Albert A. Bartlett, PhD

A physicist who won't let us stop thinking about growth

Interview by Paul Nachman

Albert A. Bartlett, Emeritus Professor of Physics at the University of Colorado ("CU"), is known to the type of people who read *The Social Contract* for his long-running insistence that humans must face up to the unforgiving arithmetic of exponential growth.

Professor Bartlett lives in Boulder, Colorado, where he is almost a household name. I visited him there on May 10, 2005. Just two days previously, *Boulder Daily Camera* columnist Clay Evans had written, "As the world faces the imminent 'global peak' in oil production – experts, including retired CU prof Albert Bartlett, believe that will occur sometime between now and about 2010 – and demand continues to rise. We may finally be forced to accept that our American way of life, which Dick Cheney has gruffly declared is 'not negotiable,' isn't even in our hands."

Professor Bartlett's many writings on exponential growth and its societal implications constitute most of the book *The Essential Exponential! For the Future of Our Planet*, available from the Center for Science, Mathematics & Computer Education at the University of Nebraska. A CD version of his famous talk on the subject is also available from the Center. The point of the talk, which he has presented more than 1,500 times, is that "Endless steady growth is the centerpiece of the U.S. and global economies. It is urgent that we educate people about the arithmetic and consequences of steady growth."

The following interview is an amalgam of our in-person conversation along with several follow-up phone calls and emails.

PAUL NACHMAN: *Before I start firing questions at you, is there anything you want to say?*

ALBERT A. BARTLETT: Today is May 10, 2005. Do you know what great events happened on May 10th?

PN: *No, I don't. VE Day was May 9th … [Interviewer's oops … May 8th, actually!]*

AAB: In 1933, it was the book-burning in Berlin. In 1940, it was the opening of the offensive on the Western Front, which, in something like three weeks, led to the collapse of France – after the Phony War. We were in France when war was declared in September 1939, but we got out in late September.

PN: *You and your wife?*

AAB: No, no, I was still in high school and with my parents. So the Phony War went on until May 10th, and, late that day, King George VI invited Winston Churchill to form a government. And on May 10th, 1869, I think, was the Golden Spike on the transcontinental railroad.

PN: *Did you look up May 10th, or are those dates in your head?*

AAB: No, over the years, I remember May 10th – May 10, 1940, because I was finishing high school, and I recall the day very well. It stuck in my mind.

And during the Vietnam War, I was Chair of the Faculty Council for the four campuses of the University, and the kids occupied the Hellems Building – because the Dean wouldn't stop the war. We heard about it on the radio at home in the evening. I immediately went up to the physics building, checked the ground floor doors and windows to make sure there was no easy access. Then I went over to Hellems, worked my way through the crowd, and got behind the counter in the Dean's office.

The kids were clamoring there. Many were from out of

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town, not students at all. I asked one where he was from, and he said, "Oh, I just blew in from Battle Creek, Michigan." I asked what brought him here and he said, "This is where the *action* is!"

At one point, when there was a lull in the noise, I said loudly to the crowd, "Do you know what student event happened exactly 37 years ago tonight?" Of course nobody knew. So I said, "Well, if you'll go get Shirer's *The Rise and Fall of the Third Reich*," – which I'd just been reading – "on page such-and-such, you'll find a chapter that starts with these words: 'On the night of May 10, 1933, an event happened that hadn't been seen in the Western world since the Middle Ages. The students burned the books.'" Not the Nazis; the students. These kids were dumbfounded – students would never do a dumb thing like that, burning books! One of the Associate Deans slipped out and returned a few minutes later with a copy of Shirer from a history professor's office. I turned to the page and read to them. They were absolutely stunned. But the occupation went on for another couple of days.

PN: *I was a student then, and I remember the de facto shut-down of campuses nationwide in the spring of 1970 over the Cambodia "incursion", the deaths due to National Guard gunfire at Kent State …*

AAB: We managed to keep from getting shut down, but I spent night and day meeting with students, just to keep the lines of communication open.

