

The Next Eighty Years

by HARRISON BROWN

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in the ecological sense, than we have assumed**

THIS IS the 20th anniversary of an attempt on the part of (originally) three of us — James Bonner, professor of biology; John Weir, then associate professor of psychology; and myself — to examine where our world seems to be heading from the points of view of such parameters as population, resources, food, industrialization, and technological change. We called this examination *The Next Hundred Years*.

Ten years ago we subjected our forecast to scrutiny and asked such questions as, "Where are we going wrong — and why?" We found that exercise was illuminating, and naturally we entitled it *The Next Ninety Years*.

Now another ten years have passed, and we are taking still another look. Naturally, we have entitled this *The Next Eighty Years*.

In rereading the published proceedings of *The Next Hundred Years* and *The Next Ninety Years*, I am surprised first of all that our batting average has been pretty good. But I am surprised far more by some of the things we *didn't* talk about. With respect to what we did talk about, I will cite two successes, if I can call them that, and one dismal failure.

First, world population is still moving up pretty much as we expected it to 20 years ago — though somewhat more rapidly. Twenty years ago we

suggested that the population in the year 2000 would be five billion. It is now over four billion, and by the year 2000 it cannot be much less than six billion. There are, however, encouraging signs from some large countries such as China, India, and Indonesia that birth rates are beginning to decline. This change appears to be largely the result of substantial official family planning programs. Political upheaval like the recent one in India can always change the picture and change it rather rapidly. But if the trend persists, there is a fighting chance that world population can be stabilized eventually at somewhat less than ten billion persons.

Secondly, we had an interesting success involving the U.S. energy situation. Twenty years ago we suggested that petroleum production in the contiguous U.S. would peak at about 1970. Ten years ago this still seemed to be true, and in 1970 it happened. Of course we will experience a rise when Alaskan crude comes into production, but as far as the contiguous U.S. is concerned, it seems likely that it's downhill all the way.

And now we come to our major goof. We did not become overly concerned about the U.S. energy situation in spite of this peaking. To be sure, even in 1957 we were substantial importers of crude oil, but we knew that we were endowed with large reserves of coal and oil shale, and nuclear technology was being developed

very rapidly. We assumed pretty much that all of these sources would be rapidly developed in the course of the 20-year period and that the transition away from domestic and imported crude oil would be a smooth one. And how wrong we were.

Ten years ago, I think we were infected by a general optimism about the future of nuclear power. It was pointed out that the unit power cost for power from a nuclear reactor fell off with increasing size of the reactor — and all one had to do was build large enough reactors to undercut the price of electricity generated from petroleum, and everything would be fine.

This turned out to be not quite correct — not just from a technological point of view of course, but from a very human point of view. We certainly did not foresee the tremendous mystique that grew and spread over the land concerning nuclear technology and nuclear power, concerning the safety of reactors, concerning the security of fissionable materials. So now I can say emphatically that I, for one, am extremely worried about the future course of events.

The things we *didn't* talk about? It's really incredible in a way that we didn't talk about environment. Again, I think it was just a tacit optimistic assumption that environmental problems would arise but that we would come to grips with them as quickly as they came up. Here we were quite wrong. We did not talk about

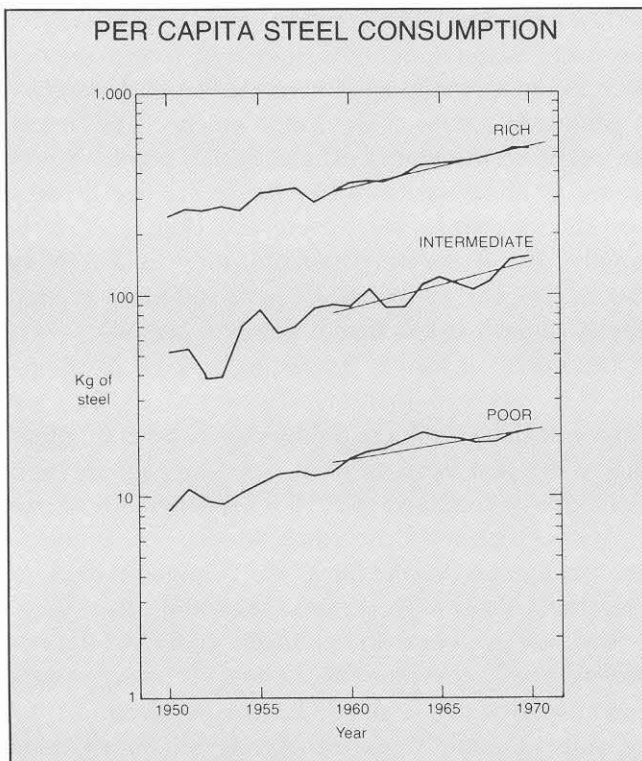
climate, and the possible impact of changing climate upon the world scene, even though in 1957 there had been a constant, steady drift downward for some 17 years of the mean temperature of the northern hemisphere. Even at that time we suspected fairly strongly that increasing concentrations of carbon dioxide in the atmosphere could eventually have a substantial effect upon the whole world's climate in the opposite direction.

