Chapter 8

ERDA, DOE, AND FUTURE-ORIENTED ENERGY RESEARCH, 1976–1983

Ball remained director of the center through mid-1978, seeing the facility through two periods of energy research reorganization. In January 1975, the Bureau of Mines energy-research facilities, including the Laramie, Pittsburgh, Morgantown, and Bartlesville research centers and the San Francisco office, were merged into the Energy Research and Development Administration (ERDA). About 80 percent of the ERDA staff were former Atomic Energy Commission personnel, and many of the new agency's approaches and practices reflected the Atomic Energy agency's way of doing business.

Although short-lived, the two-year, nine-month existence of ERDA was a period of great advance for energy research in general. Yet, at the same time, a period of hectic reorganization of research administration in Washington and consequent disruption in the field facilities.[1] After the inauguration of Jimmy Carter in 1977, the administration worked to implement a campaign pledge to raise energy concerns to a cabinet-level issue by the creation of a new department.

October 1, 1977, saw creation of the Department of Energy (DOE), which combined the research and development programs of ERDA with a number of independent regulatory functions. The new DOE administration worked to put the various research programs, including those in "Fossil Energy" which would include "liquid fossil fuels" such as petroleum, on a coordinated and integrated basis.

In an effort to hold down the size of government, the Nixon, Ford, Carter, and Reagan administrations all imposed personnel ceilings. As always, federal managers sought to find ways around the restrictions. The solution of the Atomic Energy Commission had been the "GOCO" laboratory—a government-owned, contractor-operated facility operated by private personnel but financed by government. Similarly, the Washington offices of various bureaus and agencies brought contractors in to continue and expand their efforts. The cost would be politically acceptable, since Congress and the public would allow budget deficits as long as the "size" of government, measured in total number of employees, did not expand. Advocates of this procedure even argued, in the face of contradictory budget figures, that the private sector could do the job cheaper and still make a profit.

At Bartlesville, the highest personnel count was in 1968, although the highest funding was not achieved until ten years later. Contracting out to do various types of work enabled the center to meet the increasingly severe limitation on personnel. The procedure entailed a reduction in the amount of resident personnel with skills and knowledge, and more and more staff time monitoring contracts. As a consequence, of course, the staff had less time to do in-house assigned research or to take on outside cooperative-funded research.

Over the decade of the 1970s, contracting out work and reduced personnel resulted in attrition of the center's greatest asset—a group of highly qualified petroleum scientists and engineers available to tackle new problems. The impact of this process on morale was mixed. Many "bench-men" resented the new administrative, contract management tasks imposed on them; others seemed to thrive on the change.

Within the Atomic Energy Commission, the pattern of research decision and setting of research priorities had been vastly different from those of the Bureau of Mines. The national laboratories working on nuclear problems—including Los Alamos, Livermore, Argonne, Brookhaven, Oak Ridge, and Sandia—had operated on a massive scale. With nuclear research funded as part of the national defense, Congress and administrations since World War II had recognized that, in the area of nuclear technology, such research was extremely expensive. The mission of each laboratory was thus set as a matter of national policy. Although there were still struggles over budget, the priorities of projects were set within far more generous budget guidelines than the Bureau of Mines had ever dealt with.

By contrast, the government-owned, government-operated "energy technology centers"—shifted from the Bureau of Mines into ERDA and then into DOE—had fought annual budget fights alone, as if each were a small government bureau unto itself, with no nationally recognized defense mission. With only minimal political influence—consisting of one or two congressmen, one or two Senators, and sometimes a governor—and subject to the distant jurisdictional and budget struggles of Washington, for decades the centers had survived, sometimes barely, but had never flourished like the laboratories of "big science" such as Los Alamos, Argonne, and Brookhaven. Under the new ERDA and DOE arrangement, the centers, including Bartlesville, now faced the problem of competing for funding against the more powerful atomic energy laboratories in a changing and unclear administrative forum. Always subject to Washington decisions, the centers could only hope that ex-bureau personnel at ERDA headquarters would carry on their struggle.

