

- Welcome, once again, as MIT Professor Paul Samuelson discusses the current economic scene. This bi-weekly series is produced by Instructional Dynamics Incorporated and was recorded April 10th, 1972.

- One subject that is discussed very much these days in economics is the problem of zero population growth. It's part of the whole concern over ecology. Just to tick off some items in the passing news that are related to this, a group of English scientists, Natural Scientists, got together and put out a blueprint for survival and some very sweeping predictions about the dismal future for the world and some rather drastic measures of therapy are recommended, for example any product that doesn't last a great number of years should have a special tax on it, a tax in other words upon obsolescence. Still, another indication of the tremendous interest in this matter is the work of the so-called Club of Rome. I have reference to my own colleague at MIT, Dr. J. Forrester and one of his co-workers, Professor Meadows who have put out a book that has received a great deal of attention. Forrester has a book of his own on this subject and Meadows, with the group for the Club of Rome, has put out a publication which is very much under discussion now, for example, the state department has had Meadows addressing groups in other countries. It's a subject in short which is fraught with interest. Now, I did touch on this matter in one of my earlier tapes a long time ago but because I get so many letters on the subject I'd like to speak about it. I may say that my experience is not unique. My colleague, as a Newsweek columnist, Professor Henry Wallach, of Yale, devoted a column in which he was kind of cold towards zero population growth and the heavens descended on him, a real barrage of mail onslaughts. He's a brave and determined man and he came back with a second column, I haven't heard but I suppose that that hasn't pleased everybody. I propose in the beginning to give a brief history of population and notions about population because this is not something entirely new that we're talking about and it'll give us some perspective to go back a distance. Let me go back just to the end of the 18th century and recall for you that there was a school of thought in England that believed in progress, in the perfection of man, these were the perfectionists. William Godwin was the leader of that, very interesting man in the history of ideas who has not been studied enough, I think, and who will increasingly come under new study. But, for this purpose, I need only mention that the father of the economist Malthus became a follower of Godwin and he believed that every day, in every way, things were getting better and better. That the Earth could support any size population, that man was, after having sinned in Eden, having gone through travail, man was now finally coming out at the other end of the tunnel into perfection. And T. Robert Malthus, who was to become a Church of England parson and economist, listened to his father and, as so often happens, father and son did not agree in every respect, and in arguing with his father Malthus, Malthus, M-A-L-T-H-U-S, Malthus decided that Godwin was completely wrong and he sat down and wrote a book about it, this was in 1798. Of course, that's a very famous book, it's something that everybody knows about. I say everybody, not every modern computer realizes that it is going through some of the same paces that T.R. Malthus went through at that time. Now, what was it that Malthus said? Malthus said man is not becoming perfect, we are not moving towards Utopia. Quite the contrary, there are some inevitable laws and as Thomas Carlyle came to say these are dismal laws. Economics as the dismal science got that name from Thomas Carlyle and it got that name in connection with the dire predictions of Malthusian type about the law of diminishing returns and starvation around the corner. Malthus puts his arguments in the form of