Another thing we didn't talk about, because we didn't know anything about it, was world modeling. Now people are trying to model things all over the place, and it certainly is a very interesting development. How important it will turn out to be is difficult to say.

Lastly, again in our optimism, we pretty much thought that when we look at the world as a whole, the main problem is with the developing countries: If we can help them develop, everything will be fine. We failed to think of ourselves and the other industrial societies of the world as having our own vulnerabilities. We neglected to ask the question — What is the real nature of this new society that has emerged in the world? It has existed in one form or another for fewer than 200 years, but it has never been really put to the test of how resilient the society might be, how vulnerable it might be to disruption, particularly given the situation that now exists in the world where we essentially have two quite separate cultures — that of the rich and that of the poor.

One of the most important characteristics of our own society has been a steady increase in per capita energy consumption. There have been ups and downs in economic activity, but the general trend is up, and I think it behooves all of us to ask how high it will eventually become. How large need it be? But if we look at per capita energy consumption in the world as a whole and ask ourselves how many people live under various levels of per capita energy consumption, we find that since World War II there has been a startling development.

We've always had rich nations and we've always had poor nations, but we've also always had nations in between. But for the last 30 years there's been a "fissioning" of human society into two cultures. When we look at the numbers of people who live at various levels of energy consumption, we find there is one large clump living at very low levels of energy consumption, another large clump of people living at high levels of energy consumption, and virtually nothing in between. We now have two separate worlds, the rich and the poor. Since the end of World War II the rich world has been getting relatively richer and the poor world has

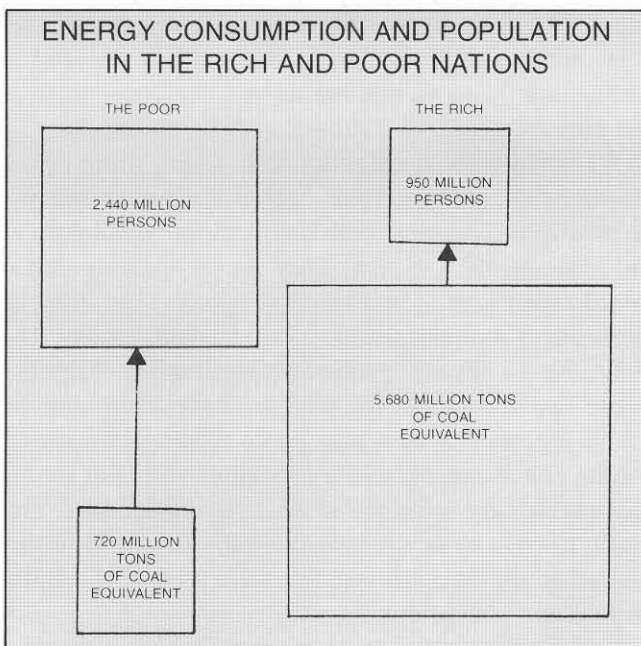


Per capita steel consumption is increasing in all countries, but there is no sign that the poor nations will ever catch up with the rich.

been getting relatively poorer from the point of view of energy consumption. There isn't the slightest trend toward convergence. Indeed, if you look carefully, there's actually a divergence. In other words, the gap between the two is getting wider.

What are the ultimate consequences of these two worlds living side by side, cohabiting the earth into the indefinitely long future? I would suggest that something is bound to give.

Let's look at what this means in terms of resource consumption. In the poor countries we have 720 million tons of coal equivalent going into the support of 2.5 billion people. In the rich nations we have 5.7 billion tons of coal equivalent going into the support of 950 million people.



A highly unstable situation exists for rich and poor nations because of the imbalance — and inequity — between their populations and their energy consumption.

Before the Industrial Revolution there were peasant villages all over the world. In India there are still over 500,000 villages. Similarly, there are huge numbers of villages in China. Those villages have a very important common characteristic. They are basically self-sufficient. The people grow their own food very close to the village. They don't live very well, but they are self-sufficient.

When we look at the industrial culture such as ours in the U.S., we see an enormously complex network of mines, factories, transportation systems, communications systems, and power grids, all linked to each other — a single system, as distinct from the peasant village culture which has many hundreds of villages very

loosely coupled with each other. In the U.S. the coupling is intimate. How much perturbation, how much of a shock can that system take without coming to a grinding halt? To what extent can the system repair itself? To what extent are there redundancies within the system that will permit it to continue functioning?

I suggest that we don't know, that we may well be far more vulnerable, and far less resilient, in the ecological sense, than we have assumed.

Let us examine some of the kinds of shocks that should concern us. Obviously, given a large-scale nuclear war, the system would probably come to a standstill, and would be very difficult to get started again. Growing dependence upon energy imports is another kind of shock. Indeed, it was the shock of the 1973 Arab oil embargo that began to get me concerned about such problems. Here in the U.S. we saw the lines of automobiles in front of gasoline stations. We saw wave after wave going through the entire economy. We were far from dying, but it was interesting how large those waves became — particularly when we recognized afterwards that the Arab oil embargo represented only a 4 percent decrease in total energy availability in the U.S. for a period of three months or so. It really wasn't a large shock, yet the effects were substantial. We must ask ourselves what would have happened had there been a 20 or 30 or 50 percent cut in energy availability. I suggest it would have been very serious.