PN: *On to my questions. You're a physicist, I'm a physicist. What was your PhD topic?*

AAB: Let me go further back. I started as an undergraduate in the fall of 1940 at Otterbein College in Westerville, Ohio. (It's a small, church-founded school, and my father was a Professor of Education there. Westerville back then was a separate town north of Columbus. Now it's been engulfed by Columbus.) In the spring of 1941, I was looking for some adventure, so I got a summer job washing dishes on an iron ore freighter on the Great Lakes. It took me several hitchhiking trips to Cleveland to get all the federal papers you need to work on the ships. I still have my license to be a deckhand.

PN: *Didn't Dick Lamm do the same thing?*

AAB: Yes, I've heard that. When September came along, I was having a good time, making good money, so I didn't return to school. And that fall was Pearl Harbor. We were unloading the last cargo of iron ore for the season at the Wickwire-Spencer steel mill in Tonawanda, New York, on December 7. I'd finished cleaning up after lunch, then gone to my room and turned on the radio. I was the first person on board to hear the report, and I went racing around the ship to tell everybody else about the attack.

After a couple days unloading, we took the ship back to Toledo, where it was laid up for the winter, because the Great Lakes ice over. Then I went home for Christmas, thinking I'd get back into college in the spring semester, starting in February. So, since I had all of January with nothing to do, I hitchhiked to New York, saw New Year's in at Times Square – it was very subdued – hitchhiked down to Florida and worked for a week in a Miami Beach hotel washing dishes, then hitchhiked back north.

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So I enrolled for the spring semester and attended. After that, I hadn't been drafted, so I went back on the boats, this time as night cook. Finally, in the middle of the summer I said to myself, "I need to get back to college." Writing from the boat, I applied to transfer to Colgate University in upstate New York. I was accepted, so, coming into Cleveland one day, I told the steward I was leaving to go back to college. I hitchhiked back to my home, changed from shipboard clothes to college clothes, hitchhiked up to Hamilton, New York, and started there in the fall semester of 1942.

That fall, I took my first college physics course. I enjoyed it and did well. At Colgate, it was night and day, summer and winter, just physics and math and very little else. I graduated in June of '44. Then what? One of my professors heard that there was an address, "Box 1663," in Santa Fe, New Mexico, where they were hiring physicists. Sounded like adventure to me, so I applied – didn't know what it was, and they didn't tell me – and I was accepted.

My only instructions were to appear at 109 E. Palace in Santa Fe. So, after graduation, I hitchhiked home to Ohio, and to Springfield where a friend helped me get two new International Harvester trucks from the factory. I drove them to a dealer in Oklahoma City and then hitchhiked to Amarillo. All my life I'd wanted to ride a freight train, so I hopped a freight in Amarillo to Belen, south of Albuquerque. Then I hitchhiked to Santa Fe and reported to 109 E. Palace. The lady there in the office was Dorothy McKibben. She did some paperwork and had me get on an Army bus in the alley in back. It took me off through the desert and canyons up to Los Alamos. Quite an experience! I arrived on July 18, 1944 and worked for 25 months there.

PN: *All this hitchhiking, up to Colgate, down to Amarillo, etc. Were you hitchhiking because it was war, or would you have hitchhiked anyway?*

AAB: I would have hitchhiked anyway. It was a way to travel if you were a penniless student.

PN: *And people weren't uneasy about picking up hitchhikers?*

AAB: There were enough that weren't that I was able to get around, although I did spend some nights on the road.

PN: *So what was your job at Los Alamos?*

AAB: Mass spectrometry of plutonium. It wasn't that I knew anything about mass spectrometry, but this was just at a time when the first plutonium was coming down from Hanford, and there was some indication that, in addition to the principal isotope ^{239}Pu, there may be some ^{240}Pu from an extra neutron capture in the Hanford reactors.

Now ^{240}Pu has a high spontaneous fission probability, which would upset all their [bomb] calculations. So they wanted to know how much was there. They'd just requisitioned a mass spectrometer from a lab in Washington, DC, about the time I got there, and Bob Thompson, who'd been a PhD student with Al Nier at Minnesota, was setting it up. Bob took me on me sort of as an apprentice and took a real interest in me, telling me what I needed to study, giving me a stack of reprints to read, etc. He was very helpful. So we made the first measurements of the isotopic constitution of plutonium coming out of the reactors.

