

Chapter V

Between a Rocket and a Hard Place: Transformation in a Time of Austerity

“I’d like to see a little less ‘crash’ and a little more ‘program.’”

—Wernher von Braun

Once the rockets are up, Who cares where they come down, “That’s not my department!” Said Wernher von Braun.

—Tom Lehrer, 1965

On 9 November 1967 at seven o’clock in the morning, the first Saturn V launch lifted off from Cape Kennedy carrying the Apollo 4 mission into space. Wernher von Braun, who watched from the firing room, exclaimed at a news conference that “No single event since the formation of the Marshall Center in 1960 equals today’s launch in significance.”¹ Later in the day, von Braun learned that a reduction-in-force (RIF) would cut 700 people from the Center, some who had helped build the Saturn that had flown that morning. The juxtaposition of the two events on a single day dramatically showed the shift in Marshall’s fortunes, for even at a peak of achievement, the Center faced an uncertain future.²

The irony symbolized by the concurrent success of the Apollo 4 mission and a budgetary crunch would recur through the next decade of Marshall’s history. As television viewers throughout the world watched the powerful Saturn rockets roar into space and marveled at the spectacle of men on the Moon, Marshall engineers could take pride in their accomplishment of a national mission. Not only were they responsible for the rocketry that powered all of the lunar missions, they developed the roving vehicle used on the Moon’s surface in the missions of the early 1970s. And the 1973–74 *Skylab* mission, the first American “Space Station,” was a Marshall achievement. But people within the Center had little opportunity to revel in the triumphs of the space program, for in the midst of its success, Marshall confronted a protracted institutional crisis.

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The causes of the crisis were many. Tom Lehrer's satiric song of the mid-sixties foreshadowed a shift in public opinion about space. As the Vietnam War and domestic divisions diverted attention from NASA, many Americans became bored with—in some cases antagonistic to—the Agency's programs. The national economy staggered under “guns and butter” budgets until hard realities mandated cuts that forced Marshall to move from the affluence of the early sixties to the austerity of the seventies. The politics of budgets increasingly defined the Center. Planning and decision-making shifted to Washington, where political priorities of the executive offices and Congress were more important than technological goals.

As the Center coped with external strains, it would be internally transformed. New leadership replaced many of the Germans and reshaped von Braun's organization. The arsenal system gradually gave way to the Air Force contracting system as in-house capabilities steadily declined. New, diversified scientific and technological responsibilities supplemented the Center's propulsion specialty. Management struggled with serious threats to the Center's well being, and even its survival, for NASA Headquarters considered closing Marshall. Funding cutbacks, RIFs, transfer of projects to other Centers, and changes in leadership were manifestations of a more fundamental question: What, if anything, was to be Marshall's role in the post-Apollo space program?

In the late 1960s, then, Marshall Space Flight Center slowly became the victim of its success, and the characteristics that made Marshall unique defined its crisis. Of all Apollo hardware, Marshall's Saturn launch vehicles had the longest lead time, the fastest buildup, and the largest workforce. The Saturn program peaked in the mid-sixties, however, and while other Centers were still building, Marshall began to retrench. Many of its facilities had been built for Saturn, rather than for long-term institutional needs, and had limited utility in NASA's post-Apollo plans.³ In short, when the heady days of unlimited funding and ample manpower were over, Marshall faced the “crash” that inevitably follows any crash program.

The Perils of Post-Apollo Planning

NASA and Marshall were both slow to initiate planning for the post-Apollo space program, and planning was often encumbered by overly optimistic projections. In 1963 Marshall was still hiring, and expected to add 2,000 Civil

Service employees in two years before leveling off at 9,500.⁴ The two years passed with only modest increases, but with 90 percent of his workforce devoted to Saturn work, von Braun expected Marshall manpower to remain constant through the remainder of Apollo. After all, contractors had already scheduled manpower reductions, and von Braun warned, “as the highly skilled engineering teams and contractor plants are disbanded, our in-house people must shoulder the burden to meet the unforeseen.”⁵ He compared Marshall’s role to firefighters in a mid-size city—essential, but underutilized when there was no fire.⁶ Initiation of the Apollo Applications Program late in 1965 raised rosy expectations of 1,500 to 2,000 new jobs at Marshall.⁷ The Center’s master plan was equally optimistic; it anticipated new construction and continued conversion of old Army facilities without consideration of financial constraints. Von Braun envisioned human planetary missions perhaps as early as the late 1970s, and he had established a Future Projects Office at the Center in the early 1960s.⁸ But he had given less attention to short-range planning. When asked about the future of Marshall, his thoughts ran to NASA’s vague plans for extensions of the Apollo Program and to possible work on post-Saturn launch vehicles.⁹

Nonetheless, critics who have chided NASA for its failure to plan for the aftermath of Apollo have been unduly harsh. Nobody anticipated a steep decline in the halcyon days of Saturn development, and NASA began to consider alternatives before the launch of the first Apollo mission. The budgetary cycle and the long lead-time on big science projects forced NASA to consider post-Apollo plans in the mid-1960s. NASA’s worries that the Johnson administration’s reluctance to commit to supporting space programs might precipitate the breakup of its team hastened Agency planning.¹⁰ Contractors agreed in 1966 that “the erosion of the Apollo space team has already started.”¹¹

Marshall developed methods for long-range planning, but institutional constraints hampered the Center’s efforts. Dr. Heinz Koelle directed an active Future Projects Office that had been formed in the fall of 1964 to draft plans for technical projects. Its tasks included launch systems, Saturn rockets, Nova, nuclear-thermal rockets, lunar stations, and Space Stations. It devised schemes for use of a spent-rocket stage as a manned orbiting laboratory that helped form foundations for *Skylab*. The Research Projects Laboratory conducted studies for science-oriented projects including High Energy Astronomy Observatories (HEAO), the Large Space Telescope, the Apollo Telescope Mount (ATM), early

lunar rover studies, lunar science activities, and scientific projects for satellites.¹² But frequent changes in funding guidelines from Headquarters, uncertainties about the goals of the post-Apollo Program, and an increasingly bureaucratized procedure for task approval limited its ability to generate new projects.¹³ Marshall executives knew that difficult years were ahead; as early as mid-1966, they discussed the impact that Vietnam and Lyndon Johnson's domestic programs would have on NASA budgets.¹⁴

As Saturn development crested, and long before the scale of the decline became evident, von Braun realized that funding limitations would force Marshall to broaden its mission beyond its traditional specialization in launch vehicles, the Center's "bread and butter." Marshall had a vast physical plant, proven engineering expertise, and demonstrated managerial ability. But how could those resources be applied? The Center was "a tremendous solution looking for a problem."¹⁵

Headquarters offered little guidance. George E. Mueller, NASA Associate Administrator for Manned Space Flight, told von Braun that Marshall should maintain its launch capability, but that NASA Administrator James Webb would ask, "Do they need 14,000 people to do that job?" Von Braun wanted Marshall to make the best pitch for all projects it could get, believing space science and operations looked promising.¹⁶ "For us the essential thing is this," he told Headquarters. "We must be able to plant a new flag in Marshall in some new field."¹⁷

Unfortunately, internal NASA politics limited Marshall's flexibility to move into new areas. Each NASA Center had its own specialization and jealously guarded its prerogatives. Von Braun's diversification would encroach on Goddard's turf in space science and Houston's in operations. Huntsville had fewer options for expansion than other Centers. Any new field might compete with others, and even work on propulsion might meet challenges. As one veteran of intercenter competition observed, "There was nothing that Marshall had that was uniquely Marshall's."¹⁸ No one rivaled Marshall's experience in large launch systems, but its expertise in launch vehicles was not unique: Lewis had rocket engine experience dating back to NACA, had built the Centaur, and had "staked out a role in advanced propulsion technology that Marshall could not expect to emulate."¹⁹ Headquarters and Wallops Island managed LTV's development of the Scout, and Goddard managed McDonnell-Douglas's development of the Delta launch vehicle.²⁰

Rivalry between Marshall and Houston's Manned Spacecraft Center (MSC) had been present since the days of ABMA and the Space Telescope Group in the late 1950s, and intensified as Apollo wound down. Apollo's neat division between Marshall's Saturn V and Houston's capsule separated authority into stages; plans for post-Apollo Programs made responsibilities in human space flight less distinct.

Marshall and Houston, described by one historian as "semiautonomous, almost baronies,"²¹ guarded their realms fiercely. Houston challenged any proposal from Marshall that related to operations, astronauts, or manned systems. Competition with Houston was most pronounced in the Apollo Applications Program (of which *Skylab* was the centerpiece; see Chapter VI), but it touched all relations between the two Centers. "We had the perception that they weren't worrying about NASA or the space program, but they were worried about feathering their nest," recalled Houston's Chris Kraft.²² The rivalry bothered von Braun, who told his staff that he was disturbed that a Marshall collision with MSC could jeopardize the lunar landing program.²³

To clarify the post-Apollo division of labor Mueller summoned all three Manned Space Flight Centers to a three-day executive hideaway meeting at Lake Logan, North Carolina in August 1966. Marshall and Houston divided *Skylab* responsibilities, and worked out means to resolve future disputes. However, as one study observed, Lake Logan provided "a convenient formula, but did not eliminate the competition between Centers for post-Apollo work."²⁴

Von Braun's designs for a Marshall role in astronomy met less resistance. In May 1966, he discussed future NASA missions with Mueller and Robert Gilruth, Center director in Houston. All three agreed that Marshall should get involved in astronomy, and Mueller suggested work on the Apollo Telescope Mount (ATM) might lead to Marshall becoming the lead Center in space astronomical observatories. When Homer Newell, head of space science at NASA, concurred, von Braun had secured one new niche for his Center. On some astronomy projects, Goddard would be considered a consultant to Marshall.²⁵

