

Chapter 22. TECHNOLOGY AND ENVIRONMENTAL DETERIORATION: INDUSTRIAL SOCIETIES

“The benefits of projects, to whomsoever they may accrue, must exceed the costs.”

U. S. Bureau of the Budget Circular, 1937

“What [Arrow's Impossibility Theorem] shows... is that there is no way of aggregating individual preferences for societies into a social preference that does not infringe on one of a number of perfectly reasonable requirements, for example that no one person be a dictator....

David Collingridge, 1982

I. Introduction

As we saw in the last chapter, a good case can be made that human impacts on, and enhancements of, ecological processes are ancient problems and possibilities. How are contemporary industrial societies different? The argument in this chapter is that industrial societies have escalated both our abilities to solve environmental problems and our abilities to create them. The jury is still out on whether on net industrial societies are better or worse environmental deteriorates than pre-industrial ones.

People from the long-civilized Old World are said to tend to view Americans as naive. American political culture is deeply affected by a 19th century idea, utilitarianism. Roughly speaking, this idea holds that if individuals are rational they can create collective institutions that, using scientifically based techniques, can solve virtually any problem. When rational means to solve problems fail, Americans tend to fall back on an even older traditional strain of thought, “fundamentalism.” We tend to blame the failure on people with selfish or evil motives. In other words, we tend to act as though any failure must be due to the malicious and intentional behavior of a person or group; seldom recognizing that even the ‘pure of heart and analytical of mind’ are sometimes wrong. Whether unique to Americans or not, this view is naive.

In this chapter, we'll review the theory that suggests that things are nowhere near this simple. We'll see that contemporary societies exemplify two inescapable difficulties in attempting to solve problems, what I'll call the “*problem of information*” and the “*problem of values*”. This does not mean that contemporary societies cannot solve their problems, only that they can only do so if they take account of these difficulties and find ways around them. In other words, there is no need to adopt a pessimistic fatalism about the contemporary problems of the world, but there is good reason to abandon fatuous optimism and the

tendency to view all problems as the result of evil intentions.

II. Specific Adaptive Challenges of Contemporary World¹

A. Modern Societies Confront Serious New Variants of Old Problems

You know the standard laundry list:

Food Production: People in many parts of the world are chronically near subsistence disaster. When economic, political, or natural catastrophes occur, massive numbers of them are often pushed over the brink.

Energy and raw materials: Maintaining and expanding industrial production requires stable access to affordable energy and raw materials. This threat has receded dramatically since the 1970s as commodity prices from oil to silver to wheat have plunged, but it will no doubt return. (As of today OPEC is failing to hold the line on oil prices. Before one gets too optimistic about the long-run availability of cheap gasoline, remember that something like half the oil left in the world is in the politically unstable and militarily vulnerable Persian Gulf region—Iraq's 1991 invasion of Kuwait vividly demonstrated this point.)

Population: Our very high and rapidly growing world population is approaching malthusian and/or ricardian limits. While some nations are terrified by the implications of this growth, others are dedicated to population growth.

Pollution: Threats from by-products of intense industrial and agricultural production appear to be worsening. Perhaps the most pernicious of these problems are the climatic changes that atmospheric scientists project will flow from fossil fuel combustion. The carbon dioxide released by fossil fuel combustion will double its concentration in the atmosphere over the next century or so. Since carbon dioxide is a "greenhouse gas", slowing the rate at which heat is radiated away from the earth without much affecting heat gain from the sun, this is likely to lead to climatic changes, including a temperature rise of several degrees, and a concomitant rise in sea level of many feet. The disruption to present settlement patterns and agricultural systems is liable to be massive.

Similarly, it appears that damage to the Earth's ozone layer by pollutants such as chlorofluorocarbons (CFCs)² may expose people to much larger doses of carcinogenic ul-

1. This is essentially a laundry list of problems about which most of you are reasonably familiar. We therefore will not go into them in great detail. The purpose of listing these problems here is to set the stage for the general analysis which follows.

2. any of a group of compounds that contain carbon, chlorine, fluorine, and sometimes hydrogen and are used as refrigerants, cleaning solvents, and aerosol propellants and in the manufacture of plastic foams

traviolet radiation from the sun.