Transitional Difficulties and Legacy of Assets

During the ERDA years, a series of developments exacerbated internal divisions at the center. Uncertainty about the future of the center continued, with hints that the AEC-dominated new agency would simply ignore the Bartlesville facility. The pattern which Ball and his division directors had established of seeking outside cooperative funding continued, but had brought with it severe internal complaints. Groups which had raised large amounts sometimes complained about Hughes and his implementation of a regularized system of an applied administrative 20 percent overhead to all funds. It seemed almost immoral to a scientist or engineer to see research funds diverted to necessary functions such as mowing grass, repainting, or other building maintenance. In addition, research funds raised by one group might be transferred from one group to another on orders from headquarters to support continuing personnel. Line researchers often saw such transfers and overhead as tantamount to theft, despite the fact that Ball, and Fowler before him, had worked diligently to keep the overhead rate low.

Hurn succeeded in raising the largest amounts of funding, often at odd moments in the fiscal year planning cycle. Ball, unlike Fowler, supported Hurn's work as one of the major assets of the facility. A few disgruntled researchers believed that Hurn was "out of control," operating as he saw fit and running his own division with an iron hand, threats, and fear of reprisals in the form of delayed promotions. Others, however, reported only restrained disagreements and procedures that were invariably perfectly honorable.[2]

Researchers and support personnel in all divisions, however, grumbled at the paucity of promotions. Several of the older employees were active in local politics, church groups, and civic organizations; some newer staff members who did not receive promotions wondered whether it was because they had failed to belong to the proper political movement, church, or men's organization. This is an unnecessary explanation, however, as the objective situation was such that Ball could make few promotions during the early 1970s.

Yet researchers did not entirely despair during the ERDA period. Under a major program, initiated at the center and supported in Washington, the center began to administer enhanced oil recovery projects in response to the energy crisis and petroleum shortage of the 1973–1974 embargo. The program, beginning in June 1974, opened major contracts in chemical flooding of oil fields already exhausted by waterflood techniques. The first of these cost-shared operations, using detergent-like compounds in a micellar-polymer process, entailed $5.4 million in government funding and $7.7 million eventually spent by the contractor, Cities Service Corporation. In 1975–1976, another micellar polymer project began between Phillips Petroleum and ERDA in the Burbank field, Osage County, close to Bartlesville. Another 1975 ERDA project, utilizing improved water flooding techniques, engaged Kewanee Oil Company which later merged with Gulf Exploration and Production Company at Shidler, Oklahoma, also near Bartlesville. Over the next years, new projects studying aspects of chemical and thermal enhanced oil recovery were added, using ERDA funds at a wide range of university laboratories and at oil fields all over the United States.[3]

Such cost-shared projects eventually absorbed, over the period 1974–1982, in excess of $96 million in government funding that was more than matched by private industrial outlays of over $130 million. For the most part, each project was "front-end funded," that is, the government share would be paid out in the first year of the project to assist in starting the project. These multimillion dollar amounts, paid from ERDA's and then DOE's contracting funds, showed up in the annual center budgets, raising the appearance of that budget to unprecedented scales.

Since the vast majority of the funding "passed through," however, the actual impact on the center was not of proportional fiscal benefit. Although the projects were funded generously, and although there were, by 1983, over twenty-five such projects, the administration—that is, the monitoring and evaluation of the projects' data and results—fell disproportionately on the staff at Bartlesville. Men and women hired as researchers were now cast increasingly in the role of administrators. Administrative responsibility consumed increasing staff hours, yet the center's total staff did

not increase during the period of increased responsibility for monitoring enhanced oil recovery cost-shared contracts; rather, the total number of staff declined.[4]

The contracts for such cost-shared projects were placed from Bureau headquarters; however, Bartlesville researchers participated in the source evaluation boards and in project planning committees, as well as serving as technical project officers and research managers once the contracts were underway. In order to manage such large-scale contracts effectively, staff members with differing research backgrounds had to be assembled into management teams to oversee the various technical aspects of the cost-shared enhanced oil recovery projects. Ball gave Johansen the responsibility of setting up the teams. Johansen assembled matrix management groups that ranged in size between four and six, drawing on the skills of different types of technical people—chemists, petroleum engineers, production specialists, and reservoir analysts.