The limits of space science as a new role for Marshall became clear with the Center's first venture into Big Science. The Center developed plans to support Voyager, an anticipated series of probes to Mars. Voyager work would place Marshall under the Office of Space Science and Applications (OSSA), and might

open other opportunities outside of the Center's usual responsibilities under the Office of Manned Space Flight. Just as Marshall neared agreement on how to proceed on space science without jeopardizing Apollo, Congress postponed Voyager in August 1967. The projected cost had risen from \$43 million to \$71.5 million, and Congress suspected that the mission might lead to more costly human missions.²⁶

Ernst Stuhlinger, Marshall's head of space science, worried that the Voyager postponement might divert the Center from expansion into space sciences. He considered development of projects under OSSA not merely good business, but essential to the Center's future. Supporters of manned programs and unmanned science programs had battled since NASA's formation, and scientists resented the dominance of Mueller's OMSF. Stuhlinger advised that Marshall's future would be most secure if the Center had a foot in both camps. Unless Marshall moved into space science, he cautioned, "our Center with its present one-project, one-HQ-boss orientation will give the image of an aging organization, unwilling to accept the challenge of broader responsibilities as the space program evolves."²⁷

Marshall's Manpower Crisis

Even as Marshall struggled to diversify for the post-Apollo era, a manpower crisis transformed the Center. By the end of the decade, reassignments, RIFs, reductions-in-grade, and other personnel actions were stultifying its activities. Morale declined, and union action led to suits that challenged the Federal Government's reliance on support service contracts, which were used to supplement work done by civil servants. Young engineers left for more promising jobs elsewhere, and the average age at Marshall increased. Recruitment, already considered a Huntsville problem at Headquarters, became more difficult. "Marshall's mood became more and more defensive," remembered Bruce Murray of the Jet Propulsion Laboratory (JPL). "Relentless efforts to maintain employment levels replaced von Braun's dream of the stars."²⁸

Marshall's dilemma first drew attention when it became clear that the Center had a larger workforce than was needed to complete its remaining Apollo tasks. Marshall transferred 200 people to Houston in 1965, and a year later much larger reductions seemed imminent.²⁹ Headquarters and other NASA Centers saw Huntsville as a source of manpower, and this "Marshall problem" became

the major manpower management issue in NASA by the time the Agency's in-house workforce peaked in 1966.³⁰

The issue prompted NASA Deputy Administrator Robert C. Seamans to request a review of Agency manpower policy. He directed a task force chaired by MSC Director for Administration Wesley Hjernevik to examine how "Center complements could be adjusted by management to meet the needs of changing roles and missions."³¹ Hjernevik met with von Braun and his staff late in August 1966. Von Braun urged Headquarters to use its vacant floating manpower allocations (positions that Headquarters could assign at its discretion which usually totaled three percent of the NASA workforce) to obtain the flexibility needed for personnel adjustments, and to let Center directors work out manpower problems among themselves. Unfortunately, the problem was already larger than von Braun realized. NASA was already planning for 10-percent cuts, and needed an Agencywide policy. Marshall would feel the pinch first, but one of those listening to the discussion remarked that "It is apparent that the MSFC manpower problem of today is the NASA manpower problem of tomorrow."³²

The Hjernevik group recommended that NASA adopt means to track personnel requirements, and suggested ways to match manpower to programs. Although the committee assumed that NASA manpower requirements would remain constant, its conclusions comprised "a warning that NASA would have to prepare for major changes within the near future."³³ The committee suggested RIFs, actually laying off people, might be necessary as a last resort: the final option of eight alternatives for restricting manpower.

NASA personnel policies were under attack from another quarter, and Marshall was at the center of the controversy. The General Accounting Office (GAO) reviewed support service contracts at Marshall and Goddard Space Flight Center, and concluded that both Centers could have saved money by relying on Civil Servants rather than support service contracts. Support service contracts are common throughout the Federal Government, so the investigations had potentially broad implications. The June 1967 report alleged that Marshall could have saved 19 percent on the three contracts examined. The GAO did not rule on the legality of the contracts, but submitted the Goddard cases to the Civil Service Commission (CSC) for further consideration.

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Leo Pellerzi, CSC general counsel, ruled in October that the contracts were indeed illegal, since they involved on-site contractor work using government equipment in tasks expected to last longer than one year, established an employer-employee relationship, and had the effect of creating new government positions by using contract personnel to perform regular NASA work. Lacking any other guidance, NASA used these “Pellerzi Standards” to evaluate its support service contracts, and the courts used them to evaluate NASA’s compliance with Civil Service regulations.³⁴

Dire warnings became reality the next year. Congress slashed NASA’s budget request for Fiscal Year 1968 Administrative Operations—the schedule from which salaries were drawn—by \$23.1 million in August 1967, then cut another \$20 million in October.³⁵ Headquarters warned that the budget cuts might require a personnel cutback (RIF) at Marshall. On 9 November Headquarters confirmed the need to cut 700 positions.³⁶

On 29 November, von Braun delivered the bad news. He explained the circumstances leading to the RIF to Marshall employees sitting in Morris Auditorium and watching on television around the Center. He described Marshall’s evolution from “a do-it-yourself, self-contained organization to a partner of industry,” and explained the mandate to reduce Marshall’s workforce to 6,386 by January 1968. Half the reduction was to come from wage board employees and technicians, half from among engineers. Attrition might reduce layoffs to 640. The personnel office expected further dislocations, with the RIF requiring 1,300 intracenter reassignments to adjust for those who would be separated. Support contractors would have to match Civil Service reductions on a one-to-one basis.³⁷

Four weeks later, the Marshall local of the American Federation of Government Employees (AFGE) and six individual Marshall employees filed a complaint in the U.S. District Court for the District of Columbia requesting an injunction to stop the RIF. The complaint accused the Center director of unfair labor practices, and alleged that the RIF was illegal as long as contract support service personnel were engaged in the same work as Civil Service employees who were to be separated. The court issued a preliminary injunction halting the reduction on 11 January, just two days before the RIF was scheduled to go into effect.³⁸

The court's order required NASA and the CSC to examine Marshall's personnel requirements and support service contracts in light of Civil Service law. The two sides reached agreement on 19 February 1968 and canceled all but 147 of the original 1,120 notices for termination, reduction, and reassignment. The court lifted its injunction on 12 March, and dismissed the complaint on 18 April. The plaintiffs appealed.³⁹ The case dragged on for years, and became a factor in negotiations between the union and Marshall in subsequent RIFs. The case was not settled until 1978, when Judge Joseph Waddy upheld NASA's use of support service contracts.⁴⁰

By the time Marshall was able to proceed on 30 March 1968, attrition and other personnel actions reduced the number of employees who would be subject to RIF action to 147, of which only 57 were terminated—the others were reassigned or reduced in grade. This greatly understates the impact of the RIF, however. Marshall lost 787 employees by May, many of them through retirement or transfers, leading to “grave and serious imbalances in the MSFC workforce.” No engineers or scientists left involuntarily, but more than twice the usual number during a comparable period departed during the four-month RIF period. The average age of scientists and engineers increased, since most of those who left—113 out of 145—were under age 40.

This trend raised questions about the future vitality of the Center, since college recruiting was made more difficult by rumors of another RIF and federal regulations that required that newly hired personnel be the first dismissed during reductions. Nor was Marshall given authority to do much recruiting; in FY 1968, the Center replaced only 1 of 14 people separated, by far the lowest replacement ratio of any NASA Center. Morale of both Civil Service and contractor personnel plunged, and post-RIF voluntary separations remained as high as they had been during RIF action.⁴¹

The RIF also had unanticipated ramifications. Many of those who received notices under the Center's original RIF plan were able to keep their jobs by the time Marshall implemented the RIF late in March, and voluntary departures and court action decreased management's ability to control the RIF. Marshall later estimated that it missed the planned post-RIF mix of skills by 47 percent. Management worried that its ability to deal with personnel issues might be impaired by the union's new image as a strong defender of employee rights.

The reductions also had an impact on the Huntsville economy. Approximately 480 people outside the Center lost their jobs as a result of the Marshall action. Local payrolls declined by \$3.4 million a year, and retail sales declined by \$1.6 million.⁴² Prime contractor manpower in Huntsville dropped even more precipitously than Marshall's Civil Service employment, falling to less than a third of what it had been four years earlier.⁴³

Reorganizing for the Post-Apollo Era

The dramatic personnel changes introduced a new dimension to the "Marshall problem" by the summer of 1968. Marshall's manpower continued to erode through attrition after the RIF, and NASA expected it to fall below 6,000 by the end of the year. Reductions at the lower levels had not been matched by corresponding adjustments in upper management. The Center was becoming top heavy, with an administration still geared to maximum workload. Headquarters worried that "the current Marshall structure does not recognize the program and operating situation under which Marshall activities will be conducted over at least the next several years."⁴⁴ Headquarters directed Marshall to cooperate with a NASA team in a review of the Center's organizational structure.⁴⁵

The request raised fundamental questions about NASA planning, Marshall's future, and the relationship between Centers and NASA Headquarters. The idea originated in NASA's Organization and Management section rather than in the OMSF, Marshall's administrative superior. NASA seemed to be losing its sense of direction, with manpower and budget considerations driving program decisions. Von Braun questioned "the need for an analysis of the current organizational structure without even mentioning the requirement for an assessment of this Center's future tasks which must obviously be addressed first."⁴⁶

The environment of the Apollo phasedown altered Center relations with Headquarters. Center autonomy had been the rule during Apollo, continuing a tradition that extended back to NACA. "The NACA figured that all Headquarters needed was somebody to go over to the Treasury to get the money," one veteran of the early space program recalled. "Wisdom is in the field, not in Washington."⁴⁷ Georg von Tiesenhausen described Marshall's attitude in the early years as "just give us the money, we were the boss."⁴⁸ Apollo, with its clear-cut division of authority, precise sense of mission, and end-of-the-decade timetable, perpetuated Center autonomy. Headquarters had "to interface with the

