MOURNFUL NUMBERS: QUANTITATIVE TOOLS FOR COMBATING THE OVERPOPULATION MYTH

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Tell me not, in mournful numbers,
Life is but an empty dream! —
For the soul is dead that slumbers,
And things are not what they may seem.

Henry Wadsworth Longfellow
A Psalm of Life

NURSERY RHYMES NOTWITHSTANDING, these are the only lines of verse I can recall my father reciting to me more than fifty years ago. Little did I realize then how pertinent they would be today, living here in the Culture of Death. Each day we are confronted by mournful numbers telling us that Life is but an empty dream. (After all, those who find it advantageous to promote this Culture have the wherewithal to provide the statistics that seem to support their position.) So many of us have succumbed to these mournful numbers that we, perhaps unwittingly, continue to propagate the agenda of those who wish to enjoy the benefits of the Culture here and now. It is my intent in this essay to provide some sound demographic data to dispel some foolish notions regarding overpopulation that have crept into the national dialogue as a result of these ubiquitous statistics. Truly, these things are not what they may seem.

As a chemistry professor I seldom employ these mournful statistics in my research or in my teaching of graduate or upper division courses. Instead, I encounter them when I am called upon to teach lower division chemistry courses to non-majors. These science appreciation courses for non-scientists appear as a part of the required curriculum at our institution and, I suspect, at most colleges and universities in the nation. They provide fertile ground for the promotion of these ideas to an unsuspecting audience.

The last time I taught this course I used the well-established text *Chemistry for Changing Times* by John W. Hill and Doris K. Kolb.[i] Its content is similar to that of other texts that are available for this course, but I prefer it because of its depth of coverage. Like all of the others that I have examined, *Chemistry for Changing Times* has the Culture's agenda concerning overpopulation. The tip-off appears in the first five pages of text as the cast of characters is introduced, in order of appearance: Aristotle, Francis Bacon, Rachel Carson, Thomas Malthus, and Robert Boyle. Thus students read Carson's *Silent Spring* and Malthus's "Essay upon the Principles of Population" before they learn of *The Sceptical Chymist,* Boyle's chemistry text published nearly two centuries before Malthus's essay.[ii]

Some three hundred pages later when the question "How Crowded is Our Spaceship?" is posed,[iii] the following response is given:

> Every day people die and other people are born, but the number born is about 250,000 more than the number that die. Every four days our world population goes up by a million people. In 1992 world population was 5.4 billion. It should reach 6.4 billion by the year 2000. A billion more people in just 8 years!
> ... At the present rate of growth, world population should be 10 billion by 2025, and one century from now it could reach 40 billion!

A plot showing the world population as a function of time is then displayed; Figure 1 is adapted from this graph. To their credit, the authors do point out that advances in the chemical sciences (pharmaceuticals, petrochemicals, agriculture and medicine) are responsible for the increase in population growth observed during the nineteenth and twentieth centuries. They conclude, however, with this admonition:

> ... One thing is sure. That curve cannot keep rising indefinitely. It must bend sooner or later. If we don't make that happen by curbing our uncontrolled birth rate, then nature will take care of the problem by

increasing our death rate. Let's hope it doesn't come to that. Nature's methods are not always kind.

