

Chapter 7

GOVERNMENT ENERGY RESEARCH: EMERGING DEFINITIONS, 1968-1975

In the period 1968-1974, Ball continued the Bartlesville Petroleum Research Center's struggle for survival and self-definition. Some of Ball's difficulties were similar to those faced by Fowler two decades earlier in the post-war period. Shortage of funds, declining importance of government petroleum research, and the competitive job market, which made it hard to find and keep talented scientists, all hampered efforts to define a clear research agenda and stick to it.

Furthermore, older justifications for Bureau of Mines work in petroleum were no longer relevant. In the 1920s, the small government laboratory had assisted the petroleum industry by sponsoring research and technological development and by giving young technicians direct experience before they moved to careers in the private sector. As the industry developed its own research facilities, such small federal efforts could no longer make a significant impact.

By the 1960s, the public no longer viewed government and private sector as two parts of national system, working together for the common good. Rather, the public, government, and industry itself viewed bureaucrats and businessmen as opposing groups, a far cry from the cooperative mood of the 1920s or the 1940s. In the new view, almost any government assistance to private enterprise, no matter how modest or carefully structured, could seem a potential violation of ethics, a betrayal of trust.

As Ball managed the center through day-to-day crises and fought for dollars in this changed political climate, he and his colleagues tried explicitly to come to grips with their plight. Ball sought help from a variety of sources. He used history to show that the past achievements set precedents and patterns which offered a variety of potential lines of research for current and future work. In addition, he maintained outside sources of support, including continued cooperation with industrial associations and other government agencies requiring work in petroleum.

Carefully staying within federal regulations regarding political activity, Ball and others at the center brought the center's plight to the attention of sympathetic congressmen, senators, and governors. In addition, Ball revived contact with the local Chamber of Commerce as a mechanism for political action.

Energy Research—An Opportunity for New Agendas

Following Presidential guidelines during the Nixon years, the Bureau of Mines began to emphasize energy research. Yet the new organizational emphasis on energy supply at first elevated those divisions and individuals in the Bureau of Mines whose backgrounds were in the coal industry. Rather than opening a new set of justifications for the center, the Washington concern with energy supply put the petroleum specialists at Bartlesville on the defensive. Ball argued forcefully that the patterns and approaches relevant to coal did not apply. The ensuing debate with Bureau of Mines headquarters provided an opportunity to develop a thorough-going self-examination and clarification of the center's function, its research agenda, and its place in the larger scope of federal research endeavors. The defense of the center by memorandum, conference and bureaucratic in-fighting consumed more and more of Ball's time as the struggle continued.

In 1971, the Bureau of Mines changed the designation of the center from a "petroleum" to an "energy" research center. And when the energy research activities of the federal government were consolidated in 1975 into the Energy Research and Development Administration (ERDA), the Bartlesville, Laramie, and Morgantown laboratories and the San Francisco office of the Bureau of Mines were transferred to the new agency.

The new Washington concern with energy supply in an overall sense did not, however, resolve pressing practical problems which had haunted the center since

1945. Exactly how would the talents and equipment of the center be utilized? What should be the center's relationship with the private sector? What particular research would be appropriate? Could a facility spending less than one percent of the nation's petroleum research budget (considering the massive private funding in industrial laboratories) realistically expect to have a leadership role, or even to make major contributions?

Ball and his staff worked to find new answers to these long-standing issues, as their holding actions against budget cuts required them to rethink thoroughly their own mission. But their lines of argument seemed to carry little weight with Bureau officials and with Congress. Their debates over the relationship of petroleum research to the total energy question, prior to the creation of the new Energy Research and Development Administration, laid a groundwork of arguments, vocabulary, and sophisticated policy positions that would be useful in the continued struggles over energy policy during the Ford, Carter, and Reagan administrations.

At the same time that Ball dealt with the larger policy questions surrounding the center's existence, he continued to manage the day-to-day business of the center. In particular, he struggled to tighten up the administration and internal budgeting practices of the center, to improve staff morale, to strengthen and develop outside cooperative agreements, and to ensure continued support for the work in emissions control which generated national recognition. The concept of nuclear explosive fracturing of gas and oil strata had held out promise for a few years of greater funding and a significant role, but the Atomic Energy Commission dismantled those projects rapidly in the period 1968–1970 due to technical problems of radioactive residue in the product and to the tendency of the underground blasts to fuse the strata rather than creating fissures and cracks. Coupled with the fact that the Atomic Energy Commission had set up an office of nonnuclear energy, the dismantling of Gasbuggy left a legacy of friction between the Bureau employees and those of the Atomic Energy laboratories—friction that was to hamper efforts to unite the two energy-related research agencies when the Energy Research and Development Administration was later planned and implemented.

Administration: Bureaucracy or Good Management?

The growth of the station and its increased reliance on outside funding through cooperative agreements and transfers of funds from other federal agencies required structuring of administrative systems at the center. As technologists and scientists, rather than managers,

senior researchers at Bartlesville approached the need for more administrative work with ambivalence, some disdaining management techniques even as they practiced them.

Watkins, who had worked at Bartlesville in the production group, now served at Bureau headquarters as Director of Petroleum Research. In order to bring some coordination to the Bureau's petroleum work, Watkins issued a call for a conference of research directors and senior staff from the laboratories at Bartlesville, Laramie, and Morgantown, and from the San Francisco office, to be held in the spring of 1968. He circularized the centers for their ideas about the agenda for such a meeting, and Ball, in turn, asked his project coordinators and his administrative superintendent, Kenneth Hughes, to develop ideas for the proposed meeting.

Ball forwarded these ideas to Watkins. The staff believed the meeting would be a waste of time if devoted exclusively to discussing strictly administrative issues. Even Hughes, whose main responsibility had become mechanical, technical, and administrative services, shared this concern. He warned against dwelling on "the nuts and bolts of our operation," "our collective areas of weakness," and "how many copies of X proposals were sent to whom!" Rather, he hoped that the meeting would concentrate on the research being conducted, with each project coordinator discussing his areas: Hurn on Air Pollution, Douslin on Thermodynamics, Eckard on Petroleum Engineering, Johansen on Basic Production, Eilerts on Fluid Flow, and Ward on Processing and Utilization, with similar reports from the other centers.

