CHAPTER FOUR

Numbers Count

Numbers have the power to evoke an incredible array of feelings in people. Some take on very personal and emotional qualities, such as the date we were born, the date we marry, and the date a loved one dies. Such events form a chronology of life, tucked securely away in mind and heart, shaped by time and number. They offer emotional anchors and guideposts within the flow of time. We navigate through life with the passing decades: "Remember the sixties? I hated the seventies. "The Eighties: The Reagen Years, The Booming Nineties."

Ten year increments may be an appropriate scale to measure a lifetime, but the stepladder for much of literature and history is centuries. Expressions like The "Nineteenth-Century Novel" and "The Space-Age Twentieth Century" allow us to catalog social, political, and historical change. But historical events do not fall neatly into prearranged time slots ending in zeros. Circumstance, history, and nature have their own internal clocks; they do not abide by our preoccupation with zero years. For whatever the reasons, it is we, not nature, who have organized and characterized personal and historical time by decades and centuries.

Many religious fanatics measure time by the millennium. In 1240 A.D. many Jews and Christians believed the Messiah was on his way, or on his way again. Twelve-forty is not a millennium year you say? True, but it just so happens that 1240 A.D. corresponded to the Jewish year 5000—and we all know the importance zero plays at the end of a year, especially three of them![1]

Geologically, a century is not much different than a millennium. Geologists measure time in tens of thousands of centuries and events are seen from the perspective of epochs and periods. Millions of years can pass before a few feet of sediment is deposited on the ocean floor. Nature has her own time scale, slowly turning ancient life into stone and energy.

Paleontologists tell us that over 400 million years separate the first true skeletal organisms from the first recognizable dinosaurs; as far as we know, life extends back at least three billion years. If one considers all the life our planet has given birth to, by comparison, there is little today. Evolution and extinction have been partners in the intricate dance of life and death. Unfortunately, over the last few decades mankind has accelerated the rate of extinctions beyond all prior accounts in human history. We may yet pay a high price for these actions.

Remarkably, biologists have discovered that all mammalian life appears to be ordained to live the same life span. However, using the sun as a time piece gives little insight into the "connectedness" of life. But when it comes to the biological clock, not so. Nature gives each mammal one-billion heart beats.[2] For some, the pace is fast; for others, it beats slowly. It turns out that if you assign an average heart rate of seventy-two beats per minute to a human being, and go on to find the number of beats in a seventy-five year period, the number comes out closer to three-billion beats. The apparent contradiction arises because a seventy-five year life span is a recent phenomenon for humans, brought on predominately by lower mortality rates due to improved sanitation conditions and advances in medical science. In the "wild", Homo sapiens have an average life expectancy of twenty-five to thirty years, as do many in poorer countries.[3] This brings the number of human heart beats into the one-billion range.

Astronomers tell us similar things about stars. Those which are blue-white burn their nuclear fuel much faster than their cooler yellow and red counterparts. Yet after each converts ten percent of its

hydrogen into helium, it strays off what astronomers call the "main sequence."[4] Main-sequence stars are in a state of equilibrium, balancing their outward thermonuclear pressure against gravity's contracting force while fusing hydrogen. The sun and most other stars, at their present stage of stellar development, are on the main sequence. After a star leaves the main sequence it may "live" for many years, but its ability to nurture life as we know it is faint. Would it be too fanciful to liken hydrogen to heart beats?

The universe may be ten to twenty billion years old. Our sun, having converted five percent of its hydrogen to helium is believed to be five billion years old. In another five billion years it will stray off the main sequence and all earthly life will end. Perhaps such information suffers too much detachment from our day-to-day concerns. On the other hand, it may serve as an analog in reminding us that our continuance depends upon our environment. There is an implied hierarchy here: When the nature of the sun's "ecology" changes, all life on Earth will end; when the nature of our planet's ecology changes, vast numbers of extinctions can be expected, possibly our own; when we poison our own bodies, we die.

Though the human mind cannot grasp what a million years, let alone a billion years, "feels" like, we have contained them in our mind's eye with ones and zeros. To the ancient Egyptians a million was an uncommon number. Their hieroglyph for it was a human figure in astonishment (*See Figure 3.1, page 26 for a list of Egyptian numerals*). Today we deal in millions, billions, and trillions. They have become, in some sense, our modern version of "1,2,3, many." There are names for numbers higher than a trillion but most people wouldn't know them. Our current economic and social development does not put us beyond the trillion in most cases.