PN: *While you were there "on the Hill," did you meet any of the physicists of the Heroic Generation?*

AAB: Well I certainly *encountered* them. Fermi on the ski slopes… Neils Bohr sitting down next to me at the soda fountain… And I went to the scientific seminars, where you'd see all the big shots.

PN: *From the dates you gave, you must have been at Los Alamos for awhile after the war ended.*

AAB: Right after the end of the war I worked on the weapons tests at Bikini Atoll. There was no longer pressure to do mass spectrometry, so I joined a high-speed photography group, setting up high-speed movie cameras out in the Pacific, so I went out there and saw the first test, the air drop and then came home and we got married and, in the fall of '46, I started graduate school at Harvard.

PN: *Whom did you wind up working with?*

AAB: Ken Bainbridge. I'd gotten to know him at Los Alamos. He was the one who said, after the Trinity test at Alamogordo, "We're all sons-of-bitches now."

PN: *And your thesis topic was …?*

AAB: Building a beta-ray [electron] spectrometer. I finished at Harvard and came out to Colorado in the late summer of 1950. I've been here ever since.

PN: *Did you continue research in that area?*

AAB: There wasn't much research going on here back then, so I got very heavily involved in teaching. About four or five years later, Dave Lind and Jack Kraushaar joined the faculty with a mandate to build a cyclotron, so they set up a nuclear physics group. I was a member of that group and got a grant to build a beta spectrometer here to go along with the cyclotron. It was coming online in the late 1960s, when I was elected chair of the faculty council for the four campuses. That happened while I was at a scientific conference out of town. I came back and found I'd been elected.

PN: *The classic story! If you miss the meeting, you're*

the stuckee!

AAB: Fortunately, the Vice Chair was a sociology professor who was very outspoken and very knowledgeable about how people react to situations – in any rational world, he'd have been the Chair and I would still have been in the back row – but he just plunged in with me, and we met monthly with the Board of Regents, including Joe Coors, who was also very outspoken. All in all, we had our hands full trying to keep the place from getting burned down.

PN: *Did you have grad students?*

AAB: I had just a couple. I was never a big research person, myself.

PN: *So you weren't an exponential generator of PhDs!*

AAB: Hah! No …

PN: *You've probably read some of David Goodstein's articles* [e.g. "Scientific PhD Problems, *The American Scholar,* Spring 1993] *about how the routine expectation of research faculty is that they're going to reproduce themselves N times over, where N is much bigger than one …*

AAB: I haven't read David Goodstein on that. In my paper on the fundamentals of growth, part 2 ["Arithmetic of Growth: Methods of Calculation, II," *Population and Environment*, vol. 20, pp. 215 – 246 (1999)], I talk about "What's the growth rate if every professor has an academic life expectancy of 30 years and produces 5 graduate students or 10 or 15?" and so on, what is the growth rate of the population of physicists? That paper's in *The Essential Exponential!* compendium.

PN*: I didn't actually read the "exponential" articles in the* Exponential *compendium …*

AAB: A lot of it's trivial. [*Interviewer's note: That's one physicist talking to another!*]

PN: *And most readers of* The Social Contract *won't need any convincing about exponential growth, either, so I wanted to ask you about other things. You're a Fellow of the American Physical Society [APS] because of…*

AAB: Education.

PN: *Specifically "our" subject here or …?*

AAB: In 1978, I was national President of the American Association of Physics Teachers [AAPT]. I had four years in the AAPT presidential sequence – vice-president, president-elect, president, and past president – with duties in each of those offices. In '78 I was the President, so I was quite involved with physics education, and I think that was why I was named an APS Fellow.

PN: *Because you had a really vital year as president of AAPT …*

AAB: Yes.

PN: *I mean, APS doesn't routinely recognize the AAPT president as a Fellow, do they?*

AAB: No, not to my knowledge.

PN: *OK then, what about your origins for work on the issues of growth? What influenced you to get into this?*

AAB: Well, during all the uprising on the campus, there was a surge of student interest in the environment, and I had been slowly coming to the realization that students and other people didn't have an understanding of the arithmetic of compound interest. So I started putting some notes together, and in September of 1969 the undergraduate pre-med honor society asked if I could speak on something or other at one of their meetings. I'd known many of these kids from the previous year when I was lecturing in the pre-med beginning physics course, so I put these notes together and on September 19, 1969 talked to them about growth and the problems of growth.