The project coordinators agreed with Hughes: Johansen noted that the meeting should be "as short as practical" and that it should "stick to petroleum research problems." Eckard, even more skeptical, did not even think such a meeting should be held. Douslin suggested that the meeting be limited to 50 percent "administrative matters," and he hoped each project coordinator would be required "to review and interpret his research in light of long-term objectives." Hurn stated bluntly that the meeting should cover "technical research *only*; no administrative matter whatsoever." Ward, like Eckard and the others, thought such meetings a waste of time, with a ritualistic "commiseration" as the main function; if a meeting absolutely had to be held, he thought the project coordinators should not be required to attend.

Ball relayed the comments to Watkins, who had received similar comments from the other centers. In spite of the expressed views about administration, however, Watkins noted an undercurrent of ambivalence: "Some consensuses were expressed. The principal one was that such a meeting should be devoted to research, rather than administrative matters. This really is a

hard one to analyze, because many of the examples of topics suggested for discussion fall into the category of research administration."¹ In the end, no agenda was needed. The proposed spring conference was cancelled due to the Poor People's March on Washington and the Washington riots following the assassination of Martin Luther King, Jr.

Ball, with his own background in petroleum chemistry and his experience at Laramie as a researcher, often felt uncomfortable about the administrative duties and behavior expected of research directors. In a sardonic, almost tongue-in-cheek "trip report" regarding dedication ceremonies for monuments at the helium facility in Amarillo, for example, Ball told Watkins that "unusual touches which added to the general interest included helium filled balloons at all events, the use of a helium filled balloon to pull the wrappings off of the Helium Monuments at the moment of dedication, the presence of Donny Anderson, the Green Bay Packer, to kick footballs filled with helium into the crowd as souvenirs." Ball's discomfort with the public relations efforts of Dr. Seibel at the Helium Research Center reflected his own, more formal attitude towards the Bureau's mission.²

All the project coordinators shared his ambivalence and disdain toward administrative duties. As scientists and technicians, they sought recognition from their peers in professional associations and from industry, but most of them did not thrive on publicity or on administrative power. Eilerts expressed this most explicitly when he argued against changing his own title from Research Scientist to Research Supervisor following a Bureau of Mines directive to that effect. "I have never sought to have large and increasing appropriations, many people to supervise, or numbers of publications . . . I want to continue on difficult assignments that can yield a novel, reliable, and potentially useful result if I succeed. I want associates enough and money enough to make efficient progress at those assignments and no more." Men with such values found it difficult to survive political and budgetary in-fighting.³

Within this general resistance to increasing bureaucratization, Ball and most of his project coordinators did work diligently to increase the efficiency of the center, to structure more formally the system of research, and to improve the center's publication output. Some of their methods reflected traditions of the center. The addition of Bill Linville as a "writing engineer" to improve the technical writing of the center, for example, was a conscious effort to fill the function once performed informally by Superintendent Smith. Linville, as Technical Writer-Editor, conducted workshops and seminars, inviting outside specialists to help in the in-house training. In addition to conducting his own course in Technical Report Writing, he brought in a variety of consultants to offer pointers on

such topics as the writing of effective abstracts.⁴ Ball also worked on the writing issue directly, issuing guidelines and clarifying the distinctions between papers given at conferences, reports to associations, and formal and informal talks.⁵

In day-to-day administration, Ball put in several new procedures to tighten up the working of the center. On details requiring action by all project coordinators, Ball issued regular, short, numbered memoranda, keeping the coordinators informed as to due dates for budgets and reports, visits by outside VIPs, news of awards and honors to staff members, arrangements for remodeling of facilities, and requests for standard information. Ball also developed a straightforward system of assessment against outside funds raised under cooperative agreements and transfers from other agencies, which allowed each project coordinator to know how much administrative cost for the center as a whole would be assessed against each outside fund. By forewarning his coordinators of forthcoming budget changes, Ball hoped to avoid unpleasant surprises and awkward shortfalls.⁶

Ken Hughes worked as Ball's assistant on administrative, budget, maintenance, and personnel matters. Hughes was able to determine for Ball those coordinators who over- or under-spent government appropriations or cooperative funding, to arrange for balancing transfers of funds inside, and to signal forthcoming problems. With funding coming from fifteen to eighteen outside agencies or associations, Hughes' assistance was vital.⁷

Further, Ball worked to keep the project coordinators informed of developments in Washington and to seek their involvement in policy discussions. Like it or not, the project coordinators learned about the political and policy battles surrounding the center; Ball sought and usually received their help and ideas. When Ball was called to Washington to meet with other research directors from the Bureau, he named a project coordinator, usually Johansen or Ward, to serve as protem research director of the center, and on his return he would give his senior staff a detailed report of the meeting. In order to involve the researchers who worked in the project coordinators' groups, Ball set up meetings with the members of each group to discuss finances and research progress. Through these meetings, even frontline researchers—the "bench men"—knew what was going on regarding the funding of their work.⁸

Ball then used the communication channels he had established to strengthen his hand in dealing with headquarters. He insisted that each project report emphasize at least one element of clear progress. As a scientist himself, Ball asked for such reports with a sympathetic understanding of the researcher's difficulties: "The pace of scientific research is slow enough so

that it always becomes a problem as to when items should be reported. Nevertheless, even if progress was small, even slight positive results should be specifically noted so that Washington would gain no false impression of inaction."⁹

Despite Ball's efforts, the fundamental problems facing the center continued to plague him. Over the period 1962–1969, appropriated funds for Bartlesville increased by 11 percent, although not in regular increments. Yet out of those funds, the center was required to grant pay raises to all employees which averaged 35 percent. In 1967, when the station faced a reduction in force, Ball and his project coordinators scrambled to raise outside funds to offset the possible cutback. But dependence on nongovernmental funds entailed serious problems, especially since private groups would not build in inflationary increases from year to year.