Many people have either forgotten or never knew the definitions for numbers greater than a million. Their enumeration is straight forward, the key being multiplication by a thousand. For example: a thousand thousands (1000 × 1000) is a million (1,000,000). Notice that a million can be made by adding three zeros to a thousand. A thousand millions (1000 × 1,000,000) is a billion (1,000,000,000). Notice again, a billion is just a million with three more zeros added to it. And similarly, a thousand billions (1000 × 1,000,000,000) is a trillion (1,000,000,000,000). Try to remember them like this:

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1      000      000      000      000
   one thousand |
   ___one million________|
   ______one billion_____________|
   _______one trillion_____________________|
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All of this is arbitrary. There would be nothing incorrect if a system were invented that assigned new names to large numbers that were multiples of a hundred, ten thousand, or whatever you like. In fact, Britian and Germany define their "billion" the same as we define our trillion.

It is sometimes difficult to imagine just how large thousandfold changes can be; an example is helpful.

Assigning units of seconds to these Really Big Numbers (RBNs) gives:

one thousand seconds
one million seconds
one billion seconds
one trillion seconds

Since there are 60 seconds in a minute and 60 minutes in an hour, this works out to 60 × 60 (3600) seconds in an hour. Therefore, 1000 seconds is less than an hour. Actually, it is 1000/3600 hours, or if expressed decimally: .277… hours or 60 minutes × .277… for 16.66...minutes.

For one million seconds we have: 1,000,000/3600 = 277.77… hours; or, 277.77/24 = 11.57 days, approximately.

Going on to one billion we have: 1,000,000,000/3600 = 277777.77... hours, and again: 277777.77…/24 = 11,574 days or 11,574/365 = 31.71 years.

And finally, if we continue the pattern that has been emerging, we would add three more 7's to the first number in our series of operations: i.e., 277777777.77, this divided by 24 which gives 11,574,000 days (again three more places) and this divided by 365 yields 31,710 years (again three more places than our previous 31.71 years.) How many years would a thousand trillion seconds (a quadrillion seconds) be?

Collecting our results we have:

one thousand seconds = 16.66... minutes
one million seconds = 11.57 days
one billion seconds = 31.71 years
one trillion seconds = 31,710 years

As anyone can see, growth by thousands is quite substantial.

Developing a feel for RBNs is essential in today's world, especially with regard to the environment, population, production, waste, health care, and government spending and debt. In the decade of the nineties we can expect to read increasingly about the RBNs associated with these topics. It will become more important for us to understand what these numbers represent objectively, as well as subjectively. We must learn to intelligently personalize their meaning. The rest of Chapter Four is devoted to the role RBNs play both directly and indirectly in our lives.

A Hodgepodge of RBNs

World production of cigarettes reached over 5.1 trillion in 1987,[5] with the United States producing 1,215,221,360 pounds of tobacco for a value of $1,929,763,000.[6] The number of cigarettes produced per person in the United States has, however, dropped to levels comparable to the early 1940s—below 3000 per person.[7] Since less people are smoking in America, tobacco companies are peddling their products overseas where health education is less prevalent. (Unfortunately, as of late 1995 there is a noticeable increase in teenage smokers in America.)

Soybean production in the United States in 1987 was 1,838,053,979 bushels, valued at $10,007,455,000.[8] Ninety percent of the soybeans grown in America are used for animal feed, rather than for direct human consumption.[9] A pity, since soybeans are an excellent source of protein and calcium without any of the cholesterol or animal fat.

Soft drink consumption reached 85 billion twelve-ounce servings internationally in 1990.[10] One wonders how much aluminum was used to spread the gospel of carbonation.

Worldwide over 200 billion bottles, plastic cartons, cans, and paper cups are produced and discarded each year.[11] What happens when all the landfills are full?

Over 450 million vehicles have been instrumental in a quarter of a million traffic fatalities a year worldwide.[12] This is about five times the number of U.S. soldiers that died in Vietnam and one-half the number of people that will die of cancer in the U.S. next year.[13] We can look forward to another 250 million cars joining us over the next seventeen years.[14] Can we assume a proportionate number of deaths?

