

The CO2 Newsletter, created, published, and edited by William N. Barbat, ran from 1979 to 1982.

In 2025, the family of Mr. Barbat donated an original set of all issues to Dr. Marc Hudson, and agreed that these could be digitised and placed online as a resource for anyone who wants to understand how long we've known about the carbon dioxide and global warming problem.

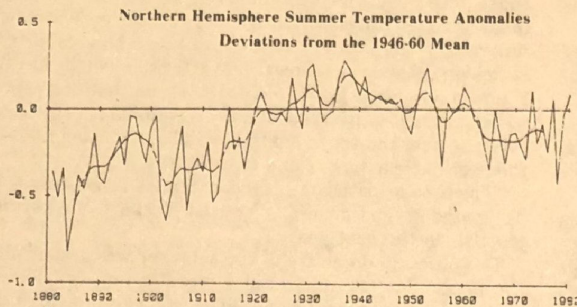
CO₂ Newsletter

Volume 2, Number 3

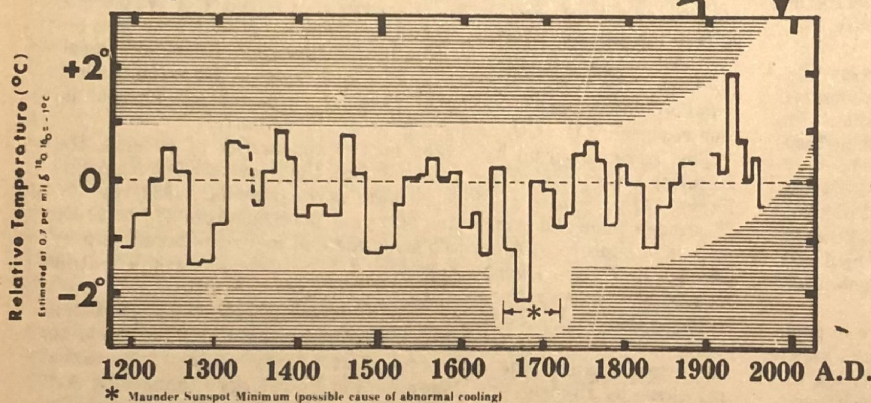
February - March, 1981

A bimonthly summary of advances in knowledge of the CO₂-greenhouse problem, and of the social, political, and economic implications.

Warming Trend Resumes



Paleotemperatures - Northwest Greenland



Meteorological observations of the upper graph show that the brief post-1940 cooling trend has apparently bottomed out to herald the resumption of the long-term warming trend. This trend is evidenced over the last two centuries from measurements of oxygen isotope ratios in the Camp Century, Greenland, ice core by W. Dansgaard and associates (lower graph). Some workers have speculated that large-scale forest clearing started a man-made CO₂ buildup prior to large-scale use of fossil fuels.

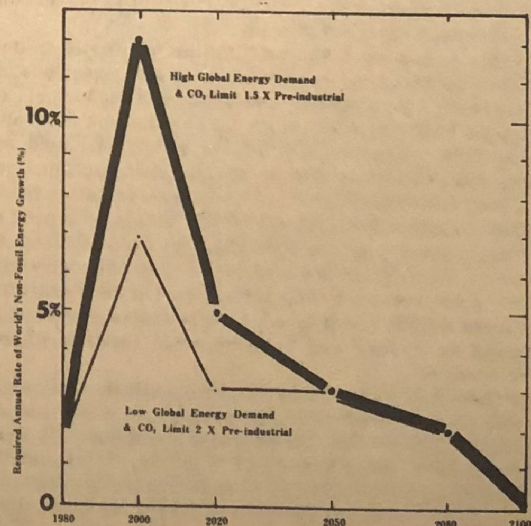
The chart of summer temperatures in the Northern Hemisphere appeared in the June-August *Climate Monitor*. Authors P.D. Jones and T.M.L. Wigley noted that "there is some evidence for slight warming in the 1970s, heavily disguised by marked year-to-year variability," and that "If a binomial nine-weight filter is used to obtain long-term trends (dashed curve) then the summer and annual values have a correlation coefficient of 0.94."

Northern Hemisphere temperatures exhibit much less thermal inertia than the Southern Hemisphere due to the much smaller oceanic area in the north. Warming rates as high as 0.4°C per decade have occurred in the Northern Hemisphere in the recent past. Without exceeding this warming rate, any CO₂-induced warming could theoretically cause mean Northern Hemisphere temperatures to surpass the warmth of the 1930s (which is thought to have caused widespread drought in the U.S. and southern Eurasia) in a decade and could surpass the estimated 1°C higher temperatures of the last Interglacial age (when sea level was about 6 m higher than present) by the year 2005. The contribution from the Greenland icecap to that sea level rise is not known.

CEQ Recognizes CO₂ Threat

On January 13, 1981—one week before a change of Administrations—The President's Council on Environmental Quality, Gus Speth Chairman, released a report entitled *Global Energy Futures and the Carbon Dioxide Problem*. The report contains a recommendation to "Assign a High Priority to Incorporating the CO₂ Issue into U.S. Energy Planning."

The council developed a model for examining the energy policy implications of a range of reasonable fossil-fuel use scenarios capable of holding atmospheric CO₂ at certain ceiling levels. The accompanying graph derived from their Table 2 shows that the critical period for non-fossil energy growth is from now to 2000 regardless of the targeted ceilings or selected energy demand scenarios. Also the model shows that the non-fossil energy growth which could halt CO₂ at two times Pre-industrial and supply 'Low Energy Demand' (that provides an assumed stable population of 8.5 billion in 2100 with only 1/3 the present per capita U.S. energy use) is more than half as much as the non-fossil energy growth which could halt CO₂ at 1.5 times Pre-industrial and supply 'High Energy Demand' (that provides an assumed stable population of 10 billion in 2100 with 2/3 the present per capita energy use.)



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"Our grand business is, not to see what lies dimly at a distance, but to do what lies closely at hand."

— Thomas Carlyle

Editorial

In recent years the public has become subjected to 'managed' scientific information which has negated the value of knowledge arrived at in a truly scientific manner. Also a realization is setting in that 'Science, the Servant of Mankind' may differ from 'Science, the Business Enterprise' which depends on governmental sponsorship. The CO₂ problem in particular has suffered.

On May 9, 1977, *The Oak Ridger* newspaper reported that over 250,000 booklets, pamphlets, and folders had been ordered destroyed by Edwin Stokely, assistant director for communication services of the ERDA (predecessor to DoE) Office of Public Affairs in Washington DC on April 14. Stokely was quoted as saying that the materials on spent nuclear fuel recycling, reprocessing, plutonium recycling, and nuclear breeder development "contain incorrect information" and that the disposal (by shredding) was intended to agree with the energy policy of the then new Administration.