Violent international conflict: The world is presently experiencing a reduction in the “normal” level of violence; the Iran/Iraq and Afghan/USSR conflicts are over and the threat of nuclear war between imperial superpowers seems to be substantially diminished. However, the risk of nuclear devices being used by a small group or nation appears to have increased with the loss of centralized control over the former USSR’s nuclear arsenal. Moreover, as the devastation of the Persian Gulf region showed, even conventional warfare can have catastrophic environmental consequences.

Poverty: In many countries, the per capita production of wealth is extremely low³. In even the richest nations, maldistribution of wealth between classes creates problems and maldistribution of wealth *between* nations is even more striking.

Race, ethnic, class, and national prejudices: Even the most economically advanced and pluralistic industrial states have serious problems with prejudice and conflicts between different racial, ethnic, and national groups. Ones serious enough to make the newspaper lately include the Catholic/Protestant conflict in Northern Ireland, Tamil/Sinhalese violence in Sri Lanka, the Intifada in Israel/Palestine, Basque terrorism in Spain, Latin American leftist revolts and terrorism countered by state “dirty war” tactics in Chile, Argentina, Peru, and Guatemala, Sikh/Indian conflicts, Armenian/Azerbaijan riots in the former USSR, conflicts between several ethnic and religious groups in Yugoslavia, fighting between Mujahadeen groups from East, South, and Northern Afghanistan, and the atrocity-ridden civil wars in Liberia, Lebanon and Angola. You can extend this list yourself. Of course, conflicts between whites, blacks, and “coloureds” in South Africa in many ways exemplifies this entire genre of problems.

Strong international interdependence, but weak international institutions: Even putting aside war-and-peace issues, international institutions are not very effective, and international affairs often tremble on the brink of catastrophe. Trade, debt, and monetary issues threaten economic collapse from time to time, and often catch particular nations and subgroups within nations in a cruel economic plight. American wheat growers and Latin Americans in general are recent victims. Perhaps the most dramatic recent example involves the collapse of the former USSR’s economic institutions. Perhaps the best positive note here is the recent growth in the United Nations’ stature following large-scale international cooperation during the Persian Gulf War.

3. Some examples of annual per capita Gross National Product in 1983: Switzerland=\$15,552; U.S.=\$13,492; Canada=\$11,535; Japan=\$9,149; Spain=\$4,774; South Korea=\$1,870; Turkey=\$1,125; Nepal=\$153; Ethiopia=\$147; Bangladesh=\$124.

In sum, a large number of problems of great scale face us at the close of the twentieth century. The inset on the following page is an essay written by Britain's Prince Charles regarding the 1992 Earth Summit. It illustrates many of the problems with which we are dealing in this chapter.

B. Modern Societies Have Unprecedented Means With Which to Solve Problems

We have access to more institutional, organizational, economic, and cooperative resources on a larger scale than at any time in the past. For example we have:

- a. Institutions for the development of science and technology such as universities.
- b. Rational government and private industry bureaucracies to apply science and technology.
- c. Rationalized markets with carefully administered flows of information and cheap transportation of people and goods.
- d. People with broader loyalties than in the past.

This latter point bears explication. Most modern states can normally count on a reasonable level of sentiment in favor of reasonable solutions to national problems. This was much less true a few centuries ago before nationalism became a powerful ideology. In Europe, loyalties remained primarily to one's village, city or district until the last few hundred years. In many places rather narrow loyalties are still the rule. "Tribalism" is much more important than nationalism in most contemporary African states, for example. And there is no guarantee that political loyalties will remain at the nation-state level, much less will expand; witness the various ethnic separatist movements in Europe and the West-Asia. Essentially, it seems that the scale at which we are able to solve public goods problems is limited by the scale of our loyalties.

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C. Given Such Powerful Means, Why are Our Problems Not Easily Solved?

