

# Annotated Bibliography of Exponential Articles

Albert A. Bartlett

This chapter is a list of almost all of the articles written by Professor Bartlett that use the exponential model as a way of understanding various aspects of modern society from the construction of highways to the growth of population.

The entries are listed approximately in chronological order from 1969 to the present.

Some of the entries are accompanied by comments written by Professor Bartlett.

Some of these papers have been written with co-authors. The institutional affiliations of co-authors are listed only when co-authors are not with the University of Colorado, Boulder. The authors are listed only in cases of multiple authorship. Otherwise the articles were written solely by Professor Bartlett.

## 1) THE HIGHWAY EXPLOSION

*Civil Engineering*, December 1969, Pgs. 71-72 (Amer. Soc. of Civil Eng.)

A revised version of this paper appeared in

*Environment*, Vol. 15, April 1973, Pgs. 43-44

This paper shows that the differential equation for the number of miles of highway in the country is exactly the differential equation that predicts steady (exponential) growth of the miles of highway in the country.

## 2) THE EXPONENTIAL FUNCTION, PART I

*The Physics Teacher*, Vol. 14, October 1976, Pgs. 393-401

This is the first of a series of numbered articles on the behavior of the exponential function as it is used to describe steady growth of populations, of numbers of things, of bank accounts with compound interest, etc.

## 3) THE FORGOTTEN FUNDAMENTALS OF THE ENERGY CRISIS

*Proceedings of the Third Annual University of Missouri - Rolla*

*Missouri Energy Commission Conference on Energy*,

October 12-14, 1976, Pgs. 10-19

At this point I had been giving my lecture on the exponential arithmetic of steady growth for seven years. These lectures were focusing on the surprisingly short life expectancy of non-renewable resources if rates of consumption of these resources continued to grow. My series of articles on "The Exponential Function" had not yet gotten through very many topics, and I did not know how soon the series would get to the questions of the life-expectancy of resources. So, to get these life-expectancy concepts out into the educational community, I put this paper together and gave it at the Conference in Rolla, Missouri. I later enlarged it into Paper No. 12, below.

## 4) THE EXPONENTIAL FUNCTION, PART II

*The Physics Teacher*, Vol. 14, November 1976, Pg. 485

- 5) THE EXPONENTIAL FUNCTION, PART III  
*The Physics Teacher*, Vol. 15, January 1977, Pgs. 37-40
- 6) THE EXPONENTIAL FUNCTION, PART IV  
*The Physics Teacher*, Vol. 15, March 1977, Pg. 98
- 7) THE EXPONENTIAL FUNCTION, PART V  
*The Physics Teacher*, Vol. 15, April 1977, Pgs. 225-226
- 8) EXPONENTIAL GROWTH  
An Invited Essay in the text  
*Physics*, by David Halliday & Robert Resnick, Third Edition, 1978  
(John Wiley & Sons, New York City)
- 9) THE EXPONENTIAL FUNCTION, PART VI  
*The Physics Teacher*, Vol. 16, January 1978, Pgs. 23-24
- 10) THE EXPONENTIAL FUNCTION, PART VII  
*The Physics Teacher*, Vol. 16, February 1978, Pgs. 92-93
- 11) THE EXPONENTIAL FUNCTION, PART VIII  
*The Physics Teacher*, Vol. 16, March 1978, Pgs. 158-159
- 12) THE FORGOTTEN FUNDAMENTALS OF THE ENERGY CRISIS  
*American Journal of Physics*, Vol. 46, September 1978, Pgs. 876-888  
This is an expansion of paper No. 3, above. It explores topics such as populations and growth in the rates of consumption of resources and the large numbers that steady growth can produce in a short period of time. The paper explores the shortening of the life expectancy of non-renewable resources when the rate of consumption of the resource is growing steadily. It then displays some of the meaningless and even absurd statements that are made about the lifetimes of resources by both experts and non-experts.  
This paper was included in a list of  
“Memorable papers from the *American Journal of Physics*, 1933-1990”  
It is one of ten “memorable papers” listed for the year 1978.  
See R.H. Romer,  
*American Journal of Physics*, Vol. 59, March 1991, Pg. 205.  
Reprinted in the  
*Physics Teachers’ CD-ROM Toolkit*, University of Nebraska, 1993
- 13) THE EXPONENTIAL FUNCTION, PART IX  
*The Physics Teacher*, Vol. 17, January 1979, Pgs. 23-24
- 14) LARGE CONSEQUENCES OF SMALL EVENTS  
*The Physics Teacher*, Vol. 18, April 1980, Pgs. 300-302