United States consumers throw away 7.5 million televisions each year.[15] I commend this action. Regrettably, they are discarded because of a failure to function, rather than as a sign of good taste.

We are presently eating the bluefin tuna into extinction. There were some 250 million of them in 1970, but in 1990, estimates put their number at 20,000.[16] Fishermen use nets that are miles long that sweep up everything in their path. It appears no price is too high for sushi.

In 1991 the U.S. produced close to 20 trillion cubic feet of dry natural gas and 9,000,000 barrels of crude oil per day.[17] A barrel contains 42 gallons (for a total of 9,000,000 × 42 = 378,000,000 gallons a day) and we still import roughly one-third of our petroleum.

Americans throw away 135,000,000 tons of garbage every year. This is 270,000,000,000 pounds (2,000 × 135,000,000 = 270,000,000,000) which comes to 1,080 pounds per year for each American (270,000,000,000/250,000,000 = 1,080) or nearly 3 pounds per day (1080/365 = 3) for each of us.[18]

There were 19,071,000,000 pounds of chicken consumed in the United States in 1991. Assuming a population of 250,000,000 Americans gives an average of over 76 pounds (19,071,000,000/250,000,000 = 76) of chicken consumed per person.[19] Many people would be surprised to learn that ounce for ounce the average cholesterol content of chicken is no different than red meat. Roasted light meat chicken without skin has more cholesterol than an equivalent amount of broiled sirloin or salami.[20]

Twelve percent of the adult population of the United States is functionally illiterate with skills at or below a fourth-grade level. Try a rough calculation on your own to find a reasonable figure for the number of adult illiterates in America.[21]

The RBNs of Population and Food Production

Another important RBN is population growth. Population does not grow linearly—few things do. Linear growth appears as a straight line when plotted on a graph. (One example of a linear graph is Figure 7.4 on page 129.) Linear means that the rate of growth is constant. For example, if each year you are given a $2000 raise, your salary grows linearly. If the ingredients of a recipe can be doubled, tripled, quadrupled, … in order to serve two, three, and four times as many, … then it too is linear. (I am told this is often not the case.)

It took from the dawn of human existence until 1801 for the human population to reach the 1 billion mark.[22] One hundred and twenty-four years later (1925) it had doubled to two billion. (See Chapter 8, page 168, Figure 8.6 for the rise of population in both the First and Third Worlds. The trend noted in the Third World exemplifies the rapid population growth we are currently discussing.)

Successive years for the population growth are cited below:

Year	Population in Billions
1959	3
1974	4
1986	5
1997	6

Notice how the time change is not uniform though the population change is; this is a sure sign of nonlinearity. Population growth is said to grow exponentially—a concept we will explore in detail in Chapter Eight.

Populations in many areas of the world are growing far too rapidly.[23] Over 14 million children (age 5 and under) die preventable deaths every year[24] yet there are over 141 million born each year to replace them.[25] Millions more die every year of malnutrition and disease. The overwhelming number of these births and deaths belongs to the 1.1 billion people who live in the ever worsening Third World.[26] (The term "Third World," though meant originally for those countries not aligned with the U.S. or Soviet Union, has become synonymous for developing or poor countries. Similarly, the term "First World" is used for industrially developed or wealthy nations.) Roughly a third of the people in the Third World are slowly starving to death.[27] By the year 2000, seven-hundred and fifty million people will be without an adequate water supply.[28] Unless there is an abrupt moral, social, and political change, these numbers will continue to rise, making the world even more ecologically and politically unstable.

There is an equal number (1.1 billion) of people in the First World—North America, Japan, and developed Western democracies. We in the First World use the vast majority of the world's resources, though we represent a minority of the population. In terms of food, for example, the waste is tremendous. It is sadly ironic to watch an American family sit down to a dinner of pot roast or chicken, with

their heads bowed, giving thanks.