Stokely later explained to *Nuclear News* that all materials that emanate from his department must be correct in "current information both from policy and technological standpoints"—and he stated that with the new Administration's policy announced, every item proclaiming the breeder reactor to be a major ERDA energy priority was made incorrect.

Subsequently, Alvin Sweet of the Chatanooga Section of the American Society reported, "In May 1980, one of our members requested brochures from DoE on nuclear (energy). He was sent three huge boxes of solar literature . . . A call to DoE in September 1980 revealed the following: DoE has no brochures on nuclear."

The goal of 'Science, the Business' may become economic survival either by feeding back information that political sponsors want to hear, or by avoiding implicit ethico-scientific responsibilities, as Edward Friedman has put it, "to maintain a position of objectivity which will help them avoid the pressure to bend their scientific conclusions to accommodate political views."

Editorial staffs of widely circulated scientific magazines are in position, if they so choose, to 'filter out' articles that offend particular viewpoints and to boost favored views by inviting only certain articles. Indeed, a surprising number of scientists of our acquaintance assert that deliberate filtering with bias has occurred frequently in certain prestigious magazines both here and abroad.

One concrete example has been the proliferation of relatively undisciplined articles supporting the conjecture that great continental masses are actively moving in relation to each other, and the virtual exclusion of rigorous technical articles which point out some very apparent fallacies in this conjecture. To fill the reportorial void so created, geologists John C. Holden and Jeannette Nielsen originated the 'International Stop Continental Drift Society' whose privately sponsored, entertaining and educational *Newsletter* is circulated among a few avowed skeptics and more not-too-sure followers of the drift idea.

Readers of the *CO₂ Newsletter* are also aware that this privately sponsored publication was created to fill a serious void in the literature. The CO₂ problem lacks a lobby and it invades the sensitive area of political decision-making on energy and environmental matters where large budgets are involved.

In recent years there has also been a rise of subjectively motivated scientific material. Defending such motivation in an article in *Technology Review* February 1979 entitled, 'Subjectivity and Science: A Correspondence About Belief', author Vince Taylor stated, "I have no desire to deny that my views of the world influence my work. By drawing on all of my perceptions of the world, I believe I obtain a more complete

and coherent view of the world processes that are unfolding than would be possible if I limited myself only to information that I process intellectually and analytically. In a sense, I *work backwards* from my overall view of the world to the specifics of a given problem." Taylor reportedly helped develop the economic rationale used to re-direct the U.S. nuclear power program away from burning up fissionable plutonium in conventional reactors, to be disposed of as waste.

Another set-back to scientific objectivity has been the injection of the adversary system (the object of which is victory, not truth) on a large scale into scientific debate. A disconcerting example of such an abuse of the scientific system is represented by the attacks on Herbert Inhaber's study of comparative risks of energy systems. Richard Saltus reported in the *San Francisco Examiner* November 6, 1979, one such attack on Inhaber as follows: "An attack unusually savage for a scientific forum was made [in Palo Alto] on the author of a report that calculated the overall health risks of unconventional energy sources—including solar electric and space heating, wind and alcohol fuel—as greater than those of nuclear power and natural gas.

"The tone of criticism . . . was defended as necessary by _____, who has hounded the Canadian physicist Herbert Inhaber through scientific journals in the past year. . . ."

The ultimate objective of the attacker was apparently not to protect the public health, but to aid a moratorium on nuclear fission and to substitute government-financed or -subsidized energy alternatives that would employ many persons at academic institutions. Subsequently the attacker in this case strongly promoted a greatly accelerated nuclear fusion program of which his university is one of the largest beneficiaries.

Without detracting from the long-range need for fusion energy as an alternative to CO₂-producing energy, we must point out that at best, the introduction of practical fusion energy is expected to arrive too late to help the anti-Co₂ effort when non-fossil energy growth is seen as being most critically needed. Nuclear fission appears to be the only feasible large-scale energy alternative during the critical near-term period. Funding of fusion research should therefore not be at the expense of fission research if the CO₂ problem is to be solved early.

The fusion program has taken on the appearance of 'Science, the Business Enterprise' rather than 'Science, the Servant'. The magazine *Fusion at the Frontiers of Science and Energy* (February 1981) reports: "Fourteen thousand Americans last year invested from \$75 to \$1000 each in the future of America's scientific and industrial leadership by joining the *Fusion Energy Foundation*, the nation's largest scientific membership organization.

"With this kind of clout, we waged a vigorous educational campaign nationwide and on Capitol Hill, culminating in what Congressman Mike McCormack called 'the most important energy project undertaken anywhere by anyone'—the Magnetic Fusion Energy Engineering Act of 1980. As the first national organization to support an Apollo-style fusion program for America, we and our 14,000 members are proud to take credit for creating the environment in which Congress and the president have mandated fusion as the energy source of America's future."

To get a better understanding of the CO₂ problem in time to be of much help and to initiate effective countermeasures in timely fashion, a concerted re-dedication to scientific objectivity is called for. Moreover, it is important to note that the U.S. taxpayers have been very generous in the past in supporting what they perceive as 'Science, the Servant of Mankind', but they tend to tighten the purse strings when they feel they are getting the Business.

CORRECTION

On page 5 of Volume 2, Number 2 (Dec. 1980-Jan. 1981) we erred in the dates at the bottom of Figure 6. The dates should read the same as the adjacent figure to the left.

We attribute this lapse to the fact that we were busily patting ourselves on the back for having caught the following error before it slipped through:

"Another contributing factor to insect outbreaks would be changes in winter temperatures and snow cover."

On Beyond Neo-Hypsithermal

Analogs from earlier warm climates are necessary for predicting climate changes that may accompany a CO₂-induced warming and to provide verification of mathematically-based climate models.

The Hypsithermal (Altitheermal) Age of 4000 to 8000 years ago provides an analog only for temperatures slightly elevated from the present. Hence, the Neo-Hypsithermal might be produced by a continued CO₂ buildup before the Hypsithermal paleoclimate is completely understood.

A brief period with temperatures elevated possibly only 1°C above Pre-industrial occurred at the height of the last Interglacial, about 120,000 years ago. This has served as an analog primarily for estimating a slightly elevated ocean (plus 6 m). No syntheses of paleoclimatic conditions even on a regional scale are available for that age.