It didn't have anything like the scope of today's presentation. But, fortunately, I kept my notes and the next year I had two or three more invitations. It evolved as I became more interested. Finally in '78 or '79, I gave the talk 131 times. It was sort of like a Hubbert peak! It went down after that, but instead of going to zero, it's leveled off at about 40 times a year.

PN: *That was the year, '78 – '79, you were AAPT President, so it was probably a matter of "Well, the President is visiting lots of local AAPT sections at colleges and universities, and he might as well give a talk while he's there…"*

AAB: Right; there was a lot of travel that year. But I found there was also plenty of interest in other groups. I've talked to national conventions. Once, in Madison, Wisconsin, I talked to a convention of state public utilities commissioners. And it was interesting, the next speaker was Ben Wattenberg. Ben writes for *The New York Times* and he writes books about the "birth dearth" and how we have to get more people. And his

opening words, after hearing my talk, were "I disagree with everything Prof. Bartlett just said."

PN: *That's one of the things I want to ask about, how do we account for people like him? But before that, have any other writers strongly influenced you? I'm thinking about Meadows …*

AAB: Yes, their *Limits to Growth* came out in 1972. That was a real eye-opener. And I was so taken by the way this polarized people – the entire world community of economists fell all over themselves asserting that *Limits to Growth* had to be wrong, that it was too terrible to be true … that Jay Forrester, Dennis Meadows, and their crew at MIT didn't understand economics. The economists kept saying, "It's too simplified".

And you may remember editorialists were attacking the conclusions of the Club of Rome. [*Interviewer's note: The Club had sponsored the research and computer-modeling that led to* Limits to Growth.] At some point, a rumor got started that the Club of Rome had renounced this, had recanted and had said that things really weren't so bad. And I remember a conference in Denver that I attended – Dick Lamm arranged it – and there were some people there from the Club of Rome. I talked with them and no, they hadn't recanted.

A friend in the economics department at CU said, "Al, you should read the book called *Models of Doom*, and that'll explain to you why doing arithmetic like this is all wrong." I read it and didn't find it scientifically acceptable.

PN: *I never read* Models of Doom*, but I certainly heard about it. Always my feeling is that to get into that, to really understand the other side – if there's actually anything to be understood – is just a lot of work, and people with our views go a lot on instinct: It's simple numbers. The earth is finite. There can't be more oil than the mass of the earth, et cetera.*

AAB: Yeah. That isn't instinct, that's just arithmetic. These *other* people are going by instinct. They don't like the way things are this or that, so they pronounce that these things are wrong or right, depending on their orientation. You know in '92 there was a sequel to *Limits to Growth* …

PN: *Right, led by Donella Meadows.*

AAB: …and they said, "Look, we've lost 20 years." That was their conclusion. In '02, there was a 30-year revisit and they said, well, we've lost 30 years. And in all of their computer simulations in this thirtieth-anniversary book, only *one* shows things sustainable out to the year 2100, which is the end of all of their graphs. (They examined a 200-year span from 1900 to 2100.) And this single scenario, which has two children per family – *instantaneously and from now on* – and great reduction in energy consumption per capita, showed no collapse of population out as far as 2100.

PN: *I remember Donella Meadows once noted that her MIT group read somewhere, like* Time *magazine, about their "discredited"* Limits to Growth*, "But we never agreed it was debunked; we stand by it." Well what about other influences? Did you read Bill Catton's* Overshoot*, for example?*

AAB: I have not. I read Paul Ehrlich's book, *The Population Bomb*. I don't remember it very well, and I don't know if I can find my copy, but I'd like to check it because everyone now says of the book that Ehrlich predicted massive famine and so on by now, which – to people in this country – it's obvious it hasn't happened.

PN: *I think* The Population Bomb *predicted famine would happen by 1975, although I haven't seen it directly. It's part of the book's reputation.*

AAB: I haven't read it in a long while.

PN: *Have you read Edward Abbey? Dave Foreman?*

AAB: I've met Dave Foreman a time or two. I haven't read Edward Abbey.