Bad motives and stupidity do not create the world's problems. The frequent refrain of editorial writers that "If mankind can send a person to the moon, why can't we solve _____ (fill the blank with any modern problem) _____?" is instructive. But questions of this form are rooted in fundamental problems. As is the case with warfare, it is not just

simple bad motives and stupidity that create these problems. Rather the difficulty in solving these problems arise from (1) discrepant values; and (2) limited information.

Problems arise from differences in values between individuals and between groups. The essence of the “value problem” is that individual preferences vary according to each person’s system of values. This means that the **value** we place on a particular good or service reflects our own preferences and group loyalties—not necessarily what is best for humanity. In other words, even though humans engage in a great deal of cooperative activity, the scale at which they are willing to subordinate their personal desires in favor of group needs tends to be quite limited.

“Mankind” does not solve its problems⁴. Individuals and groups of various sizes and levels of cohesion solve their own problems, and in so doing often create problems for others. For example, the U.S.’s high interest rate policies of the 1980s were designed to correct our inflation; but they had a savage effect on countries that had borrowed too much money⁵ at high nominal interest rates. The idea here is that conflicts between people usually stem from deep causes, not from mere easily-corrected mistakes or simple evil intentions. Recall the problem of the evolution of cooperation in this context. The logic of the tragedy of the commons or of arms races is “out there” in the real world, not just a result of a few bad people’s selfishness. If our theory is correct, even if we begin with societies of saints, these kinds of dynamics would tend to bring us right back to the present set of problems after a few generations of cultural evolution. This not to say that there are no people who are just plain rotten. Rather, it is important to remember that the worst of us are only a small part of the problem, compared to more deep-seated problems associated with living on a limited planet.

Problems arise from limited information. It is hard to predict the future. Even the best science is limited. Climate modeler Steven Schneider describes the best attempts to predict the effects of CO₂ increase on climate as “a dirty crystal ball.” One reason many developing countries (and their bankers) got in such a desperate debt jam is that 10 years ago almost everyone expected commodity prices to keep on rising, and inflation to remain high. Borrowing billions of dollars at real interest rates of zero or less, against expected oil revenues at \$30/bbl and rising, seemed sophisticated to Mexican policy makers (for example). Take the ‘First World’ bank depositors for a ride, they could afford it! Then Paul Volker slammed on the brakes and OPEC lost control of oil prices and the potential value of Mex-

4. This is known as the fallacy of the collective singular.

5. which seemed like a quite sensible thing to do during the inflationary times in which the debts were contracted

ico's resources slumped. How can effective long term goals be achieved when unpredictable decisions can upset the most carefully thought out plans?

III. Two Fundamental Problems for Rational Problem-Solving

The problems of large-scale cooperation and environmental limits and the information problem challenge the ability of even the most sophisticated rational problem-solving institution. Let's examine them in more detail now:

A. *The Problem of Values—It's Human to Fight*

As an individual, family member, community member and national all humans hold somewhat unique values and expectations. We have already discussed this problem from the perspective of the evolutionary theory of cooperation and the game theory analysis of war. Social scientists often refer to a theoretical position, conflict theory, derived from Karl Marx in this context (Dahrendorf 1974). The main difference between the Darwinian approach and that of traditional conflict theory is that conflict theorists tend to take as given that conflicts occur mainly between groups, whereas Darwinians focus more on conflicts among individuals.