Congress, interface with the OMB, [and] set policy,” Kraft conceded, but the Centers neither needed nor wanted direction from Headquarters.⁴⁹ One study of NASA management during the 1960s concluded that “Most planning, and almost all that mattered, was carried out by the Centers and program offices, not by Headquarters staff offices reporting to the Administrator.”⁵⁰ Only occasionally—as in the case of Mueller’s all-up testing decision—did Washington intrude. “Quite a few of us originally thought that all the directions from Washington should come through Dr. von Braun so that he is informed about what is going on,” von Braun deputy Eberhard Rees explained. Marshall had “always thought that nobody from the outside should actually rule into our place here but through Dr. von Braun.”⁵¹

As budgets, personnel limitations, and the uncertainties over future programs began to drive NASA decisions, authority shifted from the Centers to Washington. NASA began to set policy based on available resources rather than on program goals. With Great Society programs and Vietnam competing for funds, Congress began to challenge the Agency’s budget. Moreover, post-Apollo Programs were vulnerable and unlike the lunar landing program were not blessed by any aura of national prestige. External pressures forced Headquarters to assume a new controlling role and make decisions that had been unnecessary in the boom years. NASA, despite Webb’s reservations about the value of such an Agencywide enterprise, established a Planning Steering Group to review long-range plans, and OMSF established a Cost Reduction Task Force.⁵² The burden fell on the Centers, and Marshall was the first to move into a less certain post-Apollo world.

Marshall’s size, its manpower predicament, and the doubts about its future placed the Center at focus of a NASA end-of-the-decade self-examination. The Center’s future had been under review for four years, and with uncertainty now an Agencywide phenomenon, Marshall’s destiny was doubly in doubt. Von Braun’s usual optimism could not withstand fear that he was presiding over the dismantling of his dream, and he occasionally lashed out. He described his mission as scrapping a vital industrial structure, and claimed that the goal seemed to be to ensure that there would be no capability left by 1972.⁵³ He decried the “rapidly deteriorating environment in our industrial complex,” and feared that complacency about space research, scattering of subcontractors, and pressures to reduce costs were creating a “hazardous situation.”⁵⁴

The Headquarters requirement for a new Center organization typified the new NASA of scarcity and bureaucracy. Marshall had reorganized before, but the initiative had always come from within the Center. Now, von Braun reacted to circumstances beyond his control. He feared “irreparable damage to a working team that has been built up over a number of years,” and asked Headquarters to grant him time to reconcile the Center’s loss of manpower and change of mission before initiating precipitous changes.⁵⁵ He conceded that Marshall would have to realign its workforce in order to get future space projects.⁵⁶

Within two months, Marshall developed a reorganization plan that responded to the Headquarters mandate and prepared the Center for changing times. Von Braun and some of his closest advisers worked out the basic plan on a hide-away at Jekyll Island in Georgia in the late fall of 1968. Particularly influential was William R. Lucas, Marshall’s director of propulsion and engineering, who proposed a Program Development Organization to centralize planning at Marshall. Von Braun explained that the new organization would “help chart the course for this Center in the post-Apollo period,” and he appointed Lucas as director.⁵⁷

Program Development’s planning process was unique in NASA. No other Center had Marshall’s problems; no other Center needed something like Program Development. Marshall’s managers reasoned that planning during the Apollo Program had suffered because laboratories and line personnel were too busy working on Saturn to attend to new projects. Maintaining line and lab attention was worsened by the long lead time between preliminary design and final development of a big science project. Therefore Marshall’s managers separated planning from doing and new business from old. Program Development was, as Lucas recalled, “a new business organization,” a central office to design and sell new projects and ensure that the organization would never run out of work.⁵⁸

The staff of Program Development consciously acted as business people and quickly became Marshall’s entrepreneurs. Indeed von Braun referred to Lucas as his “vice president for sales.”⁵⁹ Like a business, Program Development studied the technical capabilities of the Center in order to find its marketable skills. They found that building rockets was so complex that Marshall had skills not only in propulsion but in general engineering, management of large systems, big structures, strong and lightweight materials, guidance and control, computing, power, and astrophysics. Next the office sold Marshall by seeking new

customers in the scientific community. The selling was often difficult because many scientists doubted the Center's skills. Bob Marshall recalled that scientists often felt that "here is this group coming from the South, from Alabama with this funny talking language, trying to get into science."⁶⁰

Even when customers were sold on Marshall, Program Development was not done. The office still had to assess feasibility, compare alternative proposals, develop preliminary designs, define support requirements, perform cost analyses, forecast NASA funding, and finally recommend the best projects to Center management. Marshall said that Program Development had to sell projects to outside groups ("We can do it") and to Center managers and engineers ("You can do it"). If management consented, the Center then solicited Headquarters for the final sale.⁶¹

At times the transition between Program Development and project offices encountered difficulties. Project offices found Program Development's oversight intrusive. "Some of our worst problems grew out of sending PD people who were not skilled managers over to a project office to lead a major project," recalled George McDonough, who saw several such instances during his work in project offices.⁶² Program Development people sensed resistance in the project offices, and believed that project officers and laboratory personnel could lack understanding of and commitment to the new project; they could experience the "not-invented-here syndrome." To overcome this hand-off problem, Lucas and Program Development created pre-project teams. Headed by a pre-project manager, each team drew line personnel from the laboratories and worked on the first two parts of NASA's phased project planning, Phase A (preliminary analysis) and Phase B (definition). In the process, the pre-project team mediated between experts outside NASA and engineers in the Center. When the project got a "new start" and moved into Phase C (design) and Phase D (development/operations), the preliminary design team formed the nucleus of a formal project office.⁶³

Program Development became an important source of projects at Marshall in the seventies and eighties. The office oversaw the Center's diversification from Saturn into Shuttles and satellites, solar energy and coal mining, telescopes and materials processing. When projects came out of individual efforts in the labs, Program Development often institutionalized them.⁶⁴ The resulting diversity created a new identity for the Center and would give it unique problems.

The other major change introduced during the 1968 reorganization was creation of the new post of associate director for science, acknowledging the importance space science would play in Marshall's future. Stuhlinger became the first to hold the position. Von Braun described him as the "scientific conscience of the Center," and directed him to work closely with the scientific community.⁶⁵ The new directorates fell directly below von Braun's two chief deputies, Rees and Harry Gorman.

Reorganization alone could not address all the Center's problems. The Center's appropriations were less than half of what they had been four years earlier.⁶⁶ Manpower continued to drop, pushed lower by hiring freezes, attrition, and low replacement ratios; by the end of 1968, Marshall's permanent Civil Service strength had fallen by more than a thousand positions since its peak four years earlier.⁶⁷

Reductions eroded Marshall's historic strengths. Von Braun scrambled to find ways to maintain rudiments of the arsenal system. The Center reassigned wage board employees and technicians to replace support service contractor personnel for testing and quality surveillance, and retrained engineers who had been serving in management. Von Braun informed Mueller, "Our goal is to achieve a systems engineering capability in-house which will permit us to review in depth the design concepts of our stage contractors; and the technologies associated with the manufacture, test, quality maintenance, and reliability assurance employed by our current and future prime contractors."⁶⁸ These skills had been the foundation of Marshall's success in the 1960s; once lost, such skills would be difficult to regain in a time of retrenchment.

Charting a New Course

NASA's directive requesting Marshall to reorganize was but part of a larger Agency effort to chart a future course. NASA's prospects at the end of the 1960s were unclear. The Apollo 11 Moon landing in July 1969 culminated a national quest, and public interest in space waned. Ever-tightening budgets constricted vision, and changes at Headquarters brought in leaders with new goals.

Three changes at the top of NASA management had a substantial effect on Marshall. Administrator Webb resigned in the fall of 1968, and his deputy Thomas O. Paine took over as acting administrator. Webb's resignation would

affect the Agency in countless ways over the years, but of more immediate impact on Marshall were two changes in the next echelon of NASA management. In November 1969, NASA announced that Mueller would retire as associate administrator for MSF, and that George Low, Apollo manager at MSC, would become deputy administrator.

Mueller, who left NASA to go into private industry, was best remembered at Marshall for his Saturn all-up testing decision, but as head of OMSF he had helped shape the Center in the late sixties. Presiding over NASA's two largest Centers—Huntsville and Houston—Mueller exploited their rivalry. "I think he played Johnson Spaceflight Center (JSC) and Marshall against each other," claimed Kraft. "He did that purposefully. I think he was Machiavellian in that respect." At a time when Marshall was declining, however, Mueller tried to prevent reductions from unduly crippling the Center, and emerged as something of an advocate. Houston sensed favoritism, and Kraft suspected that Mueller showed partiality because "he could tell Marshall what to do and they would do it."⁶⁹ Lucas agreed that Houston's intransigence influenced Mueller, and that as a result "Mueller did lean a little bit more to Marshall than to Houston, although I don't think that it was distorted."⁷⁰

George Low's arrival in Washington signaled a change in environment, for if Mueller was in any sense Marshall's advocate, Low was Houston's. Low had served at Headquarters during NASA's first six years, and said later that during that period "I considered myself Bob Gilruth's representative in Washington." Like most of his colleagues in Houston, Low resented Mueller for his alleged Marshall bias. Just months before he became deputy administrator, Low claimed that MSC had always taken the lead on key Apollo decisions, and "as a Center it has generally prevailed, more often than not against Dr. Mueller's desires." He also shared the self-confidence that hallmarked Houston at the height of Apollo, and claimed "We have better people than will be found at the other Centers."⁷¹ Marshall had a high regard for Low, but as the Center's problems deepened after 1969, Huntsville often saw him at the source.⁷² Discussing the Marshall dilemma of the late sixties and early seventies, von Tiesenhausen recalled that "One Headquarters name pops up all the time in this context. George Low. He was von Braun's adversary."⁷³

Paine inherited control of a NASA in transition. More committed to long-range planning than his predecessor, he announced an ambitious agenda for the Agency

despite fiscal constraints. After the inauguration of Richard Nixon, Paine got little support from an administration less committed to space. A Democrat who always felt like an outsider in the administration, Paine nonetheless convinced the President to review national space policy.⁷⁴ Nixon appointed Vice President Spiro T. Agnew to chair a Presidential STG and develop a plan for America's next decade in space. The composition of the STG posed problems for the Agency. Its members included not only Paine and former NASA deputy administrator Robert Seamans, but the President's Science Advisor, Lee DuBridge; and placing planning for space in the hands of an external group decreased Agency leverage.