In the case of Japan, which does not have any petroleum resources of its own, that sudden shock had a profound effect — a 180° about-face in foreign policy in about three microseconds. In the case of the United Kingdom, there was almost a synergism in operation. First there was a strike of electrical workers so that power plants and transmission lines could not be repaired. Coincidentally, there was a strike of coal miners. Then, also coincidentally, the Arab oil embargo came along. The net result was the declaration of a state of national emergency and a three-day workweek that persisted for several months.

A third kind of vulnerability involves the growing need to import non-fuel minerals. We are now almost completely dependent upon the importation of several critical minerals. Japan is even more vulnerable from this point of view. Europe is highly vulnerable as well. The poor countries have the overwhelming preponderance of exportable energy and mineral resources, and we should realize that they have discovered that this can be a very effective weapon.

Growing dependence in major regions upon food imports is another vulnerability. The U.S. is a major food exporter, but as affluence has grown, Europe has

Activity	Percent
Pipeline transport	0.02
Water, steam and sanitary employees	0.07
Petroleum refining	0.17
Coal mining	0.18
Oil and gas extraction	0.31
Fire protection	0.31
Air transport	0.39
Mining (other than coal)	0.54
Railroad transport	0.63
Steel production	0.65
Police protection	0.70
Electric and gas utilities	0.73
Telephone communications	1.06
Truck transportation	1.27
Total	7.03

Work stoppages by a mere 7.03 percent of key segments of the U.S. labor force could completely paralyze this country's complex industrial system.

imported increasing quantities of feed grains and the like from the U.S. Japan too has imported increasing quantities, and indeed Japan buys up a large proportion of our soy beans. Soy beans are a staple in the Japanese diet, and Japan has become even more dependent upon us for soy beans than we have been dependent upon Saudi Arabia for oil. Then in 1973 came what my Japanese friends call "the first Nixon shock" — a soy bean embargo, because we were afraid the price of food was going up too rapidly. The Japanese have not forgotten that, and I think they are very wisely taking remedial measures. When I was in Japan in September, the president of Brazil was there with an entourage, and they signed three billion dollars worth of agreements, including a major agreement on agricultural development in Brazil, with Japan to receive substantial quantities of foodstuffs.

Technology is fragile — it can break apart by itself, and it can be broken apart by outside interferences. We have already seen considerable airline hijacking. I would suggest that, with the upsurge of terrorism in the world, as terrorists get smarter, and as the weapons in their hands become increasingly powerful, there will arise dangers of no small proportions. We will have to ask ourselves just what the ultimate consequences might be.

Terrorism has emerged as a new form of warfare. Until recently its main objective has been essentially to draw attention to political causes — to make people sit up and take notice. Terrorists would try to get on TV, and one way to get on TV is to kill somebody. But largely as a result of research and development efforts on the part of the West (which are meant to compensate for the very large Soviet manpower presence in

Europe), many powerful weapons have now been miniaturized to the point where they can be carried by a single individual. In the case of anti-aircraft missiles, for example, both the missile and the launcher can now be carried and set up and fired by an individual. As time goes on, I think we will see more and more of these kinds of weapons — particularly as terrorists get smarter and are able to identify the points of vulnerability in this massive, complex industrial system. One of the advantages of this kind of terrorist activity is that conventional large military systems can be bypassed.

But, quite apart from terrorist activities, consider what can be done peacefully through work stoppages. About 0.02 percent of the labor force handles all of the pipeline transport in the U.S.; water, steam, and sanitary employees come to 0.07 percent; petroleum refining — 0.2 percent; coal mining — 0.2 percent. If one were highly selective, the nation could be paralyzed if only a tiny proportion of the labor force chose to stop working.

So-called wars of redistribution are beginning to be waged by the poor countries, which are understandably becoming increasingly belligerent about wanting their cut of the world's wealth. They are recognizing that a broad assortment of economic weapons — as distinct from direct military action — are in their hands.

Lastly, we have the problem of the fragility of democratic institutions. In the past we have been able to afford procrastination in making decisions, because our wealth and our resources have been so vast. But if one looks at the time scale within which major decisions are going to have to be made throughout the world in the course of the next decade, we have to ask: Can our democratic institutions survive?

In this connection I think we must examine the following facts. Constitutional democracy is really not very old; it's about as old as the industrial state. It has disappeared in the greater part of the third world. The industrialized states of eastern Europe are totalitarian.

From the point of view of resources, the Soviet Union is independent, and will continue to be independent for its energy and mineral needs for the foreseeable future. It exports large quantities of natural gas and crude oil to other eastern European nations — many of which have become dependent upon it. Under those circumstances, who needs armies?

These, then, are some of the problems we did not talk about 20 years ago, or 10 years ago, which have surfaced (at least in my own mind) as a result of the recent actions of the OPEC states — in increasing the price of crude oil by a factor of four, and by the imposition by the Arab states of the oil embargo. □