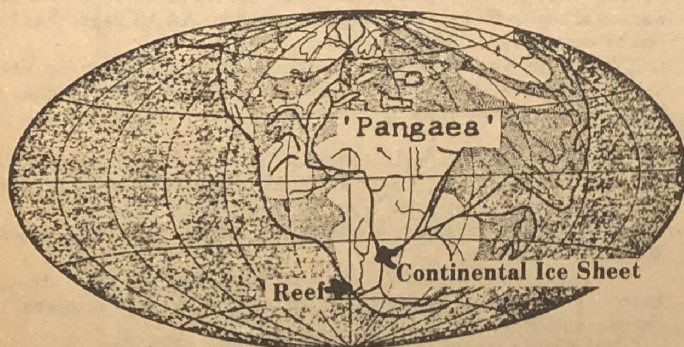
To find climatic analogs corresponding to the warmth of a doubling or quadrupling of CO₂ requires searching much farther back in geologic time. The utility of such analogs cannot be established until the relative positions of continents, oceans and poles of rotation are determined. Central to this problem is a need to resolve the deep (and sometimes heated) conflict over the conjectural drifting of continental masses.

Widespread support of the drift hypothesis stems from the irresistible observation that continents' shapes could fit together like pieces of a jigsaw puzzle. The commonly advanced explanation is that a single supercontinent ('Pangaea') remained intact for more than four billion years and then began to float apart as big 'plates' about 130 million years ago (early Cretaceous). The extremely huge lateral driving force (which so far lacks any acceptable quantification) is supposed to be translated from the vertical forces caused by slight density differences due to differential heating (convection) below the crust. Supposedly continuous upwellings of fluid rock in mid-ocean split great crustal masses apart repeatedly, leaving upon cooling vertically bounded homogeneous slabs of rock which have recorded the earth's magnetic strength and polarity in the form of symmetrically distributed stripes astride the 'split'.

Critics of drift note that the many holes drilled into rocks of the deep oceans instead have found horizontally layered rocks (mostly submarine basalt flows) which become increasingly older with depth, and which have recorded the flip-flops of the earth's magnetic field within extensive horizontal sheets rather than long, vertically-bounded slabs. Apparently for convenience in supporting the drift hypothesis, the drill holes have penetrated only to basalt flows of the desired age, which dating has then been termed the age of the 'basement' even if the basalts are intercalated with beds of limestone.

Non-drifters also cite numerous localities where fossil-bearing marine sedimentary rocks of Paleozoic age have been found *in place* on the ocean floor along the mid-Atlantic Ridge. Much more information on an extensive mid-Atlantic subsea outcrop of limestone containing Ordovician trilobites and graptolites is expected to be published soon as the result of work by a non-U.S. research vessel.

The dispute over active drifting might be resolved by ascribing the rapid breaking apart of 'plates' of thin granitic crustal shell during an explosive breakup of a large parental planetary body some 4.5 billion years ago, which explosive event could have given rise simultaneously to all the present planets and satellites in the solar system. Such 'plates' would then have been floating on a sea of molten basalt which cooled and became fixed very early in the planets' and satellites' separate histories.



'Pangaea' hypothesis showing proximity of warm-water reef to contemporaneous continental ice sheet in Lower Permian.

The driving force for mountain building, overthrusting, and extensive fault slippage would then necessarily fall to the well-documented slowing of the earth's rotation over geologic time, which has shrunk the earth's oblate surface relative to its volume. From the General Theory it is possible to show that such slowing is due to the ponderous mass of the moon plus the Lense-Thirring effect due to the momentum of the sun's rotation. (The Lense-Thirring effect is manifested by the accelerated rotation of the sun's equatorial belt, so that the period of rotation is 25 days at the equator versus 35 days at the poles.) The very slow positional change of the earth's rotational axis may arise from the Lense-Thirring effect acting on inhomogeneities of rock density in the earth's crust.

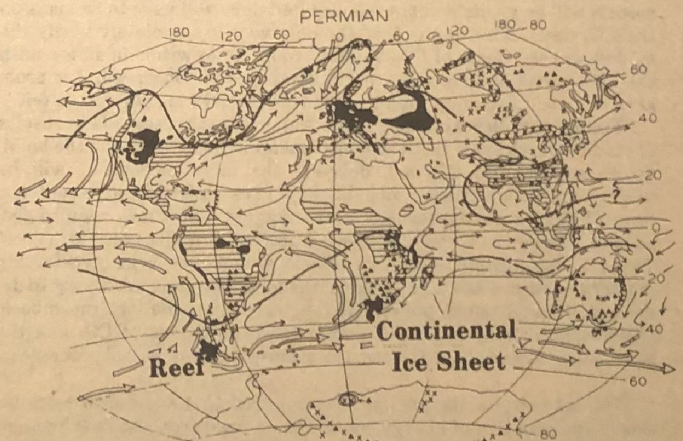
Acceptance of the active drifting hypothesis virtually forecloses the use of any reasonable climatic analogs older than mid-Tertiary in CO₂-greenhouse studies. In contrast, the fixed-continent theory provides virtually unlimited climatic analogs from the geologic past, many of which have already been synthesized by geologist Arthur A. Meyerhoff.

An assumption of Pangaeatic 'pre-drift' geography would place a relatively warm-water Permian coral reef of southern Chile within 10° latitude of a contemporaneous continental ice sheet in southern Africa. The fixed geographical picture of Meyerhoff shows instead the Chilean reef to be greatly distant equatorward from the continental icecap but close to high-mountain glacial deposits, which resembles occurrences in the late Cenozoic ice ages.

Paleoclimatic syntheses based on fixed continents also may help establish a direct relationship between large-scale climatic swings and large variations in atmospheric CO₂. The ages of the most voluminous CO₂ removal from the atmosphere to be sequestered in the lithosphere appear to have initiated cooling trends which ultimately led to widespread glaciation, when CO₂ removal became low. The early Ordovician worldwide anoxic event saw much atmospheric CO₂ removed by organic muds and later limestones. This was followed by continental glaciation in late Ordovician. The Carboniferous Period—as its name implies—saw much CO₂ removed from the atmosphere, and was followed by widespread glaciation by early Permian. Large CO₂-removing events occurred in late Jurassic and early Cretaceous. A long-term cooling trend began then which culminated in the late Cenozoic ice ages.

Meyerhoff (1970) notes that the planetary wind- and ocean-current circulation patterns have undergone little or no important change since middle Proterozoic time. He states that "In the Northern Hemisphere, the northern limit of evaporite deposition (which approximates the northern limit of the semi-tropical desert bands less the tropical rain forest belt) through time fluctuates from about lat 40°N to 83°N," and that the evaporite belts have had a spread of 125° when the earth was very warm.