Furthermore, some associations expected a minimal matching fund from the Bureau. If the Bureau contribution remained static and matching funds were required, a limit to the proportion of outside funding would very quickly be reached. In 1968–69, when the center achieved about 55 percent of its budget from non-Bureau sources, this natural limit of outside funding, given an inflexible federal appropriation, appeared to be reached. Ball recognized these limits but continued to fight for growth. Growth was essential, not for its own sake, but because the lab needed more staff and equipment to achieve any stability and to maintain its reputation for excellence. Ball complained to Bureau headquarters that the center remained inadequately equipped, partly because increases in budget had gone to preserve personnel rather than to modernize facilities. The center was simply not up to what Ball regarded as "critical mass"—that is, a budget and staff large enough to afford such basic needs as computer facilities, interchange of scientists with other laboratories, information services, and craftsmen for production and repair of equipment.¹⁰

Cooperative Funding: The Heyday

Ball also recognized that reliance on outside funding brought administrative headaches to the center. "We are particularly vulnerable," he noted in 1968, "because of the high percentage of contributed trust and working funds . . . No supplement to these funds is available to take care of the pay increase." And reliance on such money led to other difficulties. "Many of the working or trust funds," Ball wrote, "expire at various times during the fiscal year and no certainty of renewal is available until that time." Federal agencies that transferred funds to the Bureau for petroleum work received their final appropriation late in the fiscal

year, keeping the final amount to be transferred uncertain. Past experience indicated that only about one-half of new funds under preliminary discussion from private sources ever materialized; yet that experience could not provide a firm guideline on which to base long-range planning. As scientists, Ball's staff could not bring themselves to ask regularly for 200 percent of needed money and expect to get 100 percent. The budget game might be played in that fashion in dozens of agencies, but Bartlesville persisted in asking for specific, needed equipment, supplies, and personnel using real, predictable costs.¹¹

Ball tried to explain some of the difficulties to friends in industry. Specifically, a pay raise in fiscal year 1968 was difficult to cover. The government provided a supplemental appropriation for government budgeted funds. Yet cooperative funds from associations, such as API funding, would only be increased if the association would agree to do so. Without an increase, staff would have to be cut from the association-funded groups since the mandated pay raises had to be funded from somewhere. Federal budget cuts to the Atomic Energy Commission, the Air Force, and the Office of Saline Water led to slightly reduced transfers of funding from those agencies to the center. Ball tried to minimize the consequent expected 10 percent reduction in force by accepting retirements and resignations, and making some transfers of personnel to other facilities. Nevertheless, the staff cut claimed twenty-four positions. Ball asked his contacts at Shell Oil to use their influence with the API committees to work toward increased funding so that the API project work at the center would not have to be cut.¹²

The fact that private groups, by providing such money, could determine internal research agendas remained a sore point. When questioned by the Bureau of Mines on the degree to which non-Bureau funding determined the level of thermodynamics work, Ball admitted that thermodynamics research was planned in response to private funding. But Ball saw this in a positive light—in that private funding served to validate and insure the relevance of the research to national and international needs. Ball said he would "aim our work toward Bureau projects" if he could, but he doubted "if we can find groups working with sufficient sophistication to need thermodynamic data. However, I should point out that laboratories with the capability of our thermodynamics laboratory are 'rare birds' indeed (there are perhaps two in the free world) and that a concept of serving only Bureau of Mines research would reduce our benefit/cost ratio to an unacceptable level. Consequently we must base our assessment on an international service." The Bureau simply had to allow thermodynamics a wider field of clients to support the work if it was to continue.¹³

Private funding had become a case of the tail wagging the dog. Ball confessed to his colleague G. U. Dinneen, Director of the Laramie Center, that he and the Bartlesville staff had virtually given up trying to prepare programs based on the fiscal year. "We believe ourselves unable to write a fiscal year program and attempt to make ours for the calendar year. This is a reflection that our outside funding makes a bigger difference in our program than the appropriated funds."¹⁴ Of course, for government planning purposes, Ball and Hughes still produced fiscal year plans despite the awkwardness of adjusting the two budgeting calendars. Through the late 1960s and early 1970s, this practice of keeping dual calendars was continued to keep both government and private sources satisfied.

In preparing the fiscal year 1972 funding, the center projected that more than 50 percent of its funding would still come from sources other than Bureau of Mines appropriations for petroleum research. Bureau funding for oil shale, mine safety, helium work, and coal research accounted for 22 percent of the proposed funding, with an additional 29 percent planned to come from other agencies and from cooperating associations:

Petroleum Research-Bureau	1,882,900	49%
Other Bureau Funds (coal, shale, etc.)	841,268	22%
Other Agency and Cooperating Groups	1,114,500	29%
Total Proposed for FY 1972	3,838,668 ¹⁵	100%

Ball summarized his thoughts about the advantages and disadvantages of the high level of outside funding that had developed for Watkins at Bureau of Mines headquarters in a clear-cut list of pros and cons. The arguments against outside funding, in his view, were that such funding prevented concentration on Bureau of Mines programs, could not be relied upon for renewal, did not provide for escalating costs due to inflation or for capital expenditures, and tended to divide the allegiance of the laboratory.

On the other side, outside funding permitted larger staff with a wider area of competence, provided new programs to enlarge areas of work, kept competent employees interested, and allowed for a larger laboratory (which, in turn, provided greater opportunities for personnel advancement, interdisciplinary consultation, and wider resources for problem solving). The competition for outside funding provided incentives for developing better proposals, and sometimes required a higher standard of performance than in-house programs. The reports from the center to other laboratories improved communication and transferred research know-how to the field. Finally, outside funding provided recognition and liaison from industry through advisory committees and monitors. Arguments in favor, thus, were quite compelling.

Ball also pointed out that some of the disadvantages of outside funding, particularly budget uncertainty, were not restricted to outside funding but applied also to internal Bureau funding. And in point of fact, the greatest single loss of funds during his tenure (the cut which had caused the center to search out greater outside funding) came in the sudden and unexpected cut of 1967 appropriated funds from the Bureau. With encouragement from the Director of the Bureau, Hibbard, the center raised its outside funding from 40 to 55 percent in that year. Hibbard expected to be able to restore and even raise the appropriated contribution to the center's work to match the outside funding. But Ball noted sadly that "this has not come to pass and our holding operation becomes more difficult each year."¹⁶ Ball could argue in favor of outside funding when he was called upon to do so, but he remained well aware of the administrative and fiscal difficulties that it imposed.