Animal food is highly inefficient to produce, in that it takes many pounds of grain to produce one pound of edible meat. Beef is the greatest offender and poultry the least, which is still considerable. The grain fed to "farm animals" could nominally (in the right political and economic environment) be given to starving people instead. According to John Robbins, seven people could be fed with the grain and soy used to produce the meat, poultry, and dairy products consumed by only one American.[29] A little arithmetic shows that this amounts to 1.75 billion people (250,000,000 Americans × 7 = 1,750,000,000). Such comments are not meant to foster international hand-outs nor are they a necessity. Frances Moore Lappe helped put this in perspective when she wrote:

> Consider Japan and Western Europe, which together contain only one-sixth the population of the poor world. They import 20 times more grain than all the underdeveloped nations combined!
>
> It is our disproportionate use and waste of the world food supply that pushes the price of grain up beyond the reach of those with genuine needs and ensures that the real 'scarcities' appear elsewhere.[30]

The real villain is waste, not scarcity. First World consumption is highly inefficient and politically hazardous to the Third World—which may eventually become hazardous to us. When it comes to diet, First World waste and pollution are mind-boggling. The amount of grains and soy used in producing just 14 percent of our meat-centered diet could sustain nearly 250 million people—our present population.[31] This assumes a linear model, which is the simplest, and most suspect, of all extrapolations. The 14 percent figure works out quickly, if you divide our present population (250,000,000) by the total number of persons (1,750,000,000) that can be fed with the grain and soy given to livestock. (Don't forget to multiply by 100, your answer should read 14.28%; percentage concepts will be covered in depth in Chapter Five.) Could the incredible amount of pesticides, herbicides, and chemical fertilizers that go into our air, land, and rivers to support our present diet be drastically reduced if the focal point of our diets were shifted from animal to plant foods?

To date, 260,000,000 acres of forested land have been cleared to create cropland, pastureland, and rangeland to produce a meat-centered diet.[32] We could return 204,000,000 of these acres to forest and have plenty of cropland available to produce all the food Americans need.[33] This could mean a reduction in farm associated pollutants and toxins by as much as 78 percent. This figure is arrived at by assuming a linear model and computing 204,000,000/260,000,000 × 100. Additionally, over half of all water used in this country is for livestock production.[34] When everything is added up, one-third of all the raw materials (base products of forestry, farming, and mining—including fossil fuels) consumed in the United States is used for the production of livestock.[35]

Carbon Dioxide—an Unlikely Danger

If we were to take a trip back in time, before the emergence of plant-life on Earth, we would find little oxygen to breathe. Plants made the world habitable for us. They converted much of the carbon dioxide in the atmosphere into oxygen. In a sense, plants terraformed the world for humans. They went on to provide us with food, and over millions of years, slowly created the fossil fuels that society depends upon today. How ironic that those ancient plants are now returning our atmosphere back into its primeval state.

As we continue to burn fossil fuels and hack away at the Earth's forests, the amount of carbon dioxide increases. According to frozen samples within Antarctic ice cores, carbon dioxide levels have risen from 280 parts-per-million (ppm) in 1750 (the onset of the industrial revolution) to 330 ppm today.[36] Along with ozone, methane, and chlorofluorocarbons (CFCs), carbon dioxide is commonly known as a greenhouse gas.

Greenhouse gases are so named, because they perform the same

function as the glass of a greenhouse. Certain frequencies of sunlight enter unhindered through the glass of a greenhouse. The sunlight is absorbed by the greenhouse contents and re-emitted at a lower energy level (infrared radiation) which cannot breach the glass barrier. The infrared radiation heats up the greenhouse, as sunlight continues to be absorbed. At night, the trapped heat makes its way through the glass by conduction. Unless the outside temperature falls low enough, the conduction process will not equalize the two temperatures by morning. Without a dense enough atmosphere and molecules capable of blocking infrared heat from escaping into outer space, our planet's temperature would plunge each night to levels ill-suited for life. Too much of a good thing, however, can be deadly. Venus, our nearest planetary neighbor in space, has a dense atmosphere made mostly of carbon dioxide. Temperatures at its surface reach 800° F and the sun is never seen through the cloud cover. Its atmosphere acts like a huge greenhouse keeping in a significant amount of the solar radiation that enters. A rise in greenhouse gases on Earth could have disastrous ecological, social, and political effects.

