

# *The Eclipse of the Century: A Story of Science, Money, and Culture in Saharan Africa and the American Southwest*

DAVID A. CONRAD

Cécile DeWitt-Morette sat on a roof in a sandstorm in the Sahara Desert. It was 10:30 a.m. on June 30, 1973, and nearly 100 degrees Fahrenheit. If the storm did not let up soon, all was lost. A year and a half of preparation and approximately \$100,000 in grants would be for naught, and a similar opportunity would not come for another 18 years. But Cécile had no power over the wind or sand or time. She could only wait. Beneath her feet, inside the structure she and her colleagues from the University of Texas (UT) McDonald Observatory built, her husband Bryce DeWitt—head of the expedition—and five other men waited for the storm to abate. The clock ticked off the seconds, and still the sand blew. All the money and effort spent to send these people here, to the oasis of Chinguetti in the Islamic Republic of Mauritania, could not alter the forces of nature.<sup>1</sup>

It was a natural phenomenon, but not a terrestrial one, that brought these researchers to Africa. Sandstorm or no, at 10:45:41 a.m. the sun would go dark as the moon passed directly between it and Chinguetti. A brief, dusky night would fall over the oasis, and stars would appear in the sky. This total solar eclipse offered a rare opportunity to photograph, through an Earth-based telescope, the sun and distant background stars simultaneously. If the resulting images were of sufficiently high quality, physicists and astronomers could use them to solve a decades-old physics problem. This problem concerned perhaps the most famous scientist of all time, Albert Einstein, and his influential theory of relativity.<sup>2</sup>

Einstein's theory, the key ideas of which he formulated between 1905 and 1916, in part described how the gravity of a massive object like the

DAVID A. CONRAD *is a PhD candidate in the Department of History, University of Texas, Austin.*

sun warped the space around it. This gravitational distortion caused everything, including light itself, to bend toward the massive body. By the 1970s, no serious scientist objected to Einstein's ideas in principle. But there was still substantial disagreement over just how severely gravity bent light. If Einstein's prediction of the value of this "light deflection" was correct, then his theory of relativity might describe the true nature of the physical universe. If, on the other hand, his theory predicted a light deflection value that was substantially greater or less than that which occurs in reality, as some scientists suspected, then Einstein's model would contain serious flaws.<sup>3</sup>

For decades, solar eclipses offered the best chance to observe the gravitational deflection of starlight in action. Usually, the sun makes all other stars impossible to see through Earth's atmosphere. But during a total eclipse, in which the moon blocks nearly all of the sun's light over a particular spot on Earth, stars in the background of the sun become visible. The stars appear to occupy a slightly different space in the sky than they do when the sun is not there to warp their light. The first opportunity to measure this phenomenon during a solar eclipse came in 1919. That year, a total solar eclipse took place over Brazil, the Portuguese-controlled island of Principe, and parts of French and Belgian Africa. Britain's Royal Greenwich Observatory sent astronomers to some of these far-flung locales to photograph the event. However, the equipment and techniques of the day were insufficient to determine the deflection of light with precision. For the moment, Einstein's theories outmatched scientists' ability to test them.<sup>4</sup>

The scientists who endured a Saharan sandstorm in 1973 hoped to set the record straight at last. Ten minutes before totality, the moment the moon completely covers the sun, the wind finally stopped. The sky still contained loads of fine sand particles, but Cécile saw the dark disk of the eclipsed sun from the roof of the hut that housed the team's telescope and photographic equipment. The team prepared for totality. At 10:45:41 it happened, and everyone sprang into action. They each knew exactly what to do and when. Bryce used a stopwatch to track each second that elapsed after totality. At the 5-second mark, Cécile opened the telescope shutter. Another scientist noted the temperature of the air and the telescope. At the 35-second mark, Cécile closed the shutter. Again, another team member noted the temperature while still another one adjusted the position of the telescope. One hundred and five seconds after totality, yet another scientist added a fresh photographic plate to the telescope. They repeated these actions until the totality phase of the

eclipse was over. This most delicate part of the experiment, which took months to plan, ended exactly 363.7 seconds after it began. The UT scientists now possessed what may have been the three most valuable photographic plates ever taken of stars near an eclipsed sun.<sup>5</sup>

Yet the UT trip to Chinguetti was never just a science experiment; it was, start to finish, an adventure in domestic and international collaboration. The funding that made the expedition possible came from the U.S. government's robust science bureaucracy, a product of the early Cold War. The Texas-based expedition members were long-term guests in a newly independent Islamic African nation. The successful completion of the expedition depended not only on the scientists' technical proficiency, but on their ability to navigate an evolving domestic funding system and adapt to a foreign host culture. In all of these respects, the trip to observe the 1973 solar eclipse was a remarkable undertaking for the UT McDonald Observatory.