The general impression is that a very warm earth—due to a continued CO₂ buildup—would not resemble a 'greenhouse.'



Fixed-continent hypothesis showing great distance between warm-water reef and contemporaneous continental ice sheet in Lower Permian. Distribution is shown of Permian evaporites (black); glacial tillites, mostly of Early Permian but including some Late Pennsylvanian and Mid Permian (black triangles); and coal which is generally younger than tillite (black crosses). Modified after A.A. Meyerhoff 1970, revised 1981.

Excerpts from recent reports

From Summary Report of the NCAQ Carbon Dioxide Workshop, St. Petersburg, Florida, October 30-31, 1980, prepared for The National Commission on Air Quality (Project Officer: James E. Fairbent) by Schwartz & Connolly, Inc., January 1981:

"... the primary purpose of the October 30-31 workshop was to bring together both leading scientists and policy-makers to assess whether, and if so, when, public policy measure should be adopted to either prevent or adapt to CO₂-induced changes in global climate. Specifically, the workshop discussions were expected to focus on two major policy-related questions:

"1. Are the consequences of increased atmospheric CO₂ levels significant enough to warrant development of public policy responses either now or in the future?

"2. What is the nature of the relationship between scientific endeavors relating to CO₂ and climate change and the development of public policy? For example, what are the possible trade-offs between taking actions now, based on very limited information, and delaying action a decade or more in the hope of having better information on which to act? ...

"The 'FINDINGS AND RECOMMENDATIONS' section of this report is based on the discussions that were held during the second day (when) the participants attempted to reach a consensus on a statement of the nature of the public policy concerns relating to atmospheric buildup of CO₂ and on a series of specific findings and policy recommendations to be made to the National Commission on Air Quality.

"... During the workshop and again at the time of the participants' later review, it was emphasized that the findings and recommendations were to be presented as a consensus view, but not necessarily the unanimous opinion of the group. Some participants expressed strong dissenting views on specific statements and these views are summarized ...

"Approaches to Resolving CO₂-Related Problems

"The participants discussed the types of policy actions that should be considered in attempting to control increases in atmospheric CO₂ concentrations or to adapt to climatic and other changes that may be brought about by increased CO₂ levels. Among the issues discussed were: the unconventional nature of CO₂ as an 'air pollution' problem; the need to act with imperfect knowledge; the timing of policy actions; the development of industrial revitalization policy; the formulation of synfuels policy; the options available as alternatives to fossil fuels; the need for international actions; the equity aspects of CO₂ effects and controls; the need for research; the available approaches for limiting CO₂ buildup; and the possible options for adapting to CO₂-induced climate change.

"... Without major changes in current energy and land use policies ... atmospheric CO₂ levels appear likely to continue to rise.

"**Acting with Imperfect Knowledge** ... The participants acknowledged that although future research may improve the understanding of CO₂ buildup and its effects, it is not likely that completely validated models will be available before policy decisions will have to be made on the CO₂ issue. An irony is that the only way to completely verify the models of the effects of CO₂ buildup would be to withhold action until the effects had occurred. But once the effects are observed, it is probably too late to reverse them before substantial impacts will be felt.

"**Timing of Policy Actions** ... some participants presented the results of studies which show that the longer policy actions to control the buildup of atmospheric CO₂ are delayed, the more difficult it will be (technically, economically and politically) to establish effective controls. Several factors were discussed which suggest that it may require decades to change the trend of increased atmospheric CO₂ concentrations. These factors include the inertia which accompanies large investments in energy sources and technologies, the long lead time necessary to develop and adopt public policy, the long response time for atmospheric CO₂ concentrations to reflect man-induced emissions of CO₂ and the slow rate of removal of CO₂ from the atmosphere by natural processes. ...

"The majority of the participants believed that some near-term actions (e.g., adoption of energy conservation measures and development of alternatives to fossil fuels) need to be taken. A few participants, however, strongly felt that no such actions could be justified by concern for CO₂ emissions, given the substantial uncertainties about the CO₂ issue. ...

"**Industrial Revitalization** ... the choice of industries or technologies for revitalization will affect future releases of CO₂. It was also noted that current capital investments in CO₂-intensive technologies (e.g., coal-fired processes) will affect CO₂ releases over the long term and that future 'retrofit' conversions to less CO₂-intensive processes would be very costly.

"**Synfuels Policy** ... There was disagreement among the participants about the extent to which synfuels development should be encouraged (e.g., by government subsidies or other forms of support) and about the importance of considering CO₂ releases during the development of synfuels policy. ...

"**Alternatives to Fossil Fuels** ... there are at present only a limited number of alternatives to fossil fuels as sources of energy. The two most prominent alternatives are nuclear power and the 'renewable' energy sources (e.g., solar, hydro-electric, biomass and wind) ... The participants decided explicitly not to endorse any particular alternatives to the use of fossil fuels in formulating their consensus recommendations.

"**International Action** ... It was noted that the U.S. currently has the world's highest energy consumption per person and that it would be difficult for the U.S. to convince developing countries to take actions to limit CO₂ releases (e.g., by limiting the use of fossil fuels) without first taking some unilateral actions. ...

"**Research Needs** ... The establishment of an international CO₂ research assessment board was suggested as one means of providing both a focal point for CO₂-related research and an authoritative mechanism for assuring that CO₂-related research is conducted in a scientifically rigorous fashion. Concerns were expressed by some participants that, without such an assessment board, there is danger of the credibility of CO₂-related research being destroyed by the publication of poor quality research conducted solely to attract publicity to this sensitive issue.

"**Control Approaches** ... Among the types of approaches discussed as possibilities were energy conservation incentives, a tax on CO₂ emissions, reforestation, and accelerated development of energy sources which are not based on combustion. ... It was also noted that even to take CO₂ emissions into account in the development of energy policy would be a major change from current practice.

"**Adaptive Approaches** ... Among [the approaches mentioned] were the establishment of food reserves to lessen the effects of changes in agricultural patterns; the development of land use policies to discourage long-term development in areas that could potentially be affected by CO₂-induced changes in sea level; and construction of sea walls to protect against possible sea level changes. The participants did not attempt to reach consensus on any of these adaptive approaches and the group appeared to assign these approaches a lower priority than approaches designed to prevent adverse effects from CO₂ buildup. ...

From Scientists see global warming and big floods', by Richard Saltus, Science Writer, San Francisco EXAMINER-CHRONICLE, December 10, 1980:

"More than 20 years after scientists first began worrying about a climatic catastrophe caused by industrial pollution, they are still uncertain what course to recommend and now are looking for a silver lining in the situation.