## 15) CORRECTIONS TO ESTIMATES OF FOSSIL FUEL LIFETIMES

*Journal of Chemical Education*, Vol. 58, June 1981, Pgs. 501-502

This short piece is the culmination of a two-year effort to correct serious quantitative errors that appeared in an article that was written by the staff of the *Journal of Chemical Education*, (Vol. 55, April 1978, Pg. 263). For many months the editor of the *Journal* refused to print my correction as a refereed article, insisting that it be only an un-refereed letter-to-the-editor. I insisted that I wanted my correction to be refereed, because I did not want to have it published if a referee thought that my correction was wrong. The Editor would not have my correction refereed, and instead, he printed a "Correction" of his own, (*Journal of Chemical Education*, Vol. 56, March 1979, Pg. 188). This "Correction" introduced new and serious quantitative errors. It contained an estimate of the reserves of coal in the U.S. that was high by a factor of 1000, and it was referenced to a government report. I searched the referenced report and could not find his figure anywhere in the report. I then revised my correction to correct the initial errors and the errors in the Editor's "correction." This correction of mine was published only after a new person was named to be editor of the *Journal of Chemical Education*.

## 16) ENERGY WASTE IN A UNIVERSITY BUILDING

Neil J. Numark and A.A. Bartlett

*American Journal of Physics*, Vol. 50, April 1982, Pgs. 329-331

This was a report on the waste of the rejected energy from the compressors that freeze the ice in the ice rink in the Student Recreation Building on the University of Colorado campus. Instead of using all the waste heat from the compressors, the heat was thrown away in a cooling tower.

In 2003, Neil Numark operates his own energy consulting firm in Washington, D.C.

## 17) EXPONENTIAL GROWTH

This is an invited essay in the introductory physics text

*Physics*, by Paul Tipler, (Worth Publishers, New York City, 1982)

Second Edition, 1982. Third Edition, 1991, Pg. 586

## 18) EXPONENTIAL GROWTH

An Invited Essay in the Text, *College Physics*

By R.W. Serway and J.H. Faughn

(Saunders College Publ. Co, Philadelphia), 1985, Pgs. 762-764

## 19) EXPONENTIAL GROWTH

An Invited Essay in the Text, *Physics for Scientists and Engineers*

By R.W. Serway

(Saunders College Publ. Co.), Philadelphia, 1986, Pgs. 628-631)

20) SUSTAINED AVAILABILITY: A MANAGEMENT PROGRAM FOR  
NON-RENEWABLE RESOURCES

*American Journal of Physics*, Vol. 54, May 1986, Pgs. 398-402

This article shows how it is possible mathematically, to make the reserves of a non-renewable resource last forever by having the rate of consumption of the resource decline at a steady rate.

21) FORGOTTEN FUNDAMENTALS OF THE ENERGY CRISIS:  
A CANADIAN PERSPECTIVE

This is item No. 12 considerably adapted to data on resources in Canada. It was published in May 1986 by the Industrial Energy Division of the Ministry of Energy, Mines, and Resources of the Federal Government of Canada, Ottawa, Canada.