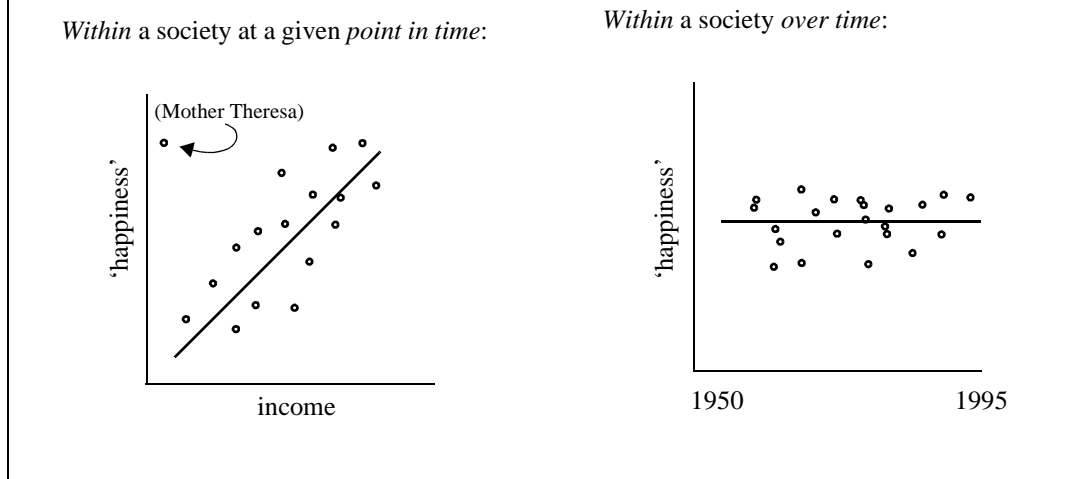
The basic problem is that because people all want the same scarce resources they cannot all be happy⁶. They want to satisfy their basic subsistence needs. They want love, respect, and social interaction. And they also want status and power.

Status, wealth and power are rather pathological if what we enjoy about them is having more relative to others. What is crucial to understand is that these needs are in part inherently impossible to satisfy for everyone because satisfaction comes from the degree to which one has *more* than one's fellows. Economist Richard Easterlin's (1976, 1995) empirical case that relative wants are just as real and perverse as in theory is illustrated in figure 22-1. What Easterlin did was to collect data on happiness in many countries at many points in time, as collected by standard polling techniques. It is quite typical in these surveys to find that wealthier people are happier. Modern industrial economies are growing rapidly, and making us all wealthier year by year. To the extent that industrial economies are mainly satisfying real desires for personally useful things, economic growth per capita should make us happier on average. But to the extent that it is merely satisfying relative wants, the rising tide will lift all boats equally, and on average no one will feel any better off. The data strongly support the relative wants hypothesis. A dramatic example is Japan. Since 1958, the Japanese income level per capita has expanded five-fold, from 1/8 of that in the US in

6. W.D. Hamilton referred to this problem as one of the main reasons to expect little cooperation in nature.

1958 to 2/3 of that in the US in 1987. Over that time the measured level of happiness in Japan has been dead flat! Other advanced countries in which many surveys are taken tend to have more ups and downs than Japan, but no evidence of any upward trend..

Figure 22-1. The problem of relative wants and relative satisfaction is illustrated by hypothetical plots. Here we compare the relationship between 'happiness' and wealth *within* societies at a particular point in time with the same relationship *within* societies or within a society *over time*. (Adapted from Easterlin 1976, 1995.)



This relativity of satisfactions hypothesis proposed by Easterlin may even extend to international comparisons (e.g., the “revolution of rising expectations” in Third World countries due to mass communications). People may not get much satisfaction from being absolutely better off, if people in other countries are still relatively better off. In other words, as we saw in an earlier chapter, people in many Third World countries are getting rich faster than the now-advanced countries ever did—largely because of the rapid diffusion of innovations. But they are also becoming literate, getting TVs, and finding how much worse off they are than Americans and Europeans⁷ The data as of about 1960 showed no significant trend as a function of GNP per capita. Nigerians were about as happy as West Germans, for example. However, by 1984, significant cross-cultural trends had appeared. People seem to have begun to make comparisons not just within their own society, but across all societies. When Nigerians start to watch television, they discover from movies and the like just how much better off Europeans really are, and perhaps vice versa. The Nigerians become less happy and the Germans more.

Another economist, Robert Frank (1985, personal communication), speculates that the communication revolution is having the effect of making most people in the world more

7. See footnote 3.

systematically *unhappier*. Suppose that the effect of cheap mass communication is to make everyone more aware of how well off, talented, beautiful, respected and so forth other people are. Even those of us who are quite comfortable will be reminded daily by celebrity stories and video images that there are people a lot more comfortable, talented, beautiful, and respected than we are. Before mass media, those of us in comfortable circumstances were happy big frogs in small ponds. Now we realize how relatively small our pond is. It could be possible that the mass communications revolution has had the effect of massively deflating relative wants.