Humanity presently spews over 13 trillion pounds (13,000,000,000,000) of carbon, in the form of carbon dioxide, into the atmosphere each year. This amounts to over 412,000 pounds of carbon every second. The burning of fossil fuels and continued deforestation are mostly to blame.[37] Many scientists believe the Earth has begun a warming trend due to increased carbon emissions, as well as other compounds, that are carrying the Earth's natural greenhouse properties to dangerous levels. Seven of the hottest years on record for more than a century have occurred since 1981.[38] If global temperatures rose only a few degrees Fahrenheit, low-lying communities would be submerged under melting ice from polar regions, leaving a significant portion of humanity homeless. In the United States alone, some 53 percent of the population (about 133,000,000 people) live within a fifty mile strip along our coasts.[39]

Weather patterns could also change, possibly causing one-third of the American Midwest's cropland to whither.[40] We must act quickly in reducing the amount of greenhouse gases expelled into the atmosphere. Estimates by many world experts project that by the year 2020, world temperatures will be on average 1.3° C warmer. An increase of 2° C would push the Earth's average temperature to what it was 125,000 years ago.[41] We have no idea what the overall effects of such changes will bring. Reforestation, fuel efficiency, alternative sources of energy, and conservation, must all be understood for the parts they can play in helping to alleviate this potential problem.

The RBNs of Extinction

By the year 2000, a million species may be driven to extinction. Never in human history has the world been depleted of life at such a rate. Prior to mankind's emergence, the Earth experienced great numbers of extinctions, and always with extreme consequences. When the biosphere's equilibrium is upset, some life forms, sometimes very successful ones, lose heavily; the extinction of the dinosaur and the emergence of mammals is a prime example.

The most popular theory for the disappearance of the dinosaur is extraterrestrial. Most scientists now believe that the Earth was impacted by a large meteorite, which hurled enormous amounts of dust into the atmosphere diminishing sunlight and consequently reducing vegetation. The larger creatures died off and those smaller distant relatives of ours had the upper hand when the dust cleared.

The massive extinctions we are experiencing today have nothing to do with outer space. Mankind is burning down tropical rainforests to raise "cash" crops and cheap beef. Though only 6 percent of the planet is covered with tropical rainforests, at least 50 percent of all species reside there.[42] At current rates, we may eliminate some 15 percent (15 out of every 100) of the world's species between 1990 and 2020. Estimates are hard to come by, because the number of species on our planet is believed to be anywhere from three to thirty million.[43] Many will be gone before we are able to know of them. In the "genocide" that occurs, we may lose plant life capable of strengthening the genetic make-up of our basic food crops.

Common varieties of food, such as corn, wheat, or rice, are sometimes not hardy enough to fend off a disease that is killing it. Scientists rely on wild plants that have not been cultivated, in order to engineer a new strain to fend off the disease. Without sufficient biological diversity, disease and changes in soil or temperature can put an end to our cultivated foods. In recent years scientists have crossbred beans, corn, and tomatoes with wild varieties found in Mexico, Central America, and South America.[44] The importance of biodiversity cannot be overstated. Consider a quote from Vice President Gore:

> It is virtually impossible to calculate the value of maintaining the rich diversity of genetic resources on earth. And indeed, their value cannot be measured by money alone. But where food crops are concerned, we at least have some yardsticks with which to approximate the value of genes that are now endangered. The California Agricultural Lands Project (CALP) recently reported that the Department of Agriculture searched through all 6,500 known varieties of barley and finally located a single Ethiopian barley plant that now protects the entire $160 million California barley crop from yellow dwarf virus.[45]

It is not the $160 million dollars that should stand out here, California's Gross State Product (GSP) is over half a trillion dollars.[46] There is too much at stake to continue practices that imperil our food supply. Specifically, the destruction of our virgin forests both in the tropics and at home.

Many of the wonder drugs of tomorrow may be waiting within tropical rainforests. Curare and the rosy periwinkle are two such examples. The former is used as a muscle relaxant during anesthesia, the latter for treating Hodgkin's disease and childhood leukemia. Both substances originated in tropical rainforests. One-fourth of the prescription drugs used in the United States today are derived from rainforest products, yet only one percent (one out of every hundred) of the plant-life in the tropics has been studied for medicinal use.[47] Presently, humanity is converting rainforest into desert at the rate of over forty million acres a year—an area the size of the state of Washington, and the rate increases every year. This is a sad but important example of nonlinearity. The average loss of rainforest from 1976 through 1980 was about 22 million acres. However, from 1981 through 1990 the average loss was 40 million acres.[48] Using the average amount of rainforest destroyed for the period between 1976 and 1980 would give an expected rainforest loss of 220 million acres from 1981-1990 (22,000,000 acres/year × 10 years). The actual number is 400,000,000 acres (40,000,000 acres/year × 10 years).

