as personal consumption expenditures, a net increase of labor and energy would have ensued. If the dollar savings had been absorbed as a tax and respent on railroad and mass transit construction, about 0.3 billion more gallons of gasoline (energy equivalent) would have been consumed annually and 1.2 million jobs created, under a complete shift to rail.

Had there been a full shift from intercity car and truck transportation to transportation by railroad with dollar savings spent on railway construction, 2.7 billion gallons of gasoline (energy equivalent) could have been saved and 2.4 million new jobs could have been created in 1963.

References and Notes

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2. R. H. Bezdek, *The Long-Range Forecasting of Manpower Requirements: Theory and Applications*, in press.
3. R. A. Herendeen, *Use of Input-Output Analysis to Determine the Energy Cost of Goods and Services* (Center for Advanced Computation, Document No. 69, University of Illinois at Urbana-Champaign, Urbana, March 1973).
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6. We could also have considered various combinations of the programs totaling $5 billion; however, here our objective was to identify the impacts on energy and manpower of highway construction as opposed to each of six other programs.
7. For a discussion of the development of the program vectors see Bezdek (*2*, chap. 4).
8. A more comprehensive tax relief alternative would have required the consideration of different progressive and regressive tax rebate schemes, analysis of the impacts of reduced taxes on both consumption and investment and the impact of tax reduction on demand for detailed consumer goods and services and for the outputs of detailed input-output industries. This would have been a major research project in itself.
9. Because we used the 1963 energy input coefficients, we could not take into consideration pollution devices on automobiles which reduce gasoline mileage and other factors which have increased in importance since 1963.
10. Conversion factors are as follows: 1 Btu is equivalent to 1055 joules; 1 gallon is equivalent to 3.6 liters; 1 cubic foot is equivalent to 2.83×10^{-2} cubic meters.
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24. We owe much of the background for this paper to Dr. R. Herendeen and A. Sebald for their work in developing the energy data, to M. Ades who did the computer programming, and to M. Howell who did the typing. This work was supported in part by the National Science Foundation and the Ford Foundation's Energy Policy Project.

NEWS AND COMMENT

The Nixon Administration: End of a Long Campaign

With the Nixon resignation, the long agon of Watergate ended like a tragedy without a last act. In Washington there was no state occasion to mark the change of Presidents, only a pompless transfer of power and, in the city half abandoned in the August exodus, an atmosphere of relief and regret and a sense of another beginning.

As the transition proceeds, consideration for the new President seems to have muted critical stocktaking of the Nixon Administration, which, after all, substantially remains on the job—minus Nixon. In the case of science and technology, of course, the sectarian view is that science suffered in budget and status and was "down-graded" during the Nixon years. In retrospect, admittedly in circumstances that make it easier to see the trees than the forest, it looks rather as if Nixon as President was preoccupied in his first term with the initiatives in foreign affairs which were the triumphs of his Administration and in the second term with Watergate which destroyed it, and that for him science was at most an afterthought.

At least it is possible to say that Nixon science policy was consistent. When Richard M. Nixon took office he had made it clear that he felt research should contribute more directly to the solution of national problems, particularly to advancing the cause of national security and national prestige. In general, treatment of science hewed to this philosophy.

Grand technology seemed to have had a special fascination for Nixon. This was most evident in his enthusiasm for the Apollo program, particularly through the first landing on the moon in July 1969. He appeared to relish the company of astronauts, perhaps because they embodied the steadiness under pressure which Nixon has proclaimed as a personal ideal, and he even put in a call to Armstrong and Aldrin when they were on the moon's surface.

Nixon was a strong advocate of the supersonic transport (SST), emphasizing its implications for American technological leadership, and he persisted in this advocacy of the SST even after

POINT OF VIEW: Technopolitics

Technology has become the preferred currency of foreign affairs. It is the bedrock of détente with the Soviet Union, improved relationships with China, and our ability to dilute the centuries-old issues in the Middle East. Technological politics is replacing geopolitics. Nations eye a technological, not a geographical "heartland". Tomorrow's security will come not from mutual fear of MIRVs and ICBMs but from mutual dependence of each country on the other's technological resources, natural resources and markets.

Overall, the effective use of technological resources depends upon a venturesome public attitude. Such an attitude is traditionally American, but in recent years we have had our doubts and doubters. Indeed, it is not too much to ask that we assess beforehand as best we can the consequences of technological action. . . . Public confidence hinges upon an absence of unpleasant technological surprises.

—From an article in the Wall Street Journal *by Edward E. David, executive vice president of Gould Inc., and former science adviser to the President.*

Congress killed the project, an action which later developments have done little to put into question.