"A new report by the prestigious American Association for the Advancement of Science forecasts a gradual global warming that could, by the middle of the next century, melt parts of the ice caps, raise sea levels all over the world and flood coastal areas. ...

"So complex are the elements working for and against the greenhouse effect that the consequences are terribly hard to predict, and no less difficult to avert, a session of the American Geophysical Union was told yesterday.

"'We don't know what the proper steps to take are,' conceded Roger Revelle of the University of California at San Diego. Revelle, who has warned of the trend for two decades, chaired an AAAS panel that has just released a report on the problem.

"'We can try to reduce the production of energy and develop alternative sources like nuclear power. And we can try to change trends so that we get more benefits (from climate transformation) than we get harm,' he said. ...

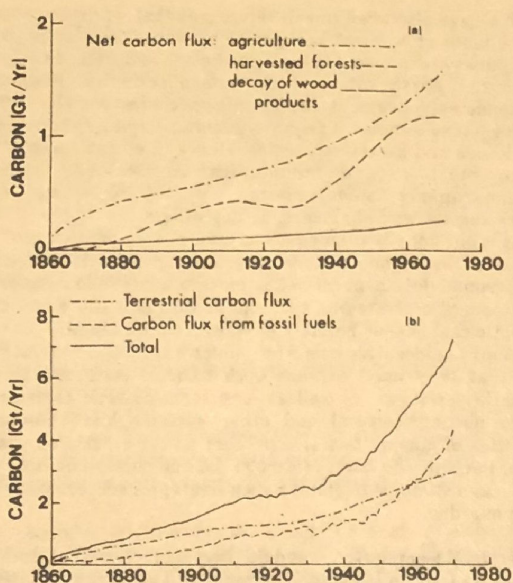
"'Suppose,' said Revelle, that average temperature rose 4 degrees in Chicago. You would have hotter summers than ever before. Last summer, about 2000 people died from the heat. 'What if, instead of long stretches of 100 degree heat, it was 110? You might have 10,000 deaths, 20,000 deaths or more. ...'

"... 'As presently conceived, the U.S. synthetic fuels effort, though based on coal, won't in itself hasten the cataclysmic temperature change, said Revelle.

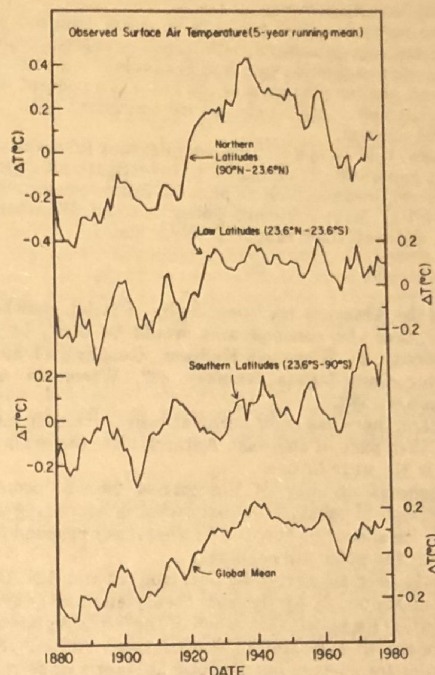
"'But if other countries decided to do the same thing' the effect could be significant, added (William) Kellogg.

"Revelle said the warning, by now oft-repeated, is beginning to be taken seriously by other scientists and by politicians, and that needed further study is slowly getting underway."

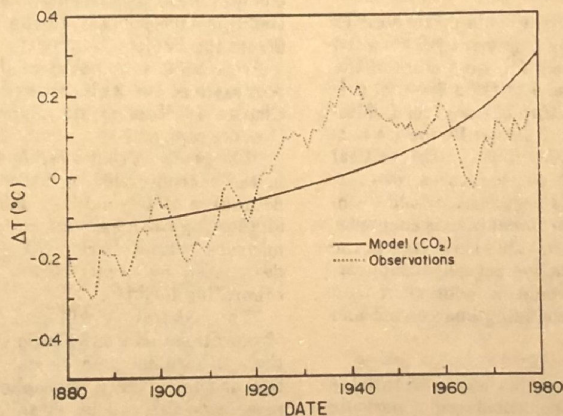
Graphs from CONF-8004110, U.S. Department of Energy, December 1980:



(a) Carbon release from forest clearing and agricultural activity, 1860 to 1970; (b) global carbon flux, showing terrestrial and fossil fuel components, 1860 to 1970. [From Moore *et al.* (1980).]



Observed surface air temperature trends for three latitude bands and for the entire globe. The results for a given year are the mean for the 5 years centered on that year, except for the 1978 result which is a 1-year mean and the 1977 result which is a 3-year mean (after J. Barbera *et al.*, in preparation).



Global mean temperature trends predicted by a global climate model if only the effect of increasing CO₂ is accounted for, compared to the observed global temperature trend. The model, which has a sensitivity of ~3°C for a doubling of the CO₂ concentration at equilibrium, uses a 100-m mixed-layer ocean for heat capacity (after J. Hansen *et al.*, in preparation).

From 'Man-Induced Climate Change: Policy Implications,' by Edward Friedman, Internal Research & Development of the MITRE Corporation, McLean, Virginia, January 1981:

"The most significant environmental threat which may result from man's industrial activities is the alteration of the earth's climate. Although we cannot be certain of the location or timing of the possible impacts, it is clear that the potential costs of such an eventuality might be enormous.

"... (A) man-induced climate change represents a major threat to social development and commerce. Yet, little effort has been put into seeking solutions to the problem.

"... it is always possible that this pessimistic view will not occur and that the eventual impact of man on climate will range somewhere between 'none' or 'little'. Since we cannot be sure what the future will bring,

we must recognize the fundamental principle used in decision-making where uncertainty is great; *select from among long-range policies which have the greatest chance to minimize costs, no matter what future actually occurs.*...

"Short of reporting that new research reveals that carbon dioxide is not a threat after all, science can be viewed as having done its job by presenting a warning. Only the most optimistic among us can believe that climatologists will expand their meager knowledge of the climate system to allow prediction of scales of interest to decision-makers years or decades before the fact; spatial resolution of a few hundred kilometers and temporal resolution of a few hundred years. There is also the question of how long it might take to achieve such understanding that decision-makers can benefit. In analyzing the relevance of the carbon dioxide problem to energy policy in general and the development of a synthetic fuels program in particular, a prestigious panel

organized by the Senate of the United States (1979) 'had no general sense of confidence that a definitive assessment of the effects of carbon dioxide accumulation would be available by the time the most critical decisions would have to be made' . . .