Note that the Easterlin-Frank hypothesis is an exceedingly radical challenge to the very foundations of modern industrial society. President Jimmy Carter discovered the danger of tampering even marginally with the sacred principle of modern politics that economic growth is good. Virtually every world leader promises economic growth, and attempts to deliver. The Soviet Empire fell because Communism couldn't deliver economic growth. Only the Pope and a few other old-fashioned and hippy-environmentalist romantics have dared to question economic growth. Yet the argument of Easterlin and Frank is from the hard-headed school of modern economics. Above some apparently rather low threshold, all economic growth appears to do is to give individuals temporary satisfactions of envious desires. When I get my new car it gives me great pleasure to have the nicest one among my friends and gloat on their envy. But then it fades a bit, and one day Jones comes home with a shiny new one and it is my turn to suffer the pangs of envy. This makes economic growth much like the Red Queen idea, or like an addiction. We feel each increase in our paycheck as a pleasure, not understanding that the rising tide of economic growth will soon cause us to demand another fix. The economy must run faster and faster but all it does is keep us all at the same level of happiness. Or we can fall behind merely by knowing more about the bigger fixes of others.

Partly because of intense competition, groups of people specialize with respect to how they satisfy goals. To some extent, they even specialize in *which* goals they select. These groups are sometimes culturally endogamous units, and therefore might be subject to some measure group selection. At any rate, they seem to be foci of cooperation⁸. This tendency is particularly marked in modern societies where we have many interest groups. Conflict between these groups becomes highly organized, and is often highly rationalized as well. These groups often employ some type of technology (e.g., armies; opinion polls) in their conflicts.

8. For a solid introduction to this suite of problems, see Olson's (1982) *The rise and decline of nations: economic growth, stagflation, and social rigidities*.

What we see is humans using rational means and the tendency to cooperate to solve problems at the individual, group, and sometimes even national scale. Seldom however, do we find humans using their potential to solve the problems of humanity. Our loyalties to nations, ethnic groups, co-religionists, etc. shift the scale of conflict, but do not eliminate it. As we saw in the case of war, conflict can arise in certain situations for quite sensible but perverse reasons. The logic of arms races can lure us forward—in spite of our attempts to behave in an objectively rational manner. This, of course, is problematic because we are moving rapidly toward a global community; increases in population, improved transportation and communications technology, and the emergence of a global economy all cause ‘local’ problems to be felt by more people than ever before.

B. Problem of Information—It’s Human to Err

Rational calculation has clear limits. Fundamentally *unpredictable* events such as the random nature of weather, earthquakes, stock markets, wars, and whims of important political figures have important consequences. Even events that are potentially predictable may not yet be scientifically understood; this sometimes makes them hard to separate from the last category. Moreover, information is costly—almost all decisions are made with less than the maximum conceivable amount. You are quite familiar with this argument by now; the high cost of learning (or scientific research, to take a more sophisticated example) is quite fundamental to explaining human behavior. Problems associated with informational deficits are aggravated by intentional deception on the part of governments, businesses, and various interest groups (e.g., “disinformation” campaigns by government intelligence agencies, misleading advertising, political campaign propaganda, etc.).

IV. Organizing Rational Solutions to Social Problems

There are two fundamentally different rational approaches to solving large-scale social problems, market rationality and plan rationality. Each approach uses a different scheme for organizing critical social interactions⁹.

A. Market Rationality

Markets are organized around an institutionalized set of rules that govern interactions between individual rational actors, allowing them to collaborate in exchange transactions for their mutual benefit. Much of American and British economics deals with the workings of (idealized) markets. Although we generally associate the concept of “market” with financial and business transactions, market models of the political process in democratic legislatures have also been extensively analyzed. Liberal democracies, at least, create

9. discussion borrowed from Dahrendorf (1968:ch. 8)

a “market” in which the commodities are votes and influence. Economic and voting markets have in common that society's decisions are the aggregated outcome of individuals' expressions of their preferences.