When justifying high outside funding, of course, Ball stressed only the positive aspects of cooperative work. In explaining and justifying the high proportion of outside funds in the January 1, 1968, program statement,* the program stressed only the positive aspects of cooperation:

"Advisory Committees bring new viewpoints into the planning and development of projects. Projects sponsored by industry often have access to information from company laboratories which constitutes a substantial contribution to the success of the research. Committees from industry associations can bring to the attention of government researchers the needs for information in specific fields. Most particularly, however, the association provides a means for disseminating the results of Bureau research to those who can most effectively use it in the interest of conservation."¹⁷

Such a presentation was not mere puffery. The high level of outside funding through this period did allow the center to survive, to maintain its reputation for professional work, and to disseminate the resulting information. Without the funds, the station would have shrunk to one-half its size, much too small for survival according to Ball's own calculations. Work with the API sustained several groups, including the continued crude oil and product surveys, the analytic work on the heavy ends of petroleum, basic thermodynamic work on petroleum hydrocarbons, and chemical analysis of compounds found in automotive and industrial exhausts. By 1974, for example, work on the "heavy end distillates" at Bartlesville had led to the preparation of some forty-five papers.¹⁸

Cooperation with other associations also continued and expanded. Funds from the AGA helped projects on oil and gas well stimulation by chemical explosives.

*Ball noted that "the ratio of direct to transferred funds is about 1:1." Actually, the proportion of outside money was slightly higher.

Individuals' membership and participation in associations also served to keep the station informed of developments and provide a degree of access to the business network, although they rarely yielded funding. Johnston and Eckard from the Bartlesville center and Watkins from Bureau headquarters, for example, attended meetings of the Independent Petroleum Association of America.¹⁹ Johansen and Eckard served on the Secondary Recovery and Pressure Maintenance Committee and the Research Committee of the Interstate Oil Compact Commission.²⁰ Thus, despite increasing government-business tensions in the 1960s and 1970s, the center remained in relatively close contact with the private sector through business, professional, and cooperative work.

Specific cooperation with particular companies in exchange of information, equipment, and samples continued in much the same way as it had for decades. In particular, the center worked with DuPont, Shell, Sun Oil, and, of course, with nearby Phillips Petroleum on a range of specific projects. DuPont provided samples and information regarding its chemical explosives.²¹ The center studied a Shell compound of sodium tri-polyphosphate to improve oil well deliveries by its injection. Shell representatives came to the center for discussions of that project and received the obligatory tour of the facility. Ball and the staff believed that this and dozens of similar minor meetings and center tours through this period kept industry aware of the potential help and technical capacity at the center.²²

More substantive cooperation in the tradition of demonstration projects went forward between Sun Oil's local DX Division and the center, with DX providing a gas well for testing with explosive fracturing methods to increase gas well deliveries. Costs were equally shared between the Bureau and Sun on a well in Osage county, convenient to the center. Publications produced under the agreement were cleared both by Sun and the Bureau.²³

Cooperation of another kind continued with Phillips, as the researchers at the center used rental time on the Phillips IBM 360 computer. The rental of computer time presented a problem, since the rate charged by Phillips (\$1,000 per hour) was higher than any other computer time charge paid by the government. Ball and Hughes worked up a justification for the expense, showing that savings on travel time to alternative facilities in Tulsa, as well as Phillips' cooperative work on debugging programs and in providing assistance at no charge, far outweighed the direct rental cost. And internally, Hughes and Ball noted that the Automatic Data Processing contract people in the General Services Administration (GSA) regional office who complained about the rate did not understand the issue. Hughes told Ball of the GSA complaint: "This is the tune they have sung for a long time; however

switching cities will not help our service." Independent time-sharing consultants felt that the arrangement with Phillips was a bargain, and the center was able to keep the contract.²⁴

Throughout the period, less formal, day-to-day community contact with former colleagues at Phillips and with other researchers there kept the two laboratories in touch. By 1970, however, the research facility at Phillips far outstripped the Bureau facility in staff, capital equipment, floor space, and budget. Indeed, the significance of the Bureau facility had so diminished that many local residents were no longer aware that Bartlesville was the site of the federal government's major petroleum research facility. The several thousand employees of Phillips and the company-town atmosphere served as a constant physical and psychological reminder to center staff of the minor part the center now represented in the total petroleum research effort of the nation.

Cooperation with government agencies ranged from small, older projects to large, new activities, and provided more funding and activity through this period than did cooperation even with the private sector. The cooperation with the State of Kansas over oil field brine disposal, which had continued on a small scale since 1935, came to an end in 1970; but the loss of that continuing project was quite minor, since funding of less than \$1,000 per year had not even been fully expended in its last few years. By contrast, Hurn's budget from the Public Health Service (then the Health, Education and Welfare budget) and later, from the Environmental Protection Agency, represented the single largest infusion of outside money. Hurn's 1972 proposal included over \$700,000 requested from EPA alone. Requests and transfers to other groups from Navy, Air Force, and the Water Quality Administration provided a few hundred thousand dollars through the period, while large transfers from Bureau work in mine safety, coal research, and oil shale fleshed out the budget on a larger scale. After the decline of the Gasbuggy work for the Atomic Energy Commission in 1967, the major large-scale, non-Bureau funded part of the Bartlesville program remained the auto emissions work of Hurn's group, to be discussed in more detail below.

Auto Emissions

Through the late 1960s, increasing media and public concern with the quality of the environment raised the issue of air pollution from local and regional forums to the national level. The 1965 Clean Air Act set national standards to be reached in auto emissions over the 1970s; the State of California set standards even in advance of the federal standards. Political agitation over the issue caused the petroleum and automotive industries to fear that public pressure might lead

to either technically impossible standards or the pursuit of nonpetroleum fueled vehicles, such as electric-powered cars. A Department of Commerce task force in 1968 attracted wide publicity with its work on the feasibility of electric cars, for example, giving substance to the fears of the petroleum people.

In response to such pressures, in the period 1968-1970 the automotive and petroleum industries worked on several alternate solutions to the air pollution problem that would allow retaining the gasoline-driven internal combustion engine. Which path would eventually be taken depended on several factors, including the technical feasibility of alternate devices and systems, the commercial practicality of the choices, the ability to adjust control systems to established methods of producing fuel and producing automobiles, and on a range of political decisions made by state and federal governments.

Companies and industry groups experimented with several possible solutions: (a) a "reactor" to be installed in the exhaust system or manifold of new vehicles to burn hydrocarbons which otherwise would escape to the atmosphere; (b) lead-free gasoline of sufficient octane to meet popular desires for high-powered vehicles, which would be compatible with the reactors; and (c) systems of exhaust returns and crankcase ventilation which would provide for the condensation and reinjection into the fuel supply of gases containing unburned hydrocarbons. At Bartlesville, Hurn's group participated in government testing programs for all these systems; in addition, Ward's group participated in work on the development of standards for unleaded fuel.