In 1971, against the advice of his economic advisers and to the apparent surprise of the Office of Science and Technology, Nixon threw his support behind a large increase in research on coal gasification and work on the fast breeder reactor. The breeder project is now under intensive review by the Atomic Energy Commission because estimated costs of the program have more than doubled beyond the original $2 billion and because work on the demonstration plant at Oak Ridge, Tennessee, has slipped substantially behind schedule.

Nixon's attraction to the technological spectacular seems clearly to have influenced his declaration of the war on cancer, the Administration's major initiative in biomedical research. The rationale of the new cancer program and the lesser push in heart research was the demand for more practical results from the big federal investment in biomedical research. This theme had already been introduced during the Johnson Administration, but Nixon's major transfer of funds to cancer and heart research at a time when the biomedical research budget was virtually static and being eroded by inflation has resulted in a disequilibrium, the consequences of which have still not been assessed.

Even in the case of science diplomacy, the Administration seems to have chosen the grand gesture. A spate of agreements on scientific and technological cooperation was signed with the Soviet Union, for example, seemingly with more thought to demonstrating the spirit of détente than with regard to preparations for implementing them.

Similar presidential reflexes seem to have been working during the early stages of the Arab oil embargo last year, when Administration energy advisers found that a draft of a speech prepared for the President came back with the astonishing declaration added that the United States would embark on a Project Independence under which the country would achieve energy self-sufficiency by 1980. Nixon seems to have been virtually alone in the Administration in believing that anything approaching self-sufficiency could be achieved by that time. Although major increases in energy R & D funds were included in the last two budgets, there is still no bill of particulars on Project Independence.

There is little evidence that Nixon was hostile to science but rather that, except for the technological extravaganzas, he was simply not much interested. Nixon has not been the only President who used science for the purpose of national prestige or domestic political advantage. President John F. Kennedy's espousal of the Apollo program was a classic case of mixed motives. But Nixon, who has had an extraordinarily acute political sense, seems to have been unwilling, when making some major technological decisions, to take sound scientific advice.

Nixon did not remedy his lack of sophistication about science while in the White House. He is said to have been uncomfortable with scientists and with intellectuals generally, although he established firm working relationships with Henry Kissinger, George P. Shultz, and, in his first term, with Daniel Patrick Moynihan. There were some hints at one point that Nixon might develop a scientific "kitchen cabinet" made up of scientists and engineers who had favored his election, but that never occurred. He apparently listened to a few men like William O. Baker of Bell Labs and Benno Schmidt, a New York financier knowledgeable in biomedical affairs, but they were hardly intimates. The overt opposition of university scientists to Administration positions on Vietnam and on antiballistic missile defense seems to have convinced Nixon that the academics had polarized against him. And the opposition of an OST (Office of Science and Technology) panel on the SST apparently hastened the decision to dissolve the White House science advisory apparatus.

If he lacked rapport with scientists, Nixon allied himself closely with proponents and practitioners of the quasi-science of modern management. He looked to the university business schools, management consulting firms, and big corporations for doctrines and men not only to bring efficiency in government but also to implement Administration policy in the face of a balky bureaucracy and a hostile Congress. The grand strategy for management was laid out by a commission headed by Roy L. Ash, of the Litton Industries, Inc., conglomerate. The Office of Management and Budget, which Ash now heads, was created under a key Nixon reorganization plan and has served as a fountainhead of attitudes and policies for the Administration and a training ground for managers.

One senior White House official who left before the Watergate avalanche began to slide says that the great irony in light of the Nixon fascination with management was that "The White House itself was not managed. The staff got out of control. It was run as a collection of fiefdoms. There was a lot of internal churning but not much output. It may be an unfair way to state it this way, but there was a degree of paranoia. To some extent because of past experience with the press and intellectuals there was vast distrust and a vindictive attitude."

This attitude was held by relatively few people in the White House, but they happened to be highly influential. Even Nixon's overwhelming victory in 1972 seems only to have had the effect of sharpening the "distrust of people" and the "distrust of the mechanism."

Nixon's place in all this is, of course, still a prime matter for speculation and argument. As Heraclitus said—more or

less—a man's character is his destiny, and the 37th President of the United States is sure to be an irresistible challenge to the psychohistorians. But Nixon has been a national figure in American politics for a quarter century, and his remarkable career surely provides some obvious clues.