"We need to recognize that not only is action required now, it is necessary and entirely consistent with other, near-term goals. That a solution to the carbon dioxide problem is coupled to a solution to the energy, food and shelter problems of the globe is a concept which will promote the cheapest route to the future consistent with important problems of the present.

"It is my view, that in spite of the complexities inherent in climate problems, this generation is obligated to investigate all opportunities to meet near-term needs as well as plan for future consequences.

"That this effort must influence policy is clear. Whether present world leaders will face their responsibility is not. . ."

From 'And if the Antarctic Ice Sheet Melts - Glaciologists believe it is possible and that the consequences would be dire', by Charles Bentley, University of Wisconsin-Madison, Geophysical and Polar Research Center Contribution Number 382, Wisconsin Academy Review, September 1980:

"In recent years, there has been a dramatically increasing interest in the possibility that part of the vast Antarctic ice sheet may shrink rapidly in size in the near future.

". . . the general urgency of the carbon dioxide problem has highlighted the need to consider not only what is happening naturally to the Antarctic ice sheet but how the ice sheet may respond to a man-made warming of the polar atmosphere. . .

"It has recently been suggested by T.J. Hughes and G.H. Denton of the University of Maine . . . partly from theory and partly by analogy with the Laurentide ice sheet, that much of the West Antarctic inland ice could disappear in a matter of one or two hundred years, not through the major ice shelves but through another escape route: northward into the Amundsen Sea. . . According to their model, the absence of any extended ice shelf bordering the grounded ice along the Amundsen Sea coast, along with the evidence from preliminary measurements that the sea floor at the grounding line lies below the critical depth for rapid retreat, leads to the prediction of a catastrophic loss of ice into the Amundsen Sea, causing the ice in central West Antarctica to be carved rapidly away. . .

"A rough estimate of the temperature rise that could correspond to ice shelf destruction can be made by an analog argument put forward by J.H. Mercer of Ohio State University. Along the west coast of the Antarctic Peninsula, ice shelves abruptly cease north of a line that corresponds roughly to a midsummer air temperature of 0 degrees C. Midsummer air temperatures along the Ross and Filchner-Ronne ice barriers are now about -5 degrees C; by analogy, then, the critical temperature increase is about 5 degrees C. If temperatures rose further and were sustained, the ice shelf, by this argument, would eventually be destroyed. How long that destruction would take is completely unknown at present. However, it may be that rapid shrinkage of the grounded ice would start long before the ice shelves actually disappear, because the affect of a thinning ice shelf would be equivalent to a deepening of the water, thus causing both grounding line retreat and lifting of the ice of the pinning points.

"Surging

"As if the situation were not complicated enough, there is an entirely different form of unstable behavior that must be considered. . . periodic surging. . . it is possible that the sectors could surge independently; according to one model . . . the calculated surface elevation profiles for areas in both East and West Antarctica appear to match reality quite nicely if the ice sheets have surged in the relatively recent past and are now in a recovery stage. . .

"Certainly the ice is not going to disappear in a few tens of years; possibly the process would begin to be observable that soon. Once the process has been set in motion, however, there will be no way to halt it. If prediction is to play the role that it should in the formulation of a national and international policy of anthropogenic carbon dioxide, the capability for predicting is needed soon."

From *Climate Change and Society - Consequences of Increasing Atmospheric Carbon Dioxide*, by William W. Kellogg and Robert Schwart, Published in Cooperation with the Aspen Institute for Humanistic Studies with partial support of the U.S. Department of Energy, 1981:

"Overview

"If the consensus of the international climatological community is correct, and if world fossil fuel use continues to increase atmospheric carbon dioxide, mankind will likely cause a significant average warm-

ing of the Earth's surface within the next 50 years.

"However, for planning and management purposes, it is not very useful just to know that a climatic change is in store. The political, economic, social, and ethical implications of a global environmental change must be considered. In this report, we address these issues and suggest some potential strategies to deal with the carbon dioxide problem.

"We have also tried to cull references that will give readers an idea of the kinds of research being done on climate related problems; many disciplines are involved in trying to better understand the impacts that a warmer Earth will have on human activities. Even though the academic establishment encourages specialization, the carbon dioxide problem is so complex it requires a multidisciplinary approach to clarify the issues and assess strategies. Hence, a climatic impact study program must extend communication between meteorologists, oceanographers, geographers, political scientists, economists, psychologists, and engineers, among others.

"It is our hope that much of the material we present can be used as a guide for those who will undertake future climatic impact studies, and a background document for policy makers who are in a position to implement specific strategies that might mitigate the adverse effects of climatic change - or possibly even avert the change.

"A strong incentive exists for implementing these strategies; it turns out that they may increase each nation's resilience to short term climatic variations as well as long term climatic changes. This may make our agricultural and other systems less vulnerable to the vagaries of climate and also prepare us for an altered climate in any case. Perhaps the issue of carbon dioxide-induced climate change will serve as a stimulus to employ such strategies sooner. Many of them are long overdue. . ."

From 'Research Issues and Supporting Research of the National Program On Carbon Dioxide, Environment and Society', National Climate Program Office, January 1981:

Project Title, 'Determination of Atmospheric CO₂-O₂/N₂'; Principal Investigators P.P. Tans, S.D. Bloom and R.A. Muller, Lawrence Berkeley Laboratory.

". . . The credibility of current predictions of the future rise of atmospheric CO₂ is seriously impaired by the fact that the present CO₂ budget does not seem to be in balance. Very precise measurements of changes in the global atmospheric O₂/N₂ ratio in the course of a few years could provide the key to the solution of the 'missing CO₂' problem." (From the Project Summary).

Project Title, 'A Study in the Abundance of Carbon Dioxide in the Atmosphere and its Exchange with the Ocean'; Principal Investigators Charles D. Keeling and Robert B. Bacastow, Scripps Institution of Oceanography.

"The prospect that fossil fuel combustion may lead to large increases in the concentration of atmospheric carbon dioxide over the coming decades and beyond has led to plans, coordinated by the World Meteorological Organization, for a worldwide network of stations to measure atmospheric CO₂. The Scripps Laboratory has been designated by WMO to aid this program as a WMO central CO₂ calibrating facility. . .

"The Laboratory will also assist the WMO program by continuing observations of atmospheric CO₂, especially in tropical regions and in the southern hemisphere where efforts of others are far less extensive than in the northern hemisphere, and where long-term variations in atmospheric CO₂ can be established with the highest precision because seasonal variations are small. . ."