On December 29, 1967, Secretary of the Interior Stewart Udall reported on HEW-funded tests conducted at Bartlesville of an experimental model of an exhaust reactor developed by DuPont. Under the 1965 Clean Air Act, the Department of Health, Education and Welfare had initial federal responsibility for evaluating emissions control systems. But much of the technical work for the Health, Education and Welfare testing was conducted with transferred funds through Bartlesville. In an indignant tone, Henry Ford II, Chairman of the Board of the Ford Motor Company, wrote to President Lyndon Johnson complaining of what he perceived as Udall's publicity-seeking announcement of the technical feasibility of the DuPont reactor. Specifically, Ford complained that it appeared that the Department of the Interior was wrongfully invading the area set aside for HEW jurisdiction. Ford noted that, despite "some difficulties" and "differences of opinion" between HEW and the manufacturers, an "effective working relationship" had been established. Udall's announcement, claimed Ford, raised the "specter that two separate arms of the Federal government may be vying to see which shall

regulate our industry's technical efforts to reduce vehicle emissions."²⁶

After checking with Udall, Johnson explained that the Bureau of Mines undertook technical work under cooperation with Health, Education and Welfare, and he assured Ford that HEW would continue to be the responsible agency for federal regulations under the Air Quality Act. No duplication would be permitted to exist. However, Interior's Bureau would conduct some of the research because "for more than half a century, the Department of Interior, through its Bureau of Mines, has been engaged in research on air pollution associated with the production, treatment and use of minerals and fuels."²⁷

The publicity surrounding Udall's announcement of Hurn's work brought a flurry of inquiries and attention to the center. Hurn himself responded to inquiries from congressmen and state officials in Arizona and California, explaining that the testing of the reactor had only proven its technical feasibility, not its commercial application. More directly, Hurn wrote to technical people at the Ford Scientific Laboratory, explaining that the publicity had somewhat misrepresented his efforts. It was also Hurn's position that Udall released information about the reactor to reassure the public that smog reduction with internal combustion engines was quite possible, and that the electric car option advocated in the Department of Commerce studies need not be immediately pursued.²⁸

In response to inquiries from California state and local officials as to the efficiency of the DuPont reactor, Hurn documented that the installed system yielded values of hydrocarbon emissions, carbon monoxide, and nitrogen oxides, and aldehydes that, in 1967, largely conformed to the California standard and met the planned 1970 national standards. Hurn warned, nevertheless, that optimism about the device should be tempered by the knowledge that its very high operating temperatures, in the range of 1500 to 1700 degrees F, created questions about the durability of the metals involved. With similar caution, he warned that "reference to technical success with the manifold reactor is to be interpreted only in the sense that at least one control approach is available; there may be others equally or preferably acceptable."²⁹

Since tetraethyl lead would foul the reactors, a lead-free fuel had to be developed and marketed if reactors were to become commercially adopted. A special task force established by the API worked on the problem, and Hurn's group proposed a test experiment to run on several alternate no-lead fuels. However, as Hurn repeatedly explained in response to both public and technical inquiries, his laboratory did not "do developmental work on air pollution prototype devices." For such work, he referred questioners to the Department of Health, Education and Welfare's own National

Center for Air Pollution Control in Washington. The competence of the Bartlesville center lay more especially in "the analysis of combustion and mineral process gases as well as in the measurement of a wide gamut of related gas-borne contaminants."

As responsibility for emissions control was shifted to the Environmental Protection Agency, Hurn obtained funds from the new agency for his group to continue work. Cooperating with American Airlines and the EPA, Hurn arranged a project testing emissions from aircraft engines.³⁰ He continued to publish results and to give papers through this period, giving two papers focusing on fuels research at a 1970 conference of the American Society for Testing and Materials.³¹

1970 Efforts to Redefine the Center's Goal

Ball had remained dissatisfied with the underlying justification of the center's research listed every year in the statement of program. In January 1970, Ball suggested to Watkins, as Director of Petroleum Research at the Washington office, several major revisions in the program statement. In making his suggestion, Ball opened for discussion a fundamental issue which had troubled the center for decades but which had rarely received such frank and full airing. The existing program justification read as follows: "To develop new technology to increase efficiency and reduce the cost of finding, developing, producing, processing, transporting and utilizing the petroleum, natural gas, and oil-shale resources of the United States." Ball had serious objections to this statement and wanted to change "To develop new technology to increase the efficiency and reduce the cost" to language which emphasized a more proper, governmental role: "To promote the interests of the Government and the general public by the development and dissemination of technology."

Ball's recommendation was more far-reaching than might at first appear, and he was well aware that he was raising an issue fraught with political and ideological overtones. But he argued that several developments had outmoded the earlier approach of simply developing technology to increase the petroleum industry's efficiency.

First, he pointed out that the small budget of the Bureau of Mines was inadequate to affect significantly the total petroleum research picture. He estimated that the American petroleum industry spent about \$500 million on research. The Bureau's total petroleum and oil shale research budget of less than \$5 million raised the issue as to why the private sector could not simply take over all the research. He noted that there were at least fifteen private laboratories with far greater resources than those of the Bureau of Mines. Since all were profit-oriented and well aware of cost-benefit

ratios, the private laboratories, with their superior reservoirs of skill, equipment, and resources, could readily take on any projects likely to increase efficiency in the industry. Ball was careful to recognize historical origins of the point of view of government assistance to industry, but he noted that the values which had gone into supporting government research in the decade 1910-1920 simply made little sense in the 1970s. The Bureau's original mission had been achieved, in that the private sector was now fully convinced of the value of and quite capable of conducting research that would modernize and make efficient transportation, production, refining, and other aspects of the industry.

As long as the Bureau continued to search for projects with "payout" defined as individual industry profit, Ball believed there was no reason to expect that the Bureau would find projects that the private sector would not be willing to take on. However, if the Bureau defined "payout" as a benefit to the entire industry or to the general public, then the laboratory's role might be useful. Further, if the government could accept low benefit-cost ratios, then industry might feel that the government should go ahead with the work in such areas as environmental improvement. In some particular cases, the cost of a research effort could be too high for a single company, even though the possible benefits might also be high; in those situations, the government might also have a role, as in the case of the Gasbuggy project. In short, under the older "efficiency justification," in the context of current industry research, the government research role was limited to three areas: projects broadly useful to industry, but not profitable to any single company; projects with too low an advantage to attract private sector work, as in environmental work; and projects, like nuclear work, that were so vastly expensive that private risk capital was hard to accumulate.