an irrefutable syllogism. He started out by saying that in every species and in mankind there is a tendency for population to grow at compound interest. If you have a hundred parents and you get 210 offspring, that's one situation, if you have 200 parents you get twice 210 offspring, 420, and this will happen through time. So, his first law is the famous law of the geometric progression. A geometric progression is like, 1, 2, 4, 8, 16, doubling every time. Of course, to follow such a sequence, geometric progression, with a positive rate of growth for any little length of time results in enormous numbers. I will remind you of the old story about how chess was discovered. The Sultan was so pleased by the discovery of this amusing game that he said to the inventor, name your reward, and the inventor said, I'm a modest man, I don't want anything. Sultan said, nonsense, name it, and he said, well if you really wanna give me something just put one grain of wheat on the first square of the chessboard and two grains of wheat on the second and just continue in this way until you've filled the whole chessboard. Well, there's not enough wheat in the world to provide that magnificent gift. That's the way geometric progressions grow. And Malthus was not the first, and he had a great number of followers who persued relentlessly the vision down the trail of geometric growth. It always fascinates classes in economics if you discuss the fact that all the wealth in England today could be traced back, as Keynes said, to the gold that Sir Francis Drake stole from the Spanish in the Golden Hind. If you compound that forward at 6% or 8%, some similar number, you will equal the present wealth of England. The American Indians sold the island of Manhattan for \$24, so it is said, for trinkets. What if that \$24 had have been put in the bank at compound interest? In early editions of my textbook I said at 6% that would equal the value of all the land in Manhattan today. Somebody wrote in to me and said, I think that only comes to 25 billion or 100 billion, and I think that you couldn't buy all the land in Manhattan for that price. So, I asked my research assistant to look in to the matter and she came back and said well, boss, if 6% won't do it try 6.5%. You just have to step up the rate a little bit and you'll get some very large numbers. Now, Malthus based his argument upon some casual amount of experience. We had in the American colonies, at the end of the 18th century, some evidence that family-size was eight. Go to old New England cemeteries and you'll see seven, eight women died of childbirth the age of 35 then the man married again. And, the natural rate of increase of population the size of the rate of growth of the geometric progression, Malthus estimated in a prosperous era, epoch, where there was no limitation of land and natural resources would be about a doubling every generation. Now, what is a generation? In college student life a generation can be measured in four years or eight years but the technical term for a generation is the age of a parent in giving birth to a child, and then when that child grows up and becomes a parent then that gap is the length of a generation. Of course we, as parents, have children over a period of time so you must take a certain average. Let's call 25 years a generation. A generation is longer in Sweden, where the women have their babies at a later age, then it would be in India, where they have their babies at a younger age. But a doubling of population every 25 years, that's the rate of compound interest that is a natural law according to Malthus, unless something prevents that from happening. Malthus had gone to Cambridge University. He learned a smattering of mathematics, he learned about geometric progressions. Unfortunately, he learned of only one other kind of progression. Aside from a geometric progression we're taught in high school algebra courses today about an arithmetic progression. Now an arithmetic progression, instead of doubling each time, each increment being a certain percent of the previous base, an arithmetic progression is not like compound interest, it's like simple interest and the steps upward are even steps, just like a stairway that always has the same size of the steps and it depends upon the step of the increment how fast an arithmetic progression will grow. You could have a very steep arithmetic progression but it still has a straight line if you plot it on a

chart whereas compound interest, if you plot it on a chart, is always an accelerating curve that looks convex from below. Well, Malthus said America will soon be filled up with people, England certainly is already pretty much filled up with people. Every geometric progression must in the end fill up any limited amount of natural resources. And so, he said, the limit is going to be food production, essentially. Food production, said Malthus, and here we must watch his argument very closely, food production grows at an arithmetic progression. Population grows at a geometric progression. Every geometric progression, given enough time, will far exceed and infinitely exceed any arithmetic progression, no matter what the constants are. Therefore, said Malthus, there is only one destiny for mankind and that destiny is that the death rate will go up and that man can only come in equilibrium at the minimum level of subsistence. When you're finally through disease, and starvation, and malnutrition, and over crowding, get so large a density of population that the wage can be no more per man than barely enough to keep him alive. Keep him alive, by the way, and bearing in his family five, six, seven infants, half of whom die at birth, another half of whom die in infancy, and enough must always die so that each two people can only leave behind them two people. Well, I think you'll grant that, if that is the destiny of mankind, in every place, in every continent, in every time then economics is a dismal science. You mustn't, however, shoot the economist, he's just the messenger who brings the bad news. That's the way Malthus left his first edition. By his second and later editions he took pity on mankind. Perhaps he learned a little, in fact he began to study things more widely, and so he said there is some hope. What you can try to do is to change the geometric progression by late marriage. He advocated chastity until you get married. Once you were married you had a license to produce children, remember he was a Church of England clergyman, he was not in favor of birth control at that time, he says, "I will not comment on those nefarious French devices" showing us that, already, France was known at the end of the 18th century as a country which was beginning to practice familial limitation. As a matter of fact, as an aside, let me say that anthropologists are now pretty sure that in almost every culture there are certain mechanisms for limiting population. In 17th century Japan, for example, the population was fairly stable and there wasn't measure of prosperity but it was maintained by infanticide. You exposed children if you didn't want them, particularly if they were girl children, so that when a baby was born the neighbors never congratulated you until their ascertained for sure that you intended to keep the baby, otherwise you exposed the baby just as the Romans did. This was abortion after the fact instead of abortion early in the fact. Well, let me assure you that although the Malthus argument is extremely simple it had great potency and it had great effect upon the thinking of the governments of the world, the poor law reform of 1832 was guided in part by the principles of Malthus, let's make poverty as uncomfortable as possible, unemployment as uncomfortable as possible, because if you coddle the poor they'll simply have more children. Even by the middle of the century, by 1848, 1850 when John Stuart Mill, the last really of the classical economists was writing, Mill was living in the midst of the Industrial Revolution, in the greatest period of Victorian England. After the steam engine had been invented and came in to use, after the railroad had begun, after the automatic spinning jenny, after the automatic loom, the most remarkable period of progress, John Stuart Mill, who was a well informed and eclectic man was able to write the naive words that it's doubtful that science and invention have lightened the burden of a single typical average man anywhere in the world. Showing you how little you can know your own times, particularly in the days when statistics were very hard to come by. Well, what did Malthus forget? Malthus forgot two things. Most importantly, there was never a good basis for his arithmetic progression. He pulled that number out of a hat. He said population's gonna grow like one, two, four, eight. What about food? If we call present food one, he said let's suppose you could

