. Labnotes from the Jeremiah Experiment: Hope for a Sustainable Transition. Annals of the Association of American Geographers 85(4):623–640. *Abstract.*

These notes examine a case of perceived crisis after World War II—the rise, fall, and renewal of concern with the growth of population, beginning with landmark publications by Vogt (1948) and Brown (1954). Part of a larger study that will eventually address other neo-Malthusian concerns, the project seeks insight from these failed prophesies into a future sustainability transition.

In retrospect, the perception of a population crisis was based on the unprecedented growth in population. The crisis seemed to ameliorate as evidence that a transition from many births and low life expectancy to fewer births and longer life was well underway in the world. The population growth rate peaked in 1962–1963 and then began a slow decline. Development, family planning efforts, and culture all contributed to the decline, with development playing the major role. The influence of the population Jeremiahs was large in the industrialized countries, significant in some developing countries, and absent in others, including China. In a tradition ever since Malthus, the concern with population growth persists, fueled by evidence for a slowing of the transition and increased concern with the environment.

Prospects for a sustainability transition to meet the needs of a doubled population are evaluated by emphasizing long-term trends in population, energy, and materials. Three alternative visions of the transition are examined with the expectation that none of them will suffice. If a successful transition occurs, and success is in doubt, it will represent an amalgam of favorable, but not well-understood, long-term trends and intentional action. **Key Words:** Harrison Brown, demographic transition, development, family planning, human adjustment, Jeremiah, Malthus, natural hazards, population, sustainability, sustainable development, transition, William Vogt.

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