The enhanced oil recovery projects, from their inception, were viewed as a mixed blessing by the Bartlesville researchers. On the positive side, several benefits from the new contract management activity were clear. Those involved would work closely with colleagues in industry and in the universities and also travel to the field sites. As new locations developed under the system, more and more of the sites were further afield, with seven in California, two in Louisiana, two in West Virginia, and a scattering in other states. Field trips and professional exposure were fringe benefits for researchers engaged in matrix management.[5]

On the negative side, staff who were not involved tended to view the new responsibilities as detracting from the center's main research function. A few resented the removal of staff members from internal research projects to serve on Johansen's matrix management teams, as needed. Although this resentment could be interpreted by Ball and Johansen as "sour recycled grapes" on the part of those left out, in reality it reflected the complex of internal jealousies and bitterness that already existed, made worse by this infusion of contract management.

During the ERDA period, in-house and monitored research often brought results which attracted national attention. In October 1975, for example, ERDA announced an agreement with El Paso Natural Gas Company to increase natural gas production by massive hydraulic fracturing of the "tight" gas-bearing formations of the Green River Basin in Wyoming. This "western gas sands" or "tight formation" project attracted wide interest in the gas industry because hydraulic fracturing held out good chances of rather rapid pay-back in increased production. The principle was similar to earlier plans for nuclear-explosive fracturing, but would not entail the environmental problems associated with the nuclear approach. Under the project, to which ERDA initially contributed $596,000 and El Paso Natural Gas spent over $4.7 million, massive injection of polyemulsion fluid and sand proppant in the range of 200,000–500,000 gallons would force open gas-bearing formations to increase gas recovery. Like the enhanced oil recovery projects, it entailed a contract monitoring team from the Bartlesville center.[6]

Another such project was the development and testing of a process to recycle used engine oil, announced by the center in June 1977. Unlike earlier recycling processes, the Bartlesville method did not produce an "environmentally objectionable by-product" in the form of acid-rich sludge. Rather, the old oil was heated to drive off volatile hydrocarbons and water. A solvent removed carbon sludge. The clean oil could then be redistilled, and other additives to improve color and odor mixed to reformulate the oil. This "retread oil" met high engine performance tests, making it the first recycled lubricant in the United States to perform at or above new oil specifications.

Charles Thompson, Bartlesville's head of Chemistry and Refining, expected difficulties in marketing the final product of the process due to public resistance to any "used" oil, even if it was chemically identical to "new" oil. Yet the potential saving of petroleum in a time of crude oil shortage was enormous. Thompson estimated that 1.1 billion gallons of lubricating oil per year were used; of this amount of waste, 480 million gallons were burned as fuel oil, 90 million gallons were recycled by older, polluting processes, and 200 million gallons were used in road oil and asphalt. Some 340 million gallons simply vanished into the environment. With proper legislation, the Bartlesville process could convert the vanished gallons into a replacement for new products at the same time it was reducing pollution.[7]

Headquarters

If the offices of ERDA faced a mixture of new opportunities and confusion, dissension, and morale difficulties, the merger of Atomic Energy and Bureau of Mines administrations at ERDA headquarters could only be described as an organizational nightmare. In 1976, under ERDA, the Market Oriented Program Planning Study (MOPPS) task force was established to evaluate research priorities for the agency. At the very time that the Fossil Energy staff became absorbed in the MOPPS study, however, Congress approved the creation of the Department of Energy to absorb and replace ERDA. Few Fossil Energy staff members were present in the ERDA office to oversee the transition to the new agency, since most were involved in the MOPPS work. During the establishment of the Depart-

ment of Energy (DOE) after October 1977, therefore, administrations constantly had to reshuffle personnel.[8]

George Fumich, a former West Virginia political figure, who had previously run the office of Coal Research in the Department of the Interior and had extensive political experience but no research experience, assumed direction of the new Fossil Energy unit within DOE. Fumich had been confirmed by the Senate; but his nominal superior, the acting Assistant Secretary for Energy Technology, had not. Fumich himself was then appointed Assistant Secretary at Senator Byrd's specific request, under which circumstances, of course, he was able to make crucial policy decisions with de facto near autonomy.