Projections based on simple linear extrapolations can make the extinction of the rainforests a problem of the far distant future. Understanding the dynamics of nonlinearity—being literate enough to associate the mathematics with reality—can help gain popular support for ensuing problems well before their catastrophic unfolding.

Health Care, NASA, and the Military

Our health care system serves as another example of RBNs. The total spent in 1992 for all health care was projected to be $817 billion. Of this total, a Consumer Reports article of July 1992 states that at least $200 billion of this is waste.

> Of the $817-billion projected to be spent on health care this year, about one fifth—$163-billion—will go for administrative costs. Except for a fraction of a percent spent on research, the rest—roughly $650-billion—will go to actual patient care. Physician and hospital services together make up most of that total, with the rest going to dentists, nursing homes, drugs, and various other expenses.
>
> By our estimates, at least 20 percent of that $650-billion, or $130-billion, will be spent on procedures and services that are clearly unnecessary. … If overuse of medical services wastes $130-billion a year, administrative inefficiency adds about $70-billion.[49]

The article goes on to say that by changing our current method of health care, we could insure every person in the United States without any increase in cost. We also find out, not surprisingly, that hospital rooms and physicians salaries have far exceeded the Consumer Price Index. (The CPI measures the cost of basic commodities.) As a matter of fact, health care now represents a larger percentage of our GNP than what is spent on our military and public education combined.[50] You would think for all this money we would rate better than twentieth in infant mortality among the industrial nations of the world.[51]

RBNs can be misleading at times. For example, complaints often emerge by government representatives and numerous private citizens to cut government programs that do not appear to have a pressing purpose. One that is usually cited is NASA. The typical argument involves spending the money "down here on Earth" where it is needed rather than in outer space. Not only does this form of shortsightedness attack a worthy program, it displays an unfortunate level of ignorance about the relative level of funding for government programs.

NASA cost the American public about $15 billion in 1992. Yes, this is a lot of money—to have in your bank account, but not when it's evenly distributed in everyone's bank account! Considering that there are a quarter-billion people in the United States, and one-quarter goes into fifteen 60 times, this amounts to sixty dollars per person or two-hundred forty dollars a year for a family of four. A $15 billion investment in NASA more than pays for itself in space age medical breakthroughs and high technology innovations. Future industries and economic opportunities may be found in the spin-off technologies of the aerospace industry. The space program of the 1960s was, in many ways, a catalyst for the electronics revolution. Recall that the waste alone in our health care system may be at least $200 billion. That's over thirteen NASA programs ($200 billion/$15 billion =

13.33..). Or more properly, such waste could finance NASA at its present allotment (neglecting inflation) for the next thirteen years. Some fast arithmetic shows that a family of four pays $3200 ($240 × 13.33... = $3200) a year to finance the inefficiency in our health care system; now that's something to gripe about!

The public often complains about military spending. The Pentagon's budget for 1993 is $294 billion.[52] Assuming the figures in Consumer Reports are accurate, the amount of waste in our health care system could finance over 68 percent of our national defense ($200 billion/$294 billion × 100 = 68%).

A New Orleans Times-Picayune, February 3, 1993, headline read: "'Defensive' care costing patients billions each year." "Defensive care" is taken to mean those procedures (x-rays, CAT scans, etc.) that a doctor will order for a patient, even if he knows they are probably superfluous, to protect himself from a possible law suit. Since most of these expenses are covered by private insurance or federal programs (Medicare, Medicaid) doctors don't consider the costs involved. It's not like the "old days" when the doctor knew the money came out of his patient's pocket and would only recommend tests that he felt were absolutely necessary. Nor is it like the "old days" when it comes to the paranoia surrounding medical malpractice suits.

The article went on to explain that savings could reach as high as $76 billion over a five year period "if doctors and hospitals were freed of malpractice liability and there was a 'no-fault' system similar to workers' compensation." This works out to be $15.2 billion a year in savings ($76 billion/5 years = $15.2 billion/year)—about NASA's 1992 budget. The president of the Association of Trial Lawyers of America referred to the potential savings as "a drop in the health-care bucket that would be wiped out by cost increases in two months." Obviously, pricey malpractice cases are not a "drop in the bucket" when it comes to a lawyer's annual earnings.