PN: *What about Bill McKibben? Anyone else?*

AAB: I've read some of McKibben's work. I read *High Country News* regularly to keep up with what's the latest disaster in the West. It comes out every two weeks, and it's owned by Ed Marston, who has a PhD from Stony Brook in solid-state physics. He was on the faculty at a small college in New Jersey, where he wrote a text on physics in the environment. Now he's retired up in Paonia, Colorado.

PN: *Let's talk about potential technical rescues for the human predicament. What about the possibility of "escape" into – colonization of – space?*

AAB: Just for the United States that would mean sending three million people per year into space with the message: "Please don't come back." That pretty

well answers that point.

PN: *And, as Garrett Hardin argued, the people sent would have to be the ones who'd agree to stringent limits on their reproduction – just the ones best able to live on the earth sustainably.*

AAB: Yes. Same thing as letting Chinese come here who object to China's "one-child" policy – we'll get the fertile Chinese.

PN: *What about the prospects for other energy sources such as wind, fusion, solar collected in space and beamed down as microwaves, methane ices (hydrates), deep old oil, …?*

AAB: You have to keep in mind the enormous capital investment to get any new sources working – for example, if you want to get 5% of our electricity from wind…

Just consider the costs of growth with *familiar* technologies. The capital cost of a new coal-fired electric generating plant is about $1.50 per watt. That's the purchase price of the hardware. Each person added to the service area of an electric utility requires about 1000 watts (1 kW) of new generating capacity, which costs about $1500 to build. So if the population of the utility's service area is growing by one percent per year, then every person in the service area has to pay about one percent of $1500, or $15 a year, just for the new generating equipment made necessary by the growth. So, in a year with one percent population growth, a family of four would have to pay $60 in added electric fees. If the growth was three percent in the year the same family would have to pay $180.

PN: *Well, that's not really all that startling a number in the context of a family budget – I guess your larger point is that growth costs* everyone. *The existing 99 residents, say, wind up paying 99% of the capital cost incurred by the 100th resident. Put that way, it's maybe more startling. You'd be saying that growth is almost 100% a burden on the existing population, not on the beneficiaries. If so, was there ever a time when it was different? This way it sounds like a long-running, systematic racket. Maybe it is, but there's something about this argument that makes me leery.*

AAB: I suspect that growth has never paid for itself. It's a racket. A century ago not so much in the way of public services was required for new people. No electricity, no phones, minimal schools, police, and fire protection. Today a great deal has to be supplied for each new resident.

Many years ago I was discussing this with a Colorado State Senator. At one point he said, "Al, we couldn't stop Boulder's growth even if we wanted to." I agreed, but said, "Therefore let's put a tax on growth so that it pays its way." He almost shouted, "You can't do that, you'd slow down our growth!"

PN: *Wonderful! Would you say that you worried about resources and the implications for mankind's future on a consistent basis when you were in your formative years? Or more than most people?*

AAB: When I was on those Great Lakes ore boats, I'd think about the several thousand tons of iron ore we'd haul down the Great Lakes each trip to be thrown into a blast furnace. I very clearly remember wondering if we would ever run out of this rich Mesabi Range ore. But I dismissed the question, thinking, "Al, you're just a dishwasher. There are smart people in the company office and in Washington. If there is any problem with our running out of iron ore, these people will alert us so we can reduce consumption." I was living in the wonderful and imaginary world in which decisions are driven by reasoned logic. I am ashamed of the fact that it took me years to mature and to realize that logic plays only a very minor role in human affairs.

There was no thought then on my part about other resources or about the future of mankind. All I wondered about at that time was the iron ore we were transporting in such great quantities. I was not terribly bright, and it took me many years to realize the importance of thinking quantitatively about all resources and about all human endeavors.

PN: *How do you envision things shaking out?*

AAB: Well, oil went to $40 per barrel in the 1970s, and I thought that after that it could only go up. Boy, was I wrong! Now I'm careful to make no predictions, and to stick with what you can comfortably say with simple arithmetic.

PN: *Are you basically optimistic or pessimistic about all this?*

AAB: If I give the appearance of pessimism, I figure it'll turn people off. I feel optimistic at times, pessimistic at times … sometimes optimistic about getting the ideas across to a particular audience but pessimistic about our long-term prospects.

