Letters

Retirement Age for Chinese Scientists

In Marjorie Sun's article "China plans sweeping reforms in science" (News and Comment, 3 May, p. 559), there is a sentence which reads "[Zhou Guangzhao] says the [Chinese] government is now trying to 'weed out old scientists' by offering them early pensions." I am sorry to say that I never made such a remark, since it runs entirely against the policy now being pursued in China.

There are very few scientists in China and even fewer experienced old scientists. We always try our best to bring the scientists' role into play. In China, the retirement age limit is 60. In the Chinese Academy of Sciences, according to regulation, scientists may retire from a leading position, such as institute director, at the age of 65 and from an ordinary administrative position at age 60. After their retirement from administration, scientists can continue to pursue their research. Those scientists who hold the title of professor or the equivalent can work in laboratories until age 70; associate professors or the equivalent can work until age 65. A few scientists who have made special contributions can work even after age 70 without an age limit if their health permits.

This policy was made under the conditions of China. It will guarantee that old scientists conduct scientific research better while young scientists make much more progress.

Thus one may see that the Chinese government does not want to reduce the number of old scientists by offering them early retirement. Instead, it tries its best to bring their role into full play by offering them late retirement.

At present, the Chinese government and the whole society of China have attached great importance to respect of knowledge and scientific personnel in order to increase the intellectuals' role. The treatment and status of the Chinese scientists have greatly improved. With the development of economic construction in China, the role of scientific and technical personnel will be brought into even fuller play in the years to come.

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As the article reported, the Chinese leadership including Zhou are trying to advance "vigorous young and middle-aged people" to active positions in the country's scientific enterprise. Zhou himself in a *Beijing Review* story said that "A task of top priority is to bring into full play the initiatives of the 45- to 55-year-old researchers" and that achievers should be promoted to senior positions.—MARJORIE SUN

Energy and Economic Activity

Cutler J. Cleveland *et al.* (Articles, 31 Aug. 1984, p. 890) imply that they have revealed an important new relationship. They postulate a causal linear link between the consumer price index (CPI) and a variable defined as the ratio of total U.S. money supply to fuel use.

These factors are tightly linked through more obvious relationships. Money demand is itself a function of the price level, its rate of change, real gross national product (GNP), and interest rates. Demand for fuel is a function of real GNP, the relationship of fuel prices to the general price level, population levels, and technology.

The consumer price index, of course, includes a fuel price component, and CPI variation responds directly to variation in its energy price component.

The CPI = $\alpha + \beta^*(M2/Qf)$ relationship is poorly specified by Cleveland *et al.* (M2 is a money stock measure; Qf is fossil, nuclear, and hydropower energy; and α and β are estimated regression coefficients.) Its implication, if correct, would be that subsidizing fossil energy use and nuclear power would reduce inflation and increase economic welfare. This is an illogical interpretation. Overall, the article properly draws attention to the problem of the global economy's interaction with finite fossil energy resources.

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I like the approach taken by Cleveland *et al.* in their article "Energy and the U.S. economy: A biophysical perspective," but I wish they had included the full spectrum of energy inputs to the U.S. economy in their analysis. Their article neglects several forms of solar energy formerly of great significance—most important, fuel wood and work animal feed. The two greatest fuel substitutions in U.S. history were those of fossil fuels for fuel wood, largely completed between 1850 and 1910, and the substitution of distillate motor fuels for work animal feed, largely completed between 1920 and 1950.

In 1850, fuel wood and work animal feed together contributed 86 percent of the energy input to the United States. Forty years later (the earliest year studied by the authors), their contribution had dropped to 49 percent, and after another 90 years it had dropped to about 2 percent (*1*). The economic significance of fuel wood and work animal feed in the early 1800's was just as great as the economic significance of fossil fuels in the late 1900's.

Cleveland *et al.* suggest there was little reduction in the ratio of energy to GNP ratio between 1890 and 1980. The facts are otherwise when the full spectrum of energy inputs is considered. The correct figures are as follows.

Year	Energy/GNP (*4*)
1890	17.6
1895	16.3
1900	15.7
1905	16.4
1910	16.1
1915	16.6
1920	17.3
1925	13.8
1930	14.0
1935	13.0
1940	11.7
1945	9.5
1950	10.1
1955	9.4
1960	9.4
1965	8.8
1970	9.5
1975	8.4
1980	7.5

From 1890 through 1920, fossil fuels were being substituted for fuel wood with essentially no change in the efficiency of furnaces and stoves. During this period the energy/GNP ratio remained roughly constant. From 1920 through 1950, distillate fuels (and internal combustion engines) were being substituted for hay and oats (and work animals). Because internal combustion engines are much more efficient than work animals, the energy/GNP ratio dropped nearly 2 percent annually during this 30-year period.

An increasing proportion of the efficiency improvement between 1920 and 1950 should be attributed to electrification. Progressive electrification of the economy, with combustion of fuel in electric power plants displacing direct combustion of fuel for illumination, mechanical work, and high-temperature heat, has been the major energy substitution since about 1940. Because electric power is more efficient than direct combustion for these applications, the energy/GNP ratio continued to drop nearly 1 percent annually through 1980.

Consideration of the full spectrum of energy inputs to the U.S. economy shows that the energy/GNP ratio was cut in two in the 60-year period from 1920 to 1980, a triumph of energy conversion technology.