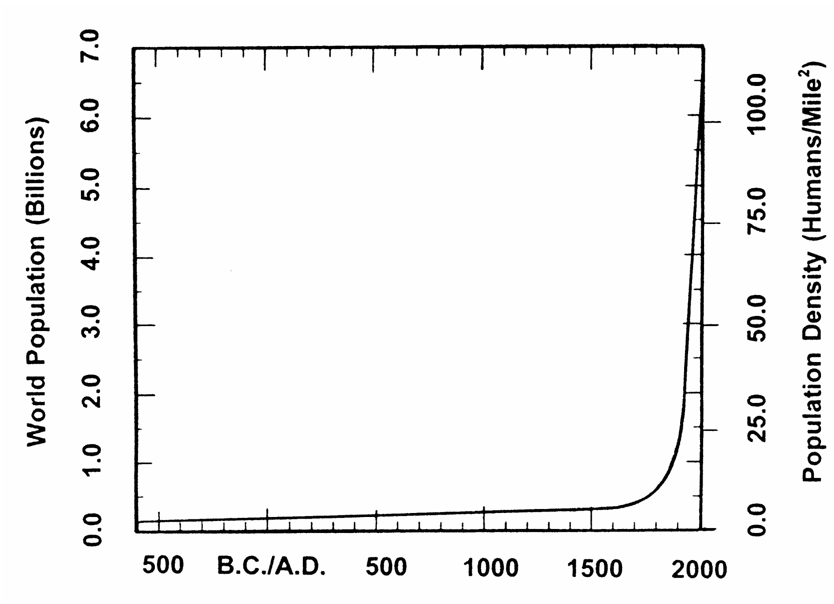

Figure 1. World Population Data as a Function of Time. Total population (left ordinate) is adapted from *Chemistry for Changing Times*.[3] Population density data (right ordinate) was computed using data taken from the *1997 Almanac*.[5]

Malthus is revisited in a subsequent chapter on agricultural chemistry. The following text[iv] (apearing in a section entitled "Some Malthusian Mathematics") is accompanied by a graph that shows geometric growth as looking remarkably like Figure 1 over the last two centuries:

In 1830, Thomas Malthus, an English clergyman and political economist, made the statement that population increases faster than the food supply.

Unless the birthrate was controlled, he said, poverty and war would have to serve as restrictions on the increase.

Malthus's predictions were based on simple mathematics. Population, he said, grows geometrically, while the food supply increases arithmetically....

Growth Period	0	1	2	3	4	5	6	7
Arithmetic	1	2	3	4	5	6	7	8
Geometric	1	2	4	8	16	32	64	128

...Note that arithmetic growth is slow and steady; geometric growth starts slowly and then shoots up like a rocket.

Clearly, readers come away from this exercise with the understanding that the Malthusian skyrocket has already taken off. It is little wonder that they are so ready to accept the inevitability of chemical abortifacients and chemical contraceptives that is presented later in the text.

It is at this point that I remind my students that some of the skepticism that Robert Boyle directed towards the alchemists of his time might well be directed towards those of ours. How much do you have to go over in order to have overpopulation? Six billion human beings seems like a lot, but six billion atoms are barely ten femtomoles, and with ordinary instrumentation, it's quite difficult even to detect ten femtomoles of atoms. Are ten femtomoles of humans enough to overcrowd our planet? That all depends upon how large this spaceship is.

Here is the relevant spaceship data taken from the *1997 Information Please Almanac.*[v] (It won't change much no matter when you read this.) The land area of the surface of the earth is 57.50 x 10^6 mile^2. The water area is 139.43 x 10^6 miles^2, almost three times as much. The sum of these two areas gives the total surface area of 196.93 x 10^6 mile^2. The *1997 Almanac* also gives the world population as 5.790 x 10^9 humans. (This will change from year to year.) From this and the total land area one can compute the 1997 world population density as (5.790 x 10^9 humans) / (57.50 x 10^6 mile^2) = 100.7 humans/mile^2. Thus, while there are nearly six billion of us living on this planet, only one hundred of us, on the average, occupy each square mile of land.

Consider what this means. Figure 2 shows a cartoon depicting 100 human beings occupying one square mile of land area. Since 1 mile = 1,760 yd, each cartoon character is 176 yd from the nearest neighbor (who may be a relative). Each occupies a lot that is 176 yd x 176 yd; that's 30,976 yard^2/person. Since there are 4,840 yd^2 in 1.0 acre, a population density of 100 humans/mile^2 implies that there are 6.4 acre of land for every man, woman, and child living on this planet.