A videotape of the lecture by this title was made and distributed throughout Canada by the Ministry of Energy, Mines and Resources in Ottawa, Canada, June 1986

22) THE ARITHMETIC OF STEADY GROWTH

*Washington Mathematics*, Vol. 32, No.1, Fall 1987, Pgs. 9-11  
(Washington State Mathematics Council)

23) FUSION AND THE FUTURE

*Physics & Society*, Vol. 18, No. 3, October 1988, Pg. 11

This article points out the difficulties that have been experienced in trying to achieve power from nuclear fusion, and it predicts that children born in 1988 will not live to see 5% of the U.S. energy needs met by terrestrial nuclear fusion.

Reprinted in the

*Newsletter of the Teachers' Clearinghouse for Science & Society Education*, Vol. 8, Fall 1989, Pg. 28

The article was quoted extensively by Richard D. Lamm (former Governor of Colorado) in "The Great Heretic", a festschrift for the famous biologist, Garrett Hardin, held in August 1990.

*Population & Environment*, Vol. 12, No. 3, Spring 1991, Pgs. 218-219

See Letter to the Editor, *Physics & Society*, Vol.19, No. 2, April 1980

24) FORGOTTEN FUNDAMENTALS OF STEADY GROWTH

This is a chapter (No.14) in

*Rethinking the Curriculum: Toward an Integrated Interdisciplinary College Education*,  
by Mary E. Clark and S.A. Wawrtki, Greenwood Press, New York, 1990, Pgs. 181-193

This was discussed at length in

*Nick Nacks*, Vol. 32, No. 2, by Alan C. Nixon,  
American Chemical Society, March / April 1993.

25) THE EXPONENTIAL FUNCTION, PART X

*The Physics Teacher*, Vol. 28, November 1990, Pgs. 540-541

26) THE ARITHMETIC OF GROWTH: METHODS OF CALCULATION

*Population & Environment*, Vol. 14, March 1993, Pgs. 359-387

This article is a tutorial for non-mathematical social scientists on the mathematics of steady growth and on the methods for calculating average rates of growth from data, etc. See also Part II of this article in 1999 (below).

27) PHYSICS FROM THE NEWS: CURVE FITTING

*The Physics Teacher*, Vol. 32, May 1994, Pgs. 278-281

This article deals with the damage done to highways by vehicles, as a function of the mass of the vehicle.

See the note by Tom Rossing in the *Newsletter of the Forum on Education*, of the American Physical Society, Fall, 1994, Pg. 10

## 28) EXPERT PREDICTIONS OF THE LIFETIMES OF NON-RENEWABLE RESOURCES

*The Mathematical Gazette*, Vol. 78, No. 482, July 1994, Pgs. 127-129

(Published by the Mathematical Association of Great Britain)

## 29) REFLECTIONS ON SUSTAINABILITY, POPULATION GROWTH AND THE ENVIRONMENT

*Population & Environment*, Vol. 16, No. 1, September 1994, Pgs. 5-35.

This paper discusses the meaning of “sustainability” in terms of population growth and the use of resources. It features the “Laws of Sustainability.” These laws are willfully ignored by most of the people who talk and write so much about “sustainability.” See discussion of this paper in the

*Newsletter of the Teachers’ Clearinghouse for Science & Society Education*, Vol. 14, No. 3, Fall 1995, Pg. 7

See discussion of this paper in “Global Ecology in Human Perspective” by C. H. Southwick, Oxford University Press, 1996, Pg. 331

See the discussion in chapter 25 of this book, Pgs 328-344, Pg. 343.

Citations on Pgs. 214, 301, 439, 443-4, 447, 467, 470, 472, 480-81, 490

See paper No. 36. below.

Reprinted in *Focus*, by Carrying Capacity Network, Washington, D.C. around 1996

## 30) ZERO GROWTH OF THE POPULATION OF THE UNITED STATES

A.A. Bartlett, Edward P. Lytwak

(Carrying Capacity Network, Washington, D.C.)