When it comes to money on a governmental scale, perhaps Senator Everett Dirksen summed it up best when he said, "A billion here, a billion there and pretty soon you're talking about real money."

Whether we deal with health care, funding for NASA, or military spending, it is imperative to see the larger picture. Dollar amounts must be seen in perspective. Isolated figures, without proper comparisons, are elements of deception. Mathematics taken out of context is at best useless, and at worst, potentially fatal.

The National Debt

Our national debt increases by $13,000 each second.[53] In early 1993, the American people suffered from a national debt of over 4 trillion dollars ($4,000,000,000,000). A majority of this debt (80%) we owe to ourselves, the rest (20%) we owe to foreigners.[54] Don't think for a moment that since we owe a substantial portion of the debt to ourselves it is not too serious—unless, of course, you're willing to toss away your savings bonds, life insurance policies, private pension plans, or the interest on your bank accounts.

Our government has run deficits throughout its history. But it wasn't until the 1980s that we started to run deficits that are considered high for a peace-time economy. During the 1980s the United States increased defense spending while cutting taxes. "Trickle-down" economics was supposed to encourage corporations to invest and expand, thereby boosting the economy, which in turn would "trickle-down" to people like you and me in terms of goods and jobs. Regrettably, most corporations used their tax savings to engage in mergers and buy-outs, thus creating more debt than anything else. Additionally, wealthier individuals took advantage of lower personal income taxes, as well as a reduction in capital gains taxes, and speculated in the stock market. Such actions leave less money in circulation for real investments and give a false sense of worth to market holdings. And finally, increased government spending in concert with tax cuts, helped to create huge revenue short-falls, or more commonly, big deficits.

Projections for 1993 put the national debt at over 60 percent of our Gross National Product (GNP).[55] This means over 60 percent (more than sixty cents out of every dollar) of what we produce is obligated for debt. At the present rate of debt accumulation, our debt will equal the GNP within seven years.[56] The United States has not had a ratio of debt to GNP this high since World War II. However, the postwar trend (1946 to 1981) showed a strong, healthy decrease. (See Figure 7.10 in Chapter Seven page 143.) This ratio slowly started to pick up momentum and further accelerated during the 1980s. Unless something is quickly done, these numbers will escalate to values indicative of a state of national emergency.

In order to finance the deficit, each year the federal government must borrow money. Government does this by selling securities—saving bonds, Treasury notes, and Treasury bills. The government must offer competitive interest rates to attract would-be buyers. A buyer could be an individual who purchases a $25 savings bond or an investment house that buys millions of dollars worth of Treasury bills. With competitive interest rates and very low risk, both Americans and foreigners purchase these securities. (Those who wish higher interest rates must go into the private sector where greater rewards mean greater risks.) But the government sells only one thing—debt. Buying government securities helps the government pay down their present debt while creating future debt. But every dollar that goes into government securities is another dollar unable to be recycled into industry and business, where real money and higher standards of living are made.

What if every person in America took all their savings and bought United States Savings Bonds in an effort to pay down the present debt? Since all of the nation's savings was going to pay off debt, none would be left in commercial banks to give small business loans, home repair loans, mortgages, etc.. To a much lesser degree, this is what occurs when the government competes with private institutions for the public's money. Less money is available to the private sector, which means loans are harder to get and interest rates rise because the money supply is smaller. A chain reaction then occurs, wherein business becomes more expensive to conduct, which translates into cut

backs and layoffs. Since the economy is doing poorly, less taxes will be collected (and more people will become dependent on the state) which means the estimated deficit for that year will be even larger. The government is now straddled with less revenue, rising costs, and rising interest payments, and an escalating debt—and the cycle continues. The net effect of this process is to magnify the national debt—**which is the sum of all past deficits**. Paying off debt by creating new debt is not wise.