Formation of the STG enabled Paine to promote planning within NASA, for the Agency's suggestions would weigh heavily. Paine requested recommendations from field units, and at Marshall the new Program Development office headed by Lucas formulated the Center's response. The resulting Integrated Space Program showed how the Agency struggled to retain broad vision while recognizing budget limits: its "transcendent objective" was to "maximize space flight while minimizing funding requirements." Marshall's Program Development report acknowledged that "The dominating criteria in the development of new systems is to reduce the cost of space flight."⁷⁵

Although the Centers contributed to the Integrated Space Program, Headquarters centralized the planning, and decision making again shifted away from the Centers. Mueller had been working on Agency plans long before Webb's resignation; a 1967 BellComm study under his direction had first targeted Mars as a post-Apollo goal for the manned space flight program.⁷⁶ "This integrated plan was pretty much Dr. Mueller's own activity," von Braun recalled. "It did not grow in the grass roots of the Centers, but it was something that he created with his Headquarters staff."⁷⁷ Both Marshall and Houston considered some of Mueller's cost projections unrealistically low.⁷⁸

The Agnew STG September 1969 report was a "partial victory" for NASA administration. The report recommended both manned and unmanned missions, and a manned Mars mission before the end of the century. But the report did not commit the administration to anything, not even a specific target date for a Mars landing. Its suggested funding levels were merely alternatives, and within months the President endorsed the cheapest alternative and dropped mention of the Mars mission. In the end, NASA had discrete programs—scientific

satellites and probes, *Skylab*, and a reusable Shuttle. But unlike the Apollo years, the Agency had no over-arching goal, “no post-Apollo space program.”⁷⁹

If the STG report did not commit the administration to an extravagant space program, neither did it forestall NASA’s ambitious expectations. But all of NASA’s plans were now constricted by the politics of budgets, and even the most visionary projections could not avoid the question of money. In the same month that the STG submitted its report, Mueller told von Braun of his hopes for manned space flight, including regular human visits to the Moon by the end of the 1970s at costs substantially below those of Saturn. He envisioned a Space Station and a reusable transportation system, programs that might lead to piloted trips to Mars and Venus in the 1980s. Mueller tempered his optimism with a caveat that was more predictive of the Agency’s future: “Costs are of paramount importance. Unless we can substantially change our current way in doing business we will not be given the opportunity to demonstrate the unique capabilities that space provides.”⁸⁰

Cutbacks and the Huntsville Economy

NASA budget cutting burst Huntsville’s space bubble. The city’s Apollo boom became a post-Apollo bust. Signs of decline were already apparent by 1968. Restaurants were still busy at lunchtime, but dinner business was sparse. Sales were down. Unemployment rose. The real estate market suffered. Four motels had closed. Apartments had vacancies in a city that had waiting lists for motel rooms a few years earlier. People worried about whether the city could rebound. A laid-off engineer offered that “If they ever want to build it back up again it is going to take a lot of time and cost a lot of money.”⁸¹

Amidst the gloom, some found grounds for optimism. Huntsville’s economy was more diversified than it had been 10 years before. The Huntsville Industrial Expansion Committee, founded after World War II, had seen the city through previous cycles of boom and bust, and had promoted growth that was not solely dependent on the Federal Government.⁸² In 1969, the committee could boast that it had just lured four major plants with no connection to the space industry to Huntsville.⁸³ A real estate salesman offered that “It may be that we profited from experiences of many years ago that have nothing to do with the space program.” Paul Styles, in charge of manpower at Marshall, explained that “Von Braun helped to get Huntsville prepared years ago. He told the community

leaders at every opportunity that they should broaden their economic base here, that they should get in more industry, that they should not be a one-industry town.”⁸⁴

Diversified or not, Huntsville’s economy still rested on the town’s two federal installations, Redstone Arsenal and Marshall. Marshall was not alone in feeling the uncertainties of federal funding in the late 1960s, for the 1,200 Redstone employees working on the Anti-Ballistic Missile defense system saw their jobs at stake in Congressional debates over limited ABM deployment. Civic leaders put their faith less in diversification than in a gushing federal spigot. One columnist observed that Huntsville had “an almost mystical faith” that Congress would not allow its considerable investment in steel and concrete go to waste, and that von Braun would not let the city down, but would “pound on desks in Washington until fresh money for more big programs is allotted.”⁸⁵

End of the Von Braun Era

Von Braun would indeed be in Washington, but not as a lobbyist for Marshall. Paine stunned Huntsville by announcing on 27 January 1970 that the man who had directed Marshall since its inception would move to NASA Headquarters on 1 March and become associate administrator for planning, the fourth-ranking position in the Agency. Paine wanted von Braun to help promote a Mars mission as NASA’s next major goal, although von Braun had reservations about the Agency’s ability to sell another large program to Congress.⁸⁶

Speculation about why von Braun chose to accept Paine’s offer abounded. The frustration of the post-Apollo phasedown, the hope that he might have a larger role in determining NASA’s future in Washington, and his rapport with Paine were factors. At Headquarters he would be less pressured by daily crises. “I’ve spent ten years doing what was ‘urgent,’” he explained, “and regrettably not doing what was ‘essential.’”⁸⁷ Close associates believed that his wife may have influenced his decision.⁸⁸ That von Braun was on a seven-week vacation to the Caribbean when Paine announced the move increased consternation in Huntsville.

Von Braun appeared before Marshall executives on 2 February wearing a beard grown on his vacation, and told them, “I am leaving Marshall with nostalgia. I have my heart in Marshall. I love this place.” He assured them that “the future of Marshall is the brightest of all NASA Centers.”⁸⁹

Huntsville declared “Wernher von Braun Day” on 24 February. Five thousand people turned out in cold, drizzly weather to bid farewell to him. A banner across the grandstand read “Dr. Wernher von Braun—Huntsville’s First Citizen—On Loan to Washington.” The city announced that its new \$15 million civic center would be named for him, and unveiled a granite marker citing some of his achievements. Supporters established scholarship funds in his name at Alabama A&M University and the University of Alabama in Huntsville. *The Huntsville Times* lauded his contributions to the city’s culture, education, and economy, and concluded, “Dr. von Braun leaves this community bigger and better than he found it.”⁹⁰

Von Braun’s decade as Center director left an imprint on Marshall that is difficult to gauge, in part because he was a figure of legendary proportions. In the public imagination, his own role in the early years of America’s space program overshadowed the Center. But Marshall took on a distinctive character under von Braun.

Von Braun’s approach to management comprised an important part of his legacy to the Center. A blend of techniques applied at Peenemünde and the methods used by the American Army during the ABMA days, von Braun’s organization was hierarchical, disciplined, conservative. Apollo veteran Bob Marshall described “a very conservative overview in management technique which went through the whole organization and even prevails today.”⁹¹ Not surprisingly, those who were part of von Braun’s inner circle remembered it as a creative system. Many of the Germans who immigrated with him remembered teamwork as one of his most lasting legacies. “This team spirit that Wernher von Braun promulgated in his days still permeates the working laboratories at the Marshall Center,” according to von Tiesenhausen.⁹² Some of those who were lower in the hierarchy saw things differently. Von Braun’s weekly notes brought forward “problems and bad things—very few good things got surfaced,” according to Bob Marshall. “Nobody at the bottom really felt free to do anything unless he got it approved from the next level up, the next level up, the next level up.”⁹³ One assessment criticized the notes as creating “an almost iron-like discipline of organizational communication.”⁹⁴

Whatever Marshall’s acknowledged discipline and engineering skills, the Center’s reputation for managerial excellence was not as high. Headquarters considered NASA’s managerial expertise to rest at Houston. Bob Marshall recalled that Headquarters considered Marshall a “very good technical

organization, but a poor management organization.”⁹⁵ Von Braun’s managerial technique contributed to this image. A 1968 study described von Braun as a model for the “reluctant supervisor” typical at Marshall—one who wanted to keep his hands dirty, and avoid red tape and committees.⁹⁶

During the von Braun years, Marshall acquired a reputation for secrecy. “We were rather closed in regard to talking with reporters, journalists,” von Tiesenhausen admitted. “That was a general policy then. It helped Von Braun to maintain his options.”⁹⁷ Some of the younger engineers found this stifling, and one recalled that “People would not go outside the Center and say what they thought if they thought it was different than what management would want you to say. You were very careful. It was as if you did something wrong, you would be banished.”⁹⁸