One of the key advantages of markets is that individuals get to express their own preferences (which are based upon personal value systems) directly. Markets enable very elaborate and efficient flows of information between producers and consumers via price signals. No one person needs to know very much about the details of what is going on, just the price. Anarchy works.

One of the important disadvantages of markets has to do with the values upon which market rules are based; fair rules are hard to agree upon. In extreme cases, there is a systematic distortion of price by powerful interest groups. Moreover, people may create and participate in “black markets” in sex, drugs, slaves, guns, etc. that are inimical to the common good. In fact, this is the public goods problem in another disguise. Here public health and well-being is the ‘good’. As the “tragedy of the commons” illustrates, people or groups expressing their individual rational preferences can cause collective catastrophes.

Public goods problems are one of the best-studied examples of market failure. As we've seen before, this problem is closely related to the problem of cooperation and altruism. The benefits and/or costs of some goods inherently accrue to the group rather than individuals. In these situations where everyone enjoys what one person buys (union dues, military service, air pollution control), people tend to hang back, hoping someone else will pay. As the selective service (draft) records of several recent Presidential candidates indicate, cheating is hard to control in these situations. As a result, public goods are under-provided by markets and require us to employ strategies such as coercive collection of payments (taxes, dues) and collective provision of benefits.

Markets also have information problems. It is hard to set up markets for goods that individuals use in very small quantities. For example, it is difficult to negotiate the opportunity to fish in a river once in awhile vs. the opportunity to pollute it all the time. In these cases, the bargaining costs are too high since every polluter cannot bargain with every fisherman. Perhaps even more important, it is hard to represent future generations; we are uncertain about their preferences, and they are not around to bargain for themselves.

B. Plan Rationality

Non-market economies attempt to organize a collective, rational attack on problems, rather than depend on the individualist anarchy of markets. As was just discussed, markets clearly fail to solve many kinds of public goods problems. Collective, plan-organized solu-

tions clearly prove superior in certain cases. Under plan rationality, collective bureaucratic institutions are created that identify goals, collect information, develop and evaluate plans, then choose and implement those plans that provide the greatest benefit for the most people. At least this is usually their initial intent.

Plan rationality has the obvious advantage of being theoretically able to escape the kinds of selfish rationality that can lead to obvious disaster. We can organize ourselves to make collective decisions on behalf of the whole group and evade the problems caused by the myopic rationality of individual decision-makers in markets. The problem of free riders or cheaters can be controlled by legitimate coercion (taxes, dues, fines), so long as we can decide what is legitimate. This approach is also more efficient for organizing and processing information on a larger scale that allows the rational consideration of problems that affect many individuals slightly.

One of the key disadvantages of plan rationality has to do with the valuation of individual preferences. It is very hard to aggregate value preferences in order to arrive at general goals. In welfare economics this is referred to as the Social Decision problem. For example, is it fair to compare anyone's values with anyone else's? How can we say 10,000 white water kayakers do or don't enjoy their sport more than 1,000 farmers enjoy cheaper water? How do we make such policy decisions? The Italian economist and sociologist Vilfredo Pareto (1848-1923) examined this problem and developed the concept of "Pareto optimality" which refers to the point at which an increase in public goods for one person or group would make another worse off. His idea was that we should do anything that will make someone better off without making anyone else worse off. This is a nice, but impractical, idea since many of the most pressing problems with which we are faced require that some bite a bigger bullet than others. The essay by Prince Charles of Britain provides several examples of this problem.

The problem with plans is that they must almost always conflict with someone's values. Plans are therefore likely to be made in the interest of the stronger party, unless political power is equally distributed (and it never is). Even if goals can be developed, planners may not try to achieve them, as the USSR's central planning demonstrated, they often pursue their own interests instead¹⁰. Utopian goals can easily lead to tyranny. Economist and Nobel prize winner Kenneth Arrow showed that rational dictators lead to *formally* rational societies. Plato proposed a similar rationalist solution long ago. The obvious trouble is that benevolent, rational dictators are hard to come by. If we try too hard for rational societies,

10. In this putatively most equal of all societies, *aparatchicks* (bureaucrats) became the new aristocracy with their own stores, schools, resorts, and even traffic lanes in major cities.

dictatorships may be the result¹¹. Arrow also showed that social decision-making could be rational if everyone has the same preferences.