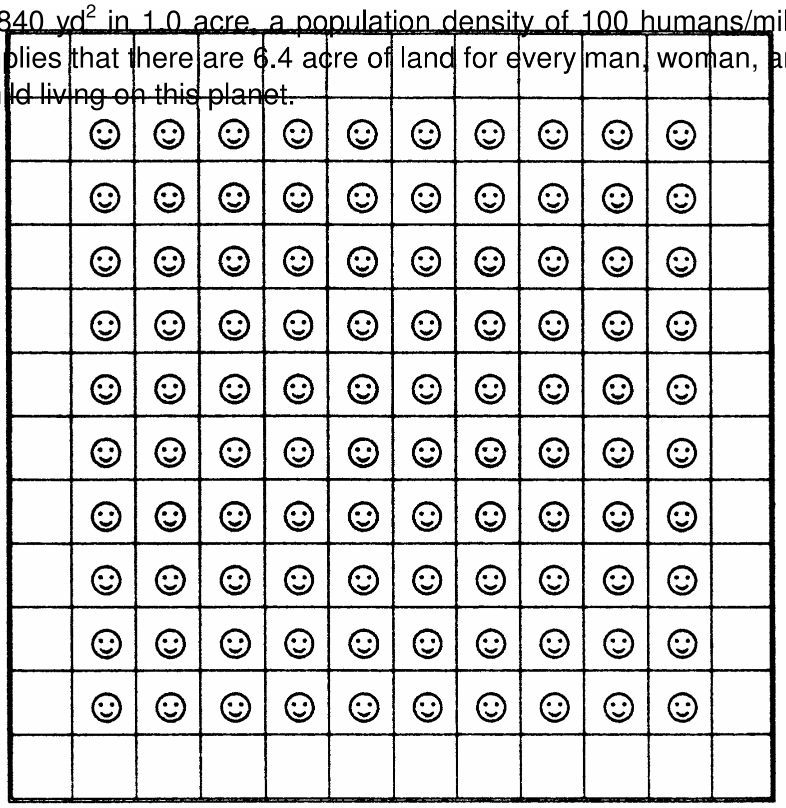

Figure 2. Cartoon Representation of a Population Density of 100 humans/mile^2. Each character occupies a plot that is 176 yd x 176 yd or 6.4 acre/person; *ca.* two such characters would inhabit the land area

that is occupied by Giants Stadium in Rutherford, New Jersey.

It is possibly more relevant to view this from a football perspective. The playing surface of a football field is 120 yd x 160 ft; that's 6,400 yd^2. A scale drawing[vi] of the field and the seating area of Giants Stadium in Rutherford, New Jersey appears in Figure 3. The footprint of the entire stadium (excluding external entrance ramps) occupies less than nine football fields; that is, the footprint of Giant Stadium occupies less than 57,600 yd^2. At the current global population density of 100 humans per $mile^2$, only two people could inhabit Giant Stadium if they were allotted this piece of real estate as their fair share of our planet.

What happens in this model when the population increases? Obviously, the area available to each person decreases. Note, however, that there is *not* a simple inverse relationship between population and the inter-personal distance. Should the population increase by a factor of four, the cartoon characters occupying the 1 $mile^2$ area in Figure 2 would have to be arranged in a 20 x 20 array. At this point, the interpersonal distance would be 88 yards, exactly half of the interpersonal distance illustrated in Figure 2. Thus, multiplying the population by four causes the interpersonal distance within the population to be divided by two. Here, the Malthusian concept of geometric growth works to the advantage of the denser population.

All of the above examples employ a two dimensional area in the computation of the population density. As implied by the Giant Stadium example, however, it is possible to build three dimensional structures that allow for much higher occupancies. Should the world population increase by a factor of ten over the next 100 years, this three dimensional structure the size of Giant Stadium would then be occupied by less than twenty inhabitants.