Such caution was but a manifestation of the Center’s defensiveness under von Braun. Marshall’s defensive posture during the post-Apollo retrenchment was to be expected, but it had become a characteristic of the Center long before cutbacks began. Von Braun had always been an outspoken advocate for Marshall’s position, but only to a point. He would back down rather than risk division, and did so several times in confrontations with Headquarters or other Centers. Marshall was a “good soldier,” sometimes to its detriment. Key decisions, such as to make Huntsville’s LOR in Florida an independent Center, to shift from the arsenal system to the Air Force contracting system, and to favor LOR over EOR cost Marshall. Mueller’s “all-up testing” concept ran against the grain of Marshall’s traditional engineering conservatism, but von Braun accepted it after voicing initial objections. Kraft noticed von Braun’s unwillingness to go beyond a certain point in intercenter disagreements.⁹⁹ And Lucas noted the difference in relations between Washington and NASA’s two largest Centers: “Headquarters would try to tell Houston what to do and they would ignore it. They just wouldn’t do it. Marshall would argue until they were blue in the face, but then they would go ahead and do it.”¹⁰⁰

Von Braun’s conciliatory attitude owed in part to the wartime origins of Marshall’s German hierarchy. Seldom stated openly, it was from the start an unspoken presence in discussions with Headquarters. When the ABMA’s Germans joined NASA, headquarters made clear that they could not bring their operating principles with them; Deputy Administrator T. Keith Glennan averred

that those principles would not work in a democracy.¹⁰¹ Charges regarding the Nazi past of Huntsville's Germans cropped up—with decreasing frequency—but enough to keep the issue alive, and enough to compel von Braun and his associates to maintain a “proper” humility. A film biography of von Braun in the early sixties entitled “He Aims for the Stars” inspired critics to add the subtitle “But Sometimes Hits London.”¹⁰² In the mid-sixties an East German publication accused von Braun of militaristic and bloodthirsty activities both in Germany and in the United States, and received some attention in the U.S.¹⁰³ Von Braun's relationship with Webb had always been proper but distant, and was tinged with the Nazi question. Paine claimed that Webb wanted to keep von Braun out of Washington: “I think Jim had the feeling that, well, the Jewish lobby would shoot him down or something. The feeling that basically you were dealing with the Nazi party here. And you could get away with it if he were a technician down in Huntsville building a rocket, but if you brought him up here. . . .”¹⁰⁴ Charles Sheldon, White House senior staff member of the National Aeronautics and Space Council in the early 1960s, remembered the resentment toward von Braun in Washington. People discounted rumors that von Braun might eventually head NASA, since “von Braun would never be given any political position. No one who had worked with Hitler and the Nazi government could be trusted.”¹⁰⁵

Webb could be patronizing, reminding von Braun that he was subordinate. During the civil rights crisis in the sixties, Webb lectured von Braun about the need to place a priority on progress in civil rights although it might divert attention from the Center's major task, even though von Braun had already taken action in advance of Headquarters interest. NASA executives resented von Braun's high profile. “When Von Braun appeared at certain occasions—symposiums, meetings at Headquarters—he, rather than the upper administrator, was the center of attention,” von Tiesenhausen observed.¹⁰⁶ Webb once warned von Braun that his speeches contained overly optimistic projections of NASA capabilities, creating unrealistic expectations of what the Agency could achieve.¹⁰⁷ Later, Webb restricted the number of paid public appearances von Braun could make each year to four, and required that he submit a list of speaking engagements to Headquarters for approval. In each case, von Braun apologetically accepted direction. These were small matters, but they established subordination beyond what Marshall's principal rival in Houston would accept, and a perception in Houston and Washington of Marshall reticence.

Examination of the von Braun legacy invited comparison with Houston, the other major manned space flight center. Even in appearance, the two Centers revealed their contrasting origins. One Marshall veteran contrasted the difference between Marshall's "gun-metal gray, plain jane buildings" and Houston's "college campus atmosphere."¹⁰⁸ The looser, freer environment at Houston showed in differing approaches to NASA business. Bob Marshall remembered giving presentations in Washington with letter-perfect charts that had been dry-run at least three times, often before von Braun. "My counterparts from Houston or Kennedy would come in with charts that they made up on the way on the airplane," he recalled.¹⁰⁹

Under New Management: The Rees Directorship

Von Braun's departure left his deputy for technical and scientific matters, 62-year-old Rees, as Marshall's director. Rees was older than von Braun, and the two had anticipated that Rees would retire before von Braun would leave Marshall.¹¹⁰ Von Braun's departure took everyone by surprise, however, and thrust Rees into command.



Dr. Eberhard Rees, Marshall Space Flight Center Director, 1970–1973.

Rees had been at von Braun's side since Peenemünde, and provided continuity needed in a time of stress. He had the respect of von Braun's staff. "He knew us and we knew him," Stuhlinger recalled. "So that was a very easy transition for both parties."¹¹¹

Rees's talents were very different from von Braun's. Von Braun was a visionary, a politician, a motivator. Rees had none of von Braun's charisma, but he was precise, practical, and a better disciplinarian than von Braun. Their collaboration had worked well. "The two complemented each other perfectly," according to von Tiesenhausen, who worked with them for more than two

decades.¹¹² Von Braun would originate ideas, Rees would carry them out. “Eberhard was the much more careful person,” according to Konrad Dannenberg. Although he was seldom “looking as far ahead as Von Braun, . . . he was a really good man to do the detail planning, to find out what facilities do we need, what people do we need.”¹¹³

Rees believed in centralized management. He reflected that one of the lessons of Apollo was the need to assign “all responsibility to single organizational management structures pyramiding into a single strong personality.” Apollo had succeeded, he believed, because of “government-industry teams,” but there remained a need for “contractor penetration” since industry’s desire to work with only minor intervention by the government had led to “too many cases of severe program impact.”¹¹⁴

The characteristics that made an ideal deputy did not necessarily correspond to those needed for a successful Center director, and Rees had the misfortune of assuming control of Marshall at the most difficult time in the Center’s history. Succeeding a man of von Braun’s stature added to the challenge, as Rees acknowledged when Paine introduced him as the new director to Marshall executives at Morris Auditorium. “Becoming the successor of Dr. von Braun is tough,” Rees said, “and I’m convinced that anyone who would have got this position would have problems to live up to the standards of Dr. von Braun.”¹¹⁵

Under Rees’s leadership, Marshall followed the path charted by von Braun. The Center continued work on *Skylab*, and increased its involvement in space science. Astronomy became a Marshall specialty, as the Center began development of the Apollo Telescope Mount for *Skylab*, the Large Space Telescope, and the HEAO. Marshall developed life science and Earth resource experiments for *Skylab*. Rees was a top-flight engineer, and had the engineering problems associated with Apollo Applications and space science been his only challenge as director, his talents would have been suited to his responsibilities.

But Rees’s administration would be consumed by the continuing phasedown that had confounded Marshall in the late 1960s. Rees soon confronted difficulties that even von Braun had been unable to master, for Marshall’s retrenchment was not over. The Nixon budget for Fiscal Year 1971, announced just days after Paine presented Rees as the new Center director, seemed to offer

Marshall a respite. Marshall would only lose 60 positions, which could be absorbed by attrition. And overall Marshall funding would actually increase. But as Congress began to debate the budget, rumors of deeper cuts circulated. Rees tried to allay fears in an open letter to employees, but both House and Senate proposals threatened NASA with personnel reductions that could have affected as many as 1,300 employees.¹¹⁶

RIF Redux

On 15 July 1970, NASA Headquarters informed Marshall that it would have to institute another RIF to reduce its manpower to 5,804 Civil Service employees by 1 October. The Center issued RIF letters to 190 employees. Of the 190 employees separated, 99 left voluntarily. Eighty-five other employees were affected, either reduced in grade or reassigned. Headquarters concluded that the Marshall RIF had gone “fairly well,” and that morale at the Center was “fair.”¹¹⁷ Unlike the 1968 reduction that singled out Marshall, that of 1970 was distributed among NASA Centers. Houston lost three more employees than Marshall, and four Centers and Headquarters had a higher percentage of employees affected.¹¹⁸

Nearly half of Marshall’s Civil Service force belonged to the AFGE, and the union followed Center actions closely. However, unlike the 1967 RIF, the union did not initiate action against Marshall. RIF action enabled the union to grow and to organize more effectively.¹¹⁹ But government unions cannot bargain for wages or strike, and except for their success in delaying the 1968 RIF, they could do little other than to monitor management, trying to ensure equitable treatment for employees who received notices.¹²⁰ As a result, the Center was able to execute the reduction under a “controlled environment.”¹²¹

Marshall’s handling of the RIF nonetheless raised legal issues. Without consulting Headquarters or the union, the Center had changed competitive designations of some employees in order to avoid the appearance of releasing personnel who were doing jobs performed by support service contractors. By increasing the number of job descriptions, Marshall could make it appear that employees who were doing similar work were performing different functions, and could then hand-pick those who were to be dismissed without fear of veteran or seniority protection.¹²² Headquarters anticipated possible unfair labor practice charges from the AFGE, and in fact the issue would rise again as the 1967 RIF action found its way through the courts.¹²³

The impact on employees who were released was greater than it had been during the 1968 RIF. The Huntsville economy was weaker, and fewer of those forced to leave were able to find new jobs in the local area. In four years, Huntsville had lost 11,000 space and defense related jobs, and unemployment was at its highest level in 10 years. Thirty-three of those affected filed appeals with the Civil Service Commission, and 10 percent wrote letters to congressmen.¹²⁴

Among those affected by the RIF were a dozen German members of the von Braun team who had come to the United States immediately after the war. Seven of them lost their jobs, leaving only 38 still working at Marshall. Six of the seven were especially vulnerable, since they had chosen to remain in “excepted” status rather than become Civil Service employees at the time they became citizens, and none had the protection afforded by American armed service veteran status. All non-veterans were especially vulnerable at Marshall, since the Center had a higher percentage of veterans than its sister Centers. Given their ages and the depressed condition of the aerospace industry, prospects for jobs were slim, and they were bitter. “How would you feel?” asked Werner G. Tiller, one of the dismissed engineers.¹²⁵ Robert Paetz, one of the members of von Braun’s team, had to accept reduction in rank from GS–15 to GS–12, and then lost his job in the next RIF. He filed an age discrimination suit against the Center that was not settled until 1988, when the court upheld the Center’s RIF procedure.¹²⁶