cultivate England like a garden, you could double food production. That's one, two. But in an arithmetic progression if we've only gone up one at each step, the next time we're at three and we're already in trouble. Even if he became more generous in his arithmetic progression and let's say we keep the geometric progression one, two, four, eight but the arithmetic progression goes one, seven, that's a jump of six, and you're much better off in the second period. Then another jump of six is 13. We're beginning to not be so well off. But, finally we go to 19. We're still ahead of the food supply. Then we're at 25 but, by this time, the population's at 32. There's just no beating the race. Now, why do I labor this particular point? I labor it because if you read the book by Dr. Meadows you will see that what is speaking there is the authoritative voice of the computer. Mustn't we be impressed by the certitude and accuracy of anything that comes authenticated by modern science, and by that most wonderful tool of modern science, the electronic computer. That's how the argument goes implicitly. I may say, by the way, that Professor Forrester and Dr. Meadows do not themselves make such claims but no matter how many times they cross themselves and say we want our analysis to be judged upon its merits we are making guesses, people inevitably think if it came out of MIT it must have a special degree of accuracy because everybody knows that everything that comes out of MIT in the field of thermal dynamics is practically guaranteed to be an agreed upon thing by all scientists. Well, I think back of the days when there was a machine that played chess and all over Europe good chess players played against the machine and were defeated, and everybody thought this to be a marvel. This, by the way, was before the age of the electronic computer. We now know that at chess a computer can be programmed to play a pretty good game of chess, can beat a kid, but it can't yet beat a master. Maybe in Chequers, by the way, a machine may be the equivalent of practically the best that there is. Well, this was before that time, and how marvelous it was, but you know what they discovered? They discovered a little dwarf who would curl up, literally, inside the machine, I've forgotten what his name was, it was a fraud. Well, I say to you that every time a message comes out from a modern computer there is no fraud, there is no little man curled up inside the solid state transistors of the computer. But, behind the computer, feeding in the input to the computer is a man and he is a mortal man with all the imperfections of man and the output cannot be better than then input. And so, although the voice is that of the computer the message is essentially that of Malthus because, although Meadows may be right that the amount of resources which can be found by geologists in the next half-century, or the next century may only be double what we now have. Or, if he said triple let's change that to that. Or, whatever he said let's double that amount. Nevertheless, because the differential equations of the Forrester-Meadows model are of the Malthusian type they involve constant coefficient. They essentially are generalized matrix, non-linear, geometric progressions, and because there are limitations upon resources put in them the Forresters and Meadows of the world cannot be wrong if they simply certify the following. That within my model, if disaster does not come by the year 2000 then it will be here by the year 2025. And, if I'm wrong in that, that it doesn't come by 2025 then it will be here by the year 3000. It's a perfectly self-fulfilling tautology. Some time, under their geometric progressions, there wouldn't be standing room for all the people in the world and there certainly would not be resource allocations. The result is that when you look at these charts the print out of the computer, which show the standard of living of even the most advanced countries of the world, some time in the next century, reaching a peak and going down, you must realize that this is not science fiction but this is speculative social science. The fact that there are interviews in Playboy on the subject shows what widespread interest, the fact that every journal I pick up, that Anthony Lewis, a very sophisticated columnist on the op-ed page of The New York Times, reports back from England approvingly on this, still