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References and Notes

1. J. C. Fisher, *Energy Crises in Perspective* (Wiley, New York, 1974).
2. *Historical Statistics of the United States, Colonial Times to 1970* (Bureau of the Census, Washington, D.C., 1983).
3. *Statistical Abstract of the United States: 1984* (Bureau of the Census, Washington, D.C., 1983).
4. Energy/GNP is measured in 10^{13} Btu's per billion 1958 dollars. The energy consumption values include contributions from coal, petroleum, natural gas, fuel wood, work animal feed, direct wind and water power, hydroelectric power, and nuclear energy. Values for the years 1890 through 1970 are from (*1*). Values for 1975 and 1980 are from (*3*) incremented by 2 percent to adjust approximately for recent consumption of fuel wood. GNP values are taken from (*2*) and (*3*).

Chapman is correct in saying that our analysis of inflation is similar to a monetarist position, which emphasizes the money supply as a primary determinant of the price level (although we hasten to add that we do not necessarily advocate other "monetarist" positions or programs). What our approach does add to the analysis of inflation is that it contributes to an understanding of how the money supply and energy use (through its influence on GNP) combine to influence prices. Rising energy prices and increasing energy scarcity discouraged energy use in the 1970's. Economic growth declined, due in part to a decline in labor productivity brought about by lower fuel use per laborer. The money supply, however, continued to increase during the 1970's, while for various reasons both fuel use and output stagnated for the first sustained time in decades. Thus an increasing money supply, which formerly had been associated with increasing fuel use and output, now only increased inflation rather than increasing output. We agree with Chapman that our equation in note 35 could be better specified. We could replace *P* (price level) with the independent term IFEP (inflation from an energy perspective) in that equation. We then could compare the model-derived IFEP (lines) with the empirical CPI (dots), as shown in our original figure 5. Finally, there is nothing stated or implied in our analysis to suggest that subsidizing nuclear power or any other energy source would decrease inflation.

Fisher correctly notes the importance of solar inputs to our economy. Our inclusion of these solar energy sources raised some empirical problems, and we decided to omit them in our final article. Also, one of us addressed this issue in a previous article (*1*). When we did include fuel wood, it slightly, but not significantly, improved the results of the regression analyses. Essentially, biotic fuels were progressively more important before 1920 and after 1973. Including them "lifts" both ends of our original figure 3 (the energy/GNP ratio), making those lines relatively straighter and, in a sense, adding a bit more support to our first hypothesis.

That Fisher does not address one of our major points is reflected by the data in his table, which are not corrected for differences in fuel quality. The changes in ratios suggested by Fisher are exaggerated because they do not include a quality factor representing the relative efficiencies of different energy sources. A horse and a tractor both operate at about 20 percent efficiency when they are working, but a horse must be "fueled" for 24 hours a day, 365 days a year, even if it is used only 6 hours a day during the plowing season. Our analysis highlights the pitfalls of drawing conclusions from uncorrected energy/GNP sources.

We did emphasize the importance of the quality of electricity in our article, but pointed out that much of what is often attributed to "triumphs of technology" can be attributed equally to (i) increased fuel use, (ii) increased fuel quality, and (iii) shifts in relative fuel use between intermediate and final demand sectors. This was the point of our fuel efficiency section. Such concerns would be academic if it were not for the impending (we believe) sharp decline in the production rate of U.S. liquid and gaseous petroleum, probably necessitating a switch to lower quality coal or oil shale. Ceteris paribus, this could *raise* the uncorrected U.S. mean energy/GNP ratio again. Alternatively, should some large-scale, reasonably cheap source of electricity be developed, and the means to use its high quality implemented, the ratio might continue its downward trend. Meanwhile other components of energy efficiency might also change—for example, we expect to see continued declines in household fuel use, improvements in manufacturing efficiency, and continued declines in extraction efficiency as we exhaust our highest quality resources. These points are thoroughly covered in (*2*).

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1. R. Costanza, *Science* **210**, 1219 (1980).
2. C. A. S. Hall, C. J. Cleveland, R. Kaufmann, *Energy and Resource Quality: Ecology of the Economic Process* (Wiley, New York, in press).

Language

If the following lines are printed, some of my many friends in science will conclude that my long-predicted descent to crotchety triviality has been completed. Of that I am afraid; but altruistic concern for our journal has given me a robust (useful word, that) shield against the fear.

There is no such thing as a "quandry," except possibly as a neologism for a quantum laundry [where, presumably, WIMP's (Research News, 6 Sept., p. 955) may be cleaned up]. The word meant in Mitchell Waldrop's otherwise superb piece (Research News, 20 Sept., p. 1251) is surely "quandary."

Whether or not whatever spelling software now used in the editorial offices can be laundered, I plead for *Science* to try ever harder, in the face of declining language-consciousness everywhere else, to maintain its traditional high standards. This journal has been a strong point of defense against claims from the Other Culture that scientists care even less about language than those Others.

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Erratum: In the briefing "Plants can be patented now" by Marjorie Sun (News and Comment, 18 Oct., p. 303), it was incorrectly reported that the American Type Culture Collection does not have the facilities to accept plant genetic material. The depository did not have that capability when Molecular Genetics Research and Development Limited Partnership filed its patent application for a genetically engineered corn plant, but it has the facilities now.