By adopting a more straightforward view that the work should benefit the government and the public, other more logical justifications were possible. Thus, the government might engage in research to benefit the environment without concern for cost-benefit analysis. Or the center could engage in research which would serve to interpret the complex technology to other government agencies concerned with regulation or prediction. Basic research and long-term research with no immediate or even foreseeable payout might be undertaken. Further, there would be unpredictable but very real benefits, such as benefits to science generally, information service to the general public, training service for individuals (including foreign nationals), and the spread of better technological practices through industrial associations, technical societies, and state governments.

Ball argued that the "government-and-people" orientation made sense, and in fact described what the

center was actually doing. But the new definition of role could also open new areas. "If the program of Petroleum Research is built around the restated objective, a new emphasis would result. This emphasis would bring increased responsibility for us to take the initiative to inject ourselves into problems of current interest."

Ball solicited comments on his new "position paper" from his project coordinators and the project leaders who worked under them, and a lively debate ensued at the center through January 1970. Larman Heath of the Petroleum Engineering Research group liked the concept of protecting the public interest, and enthusiastically suggested a range of new projects which might be justified under the new program objective. Eilerts, however, warned that moving in the direction of "surveillance" of industry, rather than cooperation, would endanger the support from the business constituency that had been built up over the years. In particular, Eilerts suggested rephrasing changes in a way that would tend to reduce the implied criticism of industry (as if its interests were at odds with the public). He continued to view industry and the public as part of a single national entity, believing that the Bureau of Mines cooperative approach worked out in the 1920s and 1930s was appropriate.

Hurn, in contrast, agreed with Ball that the new description more closely conformed with what the center was in fact doing; Hurn's own concentration on emissions work did serve other government agencies and the interests of the public and placed emphasis on environmental concerns which industry had ignored until public pressure forced changes. Hurn worked closely with industry, but his work was in the political context of growing "environmentalism" which stressed the role of government as regulator of industry. Hurn agreed that the "cost-benefit game" was a poor guideline for work at the center.

Other researchers, like Johansen, agreed largely with Ball's new direction, merely suggesting some stylistic changes to give the statement more impact and readability. Ball incorporated some of the suggestions forwarded to him and made the presentation to Watkins in Washington.

On February 26, 1970, President Nixon announced a series of economy measures affecting a wide range of agencies and departments in the government, calculated to save \$2 billion in government expenditures. As one small part of that effort, the petroleum research effort was to be redefined, according to the Presidential message, as follows: "Federal petroleum activities in the future will be limited to those research activities which are in the public interest, but which would not otherwise be funded by the petroleum industry. Research projects in the interest of the oil industry, which clearly could be

financed by that industry, will no longer be paid for by the federal government."

Although Ball's rethinking of the center's mission happened to coincide nicely with the White House policy, in line with the new guidelines, the fiscal year 1971 Bartlesville budget was to be cut \$300,000. As Ball noted in information provided to the local Chamber of Commerce, this cut came after severe cuts through the period 1967-1970 and on top of a longer period (1962-1967) in which appropriations were generally static in a period of increasing cost. The result had been a steady deterioration in the capability of the center to pursue petroleum research, even though in that same period new projects on air pollution research had expanded the competence of the facility in that regard.

Through May of 1970, Ball amplified his thoughts on the proposed new program statement, which would provide a mission in accord with his earlier ideas, and sent a fuller analysis of the Bartlesville research program and its necessary revision to Watkins, and through Watkins to W. L. Crentz, the Acting Assistant Director for Energy in the Bureau of Mines. Crentz's response appeared to miss several of the points that Ball had developed; but Ball believed, nevertheless, that he had stimulated a discussion which would help clarify the center's role. He felt that he had aroused the most "effective dialogue" in seven years of work with the exchange of correspondence with Watkins and Crentz over the question of policy direction.

Ball's basic point was that the center was "boxed in with a very narrow area of permissible work." Since the Bureau of the Budget would not fund research that industry itself could fund, only a residual area of public interest items and environmental subjects was left. Since pollution work was primarily undertaken by other agencies, the funding for emissions studies would never be direct. However, since the center had competence in the petroleum research area, it could provide assistance to the other agencies more directly involved. Furthermore, the suggestion of converting the petroleum research centers to "energy centers" raised some issues that Ball felt needed to be solved. Would each center diversify and take on a variety of kinds of energy research, or would Bartlesville continue to specialize in petroleum as an energy source? In any case, Ball wanted the Bureau to "place a stop under a badly eroding program." He argued strongly that the Bureau emphasize service to the public and to other agencies, and abandon the concept that "for a few thousand dollars" the center could have an effect on a "multimillion dollar industry." Ball patiently repeated to Crentz the differences between the structure of the petroleum industry and the coal industry, with which Crentz was more familiar.

The 1971 locally authored program for the center reflected the new language for which Ball had argued. But despite the articulation of the issues through an exchange of correspondence, Ball had received very little real policy direction from headquarters, and no fundamental change in the direction of the Bureau of Mines itself came out of the dialogue. The center staff may have clarified their own mission, from that of serving industry to a more conscious adaptation to the new politics of government-industry separation which had developed over the previous decades, but the change was seemingly lost on the headquarters personnel. The change of philosophy and adaptation to the new political environment, however, came just in time to help win local community and political support.

For example, Ball and his colleagues at the center used his new program in an appeal to the political forum in the form of a campaign mounted through the local Chamber of Commerce, which reached out to oil industry figures and state politicians. The Chamber mailed detailed materials regarding impending budget cuts to the Oklahoma congressional delegation. The materials described proposed cuts in budget from \$1,353,000 to \$1,053,000 (22 percent) and outlined the severe impact that such cuts would have on particular Bartlesville center research programs. The materials also outlined the direct impact of previous cuts of personnel and the loss of twenty-four positions in 1968 due to reductions in force combined with mandated increases in salaries for those who remained.