Within ERDA, Harry Johnson, working with Martin Adams and with Watkins, formerly of the Bartlesville center, had helped develop the rationale for the enhanced oil recovery program and had "sold it within the administration." The result was the first "real slug of money" to go into this area. After Fumich's appointment to head the Fossil Energy unit within the new DOE, Johnson went to the DOE Comptroller's office to establish what he later called a "think tank" Office of Financial Policy. Given the background of Johnson's success in promoting enhanced oil recovery and setting up the Office of Financial Policy, Fumich selected Johnson to replace Ball as Director of the Bartlesville center—holding the appointment open for Johnson, in fact, while he finished work on Commercial Task Force Studies already underway at DOE headquarters.[9]

It was during this transition period that the Department's policy of "decentralization" was put in place. Fossil Energy field offices had sought this change for years under the Bureau of Mines, as had the management of Energy Technology within ERDA. Both groups desired that research management be handled not in Washington but by the field offices. The nuclear national laboratories had in the past operated under such a decentralized plan, and the former Bureau of Mines Fossil Energy people welcomed the change.

A New Director—Harry Johnson

Harry Johnson had earned a B.S. degree in Petroleum Engineering at the University of Pittsburgh in 1960, and had served as a researcher at the Bureau of Mines Morgantown facility from 1960 to 1965. For the next ten years, he had worked at the Department of the Interior in Washington, D.C., in a variety of research management positions—putting him in a good position to participate in the transitional activity from ERDA to DOE. When he took on the directorship of the Bartlesville center in October 1978, he was charged with bringing the research capacity in the field into line with the law and policy statements of the new Department of Energy.

Johnson inherited a center which had already faced two recent administrative changes: Bureau of Mines to ERDA, 1975, and ERDA to DOE, 1977. Yet careers which had begun in the early post-war era were still in full swing. "Old-timers" now included men who had lived through the difficult Fowler years and the budget "crunches" of the 1960s, and who still had at least five or often ten years to serve before reaching retirement age.

Johnson was under a mandate, but had few powers to work with in carrying it out. He could bring only a limited number of new staff members in; given the staff configuration, retirements and resignations would only gradually open a few new slots. In order to accomplish a management reform from the "top down," therefore, Johnson would, for the most part, have the task of requiring long-term, experienced researchers—some senior to him in years of service—to change their methods, their lines of communication, their objectives, and their reporting procedures.

Johnson's approach was to bring to bear new philosophies of management: He used a "systems approach" on petroleum research and expected to plan research by the "critical path method," using "mission-oriented" and "management by objective" structures and planning tools. Skeptics saw the new language as rhetoric; supporters believed that specific, real changes would result from the new approach.

In the period before the creation of ERDA the budget of the center was in the range of $2–3 million per year. In the 1977, 1978, 1979, and 1980 fiscal years, it climbed to the range of $20–30 million per year. The vast bulk of the new funding was not spent directly at the center—in that it represented funding of outside "cost shared," or contracted out, projects with private firms and universities, largely in the area of enhanced oil recovery research and development initiated during the transition from Bureau of Mines to ERDA. The center's internal budget increased only slightly to over the $4 million per year range.

Senior Personnel—Shifts and Appointments

The appointments Johnson was able to make soon after he arrived at Bartlesville brought in staff members who had had prior experience at headquarters, including Bob Folstein, a chemical and nuclear engineer who had served with the Central Intelligence Agency from 1961 to 1976 and who managed the Fossil Energy Planning and Analysis Staff in Washington during the Department of Energy's first two years of existence; Barbara Barnett, who had a prior administrative career at the AEC and ERDA; attorney Ron Olson; and petroleum engineer Don Ward.

The autonomy of the research divisions which had grown up during Fowler's and Ball's administrations

represented a potential barrier to unification. Johnson's first priority, therefore, was to implement a new "integrated" research plan. No longer could each research division at the center, now under DOE rules, acquire separate outside funding. Instead, the center would have to develop a coordinated single research program which explicitly met the policy lines, policy statements, and legal expectations of the enabling legislation.