Marshall’s ordeal continued. On 27 January 1971 the Center learned that it would have to undergo still another RIF. President Nixon’s budget for Fiscal Year 1972 called for a reduction of another 1,500 NASA employees, of which Marshall’s share was anticipated to be 297.¹²⁷ In July the Center proposed a plan to OMSF for the separation of 241 people, hoping to meet the remaining quota through attrition. Headquarters reduced Marshall’s quota in an effort to minimize the impact on ongoing programs, and on 16 August, the Center issued notices to 183 employees. Before executing the RIF, the Center was able to salvage 42 positions of experienced technical personnel, promising to cover those reductions through anticipated attrition. The Center dismissed 141 permanent employees through RIF action on 2 October.¹²⁸

The following year, Marshall had to endure another RIF, the fourth in five years. In June 1972, the Center lost 131 employees to RIF proceedings, and another 90 to other causes. Its Civil Service manpower fell to 5,377. The average age of its employees had risen by three years since the first RIF.¹²⁹

POWER TO EXPLORE: HISTORY OF MSFC

Losses devastated the Center. Contractor strength declined even faster than Civil Service manpower. Marshall had lost 65 percent of its peak total manpower resources by early 1972. Rumors circulated, including one that 1,000 Marshall employees would be transferred to Houston, and morale plunged.¹³⁰ The Center expected further reductions, and the ability to use attrition to effect reductions declined each year; RIFs would have to be larger in the future. Prospects were so grim that the Center began to consider deeper RIFs as a means to restore vitality through hiring.¹³¹

Rees feared that continued losses would destroy whatever remained of the arsenal system. "I strongly believe that we have now reached the minimum acceptable level in Civil Service employment at MSFC," he told Headquarters in December 1972. "We absolutely need a period of no further strength reduction in order that we can better assess our situation and rebalance our skills from attrition." He argued that the Nixon administration's philosophy of reductions would lead to a situation in which industry, rather than NASA, would chart the nation's future in space. Without preserving the technical skills of its engineers and scientists, the Agency would no longer be able to evaluate and monitor contractors.¹³²

Marshall had not been the only installation affected by reductions, and tension between the Centers and Headquarters increased. NASA conducted an internal survey of attitudes of the Centers and Headquarters toward one another at a meeting of Center directors in the fall of 1972, focusing on the impact of "institutional aging." Center personnel complained about growing Washington bureaucracy, strangling red tape, declining Center autonomy, and failing communications. Headquarters criticized the Centers for shortcomings that reflected the impact of reductions. By far the most frequent criticism of the Centers was the lack of new talent coming in, a problem that Marshall had been battling since the 1968 RIF. A complaint about obsolete organization ("structured for yesterday's program, not today's") also targeted Marshall's dilemma.¹³³

The appointment of a new NASA administrator offered little hope that Marshall's problems might be alleviated. James C. Fletcher took command in 1971 following the resignation of Paine and a brief interlude in which George Low served as acting administrator. A Republican businessman, Fletcher lacked influence in the administration, and could not sell space to the White House.¹³⁴ Marshall could expect little relief from an administrator who considered Civil

Servants less efficient than contractors.¹³⁵ Although Fletcher fought hard to preserve funding for the Shuttle Program, he accepted reductions in other programs to preserve the Shuttle. Cost cutting became paramount, and overall operations at the Center suffered.

Budget battles with Washington proved wearing to Marshall Director Rees. On 17 November 1972, he spoke to Center employees in Morris Auditorium in an address that amounted to his valedictory, for he would announce his retirement the following month. “We have gone through some trying times together,” he told them, “but we have survived these stern and sometimes anguishing ordeals without any great impairment of our performance.” He announced another reorganization, one more suited to a scaled-down Center and diversified scientific missions. He tried to put Marshall’s ordeal in the best possible light, claiming that “nothing in the basic intracenter relationships has changed,” and that “our in-house capability remains.” But he acknowledged budget pressures, and concluded that the NASA had to “either find low cost routes to our objectives or these objectives will dry up or be reduced in scope to the point where our proud space program will wither and America’s significant space achievements will be just a memory.”¹³⁶

An Outsider Takes the Reins: Rocco Petrone as Center Director

Rees announced in December that he would retire in January 1973, three months before his 65th birthday. Headquarters selected Dr. Rocco Petrone, head of the Apollo lunar program, to succeed him. Although Petrone had served with ABMA, he was the choice of neither Rees nor von Braun. Von Braun had worked with him when Petrone had been launch operations director at the Cape during Apollo, and considered him too parochial, more concerned with Kennedy’s independence than with the program. Von Braun and Rees both preferred Lucas, then Marshall’s



Dr. Rocco A. Petrone, Marshall Space Flight Center Director, 1973–1974.

technical director. Von Braun had told Lucas in 1968 that he wanted Lucas to become Center director. Both Rees and von Braun had expected Rees's tenure as director to last only two or three years, and that Lucas would then move up.¹³⁷

Petrone, the husky son of Italian immigrants, had played football at West Point. He had served with the Army Corps of Engineers after leaving ABMA, and supervised construction of launch facilities at the Cape. He became launch operations director at Kennedy Space Center after resigning from the Army in 1967, and had been the director of the last six Apollo flights. One of his colleagues at Kennedy described him as hard working and hard to get along with, explaining that "Nobody crosses him. I mean nobody."¹³⁸

Why had Headquarters sent an outsider to Marshall? The Center's trials were not yet over, and Washington believed an outsider could preside over further retrenchment dispassionately. Deputy Administrator Low, the Agency's highest-ranking official with long NASA experience, saw the need for further tightening. Kraft believed that Low wanted "somebody strong and very virile. Somebody that could raise hell and cut throats and that sort of thing. He wanted somebody like that and saw it in Petrone."¹³⁹

Marshall's remaining members of von Braun's German team bore much of the burden of reductions, and it is not surprising that some believed they had been singled out. They considered Petrone a "hatchetman," sent by Headquarters to clean house. "He literally threw out the whole von Braun team out the door," claimed von Tiesenhausen, whose own situation was one of many wrenching stories. "I was not eligible for retirement at that time, so I was demoted, which was one of the blackest days of my life. My whole pride was attacked, because I had always thought I had done a good job," he recalled. Others went through similar experiences, and he remembered some being reduced four or five grades.¹⁴⁰

NASA's austerity program became even more stringent during Petrone's brief stint as Center director. Nixon's budgets continued to reduce funding for space. Even as Petrone prepared to assume control of Marshall, one observer described the Agencywide impact of new budget proposals, predicting "There's going to be some blood letting."¹⁴¹

RIFs became an annual exercise. Marshall lost another 199 employees in 1973, 97 of them terminated under RIF proceedings. While other manned space flight centers also experienced reductions, none bore as much of the burden as Marshall, which had absorbed 81 percent of the personnel reductions in manned space flight since the mid-sixties. Marshall's personnel ceiling dropped to 4,564 in Fiscal Year 1974 as the Center experienced its sixth RIF in seven years.¹⁴²

In fact, NASA had been examining the impact of aging on the Agency for several years.¹⁴³ Marshall, with a higher average age than other Centers, was again the focus of attention. "Because we had some people who had been in rocketry longer than some others and we had a lot of people coming up for retirement," recalled Lucas, "the average-age situation made us stand out."¹⁴⁴ An independent study cited NASA's attempts to counter "age creep" and to hire younger personnel, but found that some of the methods employed had not worked. "Over-RIFing"—cutting personnel to open slots for recruits—failed when successive RIFs forced Centers to relinquish the new positions. The study worried that RIFs slowed promotions, forced young people of promise out, and shunted others to less challenging jobs.¹⁴⁵ Huntsville's Germans were victims of the desperate attempts of a besieged Agency to renew itself.

That the Germans thought they had been singled out, even purged, was understandable. Many fixed the start of the decline of the German team at the time of von Braun's departure for Washington, for it seemed that without his dominating presence in Huntsville, Headquarters could move against the Germans with impunity. Von Braun's own fate had been part of the tragedy, for his job at Headquarters was disappointing, and with NASA's reduced funding under Nixon, it became virtually meaningless. He retired from NASA in 1972 to accept a position at Fairchild Industries.

"The system forced us out," concluded Walter Jacobi, who had to accept reduction from a position as a mid-level branch chief to a designer in the structures division. RIF rules, with their protection for American armed service veterans, seemed stacked against the Germans. They dominated Marshall management; if the Center was to develop new leadership in a contracting market, it had to provide opportunities for advancement. Jacobi's fellow Germans attributed the break-up of the team to petty jealousies in Washington, reduced national interest in space, changes in Marshall's mission and philosophy. Marshall's characteristic reticence may have contributed. Karl Heimburg

claimed that in the last years, “too much time was spent waiting for Washington to tell us what to do. I think we were too obedient. If you always wait for an order, that is stifling.”¹⁴⁶

But Petrone’s assignment was not just a slash-and-burn operation. Retrenchment also involved reorganizing the Center for new responsibilities. “Rocco came to Marshall to reorganize Marshall,” according to James Kingsbury, who helped implement Petrone’s plan. Headquarters sent an outsider because reorganization “was going to have serious impact on the senior management at the Center, and unless an outsider did it, the senior managers of the Center would not make significant impact on themselves.”¹⁴⁷

Thus despite the furor over lost jobs and damaged careers, Petrone’s most lasting impact on Marshall was not his administration of RIFs, but a May 1974 Center reorganization. The plan centralized the Science and Engineering Directorate and restructured its laboratories, eliminating duplication of functions characteristic of Marshall’s labs since their inception. Kingsbury, part of a five-man team that had worked on the plan for a year, explained that before reorganization “every laboratory was by and large self-sufficient. It had a little of every other lab in it.” The Center liked to describe itself as the “Marshall team,” but because of autonomy in the laboratories, it had really been more of a “Marshall league.”¹⁴⁸ The changes, McDonough remembered, “stripped all the administrative functions out of the laboratories.”¹⁴⁹ By reforming the laboratories, the Petrone reorganization undercut part of the old German and ABMA engineering system.