The problem of formulating acceptable rules for aggregating individual preferences to reach social decisions was also analyzed by Arrow -- he termed it the "Voting Paradox".

Table 22-1. An example of a public goods problem about what, if any, type of dam should be built on a currently pristine river. The preferences of three different interest groups are given.

| <i>preferences</i> | Fishermen & River Runners | Wild River Enthusiasts | Farmers |
|--------------------|--------------------------------------|-------------------------------|-----------------|
| A. Small Dam | 1 st | 3 rd | 2 nd |
| B. No Dams | 2 nd | 1 st | 3 rd |
| C. Big Dam | 3 rd | 2 nd | 1 st |

As you can see from Table 22-1, there is no happy middle ground that will please all three interest groups. If all three were equally influential¹², it would be difficult to identify a compromise position at all. Now, suppose we use voting to determine what society prefers (see Table 22-2).

Table 22-2. The problem of ranking preferences.

| Society Prefers | Should Therefore Logically Prefer | But Society Actually Prefers |
|------------------------|--|-------------------------------------|
| A to B & B to C | A to C | C to A |

What does Society prefer??? In this case society is irrational, and intransitive¹³. Arrow demonstrated that this is a general theoretical problem (e.g., markets have the same general problem); in general it is not possible to find a decision-making rule to aggregate the rational preferences of individuals and still maintain standards of rationality with regard to social choice. Arrow (1963) argued that there is no ethically acceptable way to anticipate and prevent this problem. For example, the problem can be solved if we allow a dictator to make decisions for society, but this, says Arrow, seems like a solution that is worse than the problem. No successful challenge to Arrow's reasoning has yet been found (Collin-

11. Or is it that societies are prone to the rise of dictators when the irrationality of social decision-making becomes too extreme?

12. Fat chance in California with the powerful agricultural lobby!

13. Remember the transitive rule from algebra? "A binary relation \sim on a set S is **transitive** if, for all $a, b,$ and c in $S,$ whenever $a \sim b$ and $b \sim c$ then $a \sim c$ (Clapham 1990:177)."

gridge, 1982). So much for the optimality of Vilfredo Pareto!

For an empirical example of how voting on the basis of individual rationality can lead to collectively irrational results see Ferejohn's (1974) analysis of porkbarrel politics in rivers and harbors legislation, especially his last chapter. Interestingly, the direct empirical work on Arrow's paradox is very thin. Perhaps because few economists stoop to collecting data and few political scientists are comfortable with Arrow's level of abstraction, no one has been attracted to the problem.

V. Conclusion

The improvements in rationality developed in the course of the rise of industrial civilizations are indeed revolutionary. They have proven excellent tools for solving *some* of the problems that plague commercial-industrial societies, such as epidemic disease. However, industrial societies have also exacerbated old problems, for example by applying science and industrial techniques to warfare, by becoming extremely dependent on non-renewable mineral resources, by generating geochemically significant amounts of trace gases like CFCs and carbon dioxide as pollutants, and so forth.

If the theory reviewed in this chapter is correct, there is a fundamental continuity in the problems of modern and ancient societies. There is no obvious "solution" to the value and information problems. The limitations of cooperation and social decision-making seem to be quite fundamental arising, as they do, from selfishness at the level of the individual, family, community, nation or even species¹⁴.

If markets and market-like political mechanisms ("democracy"), and planned solutions ("socialism") do solve the particular problems of the modern world it will be because of hard, careful, scientific, managerial and political efforts that *finesse* the fundamental problems rather than "solve" them. That is, by careful attention to detail and a little luck we can probably evade the worst consequences of value and information problems in most particular cases. Furthermore, conformist effects that make individuals more homogenous in terms of their basic values (see Chapters 11 & 12) can perhaps help in reducing conflict and stalemate. But there is not likely to be a scientific or moral breakthrough that will allow us to solve them in principle.

14. Species included, because we do things to other species (experiment on them, eat them) that we cannot countenance doing to our own species.

VI. Bibliographic Notes

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