Not surprisingly, Hurn disdained the management style and the Washington orientation of the new staff; and from their point of view, his persistence in proceeding on his own independent way was unworkable. His retirement came on February 19, 1980, however, and Johnson was able to bring in Ted dePalma, with over thirty years in petroleum industry experience, to replace him. Aside from Hurn, for the most part Johnson found great support among division directors. Charles Thompson of Petroleum Chemistry was "a tower of strength," Johnson later commented. He also found Bill Good of Thermodynamics to be extremely helpful in preparation of new documentation for the center. Johnson put Johansen, whom he found to be dynamic and a clear thinker, in charge of project management; he then combined Johansen's Production Division and the Resources Characterization group into a new division, Extraction, which he headed by new appointee Ward. On Thompson's retirement a little later, Johnson selected Bill Good to head the Processing Division. Thus reorganized, within two years the center had been reduced to three large research divisions, all headed by Johnson appointees: Extraction, headed by Ward; Processing, headed by Good; and Utilization, headed by dePalma.[10]

Johnson and certain of his new appointees—Folstein, Olson, Barbara Barnett in Administration, and Don Ward in Extraction—soon became regarded as the "Washington group" within the center, and their innovations and ideas were sometimes resisted by individual old-timers, particularly those who had been successful in working with Ball, as those of outsiders. But those who had felt bypassed under the Ball administration welcomed the new direction.

New Management Goals

Johnson convened a meeting in November 1978 to begin work on planning a systems approach to the research at the center which would yield a coordinated single research plan. Called the Liquid Fossil Fuel Planning Cycle, the systems approach applied at the center required researchers to view their own work as part of a larger system which as a whole produced results useful to other researchers. Beginning with exploration and moving through recovery, processing, refining, and utilization, this approach viewed petroleum as a fuel source subjected to a series of technological processes, taking it from its underground source through refineries to eventual energy production. Viewing the production of liquid fossil fuels in this systematic fashion made the connections between different research areas clear. For example, research work on one type of chemical enhanced recovery process might in fact be wasted if other technologists had already discovered in field tests that, for whatever reason, the particular chemical gave difficulty in refining. Certain sectors of the national or total petroleum research system (such as geology) were not represented at Bartlesville; but research on a good part of the whole petroleum process could be conducted at the center.

This application of a systems approach to the center's petroleum research struck some as an exercise in bureaucratic time-wasting. As staff members wrote up the planning cycle, however, several benefits became obvious. In February 1979, a draft report, based on two intensive planning conferences held in November 1978 and January 1979, explained the approach. The center staff placed their research in a national context, noting that about one-half of the energy used in the United States derived from liquid fuels. The flow of liquid fuels from discovery to use needed to be examined in three categories: extraction, processing, and utilization. Using this conceptual framework, the staff systematically studied technology objectives that would promote the orderly flow of liquid fuels into the national economy. The report described the research, summarized the state of the art, identified objectives, and described current research, future needs, and expected results.

Using this information base, the staff worked to "prioritize the options, select what is appropriate for Government involvement," and then decide who would undertake specific program elements. The program was not simply designed to reflect work underway or anticipated at Bartlesville; rather, it was constructed as a nationally applicable model for *all* liquid fuel cycle research.

Altogether, fifty staff members participated in the conferences, representing the core of the research professionals at the center. In addition, four outside consultants were brought in, including Ball, now working as a free-lance consultant.[11]

When Folstein arrived a few months after Johnson, one of his first assignments was to continue the planning work on the Liquid Fossil Fuel Cycle and related management issues. Folstein brought a mission-oriented approach from the Central Intelligence Agency and a critical path method to budget discussions.

Folstein supervised the issuance of the 1980 planning document, which extended the work of the 1979

document. The 1980 planning report took on a more definite and confident character, reflecting growing staff support for the whole process, Johnson's tactful work in bringing the staff together, and Folstein's mastery of this type of systems method. As the Department of Energy's "lead center" for petroleum research, the Bartlesville center claimed a major responsibility to make petroleum research responsive to the "national security" issue of petroleum production and efficiency. Consequently, the center declared in its plan, the Liquid Fossil Fuel Cycle concept developed by the center served as a "tool for planning and managing" its efforts in support of national objectives.

The March 1980 report asserted that the Liquid Fossil Fuel Cycle, by including the full spectrum, from characterization of the resource in the ground through combustion of the final fuel and handling of environmental effects, "forces management to confront the entire problem and to identify the critical needs of the system." The cycle included a work breakdown structure for each of the three major categories (extraction, processing, and utilization), which identified all the programmatic steps required to establish schedules and to set research priorities.

Although noting that the whole cycle could be used to describe industrial and university places in the research system, the center-authored study did not delineate the precise roles of these two groups. Rather, since "BETC [the center] occupies a strategic position as the major government agency dealing with liquid fuels on a total basis," it could exert influence on the cycle and "give primary assistance in reaching the President's goals." Prior work in enhanced oil recovery was used to illustrate the pivotal role the station could play.