Laboratory reorganization also reinvigorated Marshall’s matrix management system. The use of ad hoc, problem-solving teams drawing specialists from various labs had been used in the 1960s. But the imperial laboratories of the Saturn years had provided an alternative to such functional teams. Experts from one lab could work full-time on one project. With lab reform, personnel cuts, and diversification, however, multilab teams were necessary. “Matrix management had been talked about in the Apollo Era,” Bob Marshall said, “[but now] matrix management had to happen.” The changes also reinforced the rise of project offices relative to the laboratories. The labs acted as contractors to the project offices, providing technical services and support. Lab directors, rather than being the leaders as they had been in ABMA days, shared authority with project officers.¹⁵⁰

The Petrone reorganization also signified the formal end of another Marshall practice, the arsenal system. Petrone announced that “The in-house capability to manufacture, inspect and checkout major hardware projects has been eliminated.”¹⁵¹ Kingsbury believed that the arsenal system had been a luxury of the Saturn boom and that the post-Apollo bust forced NASA to end it. The change, especially the loss of support contractors, he thought, forced Marshall’s engineers to become less complacent and more self-reliant.¹⁵² But most “old hands” lamented the loss and worried that the Center was less able to monitor contractors and achieve technical excellence. McDonough said that “we couldn’t do anything anymore. Our shops went, our technicians went.”¹⁵³

Petrone implemented reorganization “parallel with the necessary reduction-in-force.”¹⁵⁴ The Center mailed a thousand letters to notify employees of changes in position.¹⁵⁵ Simultaneous implementation of reduction and reorganization eased the turmoil of the most dramatic internal change in Center history. “The lab directors, by and large, were all new,” Kingsbury explained. Since the older former lab directors had retired, “we didn’t have a lot of trouble putting it into place.”¹⁵⁶

The Threat to Close Marshall

As reductions continued at Marshall, people inevitably began to wonder if the Center would survive. The question had arisen informally in earlier Headquarters discussions about the post-Apollo phasedown, and in the mid-1970s NASA reopened the issue for serious consideration. “There was a good, strong possibility that the Center could have been closed before the end of the seventies,” recalled Lucas. “We came very near to it, nearer than most people know.”¹⁵⁷ NASA twice conducted studies that considered closing Marshall: in 1975, under Fletcher; and again in 1977 when the Carter administration cut space funding during Robert A. Frosch’s tenure as NASA administrator.

The challenge to Marshall’s survival resulted from further threats to NASA manpower. By 1975, the Agency recognized that even if its budget remained constant, it would have to reduce Civil Service strength by 5,000 by 1979. In April 1975, Fletcher met with his staff to discuss realignment of the Centers in the face of new reductions. They concluded that “the reduction in Civil Service positions could be reached by closing a Center.” Fletcher assigned E. S. Groo, associate administrator for Center operations, to develop a plan for reducing people, saving money, and realigning the Centers.¹⁵⁸

For the next several months, Headquarters studied options for Center realignment. Groo and his staff, along with representatives of the Centers, debated the reassignment of tasks, reduction of personnel, and the feasibility of closing a Center. Ames, Lewis, Wallops, and JPL received scrutiny, but most attention focused on Marshall. The group developed a scenario for closing Marshall that anticipated phasing out space science, applications, and nuclear technology by 1978, and closing the Center in 1982. Marshall's Shuttle and Spacelab development would have transferred to Johnson and Kennedy, its space science research to Ames and Goddard, its smaller projects distributed throughout the Agency.¹⁵⁹

Position papers formulated for the discussion of closing Marshall considered the Center's strengths and weaknesses, and showed insight into Marshall's problems. The committee wondered whether Marshall's "skill mismatches," old facilities, and its competition with Johnson for new programs met NASA's long-term needs. Reductions in resources for piloted vehicle development seemed likely, and without a major new program, the Center would likely have to be reduced even if it remained open. Constant reductions had inhibited the Center's future planning, but its "typically innovative" approaches were likely to benefit Shuttle development.

Closing Marshall would have serious implications for NASA's future. It would have been a "clear signal" that the Agency was not about to undertake ambitious missions such as space industrialization, sending men to Mars, or colonizing the Moon. NASA would have lost Marshall's capacity to develop large space systems.¹⁶⁰

Groo decided that closing Marshall was neither practical nor feasible. Closure would have disrupted the Shuttle program. A required two-year phasedown was unworkable, particularly since Marshall facilities were needed for ongoing NASA programs. Too many programs required Marshall's capabilities; not only large lift vehicles, but the Space Station, space industrialization, and future piloted planetary exploration drew on the Center's talents. Marshall gave the Agency flexibility; with Goddard's workload near saturation, Marshall could absorb the overflow. Marshall would remain open.¹⁶¹

Marshall's respite was short-lived. When the Carter administration instituted more cuts to NASA's budget, the issue rose again, for as one Headquarters

assessment noted: “Agency internal reactions are always aimed at closing MSFC whenever an institutional crisis occurs. They have few advocates.”¹⁶² Lucas, Center director at the time, recalled that “we set up what we called a ‘mole-hole operation.’ We had a few key people doing strategic planning in the basement determining how we could posture ourselves to move on. As a matter of fact, we had made the decision early in the 70s to diversify. . . . Had we not we would have been closed.”¹⁶³ Again, the Center survived.

The Impact of Retrenchment

The decade from the mid-sixties to the mid-seventies had been extraordinarily difficult. Marshall descended from a major role in one of mankind’s great scientific achievements to a fight for survival. In 1975, Marshall had 4,100 Civil Service employees. By 1978, the figure dropped to 3,760, less than half what it had been at peak a dozen years earlier. Other Centers were still growing when Marshall began to retrench, then experienced smaller cutbacks. In 1965, Houston’s workforce was 57 percent as large as Marshall’s; in 1975, 89 percent. Kennedy was 32 percent as large as Marshall in 1965, 55 percent in 1975.¹⁶⁴



Dr. William R. Lucas, Marshall Space Flight Center Director, 1974–1986.

Retrenchment destroyed Marshall’s attempts to increase minority employment. Compounding the recruiting impediments imposed by Alabama’s negative image in civil rights was the fact that new employees were more vulnerable to RIFs. In 1975, only 2.6 percent of Marshall’s personnel were minorities, the lowest of all NASA installations, at a time when NASA had increased minority employment to 6.8 percent. Marshall’s minority employees were clustered at low-level positions. Fifty-five percent of the Center’s minority employees did not have a college degree, compared to 41 percent of all employees.¹⁶⁵

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Morale at Marshall was low not only because of the constant threat of RIFs. Marshall ranked lowest of all NASA installations in 1975 in promotions and quality-within-grade increases. In 1974 and 1975, the Center still had the largest Civil Service workforce in NASA, yet its employees received fewer promotions than any other installation. In 1974, only eight-tenths of one percent of Marshall employees received promotions, compared to the NASA average of 11.2 percent. Marshall's workforce was equal to the oldest in NASA, but ranked below the NASA average in grade, and below the other two manned space flight centers in percentage of salary increases.¹⁶⁶

NASA underwent a painful transition after Apollo, and Marshall felt the impact disproportionately. The politics of budgets drove NASA's agenda. The contrast with the 1960s was telling. As Lucas explained, during Apollo, the performance (landing on the Moon) and the timetable (by the end of the decade) "were



Dr. Lucas (center) in conference.

both fixed items. The variable was funds. The schedule and performance were fixed. They were not variables. In the seventies, the funds were the only things that were fixed. The schedule and the performance were the variables. That is the best way to waste money that I know of, to stretch out the schedules."¹⁶⁷

The nature of the Center had changed by the mid-seventies. The arsenal system, the heart of the von Braun approach to development, fell victim to small budgets and demands from the private sector aeronautics industry. "The in-house capability of building things was given up with great reluctance. In retrospect, that weakened the Center," Lucas remembered. The arsenal system "is no longer practiced and industry doesn't want it to be practiced because they want to do all the work. There is merit in that argument. I don't knock it. But it

does say that an agency of the government is more nearly a captive of industry than they might have otherwise been.”¹⁶⁸

Marshall’s employees became monitors of contractors, rather than “dirty hands” engineers. “There was paperwork to do rather than technical work,” according to Walter Jacobi. Bernard Tessmann, former deputy director of the Astronautics Laboratory, retired in 1972 because he did not “want to be a paperboy and push paper.”¹⁶⁹ The transition affected the entire Agency. NASA became more centralized, more bureaucratic. One historian observed that “Increasing centralization, contracting out and the natural forces of aging have tipped the balance within NASA in favor of the forces of organization as opposed to the forces supporting the original NASA culture.”¹⁷⁰

The Center nonetheless had reasons for optimism that transcended its mere survival as an institution. Marshall’s diversification had done more than allow the Center to survive; the Huntsville Center was in the forefront of new NASA work in space science, and continued to be one of the two largest installations for development of piloted space projects. Even during the most arduous period of retrenchment, individuals at Marshall made major contributions to the nation’s space program. In 1975, only Houston exceeded the Center in the percentage of employees receiving sustained superior performance awards.¹⁷¹ Marshall emerged from its transition a very different organization than it had been a decade earlier, but it was still at the center of the American space effort.