*Population & Environment*, Vol. 16, No. 5, May 1995, Pgs. 415-428

This paper examines the question of why we, in the United States, don’t have zero population growth even though the fertility rate is approximately 2.1 children per woman in the woman’s lifetime. There are two parts to the answer. The first is immigration. The second is population momentum. A computer model of a population was made in order to understand population momentum, and it was found that if you make a change in the fertility rate at some particular time, the population will not be completely on the new growth curve determined by the new fertility rate until every person has died who was living when the fertility change was made! This means that today’s fertility rate will be having an effect for about 70 years.

This fact is reported in *Scientific American* March 1997, Pg. 26 in a short article by Rodger Doyle. Doyle does not give the source of his information.

I have not seen this specific point made before in any of the literature on population momentum.

A shortened version of this paper was published in the *Newsletter of the Biocentric Institute* of Arlie, Virginia, October 1, 1995

This was reprinted in “The Biocentric Imperative” by Editor, William Dickinson, Social Contract Press, Petoskey, Michigan, 1999. This reprint contains a serious typographical error.

A shortened version of this paper was published in  
*The Social Contract*, Fall 1995, Pgs. 62-63 with the title  
 POPULATION STABILITY AND IMMIGRATION,  
 Issued as a “White Paper” by the League of Women Voters Population Coalition , Claremont,  
 California.

A response to this paper was published:

A RESPONSE TO BARTLETT AND LYTWAK (1995)

Gretchen C. Daily, Anne H. Ehrlich, and Paul R. Ehrlich

*Population & Environment*, Vol. 16, July 1995, Pgs. 521-526

The response was reprinted in

*Focus* (Carrying Capacity Network), Vol. 6, No. 1, 1996, Pgs. 64-69

### 31) REJOINDER TO DAILY, EHRLICH, AND EHRLICH: IMMIGRATION AND POPULATION POLICY IN THE UNITED STATES

Edward P. Lytwak (Carrying Capacity Network, Washington, D.C.), and A.A. Bartlett

*Population & Environment*, Vol. 16, July 1995, Pgs. 527-537

This rejoinder was reprinted in *Focus* (Carrying Capacity Network), Vol. 6, No. 1, 1996, Pgs. 64-69

### 32) NATURAL GAS AND TRANSPORTATION

A.A. Bartlett, Robert A. Ristinen

*Physics & Society*, Vol. 24, No. 4, October 1995, Pgs. 9-10

This article deals with the optimistic predictions for the conversion of motor vehicles from burning gasoline to burning natural gas. An article had said that the reserves of natural gas were so large that they could supply all this extra demand for decades. An examination of the figures from the U.S. Department of Energy for the known and expected reserves of natural gas shows that this optimism is not warranted.

### 33) MYTHOLOGY OF POPULATION GROWTH AND THE ECONOMY

An Interview with Albert A. Bartlett by Nancy Pearlman

*Focus* (Carrying Capacity Network), Vol. 6, No. 1, Pgs. 70-75, 1996

This article is mainly a transcript of a television interview that dealt with the fact that population growth in our communities does not pay for itself, so that municipal annual per-capita taxes must rise as population growth continues.

### 34) THE EXPONENTIAL FUNCTION, XI: THE NEW FLAT EARTH SOCIETY

*The Physics Teacher*, Vol. 34, No. 6, September 1996, Pgs. 342-343

This is a quantitative rebuttal to the claim by the economist Julian Simon that we (the human race) has sufficient knowledge and resources to continue to grow for seven million years! (His original article said “seven billion years.”) Such a claim is inconsistent with a spherical earth and it implies that the earth must be flat, and hence infinite in horizontal and vertical extent.

This article was reprinted in *Focus*, Vol. 7, No. 1, 1997, Pgs. 34-36

Published by the Carrying Capacity Network, Washington, D.C.

April 2, 1997, approved a request by Anne and Paul Ehrlich to reprint this article in their journal, *Ecofables / Ecoscience*. This paper was discussed in a letter to the *Washington Post* under the heading, “Protecting the Planet” by Leon Kolankiewicz.