The report indicated the mechanisms for impact of the research. The process of passing on information to potential users, or "Technology Transfer," would include meetings, publications, seminars, workshops, grants, contracts, and direct conversation and advice. Further, the center would encourage commercialization through demonstration and cost-shared projects.[12]

In each area of work, the report suggested "milestones" and scheduled research, including projects in recovering fuel from heavy oils, increasing natural gas productivity, enhanced oil recovery projects, characterization of resources, stimulated recovery methods, mining of tar sand, liquid processing, engines as energy conversion devices, and systems integration. Each unit or branch of the center could be seen as having a specific mission which itself was part of the larger mission; each group could find its place in the larger picture spelled out explicitly. In this fashion, everyone's job could be seen as related, through a specified structure, to a clearly stated national objective.

Reaction to New Management

The overall effect of the exercise in applying systems logic to the work at the center was difficult for staff members to assess. On the one hand, specific and real benefits began to accrue. From 1976–1980, national energy supply was indeed a matter of national priority. Reseachers in various separate areas now had explicit, written missions which related their work to that of others at the center and, in a logical manner, to the national energy goals of the Carter administration. As researchers accepted these premises, they could take pride in their connection to a coordinated effort to work on matters of crucial interest to the nation. Furthermore, Johnson, Folstein, and their staff hoped that the system would provide a real weapon in budget decisions in Washington, reached within the Department of Energy and in Congress. The clear, mission-oriented approach provided excellent planning language for dealing with the engineering and research managers at the Departmental level.

On the other hand, despite such apparent uses of the new planning document, many old-timers at the center remained skeptical that the change was basically cosmetic—new terminology simply stating ongoing activities in a more stylish fashion, designed to impress Washington bureaucrats. Budgets still had to be fought for, and the approach, some agreed, while bureaucratic and impressive-sounding, might prove too sophisticated for headquarters and Congress. Research could not be produced like an industrial product, in their view. Milestones were all well and good, but as science advanced into the unknown, it was simply impossible to predict *when* a particular breakthrough would occur.

Such resistance to the systems approach did not extend to all the center staff inherited from Bureau of Mines days, however. Some researchers, like Herb Carroll who headed "Resource Characterization," enthusiastically supported the new approach even though he understood some of his colleagues' resistance. Good, long in charge of the Thermodynamics Division as a separate unit, and now in charge of processing, saw both good and bad in the new approach. Hughes and his people consciously and deliberately adapted to Johnson's system, believing he had the authority and the right to "run his shop" in his own way.[13]

Johnson recognized that the new management initiatives met with varied reactions—ranging from sullen resistance to quiet cooperation through relatively enthusiastic and professional endorsement—and attempted to provide leadership which would increase cooperation. Continuing Ball's efforts at communication, he held regular weekly staff meetings with all division directors. In addition, special meetings would be convened to communicate new developments regard-

ing budget and to deal with any problems that may have arisen. Briefings for visiting headquarters personnel and visiting outside experts, together with programmed seminars, also brought groups of staff together. Johnson developed a reputation for being open to criticism and discussion, and for not bearing grudges toward those who opposed him on matters of opinion or detail. And by late 1980 and early 1981, he had developed a coherent liquid fossil fuel program that received cheerful cooperation from a majority of the staff.

Johnson also made a concerted effort to catch up on overdue promotions. About thirty professionals who were performing tasks above their grade level received promotions between 1978 and 1982 (when he left the center), creating a solid reservoir of good will. In addition, special training and upgrading programs, labeled "upward mobility," advanced the careers of support personnel.