Consider the following example: Let's say a salesman does poorly for the year and needs to borrow $5000 to cover his expenses. He is charged 20 percent interest per year, which means a maximum pay back of $6000 if the loan is paid back within one year. (The $6000 is computed by first computing 20 percent of $5000 and then adding the principle of $5000. Note: 20 percent of $5000 is the same as one-fifth of $5000.) The salesman must therefore earn his normal salary, plus an additional $6000 during the next year. If he suffers another bad year he will be forced to borrow again. The **cumulative** money he will then owe (principal and interest) is analogous to the national debt. The money he needs to borrow at the end of the year to pay creditors is analogous to the deficit. If America, like the salesman, continues to live like this, the country will eventually be borrowing money just to pay off the accumulated interest.

The federal government had a $75 million debt in George Washington's time and now wrestles with a $4 trillion debt.[57] (An argument can be made that comparing dollar amounts over a two hundred year period is meaningless without a consideration of social and economic factors. Though this is absolutely correct, the intention here is only to emphasize a numerical change by a factor of over 53,000!) You can't really appreciate the increase in the debt unless you understand how millions and trillions are related. Do you know how many millions make a trillion? (Try to figure it out on your own. The question, however, is answered in the next chapter.)

The national debt should worry us, since each American has the burden of paying for it. Try this calculation: There are approximately

250,000,000 people in the United States today. If the national debt is four trillion dollars, how much does this equal for each man, woman, and child?

How much for a family of four? We will return to these questions in Chapter Five. Too often we carry the same incorrect mind-set into the real world that we had in school. Namely, "Don't bore me with the details, just give me the answer." We, as taxpayers, need to understand the dynamics and numbers involved in the economic follies of some politicians. When public officials tell us that deregulation will do so and so, we must demand a balance sheet showing how all those wonderful numbers are achieved. We needed to see the master plan for Reaganomics and President Clinton's economic reform package in black and white. When President Reagan asked in 1984: "Are you better off today than you were four years ago?", the proper response should have been, "Perhaps, but at what cost and where will we be ten, fifteen, or twenty years from now?"

In a front page New Orleans Times-Picayune article of February 10, 1993, titled "Clinton orders deep cuts in White House staff, pay" we find that these "cuts" will save $10 million. The 1993 deficit is projected to be $327 billion. How much of a savings are we talking about here? Proportionately speaking, it would mean that a person earning $25,000 a year could expect to save 76 cents (see Chapter Five, problem 5, page 82). If your family was on hard times, would you call a family meeting to tell them you had devised a plan to save 76 cents a year? Would it be front page news? Clearly, the president's effort to cut expenses, and hence reduce the deficit, is at best symbolic. Families on hard times need to create a mind-set that trims every corner possible. But the real solution lies in cutting large, inefficient expenditures and raising appropriate revenues. In other words, cutting the fat from many programs and increasing taxes (in one form or another). There is no other realistic way to make ends meet and pay off our debt.

My point is not to diminish the value of saving even a million dollars; it is to show the contrast between the amount of waste that is

accepted, versus meager cut backs and the lack of funding for vital programs that is astounding. (Head Start is a good example of a federal program that works, but has never been funded enough to provide for all children.)

There is nothing esoteric about computing budgets. Most of the mathematics would not go beyond seventh grade arithmetic and it could be explained in reasonable language, if the "master plan" was really understood by those espousing it. True, there is no way for the government to predict what next year's economic climate will be like; no more than a merchant can predict exactly how much he will earn. The government is also at a greater disadvantage, in that it must earmark money for programs sometimes years in advance. But there is no reason the possible risks and assumptions involved in such planning should not be presented to, and understood by, the public. This is where a cogent public education has its greatest currency. People would have a greater appreciation (and comfort range) of such matters, if there was practical meaning attached to mathematics training in school. Curricula needs to be based on the problems that students will be confronted with—not determining how many nickels and dimes Joe has in his pocket, or the fact that he will be twice his son's age in four years. If real problem solving skills were taught in school, the public would demand more than qualitative arguments and hand waving from those who set policy. Teaching with a meaningful context has a rich dividend for society. Real education helps to maintain a focus on real issues. This is the kind of training that should be carried into voting booths across America.

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In the past chapter we have briefly covered some of the more important issues facing us in the nineties and no doubt in the next century. Most of the writing has been qualitative so the reader could become familiar with these problems without being bogged down with mathematics. Chapter Five will begin the quantitative work, with references back to many of the topics already discussed.