Nonetheless, Marshall’s transition had affected the Center in ways that would not become apparent for years. One engineer reflected that cuts went deeper than the fat and were “so austere that I think we went into the red meat.”¹⁷² At the time, attention focused on space spectacles to which Marshall contributed: lunar landings, *Skylab*, Apollo-Soyuz—triumphs that eclipsed institutional developments. Decreasing budgets, pressure from aerospace firms to increase contracts, and the centralization of NASA decision-making precipitated traumatic changes that transformed the Center. When NASA encountered problems in major programs in the eighties, people looked for technological explanations and individuals to blame. The agony and the austerity of Marshall’s transition had faded from public memory. But these institutional changes were the foundation of Marshall’s future.

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- 2 "Washington Roundup" clipping, MSFC General 1959-1969 folder, NASA HQ History Archive.
- 3 Paul E. Cotton, "An Analysis of NASA In-House Manpower Management: Manpower Analysis Comment Copy," 10 February 1976, p. B-1-7, Management Studies-1970s Notebooks, NASA Headquarters History Archive; Arnold S. Levine, *Managing NASA in the Apollo Era* (Washington, DC: National Aeronautics and Space Administration Special Publication-4102, 1982), p. 134.
- 4 "MSFC Center to Employ 9,500 Within Two Years," 22 May 1963, Marshall SFC folder, NASA HQ History Archive.
- 5 "Von Braun Briefing Book, Teague Committee," February 1967, Fiche No. 317, MSFC History Office.
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- 14 Ray Kline, "Minutes of Combined Staff and Board Meeting," 16 August 1966, Von Braun Daily Journal, NASA HQ History Archive.
- 15 Compton and Benson, p. 5.
- 16 Von Braun Daily Journal, 11 May and 26 May 1966, NASA HQ History Archive.
- 17 Von Braun Daily Journal, 14 July 1966, NASA HQ History Archive.
- 18 Joe Loftus, OHI by AJD and SPW, 13 July 1990, Johnson Space Center, Houston, Texas, p. 10.
- 19 Levine, p. 134.

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- 21 Levine, p. 172.
- 22 Chris Kraft, OHI by AJD and SPW, 11 July 1990, Johnson Space Center, Houston, Texas, p. 33.
- 23 Von Braun Daily Journal, 11 May 1966, NASA HQ History Archive.
- 24 Compton and Benson, *Living and Working in Space*, p. 52; Ray Kline, "Minutes of Combined Staff and Board Meeting," 16 August 1966, Von Braun Daily Journal, NASA HQ History Archive.
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- 27 Stuhlinger to J. Shepherd, 29 February 1968, Historical (Miscellaneous) folder, Boxes 12 and 13, Stuhlinger Papers, Alabama Space and Rocket Center Archival Library, Huntsville, Alabama.
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- 29 Von Braun, memo to MSFC employees, 13 August 1965, Box 065–65, Apollo Program Chronological Files, JSC History Office.
- 30 Cotton, p. B–1–6; Levine, pp. 127–28.
- 31 Cited in Levine, p. 127. Harry Gorman represented Marshall on the committee.
- 32 Ray Kline, "Comments at Session of NASA Manpower Committee on 30 August 1966," 31 August 1966, Von Braun Daily Journal, NASA HQ History Archive.
- 33 Quote from Levine, p. 129. The task force submitted its report, entitled "Considerations in the Management of Manpower in NASA," on 8 September 1967. Cotton, pp. B–1–7 to B–2–6.
- 34 Levine, pp. 127–30; Lodge 1858, American Federation of Government Employees, et al., Plaintiffs vs Administrator, National Aeronautics and Space Administration, et al., Defendants, Civil Action No. 3261–67, United States District Court for the District of Columbia, Final Summary and Judgment Order, 12 August 1976 (hereinafter Waddy Case, Final Summary Judgment and Order), pp. 4–5, Fiche No. 1620, MSFC History Office.
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- 36 Von Braun, memo to MSFC employees, 23 October 1967; "Washington Roundup" clipping, MSFC General 1959–1969 folder, NASA HQ History Archive.
- 37 Von Braun, Presentation to MSFC Employees, 29 November 1967, Fiche No. 1626, MSFC History Office.

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- 41 *Ibid.*; “FY–68 RIF at MSFC;” “Adverse Effects of RIF (Based on MSFC 1967–68 RIF),” Reduction-in-Force folder, George M. Low Papers, NASA HQ History Archive; Levine, p. 136.
- 42 “Adverse Effects of RIF (Based on MSFC 1967–68 RIF).”
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- 45 Finger to Mueller, 9 August 1968; Mueller to von Braun, 30 August 1968, MSFC Organization 1968 folder, Box 14, MSFC Director’s Files, Federal Records Center, Atlanta.
- 46 Von Braun to Mueller, 17 September 1968, MSFC Organization 1968 folder, Box 14, MSFC Director’s Files, Federal Records Center, Atlanta.
- 47 Joe Loftus, OHI by AJD and SPW, 13 July 1990, Johnson Space Center, Houston, Texas, p. 10.
- 48 George von Tiesenhausen, OHI by AJD and SPW, 29 November 1988, Huntsville, Alabama, p. 38.
- 49 Kraft, OHI, p. 21.
- 50 Levine, p. 261.
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- 57 "Major Reorganization Underway at NASA-Marshall," *Space Daily* (10 December 1968), p. 171.
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- 67 "MSFC Civil Service Manpower Summary," in "Backup Book: 1973 Hearings before the Subcommittee on Manned Space Flight," 2 March 1972, Fiche No. 1772, MSFC History Office.
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- 69 Chris Kraft, OHI by AJD and SPW, 11 July 1990, Johnson Space Center, Houston, Texas, pp. 16, 17.
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- 98 Bob Marshall, OHI, p. 2.
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- 110 Lucas, OHI, 20 November 1990, p. 24.
- 111 Ernst Stuhlinger, OHI by AJD and SPW, 24 April 1989, Huntsville, Alabama, p. 23.
- 112 Georg von Tiesenhausen, OHI by AJD and SPW, 29 November 1988, Huntsville, Alabama, p. 19.
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- 117 “FY–71 RIF at MSFC,” Fiche No. 868, MSFC History Office; Boyd C. Myers, II to George M. Low, 9 October 1970, Reduction-in-Force folder, Low Papers, NASA HQ History Archive.

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- 119 Levine, *Managing NASA in the Apollo Era*, p. 137.
- 120 Art Sanderson, OHI by AJD, 20 April 1990, Huntsville, Alabama, p. 10; Lucas, OHI, 20 November 1990, p. 14.
- 121 "FY-71 RIF at MSFC," Fiche No. 868, MSFC History Office.
- 122 Marshall was not the only Center to use the technique to control RIFs. Kennedy was the worst abuser, and had created 46 competitive levels for 46 GS-6 secretaries, making it possible to select individuals for dismissal without fear of reprisal. Marshall had 2,800 competitive levels for its 5,600 employees. John Cramer, "12 Employees Lose Gamble Against NASA Rules," *Washington Evening Star and Daily News*, 28 August 1972; John Cramer, "NASA's 'Evil Invention' May Be on Way Out," *Washington Evening Star and Daily News*, 22 September 1972.
- 123 Myers to Low, 9 October 1970.
- 124 "FY-71 RIF at MSFC," Fiche No. 868, MSFC History Office; Myers to Low, 9 October 1970; "Over Four Years: Space, Defense Job Losses Total 11,000 in Huntsville," *Birmingham News*, 10 December 1970.
- 125 John Noble Wilford, "NASA Layoffs Hit von Braun Team," *New York Times*, 3 September 1970; National Academy of Public Administration Foundation, "Report of the Ad Hoc Panel on Attracting New Staff and Retaining Capability during a Period of Declining Manpower Ceilings," June 1973, p. 19, Management Studies—1970s Notebooks, NASA Headquarters History Archive; Pat Houtz, "At Huntsville: Emotions Run High at NASA Cutback," *Birmingham News*, 23 August 1970.
- 126 "Robert Paetz v. United States of America," Case No. CV 84-HM-5231-NE, in the District Court of the Northern District of Alabama, Northeastern Division, May 1988, Fiche No. 324, MSFC History Office.
- 127 Jack Hartsfield, "Reduction in Force Anticipated by Rees," *Huntsville Times*, 29 January 1971.
- 128 "FY-72 RIF at MSFC," Fiche No. 868, MSFC History Office.
- 129 "Dr. Petrone's Backup Information, MSF Subcommittee Visit," 1 February 1974, Fiche No. 874, MSFC History Office. The average age of Marshall employees rose from 40.4 in June 1968 to 43.4 in June 1972.
- 130 The story appeared in the *Houston Post*, attributed to a MSC source, but was denied by Houston, Marshall, and Headquarters. Rees to Marshall employees, 13 March 1972, Fiche No. 1183, MSFC History Office.
- 131 "Manpower Situation" in "Backup Book, 1973 Hearings before the Subcommittee on Manned Space Flight," 2 March 1972, MSFC History Office.
- 132 Rees to Low, memo, 2 December 1972, Management Development, 1972-73 folder, NASA HQ History Archive.
- 133 George M. Low to All Attendees at Center Directors' Meeting, 11-12 September 1972, memo re: Bruce Lundin's Questionnaire, 22 September 1972, Personnel (1970-75)

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- 135 See, for example, Harvey W. Herring, "Meeting Record," 24 March 1975, Management Studies, 1970s Notebooks, NASA Headquarters History Archive.
- 136 "Dr. Rees' Text for Director's Briefing," 17 November 1972, Director's Briefing 11-17-72 folder, Speeches and Articles 1959-1972 box, Rees Papers, Alabama Space and Rocket Center, Huntsville, Alabama.
- 137 Barry Casebolt, "Rees Planning to Stay in Huntsville," *Huntsville Times*, 24 December 1972; Von Braun, telephone conversation with Kurt Debus, Von Braun Daily Journal, NASA HQ History Archive; Lucas, OHI, 20 November 1990, p. 1.
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