New Strengths and Developments

Thus, Johnson made a series of administrative changes which improved the nature of the work of the center. Under ERDA, administrative support contracts were allowed which would assist the center in its day-to-day operations. Although DOE rules cut back on the amount of regular operational work which could be contracted out, several tasks continued to be performed by outside contractors, including specifically the use of Ad-Tech services to operate a computer-based contract monitoring system, and the recruitment of Ball, now working as an independent consultant, to assist in the preparation of quarterly reports. Under Office of Management and Budget Circular A-76, those services which could be procured commercially at a lower cost to the government than through the direct employment of government workers were placed out on contract. Including such services as plumbing and electrical contract work, this "A-76" system allowed for the cutback of fourteen positions by 1982, without diminishing the quality of maintenance.[14]

Decentralization, or the management of research from the field rather than from headquarters, greatly increased the responsibilities of center staff during a period of steady or even declining resources. The management of cost-shared projects, university research, and other contracts absorbed the manpower of an estimated thirty staff members. Under these circumstances, the publication rate of center staff members declined, but this traditional measure of excellence had become supplemented with new criteria of recognition and professional influence. First, the quarterly reports on the enhanced oil recovery work circulated among over 6,000 professionals in production, discovery, consulting firms, and financial institutions. That fact alone became a measure of the recognition of the center. Second, the data accumulated in the enhanced oil recovery projects, combined with voluntary reports from firms using enhanced oil recovery methods under some 400 tax incentive-induced projects, were placed into an "E.O.R. Data Bank" which continues to grow. The use of this data bank, available to the public, also became a measure of the center's influence.[15] By the early 1980s, indeed, researchers at the center anticipated the widespread use of the data bank as eventually the price of crude oil would rise to the point of making these relatively expensive methods more widely competitive in the marketplace. The world oil glut developing in 1982–1983 set back that expectation, but interest and work on the data base by the National Petroleum Council served as still another form of industrial recognition.

In a number of ways, the pattern of industry-government relationship which emerged under Johnson resembled patterns created and developed under Smith and his predecessors during the 1930s and the 1920s. While industry remained reluctant to share proprietary information directly, out of fear that competitors would use the information to undercut or obtain an unfair advantage, or reluctance to open themselves to charges of collusion, the fact that a neutral government office could assemble and transmit industry data clearly has created a situation that stimulated oil technological information interchange. Just as the "peg model" in the lobby of the Ardmore hotel in 1922 could pool information to the advantage of all drillers, the computer models and data banks of the 1970s and 1980s opened the door to similar sharing of private research information through government auspices. While the alumni breakfasts of Smith's day were long forgotten by the research community, the holding of briefings and seminars and the constant flow of research interests from the industrial community to the center through a host of modern media, including the rich journal collection of the center's library, served to keep the center abreast of industry interests and needs.

Despite problems of morale, incipient factionalism, and resistance to "Washington" and its methods, and despite severe budget constraints now buried in the massive pass-through, cost-shared budget, the center made several major contributions through the period of Johnson's administration. In addition to further developing the enhanced oil recovery data base, the center conducted significant thermodynamics work on synthetic fuels derived from coal, developed projects on gas production, and took on the administration of a major international agreement with the state-owned Venezuelan petroleum research facility. The last merits further discussion.

In July 1980, representatives of the center, implementing a March 1980 general agreement regarding oil information exchange, met with representatives of the Venezuelan Ministry of Energy and Mines to work out details in the area of enhanced oil recovery. Amendments to the original agreement extended the period of work from the original eighteen months, and the cooperation continued into early 1983. In particular, the Venezuelan Ministry wanted to apply enhanced oil recovery methods to heavy oil deposits in the Orinoco Basin, whereas American applications of the technology seemed most needed in California. Under the agreement, teams of researchers from Venezuela came to Bartlesville for training and for exchange of information. Unlike earlier technology transfer projects, under this agreement research at Bartlesville was coordinated with research in Venezuela; the two sides operated as equivalent colleagues, rather than structuring the relationship as a one-way transfer of American know-how. The equal partners approach, Johnson believed, could serve as a model for future international research cooperation, particularly with Mexico and Canada. By June 1983, five technical reports resulting from this agreement had been published and distributed.[16]

The Election of 1980 and its Aftermath

One of the campaign pledges of Ronald Reagan in 1980 was to dismantle the Department of Energy. In response to widespread popular suspicion that the energy crisis of the mid-1970s was an artificial price increase generated by oil firms, the new administration reflected public reluctance to assist in the financing of oil industry research. Although the new administration did not succeed in dismantling the department, many senior positions remained unfilled, and budget requests for the department vastly cut back its earlier rapid growth. As personnel resigned or retired, the center simply shrank in staff size. In 1982, a severe cut was proposed in the Fossil Energy administrative budget. That budget, if implemented, would have cut out not only the Bartlesville center, but four of the five energy technology centers. Congress restored funding to keep the centers open in 1982–1983, but during that fiscal year, the Department of Energy worked to transfer the Laramie, Bartlesville, and Grand Forks facilities to private operation. As of this writing, transfer of the Bartlesville facility to a cooperative operation under the auspices of the IIT Research Institute was planned to go into effect in October 1983. Johnson resigned in July 1982, and the center remained directed by interim administrators, Ed Lievens and Gordon Dean, through September 1983, when the center was transferred to private operation.