In the first part of that career Nixon established himself nationally by his exploits as a knight errant against the "Communist conspiracy," a 1950's code word to those who saw a pattern of Communist subversion at home and Soviet and Chinese agression abroad. Nixon's initiatives in the Alger Hiss case and his subsequent election to a Senate seat brought him national attention, and his abilities as a polemical speaker and a Republican party fundraiser put him in constant demand. Nixon never really adapted to the norms and forms of Congress, and his campaigning in the 1950's, even after he won the Vice Presidency under Eisenhower, was viewed by his Democratic opponents as exceeding the normal limits of partisanship. They never forgave him. It was during this period that Nixon also alienated many academics and some members of the working press. The mistrust was reciprocal and has been lasting, despite a great moderation of tactics by Nixon in the 1960's. Nixon was a highly effective campaigner and seemed always to enjoy the contest; through his Presidency he gave the impression of a man still most comfortable in the role of the embattled but indomitable campaigner.

Nixon's credentials as an anti-Communist are usually thought to have made politically possible the accommodations with North Vietnam, the Soviet Union, and China that are generally acknowledged to be the most brilliant achievements of his Administration and which Nixon must count on to set in the ledger of history over and against the debits of Watergate.

An achievement of a different kind has been the support that Nixon drew from the middle of the American social spectrum. He managed early to establish communion with the large and increasingly uneasy group rediscovered in the late 1960's as the Silent Majority or Middle America. To this group, which feels threatened by social and economic change, Nixon communicated, sometimes subliminally, an attitude toward such things as flag, family, and law and order that earned him a loyalty which seems to have persisted for many even after the revelations of the last, decisive tapes.

As for the tapes themselves, their importance may ultimately be seen to lie not in their being evidence compromising a President but in the glimpse they give of the governmental process.

Much has justifiably been made of

Politicizers of Government Tried to Include Science

Unpublished memoranda in the files of the Senate Watergate Committee show that even some science-based activities of government were not immune from Nixon's loyalists' itch to politicize the federal bureaucracy.

A series of such memoranda in the committee files shows that from 1971 onward, the White House personnel office tried to draw the Committee for the Re-Election of the President (CREEP) and other political groups into helping to appoint advisory committees and commissions, many of which generally include scientists and scholars. The White House chief personnel officer, Frederic V. Malek, and his staff tried to brief campaign officials regularly on the need for patronage appointments and they solicited names.

In a memo of 16 June 1972 he specifically cited vacancies on a number of committees including the President's Science Advisory Committee, the President's Committee on the National Medal of Science, the National Advisory Committee on Oceans and the Atmosphere, and the Board of Regents of the National Library of Medicine. There is also some reference in the files to successful appointments to the part-time, honorific jobs ("We placed the President of Sons of Italy of Queens on a Traffic Safety Board and he was ecstatic," wrote Malek at one point). There is also evidence of vindictiveness against those who held such posts and were deemed unworthy. One CREEP staffer, Al Kaupinen, wrote to a White House personnel staffer that Erich Segal—the author of *Love Story* who was also on the Peace Corps Advisory council—was reported to be planning to attend a McGovern rally, and added, "I trust that the attached bit of information will be considered when time for reappointment to the Peace Corps Advisory Board comes about."

Malek was deputy director of the Office of Management and Budget until his resignation from the government last week. As with another Malek initiative, the responsiveness program for sensitizing the federal bureaucracy (*Science*, 12 July), it is hard to know whether these suggestions ever bore fruit.

Another memorandum in the Watergate committee's files shows that in December 1971 Jeb Stuart Magruder drew up an elaborate proposal for increasing military strategic weapons R & D in order to offset "the erosion of conservative support for the President" among voters who had favored Nixon in 1968. Magruder, now in jail, was then director of CREEP. In the memo addressed to [then] Attorney General John Mitchell he urged that the proposal be taken up with National Security Adviser Henry Kissinger and General Alexander Haig. "Surely some of that heavy brainpower ought to be utilized to help reelect the President. . . .

"The NSC (National Security Council) will undoubtedly want to have a voice in this matter, regarding the actual decisions," he thought it worth noting. The total military research budget did go up in the President's budget request for fiscal 1973, but there is no way of knowing whether the proposal was forwarded by Mitchell or taken into account.

The abuses contemplated in these latest memos probably lie at the more legitimate end of the spectrum of actions by Nixon loyalists. Certainly, they seem less serious than President Nixon's apparent attempts to cut off federal funds to the Massachusetts Institute of Technology (*Science*, 20 July 1973). Nonetheless they do indicate something of the atmosphere of the Nixon White House and the attitudes which contributed to the former President's downfall.—D.S.

the burdens of the Presidency, but little has really been known about how decisions are made within the fastness of the White House. What the tapes show in discussions of domestic legislation and international economic problems, for example, is a President badly informed, even indifferent.