These two examples have been presented merely to illustrate the concept of population density and to point out the vast land area of our planet. Of course, they do not account for local terrain, climate, or infrastructure. For a more realistic assessment of the concept, though, consider the actual population densities of some of the representative states and nations of the world shown in Table I. This Table gives the actual population density as reported in the

1997 Almanac for each of these states and shows the nearest neighbor distance and Giant Stadium occupancy as computed using the two methods discussed previously.

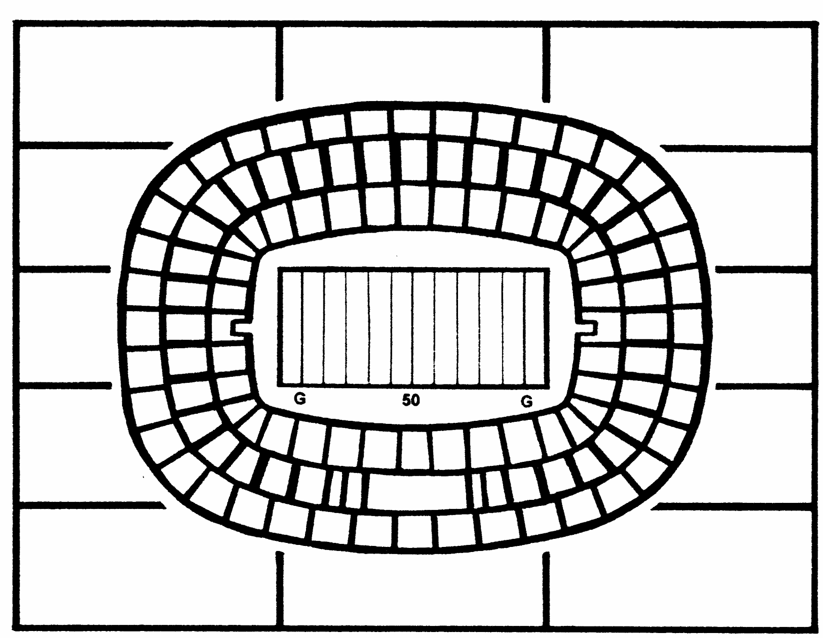

Figure 3. A Scale Drawing of the Footprint of Giants Stadium. The playing area of a regulation football field is 6,400 yd^2. The footprint of the entire stadium (excluding egress ramps) occupies less than nine field areas. At the current world population density, two persons would occupy Giants Stadium.

While the trends in Table I are somewhat informative, these data are most useful because they provide a convenient listing of locations where one can experience what it is like to live at a given population density. For example, the tour through time that is illustrated in Figure 1 might be taken today by beginning in Alaska, and proceeding through Wyoming, Nevada, Nebraska, Arizona, Maine, Iowa, Texas, and West Virginia until reaching Louisiana, the state whose 1990 population density (as reported in the *1997 Almanac)* is approximately equal to the current world population density. On the other hand, if one wants to see how things might be twenty-five years from now when the world population doubles, the tour could be extended to Illinois. To forecast conditions fifty years from now one could go to New York in order to experience that population density. And to see more than a century into the future, when the world population density is ten times what it is now, one could visit New Jersey, the home of this writer.

You see, here in the Garden State we are already more than a century ahead of the rest of the world. Our most recent population density is 1,035 humans/mile^2; that is just over ten times the current world population density and well in excess of the world population density corresponding to a global population of 40 billion that was of such concern to the authors of *Chemistry for Changing Times.* (You only have to go to Massachusetts to experience that population density.) To be sure, we have our problems here in New Jersey. We have Giants Stadium, and on some days there are a lot more occupants than the 20 person average. We have two toll roads and we pay a lot of taxes. We're not rioting over food, but it must be admitted that there are more fools per inch^2 in New Jersey than there are in any other state. Other than that, we're getting along just fine, thank you. If you want to see for yourself, come on by; there's plenty of room for visitors.