March 2, 1998 This paper was discussed by Garrett Hardin in “The Ostrich Factor”, Oxford University Press, New York, 1999, Pg.35, Pg.158 The paper was abstracted in the *Optimum Population Trust Newsletter*, January 1999. 12 Meadowgate, Ormston, Manchester, UK



## 35) POPULATION GROWTH: OBSTACLE TO MEETING KYOTO TARGET

*Population & Environment*, Vol.20, #4, March 1997, Pgs.387-388

## CITATIONS OF MY PAPERS IN A GEOLOGY REFERENCE WORK

“GeoDestinies: The Inevitable Control of Earth Resources Over Nations and Individuals,” by Walter Youngquist, National Book Co. Portland Oregon, 1997

In the Acknowledgments Youngquist writes: “The expertise and observations of Dr. Albert Bartlett, retired physicist, University of Colorado, and Dr. Garrett Hardin, retired human ecologist, University of California, Santa Barbara, on the relation of population to natural resources, through conversation, correspondence, and publications have been both factually helpful and very stimulating.”

My copy is inscribed by Dr. Youngquist as follows: To Prof. Albert Bartlett - a most thoughtful and stimulating associate with whom to view the 21st century. With warmest regards, Walter Youngquist.

Citations on Pgs. 214, 301, 439, 443-4, 447, 467, 470, 472, 480-1, 491

## 36) IS THERE A POPULATION PROBLEM ?

*Wild Earth*, Vol. 7, No. 3, Fall 1997, Pgs. 88-90

This article makes the point that, because of our high *per capita* consumption of resources, the world’s worst population problem is here in the United States.

## 37) REFLECTIONS ON SUSTAINABILITY, POPULATION GROWTH, AND THE ENVIRONMENT - REVISITED

*Renewable Resources Journal*, Vol. 15, No. 4, Winter 1997-1998, Pgs. 6-23

At the request of Robert D. Day, the Executive Director of the Renewable Natural Resources Foundation, 5430 Grosvenor Lane, Bethesda, Maryland 20814-6148, I made minor revisions in publication No. 29 (above) and the article was published in the *Renewable Resources Journal*. The following is the complete text of the letter from Robert D. Day, which accompanied six complimentary copies of the *Journal*. “Enclosed are six copies of our winter issue which include your article, “Reflections on Sustainability, Population Growth, and the Environment - Revisited.” We think so much of your article that we decided to publish a one-article issue of our journal. Unprecedented. Approximately 2,000 copies of the journal will be distributed, including those provided to each member of the U.S. Congress. We are also making your contribution required reading for delegates to our upcoming national meeting on population growth. You should be there; we will be getting back to you with details. It was a pleasure working with you. If you have any questions please do not hesitate to contact me.”

In addition, see “An Epic Struggle: Sustainability and the Emergence of a New Social Contract,” by John Cairns, Jr., Distinguished Professor of Biology at the Virginia Polytechnic Institute and State University. *The Social Contract*, Vol.9, #4, Summer 1999, Pgs.211-218. “Bartlett (1997-98) is arguably the most outspoken critic of the loose, imprecise use of the term ‘sustainability’.” In this article, Cairns quotes extensively from several of my papers.

This paper was posted on the CCN website <http://CarryingCapacity.org/bartlett.htm> with the following exaggerated statement, “Some people consider [this] to be the best population paper ever written... especially ‘The Laws’ appearing toward the end [of the paper].”

The paper was reprinted in *Focus*, Vol.9, #1, 1999, Pgs.49-68. Published by Carrying Capacity Network, 2000 P Street NW, Washington, D.C. 20036-5915. See comments in the *Renewable Resources Journal*, Vol.16, #1, spring 1998, Pgs. 6-7 with replies on Pgs.7 & 24. This article is the subject of editorial comment by Dean Gjerstad and David South in the *Journal of Forestry*, (Society of American Foresters), March 1999, Pg.48

## 38) ENVIRONMENTAL ANALYSIS AND SUSTAINABILITY

*Newsletter of the Teachers' Clearinghouse for Science and Society Education*, Vol.17, #1, Winter 1998, Pg.1.