cannot belie the fact that water cannot rise above its own source and what you have here is certain assumptions. Now, I don't want for a moment to argue that the assumptions made in this case are wrong because that would take a very searching examination. You wanna say this, that if you are a sophisticated student of economics and of the population problem I do not think you will find much new in the Club of Rome material which will sharpen your knowledge on this subject, which will enhance your understanding. This is not to deny that many members of the public may find their understanding of the whole problem improved by reading such materials. Moreover, it's a sad thought that sometimes in order to sell you must oversell and because the problem of pollution is an important problem, because the problem of the amenities of life having to do with elbow room and privacy are important it may be that I shouldn't be saying what I'm saying. Maybe I should, so-to-speak, in a good cause be quiet and say although this isn't quite right and privately, with a few elder professors, we can agree up on this, there should be a conspiracy of silence because it's good for the people to be alerted to this matter. Well, I'm assuming that my audience here is a fairly sophisticated audience and that it isn't necessary for me to take that particular position. I believe that the truth can stand being looked at and understood if only we can once arrive at it. I have only a few minutes. Let me mention, in connection with zero population growth, that Malthus was wrong because he didn't foresee how powerful would be what he called is arithmetic progression the actual progression was more powerful than the geometric progression of population. That's why, because of modern science, there's been such a tremendous increase in the standard of life. Moreover, what Malthus would not countenance later generations came to do, namely, explicit birth control, and after 1870 you could see not only in France but in the vital statistics of the middle classes, the more affluent classes all over western Europe, and increasingly in the United States, a decrease in the birth rate. This became apparent to every eye after 1925 and because people always want to be excited in these matters they go from one side of the ship, tipping it in one direction, all in an avalanche over to the other side tipping it in the other direction, and after 1925 there were a rash of books called *The End of the Human Race*, *Sweden Faces Depopulation*, there was very excellent work done by Edwin Cannan in demography showing that England's population would reach a maximum, by the way a maximum lower than the present population of England. The logistic studies by Dr. Raymond Pearl of Johns Hopkins biology department in which he compared human populations to fruit flies in a bottle and in his bottle every colony of fruit flies finally leveled off like an S-shaped curve, called the logistics curve, by him. We had calculations by A. J. Lotka and R. R. Kuczynski which showed that the population was indeed in the distant future going to decline if the average number of children per family who survived to be married, to be fertile, to have children, was less than two. So, there was ground for extrapolation of a coming-in to population growth. But, it doesn't pay to be too certain in this matter because, as we all know, after 1939 there was a whole change. There was a baby boom and the population turned very much the other way. Well, now I leave the story in its present state as it's well known after 1957 you have had a very considerable decrease in the birth rate, not only in the crude birth rate, but, if you refine the birth rate, it worked with the number of births per mother of childbearing age you find that the decline is even greater. So, the rate of population growth is leveling off. We will not have zero population growth for a long, long time even if the tendency was for a declining population because of past baby booms. How shall I sum up? Let me sum up by saying that it's worth another tape some time on the whole problem of ecology, the whole problem of whether we should be against science or whether we should utilize science for the purpose of cleaning up the atmosphere and solving some of these other particular problems. But, I think, I wouldn't do duty to the subject and to science without saying candidly that the

hysteria such as it's represented by Blueprint For Survival is really not substantiated, careful, sober analysis of the realistic facts.

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