Table I. Population Density Data for Some Representative States of the World[vii]

Country or State	Population Density (humans per mile^2)	Nearest Neighbor Distance (yards)	Number of Occupants of Giants Stadium (humans)
Vatican City	4883	25	90.80
New Jersey	1035	55	19.25
Rhode Island	951	57	17.68
Japan	861	60	16.01
India	774	63	14.39
Massachusetts	769	63	14.30
New York	380	90	7.06
China	328	97	6.10
Illinois	205	123	3.81
Georgia	110	168	2.04
World	101	175	1.90
Example	*100*	*176*	1.86
Louisiana	95	181	1.77
United States	75	203	1.39
West Virginia	74	205	1.38
Texas	65	218	1.21
Iowa	50	249	0.93
Maine	40	278	0.74
Arizona	32	310	0.60
Nebraska	21	388	0.38
Nevada	11	531	0.20
Australia	6	718	0.11
Wyoming	5	787	0.09
Alaska	1	1760	0.02

The data in Table I also allows one to compare the population density of some of the nations of the world with those of more familiar states in the United States. Thus, the population density of China is slightly less than that of New York. The population density of India is not unlike that of Massachusetts, while the population density of Rhode Island exceeds that of Japan. All of the countries reported in Table I except Vatican City have a lower population density than New Jersey, our most densely populated state. We do not impose population control measures on the citizens of our country. How, then, could someone try to justify population control measures on the citizens of other nations on the basis that they are overpopulated?

In this regard, it is useful to identify those countries that exhibit a greater population density than the state of New Jersey. Only 18 of the 224 countries appearing in the *1997 Almanac* have a population density higher than that of New Jersey. These are listed in Table II along with their population densities and their actual populations. There is a grand total of 203 x 10^6 humans living in these 18 countries. These 203 x 10^6 human beings comprise roughly 3.5% of the total world population of 5,790 x 10^6 humans. Therefore, more than 96% of the current world population lives with less overpopulation than the people of the state of New Jersey. Surely, there is no way to justify global population control measures on the basis of overpopulation.

A clear understanding of the meaning of population density, combined with a cognizance of the actual demographic data can go a long way toward dispelling the concerns regarding overpopulation that are presented in the literature of the Culture. For example, by merely changing the scale of the ordinate of Figure 1 to include the population density of New Jersey one can easily show that the old the Malthusian skyrocket is more fizzle than fire. Those who buy into the overpopulation myth should note this well: you are being offered solutions for which there is no problem.

Table II. World Countries Having Population Density Exceeding That of New Jersey[viii]

Country	Population Density (humans/mile^2)	Population (millions)
Bahrain	2,459	0.6
Bangladesh	2,213	123.1
Barbados	1,548	0.3
Bermuda	3,105	0.06
Gibraltar	14,252	0.03
Guadeloupe	1,247	0.4
South Korea	1,195	45.5
Maldives	2,354	0.3
Malta	3,051	0.4
Mauritius	1,447	1.1
Monaco	43,450	0.03
Nauru	1,252	0.01
Macao	82,806	0.5
San Marino	1,039	0.02
Singapore	13,769	3.4
Taiwan	1,533	21.3
Hong Kong	15,158	6.3
Vatican City	4,883	0.0008
Total	----	203.4

NOTES

i. John W. Hill and Doris K. Kolb, *Chemistry for Changing Times*, 7th edition (Englewood Cliffs: Prentice Hall, 1995).

ii. *Ibid*., pp. 1-5.

iii. *Ibid*., pp. 333-34.

iv. *Ibid*., p. 549.

v. *Information Please Almanac* (Boston: Houghton Mifflin, 1997), p. 129.

vi. The maximum width and length of the outside stadium walls are 610 feet and 780 feet, respectively. This information was obtained in a personal communication with Fred Clements at the Meadowlands Sports Authority.

vii. *Almanac*, pp. 143-297 and p. 831.

viii. *Ibid.*, pp. 143-297.