The tapes, of course, provide an incomplete record, but the transcript of conversations on 23 June 1972, which led directly to the Nixon resignation, also include chillingly casual exchanges between Nixon and aide H. R. Haldeman on matters which had nothing to do with Watergate.

In response to a Haldeman report that the British have floated the pound the transcripts show Nixon saying, "I don't care about it. Nothing we can do about it." And later, on the same subject, "Good, I think he's right. It's too complicated for me to get into."

To Haldeman's remark that Federal Reserve Board Chairman Arthur F. Burns is worried about speculation in the Italian lira, Nixon is shown replying, "Well I don't give a (expletive deleted) about the lira."

Later, in discussing a legislative issue, the identity of which is lost in an unintelligible patch, Nixon says, "There ain't a vote in it. Only George Shultz and people like that think it's great (unintelligible). There's no votes in it, Bob."

Shultz, of course, was Secretary of Treasury at the time and Nixon's chief adviser on the economy, and the remark provides an eloquent comment on the dichotomy between Nixon's inner circle and his other advisers. The attitudes expressed by the former President help to explain why Administration policies for combatting inflation, managing the economy, and dealing with serious international monetary problems have been inconsistent and ineffective.

The transcripts also help explain how the White House science advisory machinery was deemed expendable and disposed of. The concern about White House science advisory machinery shown by the scientific community has sometimes seemed a bit parochial and self-serving. But in the present situation it takes no special wisdom to see how R & D decisions will affect how the government deals with serious energy and food problems and how important these actions will be in future economic developments in this country and abroad. The Nixon tapes illustrate why good presidential advisers and good mechanisms to transmit their advice are necessary in every sphere of policy; this should not be overlooked among the lessons of Watergate for the new Administration.—JOHN WALSH

EPA Study: National Academy Set to Serve Two Masters

The National Academy of Sciences (NAS) is beginning a $5 million study for the Environmental Protection Agency (EPA) under circumstances that leave the academy entangled in an uncomfortable political thicket.

Although its contract is with the EPA, the academy will, in doing the study, also be under the scrutiny of two powerful and mutually antagonistic congressional subcommittees. One of these is the House Appropriations Subcommittee on Agriculture-Environmental and Consumer Protection, chaired by Representative Jamie L. Whitten (D–Miss.), who thinks that DDT is as wholesome as mother's milk and who complains that EPA's approval of "overly restrictive" state air pollution control plans has been a major contributor to the energy crisis. The other is the Senate Environmental Pollution Subcommittee, chaired by Senator Edmund S. Muskie (D–Maine), principal author of the statutes which the EPA is charged with carrying out.

As reported to the House floor by the Whitten subcommittee June a year ago, one of the fiscal 1974 appropriations bills included $5 million for the NAS to do a "complete and thorough review, analysis, and evaluation of the [EPA], its programs, its accomplishments, and its failures." Representative John Dingell (D–Mich.), chairman of the House Fish and Wildlife Subcommittee, raised a point of order on the grounds that this was legislative language inappropriate in an appropriations measure. His objection was sustained and, as the bill subsequently passed the House and Senate, it merely included $5 million for an NAS study "in connection with the [EPA]."

A few days before the Senate acted on the bill, John S. Coleman, executive officer of the NAS, wrote the Senate Appropriations Committee to say that it would not be proper for the academy, as a private organization, to be assigned "responsibilities of a ministerial nature for program oversight, audit or review . . ."

Later, in December 1973, Philip Handler, president of the NAS, wrote Gordon MacDonald, chairman of the academy's Commission on Natural Resources (which would have general responsibility for the study), to warn that "we should by all means avoid placing ourselves in an adversary position with EPA."

Yet, on the same day that Handler was cautioning MacDonald, Representative Whitten was informing the EPA that his subcommittee wanted to review all proposed contracts for the study. In a letter to Russell E. Train, EPA administrator, Whitten also in effect restated the legislative mandate that had been struck from the appropriations bill on the point of order. ". . . we will expect you to utilize the $5 million to review the programs, procedures, standards, and decisions of the agency," Whitten said.

One particularly appropriate subject for review, he suggested, would be the EPA regulations for the removal of sulfur oxides from power plant stack gases. "The electric utility industry . . . appears to be unanimous in their opinion that while sulfur removal technology does exist, it is not sufficiently developed to justify massive capital expenditures," Whitten observed.

The contract for the study—the largest ever undertaken by the academy—was negotiated by the EPA and the NAS in the spring and early summer of this year, and was finally signed on 28 June. In explaining the general thrust of the study, a "proposal" paper prepared by the NAS cites both the report of the Whitten subcommittee and Whitten's letter to the EPA administrator, and then iden-