This is based on a paper I gave at the Denver meeting of the American Association of Physics Teachers, August 16, 1997.

39) INTRODUCTION TO 20<sup>TH</sup> ANNIVERSARY REPRINT

This is a four-page introduction to a reprint of my 1978 article, "Forgotten Fundamentals of the Energy Crisis," (No. 41, above). The reprint and the added introduction were published in 1998 by Negative Population Growth of Washington, D.C. in their Academic Series of reprints.

## 40) MALTHUS MARGINALIZED: THE MASSIVE MOVEMENT TO MARGINALIZE THE MAN'S MESSAGE

*The Social Contract*, Vol.8, #3, Spring 1998, Pgs.239-251

This is one of fifteen invited articles in an issue of *The Social Contract* celebrating the 200<sup>th</sup> Anniversary of the publication of the famous essay by Robert Thomas Malthus in 1798. The title as originally submitted was, "The Massive Movement to Marginalize the Modern Malthusian Message."

## 41) REGIONWIDE PLANNING WILL MAKE THE PROBLEMS WORSE

*Population & Environment*, Vol.20, #1, September 1998, Pgs.77-81

This paper demonstrates that urban planning is designed to accommodate population growth and so, by encouraging population growth, planning makes all of the problems worse. Reprinted in *The Social Contract*, Vol.9, #4, Summer 1999, Pgs.224-227

## 42) FASTER THAN EXPONENTIAL

Albert A. Bartlett & Haym Kruglak (Western Michigan University)

*The Physics Teacher*, Vol.36, October 1998, Pgs.422-423

## 43) ARITHMETIC OF GROWTH: METHODS AND CALCULATIONS, II

*Population & Environment*, Vol.20, #3, January 1999, Pgs.215-246

This is the second part of a paper (Part I was in 1993) on the methods of calculating rates of growth from data and relating variables such as fertility, generation time, and growth rates.



## 44) AN ANALYSIS OF U.S. AND WORLD OIL PRODUCTION USING HUBBERT CURVES.

*Mathematical Geology*, Vol.32, #1, Pgs.1-17, January 2000 (International Association for Mathematical Geology)

This article reports on a least-squares fitting of a Gaussian Error Curve to the data on U.S. and world oil production. The U.S. fit suggests that we have consumed about three-quarters of the oil that was ever in our ground. The world fit, based on an assumed total world petroleum resource of 2000 billion barrels, has a peak in 2004, and the peak moves to a later date by about 5.5 days for every billion barrels added to the estimate of the world's total oil resource. This article is cited by Walter Youngquist in *GeoTimes* July 1998, Pg.24-27. in an article "Spending out Inheritance." This citation was based on an early preprint that was circulated before publication of the article. The article was cited twice by Richard Kerr in a news story, "The Next Oil Crisis Looms Large – and Close," in *Science*, 21 August 1998, Pgs. 1128-1131. This too was based on an early preprint of the article. In his book "Hubbert's Peak: The Impending World Oil Shortage," (Princeton University Press, 2001) Kenneth S. Deffeyes, a retired Professor of Geology at Princeton reports on his calculation of the probable date of the maximum of world oil production. He describes an analysis that seems to be the same as I reported a year earlier in *Mathematical Geology*. His analysis suggests the year 2003 for the date of the peak. So his result and mine are essentially identical.

## 45) DEMOCRACY CANNOT SURVIVE OVERPOPULATION

*Population & Environment*, Vol.22, #1, September 2000, Pgs.63-71

This article builds on an observation by Isaac Asimov that "democracy cannot survive overpopulation." It points out a number examples of the decline in democracy in the United States that follow directly as a consequence of U.S. population growth.

## 46) ELECTRICITY SUPPLY CRISIS: COLORADO NEED NOT REPEAT CALIFORNIA'S PROBLEMS

*The Social Contract*, Summer 2001, Pgs.267-269

## 47) OUR NATIONAL ENERGY SITUATION IS A MESS

*Forum on Physics & Society*, Vol.30, #4, October 2001