Budget cuts constituted a depressing tale and required a frank departure from the usual onward-and-upward tone of public relations material. The material prepared by Ball and Linville for the Chamber, and through the Chamber, for Congress, admitted the severe nature of the fiscal and morale problems openly. It was a sad story of unrepaired instrumentation, unmaintained buildings, sometimes overcrowded facilities, and no money to recruit younger scientists when staff retired. Instead, they noted, the center developed a staff "of advanced age whose training is obsolescent and whose average rating has crept up to an average level too high for the job being done." Morale declined from the repeated blows of 1967 budget reduction, the 1968-1969 reduction in force of twenty-four positions (from less than 200), and the proposed budget reduction of 1971. The most capable and youngest of the scientists and technicians looked for outside employment. Ball noted ruefully, for example, that of eleven petroleum engineers, two had taken outside employment in early 1970 and the others were looking for outside jobs. Despite all these difficulties, project coordinators had responded by raising outside monies and had conducted "a holding operation." But Ball and the rest were convinced, they said, that the 22 percent cut proposed in fiscal 1971 would destroy the

center. Armed with such materials, the Oklahoma congressional delegation, led by Congressman Ed Edmondson, were able to prevent the cut in the 1971 budget.³²

Crises Unresolved

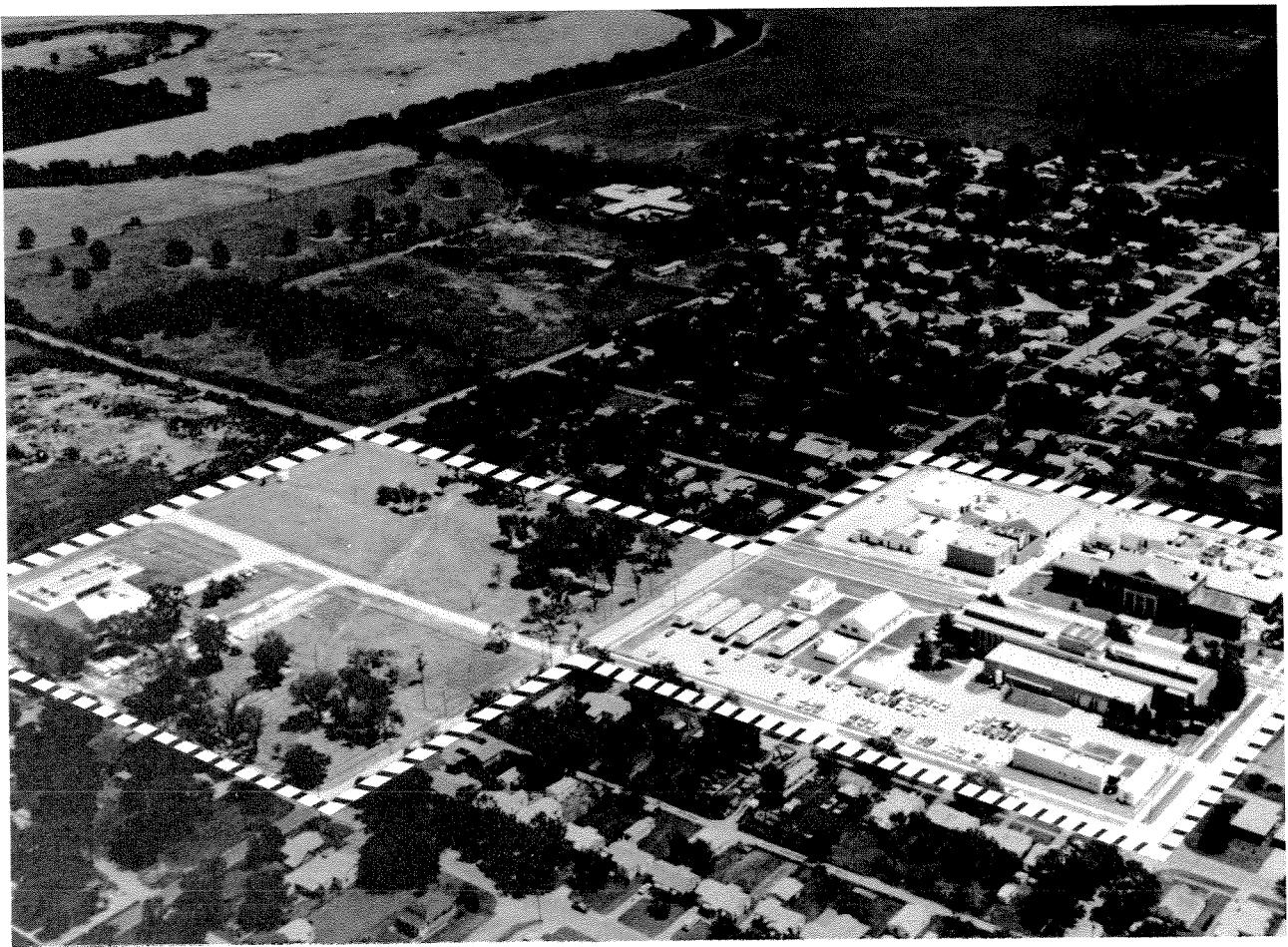
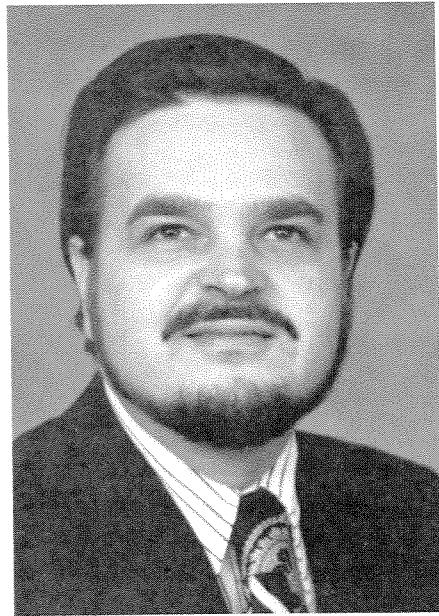
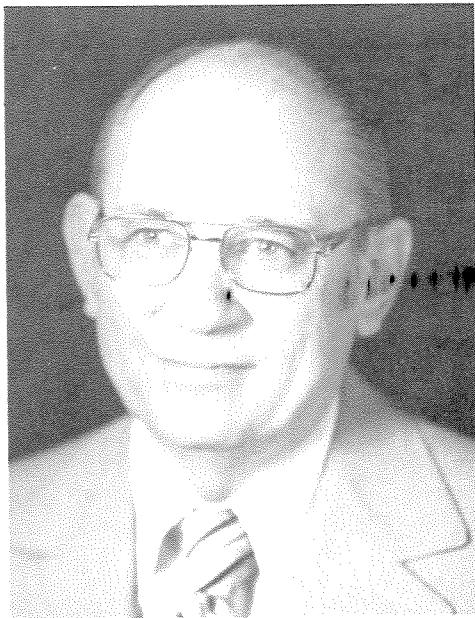
The budget crisis of 1970-1971 passed; however, Ball and his staff had found no permanent answer to the continuing need to justify the center and its research. At another level, concerns with America's total energy supply became a national priority during the Arabian oil producers' boycott of 1973-1974. Yet a concerted national response to the energy crisis was hampered by the virtual stalemate in government operations due to the Watergate scandal in 1974.