PN: *Your fellow Colorado activist Fred Elbel recently*

mused to me about our great efforts to restore sanity to U.S. immigration while being unhappily aware that we're also in the era of 'peak oil", which is going to bite us whether or not we fix immigration. So is it worth it to make the efforts we're making against mass immigration?

AAB: I prefer to not make immigration a focus of my presentation. It turns off my liberal friends. I try to make the case that the U.S. is overpopulated. Then, if they ask what we can do, I point out that ¾ of our growth is directly or indirectly due to immigration.

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[Interview continued by phone and email, mid-June]

PN: *It was about a month ago that I visited you.*

AAB: Since then I walked 10 km in the Bolder Boulder [*Interviewer's note: an annual mass run/walk on Boulder city streets*]. In my age category, I finished 14th out of 14 a few years ago. This year I moved up, finishing 7th out of 7!

PN: *Progress! Anyway, have you given 'the talk" again?*

AAB: Most recently in Lexington, Kentucky, to the Kentucky Oil and Gas Association.

PN: *How do you wind up getting invited. I presume that they pay your way … or do you often give talks at places where you happen to be passing through?*

AAB: Oh, yes, they pay my way … I couldn't afford all that traveling. Sometimes I get honoraria. In mid-July I'll be going to West Virginia to speak at the National Youth Science Camp

PN: *Do they contact you more-or-less out of the blue?*

AAB: Yes, I get contacted.

PN: *How do they make the connection, do you think?*

AAB: Well, for example, I gave the talk about a year ago to the American Association of Petroleum Geologists in Dallas. An attendee from Ohio in that audience had me invited to talk at a meeting of the Ohio Oil and Gas Association this spring, in Columbus. (While there, I also spoke down the road at Denison University's physics department.) Someone from Kentucky attended the Ohio meeting, so that's how the Lexington talk came about.

PN: *Readers of* The Social Contract *presumably don't need to be instructed about exponential functions nor confronted with basic facts about endless growth in a finite environment. I'm guessing they'll be most interested in learning from your experience about getting these ideas across to people who don't much think about these things. How has your, by now, very-well-polished talk been received by various categories of people – other physicists, for example?*

AAB: I've given it at many physics departments' colloquia and never experienced any dissent. Although there *are* physicists who assert that population isn't a physics issue. I tell them that if you, who understand this simple math, won't say anything, you're telling a silent lie. I had an article about this in *Physics Today* in July 2004. The letter-to-the-editor responses a few months later astounded me with their non-scientific arguments. Everyone goes to enormous lengths to avoid talking about population. [*Interviewer's note*: *The article from* Physics Today *is reprinted elsewhere in these pages. The responses can be read at http://www.aip.org/pt/vol-57/iss-11/p12.html. Professor Bartlett has offered to mail reprints of his article and the responses. If interested, contact him at Albert.Bartlett@colorado.edu*.]

PN: *What about with other scientists – chemists and biologists? And science students?*

AAB: It's been well-received, among math groups especially.

PN: *How about groups of lay students and more-general lay audiences?*

AAB: It's often news to such people. They're complimentary about the talk. And they want to know "What's the solution?" My answer has been that there

may be problems that don't *have* solutions – especially if you mean some pleasant extension of our present lives.

PN: *Has reception to the talk changed over time?*

AAB: No.

PN: *Has it been a Sisyphean task – tedious to have given the talk and written on the subject so many times?*

AAB: Yes, but I enjoy helping people learn. It's my mission to carry the word to as many people as possible.

PN: *In your writings and in the talk, you approach the exponential-growth/doubling-time subject in three ways:*

There's the "29 th day" approach, wherein something doubles every day until you run out of capacity at the end of the 30th day – but on the 29th day you're still "only" half full.

Second is the approach that there's as much consumption in the most recent doubling time – if the growth is "exponentially steady" – as in <u>all</u> prior doubling times, combined.

In the third approach, you get to the 30th day and, miraculously, discover three more earths, say – but if the exponential growth continues unabated, those enormous new resources only take you through day 32 – which is a shocker, too! Is any one of the three most compelling to your audiences?