The Johnson Years–The Morale Issue

Questions of morale had affected the Bartlesville research facility from its very beginnings. In the 1920s, the rapid turnover of key personnel, including the Superintendents of the station, had made continuity of research and the generation of published reports extremely difficult. Then Smith came, to operate the facility through a period of growing refinery technology, helplessly watching the station lose touch with that sector of the industry. The depression and the oil glut of the 1930s forced adaptation on the station, as did World War II. Under both Fowler and Ball, the facility faced recurrent budget and survival struggles.

Johnson's administrative group, although encountering some resistance to the "Washington crowd" by old-timers at the station, worked to implement new management systems and, at the same time, attempted to resolve some of the root causes for personal jealousies and bitterness within the center. "Morale" itself is an intangible quality, and its impact upon research might be regarded as too elusive for serious discussion. Yet, as Folstein noted in thinking back on the administration of the center, uncertainty and disruption had several offsetting effects. When faced with a possibility that the center would close, most researchers worked harder to bring pending projects to conclusion. Then, as they wrapped up projects and faced continued uncertainty during 1982, some continued to be diligent, assuming that a good personal record would assist them in career survival, either under a reconstituted center or in outside employment. A smaller group stopped work altogether, simply serving time until the change would be implemented. Still others were confused, trying to work but finding the uncertainty so disruptive and unsettling that their productivity declined.

For such reasons, a recurrent concern for the intangible quality of morale has been one of the themes of this work. In Johnson's tenure of office, it appeared that he won the loyalty and the cooperation of the vast majority of the researchers at the center within two years. In his third year, positive results began to accrue as the center coordinated its work and handled contract management, and as researchers exchanged detailed information from project to project, working to an extent as a single large team on various aspects of the Liquid Fossil Fuel Cycle. The election of 1980 and the subsequent uncertainty once again brought a crisis of morale to the center which would persist until the future status of the facility was clarified.

The larger issue—the role of the government in petroleum research—had haunted the facility since its first days as a Bureau of Mines experiment station. National politics brought constantly changing definitions of the government role. The Progressive model of

an agricultural experiment station stimulating efficiency and safety methods yielded reluctantly to Herbert Hoover's Associative State form of cooperation between industry and government through structured advisory committees. The Progressive legacy remained intact through the New Deal, as the Bureau of Mines retained the confidence of industry figures even as the regulatory model of government agencies became prevalent. World War II converted the station into a minor adjunct to the war effort with defense-related synthetic rubber and aviation gasoline projects. The survival efforts of Fowler yielded a hybrid—a government laboratory increasingly dependent on private contract work. By the late 1960s, Ball took that model to its logical extreme, until over half the center's budget derived from sources outside regular appropriation. Yet Ball fought to bring the center into tune with national priorities, coming to grips with a government role in environmental and energy supply research. The systems approach of Johnson no sooner began to work than the center fell under the effort of the Reagan administration to divest the government of its decades-long accumulation of bureaus and agencies.

The role of the center had evolved, always in adjustment to political pressures. That evolution was not toward some abstractly ideal role for a petroleum laboratory. Rather, the facility, despite continuities of personnel, reputation, equipment, and the force of heritage, changed its role to accommodate politicians' decisions and their perceptions of petroleum supply.

Never large enough to do more than stimulate research and to make occasional contributions, the center had played a small but steady role in provoking lines of research, in setting a high standard of professionalism, and in keeping alive an unbiased and objective concern for efficient use. The motto of the Bureau of Mines remains above the fireplace in the main building of the Bartlesville center. "True conservation is a wiser and more effective use of our national resources." That Progressive faith in the gospel of efficiency has survived and will shape the future of the government's petroleum center.

NOTES

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