One proposal, which held promise for the future and reflected a successful case of bureaucratic and political in-fighting, was a set of plans for enhanced oil recovery or tertiary recovery, first put forward in the spring of 1973. The proposal went from Bartlesville through Crentz into the Bureau of Mines budget proposal put before Congress. Crentz supported the plans, and the idea received backing from Senator Bellman and the Oklahoma congressional delegation, who successfully fought off an attempt to have the work undertaken by the Atomic Energy Commission. After inclusion of funds in a supplemental budget appropriation in fiscal year 1974, funding on a regular basis began in fiscal year 1975. The first work on enhanced oil recovery under the proposal began in June 1974.

NOTES

1. Correspondence, March and April 1968, Hughes-Ball, Johansen-Ball, Eckard-Ball, Douslin-Ball, Hurn-Ball, Ward-Ball, Ball to Project Coordinators, Watkins-Ball, Ball-Watkins, BETC Vault, Box 5, 1967-68, Fuels Instruments to Meetings and Conferences.
2. Ball to Watkins, May 1968, BETC Vault, Box 7, 1967-68, Org-Monthly.
3. BETC Vault, Box 1, Administrative Management, FY 71.
4. Linville to D. P. Helander, May 7, 1968, BETC Vault, Box 27, 1967-68, Public Relations.
5. Ball to Project Coordinators, Box 7, 1967-68, Organization-Monthly Operations Reports, June 7, 1968.
6. Ball to Project Coordinators, Box 7, 1967-68, Organization-Monthly Operations Reports, June 19, 1968.
7. Hughes to Ball, September 18, 1968, BETC Vault, Box 3, 1968-69, Financial Management.
8. Ball to Project Coordinators, December 6, 1968, March 3, 1969, BETC Vault, Box 10, 1968-69.
9. Ball to Project Coordinators, June 10, 1969, Box 9, 1968-69, Organization and Administration.
10. Ball to Kostner, April 3, 1969, BETC Vault, Box 3, 1968-69.
11. Ball to Watkins, November 18, 1968, BETC Vault, Box 3, 1968-69, Financial Management.
12. Ball to Hinds, January 29, 1969, BETC Vault, Box 7, 1968-69.
13. Ball to Zinner, May 14, 1969, BETC Vault, Box 3, Financial Management.

14. Ball to Dinneen, October 13, 1970, BETC Vault, FY 1971, Box 8, Proposals.
15. Ward to Crentz, March 26, 1961, BETC Vault, FY 1971, Box 8, Proposals.
16. Ball to Watkins, October 14, 1969, BETC Vault, Box 13, FY 1970, Property Management to Program Planning and Review.
17. Program for Bartlesville Petroleum Research Center, January 1, 1968, BETC Vault, Box 13, 1968-69.
18. Ball to Strauss, May 22, 1974, BETC Vault, Thompson Corr, Box 1; Summary of Program Changes and Achievements, 1967-68, BETC Vault, Box 2, 1968-69.
19. Ball to Taylor, October 10, 1968, BETC Vault, Box 1, 1968-69.
20. Ball to Watkins, March 18, 1969, BETC Vault, Box 2, 1968-69, Committees and Societies.
21. Eakin to Loving, February 15, 1968, BETC Vault, Box 4, Information Services, 1967-68.
22. Johansen to Ball, February 23, 1968, BETC Vault, Box 7, 1967-68, Organization-Monthly Operating Reports.
23. Livingston to Ball, September 25, 1968, BETC Vault, Box 4, Hughes Correspondence.
24. Hughes to Ball, June 6, 1969, BETC Vault, Box 1, FY 1970, Auto Data Proc-Bldgs & Grnds.
25. Ball to Watkins, June 10, 1970, BETC Vault, Box 4, 1970.
26. Ford to Johnson, January 12, 1968, BETC Vault, Box 5, 1967-68, Fuel Instruments to Meetings and Conferences.
27. Johnson to Ford, January 29, 1968, BETC Vault, Box 5, 1967-68, Fuel Instruments to Meetings and Conferences.
28. Hurn to Caupan, January 17, 1968, BETC Vault, Box 26, 1967-68, Public Relations.
29. Hurn to John Foran, January 18, 1968, BETC Vault, Box 26, 1967-68, Public Relations; Hurn to Pauline Koch, May 7, 1968, BETC Vault, Box 5, 1967-68, Fuels Instruments to Meetings and Conferences.
30. Hurn to Assistant Director for Energy, Bureau of Mines, June 28, 1971.
31. Ward to Ball, July 16, 1970, BETC Vault, Box 20, FY 1971, Reports and Stats.
32. "Future of the Bartlesville Petroleum Research Center," BETC Vault, FY 1971, 21, Reports and Statistics.



The BETC of the 1970s, directed by John S. Ball (1963–1978) (upper left) and Harry R. Johnson (1978–1982) (upper right), had grown both in area and stature. In sixty-five years, the Experiment Station of 1918 responded to industry needs and government policy changes, eventually becoming the National Institute for Petroleum and Energy Research in 1983. The lower picture shows the present extent of both land and buildings.



The Oklahoma Historical Society and the Oklahoma Petroleum Council cooperate in placing granite markers to commemorate important events in oil industry history. At left is the monument to Oklahoma's first waterflood (1931) near Nowata which was placed in 1973. Shown from the left are John S. Ball, then director of BETC, Kenneth Hughes, director of BETC Operations Division and R. C. "Chuck" Earlonger, a pioneer in waterflooding technology. At right is the marker describing the achievements of the Bartlesville Energy Technology Center which was placed in 1978. The marker states that BETC is the Nation's birthplace for petroleum technology.