(From the Project Summary)

Research Issue: **Model Improvements and Modification.**

". . . Although it is not likely that we will have completely satisfactory climate system parameterizations during the next five years due to a combination of limitations including computer capacity, diagnostic capabilities, and lack of a fundamental understanding of many components of the climate system, there should be a sufficiently adequate representation of the system to allow reasonable limits to be placed on the effects of increasing carbon dioxide. . ."

Research Issue: **Evidence of Climate Change.**

". . . Current model estimates suggest that the earth should have experienced a few tenths of a degree warming since the late 1800s due to the increase of CO₂ concentrations from about 290 to the current 335 ppm. . . While a few researchers suggest that we should be able to start identifying CO₂-climate signals in the near future, most experts believe that an unambiguous climatic signal might not be evident until the year 2000. A critical question is whether more refined analysis of observations may find a statistically significant signal sooner than the year 2000 so that increased confidence can be placed in model results. . ."

From *The Need For an International Scientific Assessment of the CO₂ Problem* by Ralph M. Rotty, Institute for Energy Analysis, Oak Ridge Associated Universities, December 1980 (Occasional Paper, with a statement that the views are the author's and not necessarily those of the Institute):

"A CO₂-induced climate is likely to affect different regions of the world in different ways. At least during the early decades of an observable global warming there will be 'winners' and 'losers'. Effective control of the concentration of CO₂ in the atmosphere, if that should be necessary, will require international cooperation of an unprecedented magnitude. Full understanding of the issue by both rich nations and poor nations, and by both east and west, will be required. An international assessment under the combined auspices of the World Meteorological Organization, the United Nations Environmental Program, and the International Council of Scientific Unions is a beginning in the development of the necessary understanding.

"The uncertainties involved in many of the scientific aspects of the issue are so great that a case cannot be documented for immediate action. Uncertainties are prominent in each of the areas involved in the assessment:

- "(a) Anthropogenic sources of CO₂.
- "(b) The carbon cycle — partitioning among the reservoirs.
- "(c) The CO₂-induced climate change within the background of natural variability of climate.
- "(d) Effects of a CO₂-induced climate change as well as other direct effects of CO₂ on the environment.
- "(e) Impacts on society.

"A brief introduction to each of these areas is given in the context that the experts convened by the three international organizations must attempt to develop a plan to help reduce the uncertainties." — Abstract.

From *'CO₂: Attitudes and Implications'* by Alvin M. Weinberg, Director, Institute for Energy Analysis, Oak Ridge, Tennessee, presented to the Carbon Dioxide and Climate Research Program Conference, Washington DC April 24-25, 1980, published as CONF-8004110, U.S. Department of Energy, December, 1980:

"... I myself tend to be conservative about CO₂ on two accounts. First, because of my background in nuclear energy, I have to be careful not to misuse the CO₂ issue as an argument in favor of nuclear power. But there is another more general point that encourages caution; this came out the time of the fuss about synfuels. The scientific community really does itself no favors by crying wolf if the wolf cannot be pinned down. The scientific community did cry wolf with respect to O₃ and the supersonic transport (SST), despite the fact that the SST turned out to have little effect on the stratospheric O₃ layer. . .

"I am not as pessimistic as [Ron Ridker] about nuclear energy; if it is possible to overcome the disaffection that now exists with respect to nuclear power, we may have in nuclear energy an important alternative to fossil fuel sources, one that is often discounted nowadays.

"In the world today, there are either in operation or under construction 525 very large nuclear reactors. When all of these reactors are completed, they will produce close to 10 percent of man's primary energy. This remarkable penetration of nuclear energy suggests to me that nuclear power may yet contribute a significant share of Rotty's 27 TW. A total of 5000 reactors, which could supply as much energy as man uses altogether now, must be considered possible, especially in view of the degree of penetration of nuclear power so far. . .

"I conclude that solution to the problems that bedevil nuclear energy would be an important response to the buildup of CO₂. Whether we will resolve the problems of nuclear energy in time to help very much, I cannot say. Because I am optimistic about doing just that, I am less pessimistic than Ridker about adapting to the predicted increase in CO₂."

From *'The Greenhouse Effect'*, by Harold W. Bernard, Jr., Ballinger Publishing Company, 1980:

"... the enormous amounts of carbon dioxide currently being released into our atmosphere as a result of fossil fuel burning may constitute

an insidious pollutant. Many scientists now predict disastrous effects on our climate, and on our economy, if carbon dioxide emissions continue to increase at projected rates.

"... The author estimates by the year 2040, temperatures could be warmer than at any time in the past 125,000 years. Warmer earth temperatures would severely alter our agricultural regions, rainfall patterns, coastlines, and our economic and geo-political stability. The author shows how this warming effect may currently be masked by other climate patterns, and how in the near future it may suddenly become alarmingly prominent. As the National Academy of Sciences said recently: 'If the decision to reduce carbon dioxide emissions is postponed until manmade climate changes have been felt, for all practical purposes the die will have already been cast.'

"The author agrees. In the current push to develop coal and synthetic fuel technologies, the foundation for the 'greenhouse effect' is being solidified. The author urges energy policymakers to reverse this trend and calls for carbon dioxide-free energy strategies.

"The greenhouse effect has been the focus of scientific inquiry for over a decade. This book brings the issue into the public eye and urges us to respond swiftly before the greenhouse effect becomes the greenhouse threat."

—(From the jacket)

From *'Bitter Cold May Subside, But Not Drought Threat.'* Interview with J. Murray Mitchell, Climatologist, National Oceanic and Atmospheric Administration, U.S. News & World Report, February 2, 1981:

... "Q Aren't droughts related to sunspot activity?"

"A We have some evidence that development of a major drought in the Western United States every 20 or 25 years seems to be locked in with activity on the sun.

"But the weather we've had since last summer comes a little late in the solar cycle for sunspots to be an obvious cause. In short, I don't think the current weather pattern is connected to sunspots.

... "Q What influence is the increased level of carbon dioxide in the atmosphere having on the weather?"

"A The level of carbon dioxide in the atmosphere is increasing slowly, year by year, as a result of the burning of fossil fuel — mainly oil and coal. This is a worldwide problem.

"So far, the levels of carbon dioxide have increased perhaps 15 percent above the level of a century ago. This is enough to have warmed the earth by two tenths of a degree Fahrenheit.

"But, so far, the accumulative effect of carbon dioxide is not enough to account for the warmings and coolings of our global atmosphere that we've had for the last 100 years.

"The world's temperature has been cycling up and down, and we seem to be in a warming period. But these temperature changes are quite a bit larger than we would expect from the growth of carbon dioxide in the air.

"Q So you do not see any long-term significance to the current weather?"