AAB: The last two seem to impress audiences the most. People sometimes gasp when they realize that finding three more earths is only good for two more "days". At one of my talks someone said, "And it's hard to find good earths nowadays!"

PN: *Indeed! Have you ever had a mistake pointed out? Has anything in your evolving talk changed because of feedback from audiences or others? Seems to me that it's all simple arithmetic that you've been presenting, but has there ever been a problem?*

AAB: A few typos. But nothing that was both definite and substantive. I've been in a few debates, and I try to keep it rational. Sometimes that frustrates the other side. One time an oil company man stomped out of the room with the parting shot that "If he's right, we're all finished." One time I spoke at the Ft. Collins (Colorado) City Council meeting. During my talk, the council members were four happy faces and five unhappy faces. A friend of mine knows someone on the council, and that member's reaction, passed back to me by the mutual friend, was "It's all smoke and mirrors."

The friend who's a CU professor of economics [see above] once said to me, "This stuff you're telling people is all wrong." So I gave him a copy of my 1978 paper and asked him to take a red pencil and mark the things that are wrong, since this would help me. He just returned the paper later and said "It's *all* wrong." Which wasn't any help.

PN: *Speaking of economists, you overlapped with Kenneth Boulding at CU. He's the one who said, "Anyone who believes exponential growth can go on forever in a finite world, is either a madman or an economist." Did you have any influence on him, or vice versa?*

AAB: I knew Boulding and interacted with him a bit, but any influence went from him to me. By the way, I was intrigued by that quotation, and I once asked him if he had said that. He was silent for a moment. He smiled and said, "Yes, I think so."

PN: *But did he influence you in this arena? It seems to me you've developed the exponential "story" on your own*

AAB: Well, there are the three Boulding theorems that I keep in mind: the Dismal Theorem, the Utterly Dismal Theorem, and the Moderately Cheerful Form of the Dismal Theorem. I think he first brought those up in the preface he wrote for a book that reprinted the famous Malthus essays.

PN: *What about Herman Daly, the economist-of-the-steady-state at the University of Maryland?*

AAB: I've had a little interaction with Daly, and again, the influence has gone from him to me, if anything. I think he's very good.

PN: *How did he influence you?*

AAB: Daly edited a book, *Problems of the Steady-State Economy,* that contains some of his own essays and also works by Boulding and by Garrett Hardin. Daly's book was published by Freeman 30 to 40 years ago, and it was heartening that there was at least one economist who was thinking along those lines.

PN: *You mentioned your brief, in-person encounter with Ben Wattenberg, where he disagreed with*

everything in your talk. Then there's Thomas Sowell, whose writings I admire a great deal, but not when he writes about the environment and population. (Interestingly, when he says anything about immigration, it's always succinct and useful.) Anyway, have you ever been able to account for these people? What are they thinking? Either they're nuts or we are, I would think

AAB: I've read Wattenberg's *The Birth Dearth*. There was a lot of data in it, and Wattenberg just drew different conclusions from the data than I would have.

PN: *Did you look at it in detail, did you pay close attention to the data, or did you sort of "cruise" through it?*

AAB: I really just cruised through it.

PN: *That's a project I'd like to do sometime. For instance, there's this recent book by Peter Huber and Mark Mills* [The Bottomless Well: The Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy] *apparently saying that it would be better if we used energy inefficiently and that we'll never run out. It just sounds crazy to me. Anyway, the project would be to read a book like that in excruciating detail and really figure out what's the nub of how they went wrong.*

AAB: That reminds me of the famous true story about Wolfgang Pauli [*Interviewer's note: Nobel-prize-winning physicist*] saying that another physicist's work was so bad that "It wasn't even wrong."

PN: *I know that story about Pauli. Well, is there anything you'd especially like our audience to carry away?*

AAB: I come back to an Eric Sevareid quote: "The chief cause of problems is solutions." That is *so* important. For example, as long as there's population growth, urban planning is bound to make everything worse. Here's why. Essentially all the problems planners must deal with are caused by population growth. And planners are trained to *solve* problems. For a planner, a problem is anything that inhibits population growth. So when you solve the problem you are encouraging more population growth, and this makes everything worse.

PN: *I never thought about it that way, but it sounds right. Thanks for our visits!*

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