"A If we're right about the warming effect of carbon dioxide, then it would be reasonable to expect a continuing warming of the earth's climate well past the end of this century. However, we'll continue to have a lot of ups and downs from year to year and a lot of unusual weather events."

"Q So we're going through one of those ups and downs at the moment

"A We certainly are. It's awfully hard to look back at the number of cold winters we've had in recent years — there have been four of them now in the last five years — and insist that they're not part of a long-term cooling trend.

"But before the current spate of cold winters, we had four very warm winters in the Eastern United States. We'll see some of that warmth again in future years, and more moisture returning to the Western states too.

"But I can't give you a timetable."

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Resource Wars

Major wars have started from long-range piratical designs rather than from chance happenings. Alan J.P. Taylor noted, "(I)nflationary finance, by which Germany conducted World War I, was the basis of the Reich's fiscal policy long before the outbreak of war. Implicit in it was the argument, based on the French indemnity of 1871, that the army and navy would in time pay for themselves by imposing terms of conquest on the other nations of Europe."

As William James noted in his essay, *The Moral Equivalent of War* (1910), "militarist authors take a highly mystical view of their subject, and regard war as a biological or sociological necessity, uncontrolled by ordinary psychological checks and motives. When the time of development is ripe the war must come, reason or no reason, for the justifications pleaded are invariably fictitious."

James went on to cite the brilliant military analysis of Homer Lea entitled *The Valor of Ignorance* (Harper, 1909). "Nations are never stationary—they must necessarily expand or shrink according to their vitality or decrepitude. Japan now is culminating, and by the fatal law in question it is impossible that her statesmen should not long since have entered, with extraordinary foresight, upon a vast policy of conquest—the game in which the first moves were her wars with China and Russia and her treaty with England, and of which the final objective is the capture of the Philippines, the Hawaiian Islands, Alaska, and the whole of our coast west of the Sierra Passes. This will give Japan what her ineluctable vocation as a state absolutely forces her to claim, the possession of the entire Pacific Ocean. . ."

James' comment on Lea's 'dismal forecast' was, "Ignorant as we still are of the innermost recesses of Japanese mentality, we may be foolhardy to disregard such possibilities."

A driving purpose of war has been to place foreign populations in servitude and to control valuable natural resources. A basic strategy of war is to deny critical resources to opponents. As the nations of the world have become more and more dependent upon imports of petroleum to operate their factories, farms and transportation systems and to heat homes, their strategic vulnerability has increased greatly. Coal is sometimes thought of as a potentially strategic commodity based on the supposition that more than 90% of the world's supplies are situated in the U.S., Russia and China. Large coal deposits are distributed far more evenly than oil, however. In 1980 coal surpassed wool as Australia's biggest export; the world's largest coal mine is expected to come on stream at El Correjón, Colombia, in 1986; and even South Africa is making large strides toward independence from oil imports by manufacturing synfuels from its own coal deposits.

In contrast, oil is distributed so unevenly that the majority of the world's present reserves is situated in the Persian Gulf, and the bulk of the world's oil production passes through the Hormuz Strait. The accompanying map shows the flow of oil in international commerce as of 1974, when the OPEC nations used a partial embargo to hike their prices severalfold. The most significant changes since 1974 are new, large shipments of oil from Alaska to the West coast of the U.S., the development of vast new oil reserve in southern Mexico (now 60 billion barrels) and the increase of oil imports in the U.S.

Russia seems now to be 'culminating' in the same sense that Lea noticed so early in Japan. In the February 1981 *Geotimes* A.A. Meyerhoff noted that during 1980 Leonid Brezhnev's now-famous outline of Russian strategy (which first appeared in *Pravda* in July 1976) came closer to reality: "Our aim is to gain control of the 2 treasure houses on which the West depends—the energy treasure house of the Persian Gulf and the mineral treasure house of central and southern Africa."

Since that proclamation, Russia has occupied Afghanistan—which is situated 500 km from the Hormuz Strait—and has spread its influence from Angola to adjacent mineral-rich countries. Also, Cuban-supported troops have taken over Nicaragua, which lies 500 km south of Mexico. The potential now exists for establishing a Russian submarine base in the eastern Pacific similar to the base already reportedly in existence in Cuba.

Efforts to solve the CO₂ problem with accelerated development of nuclear energy throughout the world could have a beneficial side effect of lessening this extreme vulnerability of nations' strategic energy supplies, though relief would come slowly. Nuclear fission would allow countries to sever the link between energy supply and the presently continuous need for vast tonnages of petroleum, often transported great distances across the oceans.

The aggressive nuclear construction program in France is rapidly lessening that country's dependence on oil imports, and France also enjoys the lowest electricity costs in Europe. Presently a large manufacturing company in Japan is developing a standardized, modularized nuclear-electric plant in the modest 500-600 MWe range that could be easily shipped anywhere in the world by waterways. Using assembly line techniques, this development may reduce the capital cost of nuclear plants significantly.

Currently none of the Western countries is developing anything to compete with this Japanese plant. Moreover, no country has yet initiated any program to manufacture chemical automotive and aviation fuels (other than hydrogen) from nuclear power, which is the logical second step in halting the CO₂ rise and in reducing nations' vulnerability of strategic energy supplies. The technical talent and capital that has been assembled toward an ambitious fossil synfuels program might be re-directed toward such an anti-CO₂ goal, but this probably would be feasible only with the financial help of the U.S. government. Also battery-operated cars and mass transit using a nuclear-electric source may need such assistance to phase out fossil fuels completely.

Widespread dispersal of modest-size reactors, the development of liquid non-fossil synfuels, and the development of practical electric cars and mass transit offer countries a great degree of energy self-sufficiency, and such efforts might help avert the situation which William James referred to: "When the time of development is ripe, the war must come, reason or no reason. . ." The time, then, might never be ripe. The ultimate cost to the U.S. government of creating a nuclear-based fuels industry and assisting other non-fossil projects may compare favorably with the cost of defending the Persian Gulf and other shipping lanes indefinitely, or of creating a fossil synfuels industry.

Raising such money by a burdensome tax solely on domestic oil production (as the 'windfall profit' tax, which roughly doubles the cost of domestic crude oil to U.S. refiners, but which does not tax imports) only aggravates the present strategic energy supply shortfall. It also causes a drain of the domestic capital which would be needed for non-CO₂ energy developments.

— W.N.B.

WORLD CRUDE OIL MOVEMENTS TO MAJOR CONSUMING AREAS-1974 (preliminary)
(thousand barrels per day)



OIL DEPENDENCE OF THE FRENCH PRIMARY ENERGY CONSUMPTION 1960-1990