The McDonald Observatory grew from a modest, regional facility into an ambitious, internationally active institution in a comparatively short amount of time. Its growth reflected widespread changes in the character of American academic science in the mid-twentieth century. The land and money for the observatory came from the estate of William Johnson McDonald, born in the Republic of Texas in 1844. McDonald served in the Confederate army during the Civil War. He later became a wealthy banker, traveled extensively, and collected books on astronomy and other natural sciences. He died in 1926 after a long illness, leaving no children and no spouse but over \$1 million in assets. His will bequeathed the vast majority of this sum "to the Regents of the University of Texas . . . for the purpose of aiding in erecting and equipping an Astronomical Observatory."<sup>6</sup> UT's dean of science likened the unexpected gift to "lightning out of a clear sky."<sup>7</sup> In 1934, UT opened the new observatory in the Davis Mountains in west Texas, near the town of Marfa. This location was far from the university in Austin, but it was better for astronomical purposes due to its elevation and distance from artificial light sources. However, the school lacked an astronomy faculty, and had to fill positions in the new observatory with scientists from the University of Chicago.<sup>8</sup>

The observatory's reliance on Chicago illustrates the Southwest's subordinate position in the American scientific community prior to World War II. Scientists in the nineteenth and early twentieth centuries viewed the American Southwest—a term that encompasses west Texas, Arizona, New Mexico, and sometimes Colorado, Utah, and Southern California—

as a big, open-air laboratory. Biologists cataloged new species of desert-dwelling flora and fauna. Archaeologists excavated the homes of the area's original inhabitants, while anthropologists visited reservations to interview their descendants. Astronomers, too, found the Southwest attractive for its dry climate and clear atmosphere. But for the most part, the best scientists remained on the faculties of eastern and northern colleges, and traveled to the Southwest only on expeditions. Public universities, often set on large tracts of state-owned land, cropped up throughout the Southwest in the late nineteenth century, but enrollment was low and the young schools lacked the prestige of their older, eastern counterparts. Out of 4,000 scientists in a 1906 biographical directory, just 15 lived in Texas, Arizona, or New Mexico. The Southwest in the early twentieth century was a "colony" of American science: valuable for its resources but institutionally underdeveloped. Facilities like the McDonald Observatory depended on ties with universities in other regions.<sup>9</sup>

Nevertheless, the new observatory in west Texas was an important contribution to the emergence of the Southwest as a site of advanced scientific research. Domed observatories were and are the most obvious architectural symbols of scientific research. The first in the region was the Lowell Observatory, which opened in Flagstaff, Arizona, in 1894. World War I delayed completion of the Steward Observatory on the University of Arizona campus in Tucson, but it finally opened in 1922. Texas's construction of the McDonald Observatory in the early 1930s was another landmark in the history of southwestern science. Each new bulbous structure was a sign that science was on the rise in the region. Between 1900 and 1940, the number of scientists living and working in the Southwest steadily increased. Scientific personnel in the region established the Southwestern Division of the American Association for the Advancement of Science around 1920. The establishment of astronomical observatories like McDonald was one of many indications in the first half of the twentieth century that science in the Southwest was on the rise.<sup>10</sup>

World War II prompted a restructuring and intensification of federal financial support for academic science research, to the advantage of southwestern science in general and the McDonald Observatory in particular. Before the war, university researchers received the bulk of their funds from state governments, private donors, and student tuition. The Second World War marked a sharp break with the past in this regard. McDonald Observatory staff assisted with military rocket propulsion studies taking place in the New Mexico badlands, near the secret atomic

research complex at Los Alamos. In 1945, Vannevar Bush, head of the military's Office of Scientific Research and Development and a former MIT administrator, submitted a proposal for a new government agency devoted to science funding. Bush's vision was realized in 1950 with the creation of the National Science Foundation (NSF), whose mission was to support the development of academic science centers throughout the country.<sup>11</sup>

The National Science Foundation changed the face of science funding in America. The Foundation's headquarters were two blocks from the White House. It was a federal office in control of valuable tax dollars, but academics comprised most of its 24-member board. When Bush first proposed the NSF, he stressed the need to prioritize projects according to their academic merit. The board members reviewed grant applications using the peer review process standard in academia. At the same time, the NSF made an effort to spread its limited funds over the widest possible geographic area, so that no region of the country would lack first-class research institutions.<sup>12</sup>

Thus the NSF was something of a Janus. For 20 years, the dual mission of the NSF—to support advanced research and to build up the nation's academic science infrastructure—seemed to produce the desired results. The Foundation's first budget was a modest \$3.5 million, but after the Soviet Union launched the satellite known as Sputnik in 1957, Congress raised the figure to \$130 million. By 1970, the NSF commanded half a billion dollars each year and had distributed a grand total of \$4.72 billion to science departments around the country. One commentator, writing in 1971, described the Foundation as the “patron saint of American graduate education.” Universities turned NSF funds into state-of-the-art facilities and cutting-edge equipment. An NSF research grant all but guaranteed a graduate student's career, while a rejection could just as easily break it.<sup>13</sup>

There were other governmental sources of support for academic science in the postwar period. The Cold War, like the world war that immediately preceded it, provided much of the impetus for this official dedication to scientific progress. The old War Department became the Department of Defense, with a perennially growing budget and an expanding mandate for research and development. The North Atlantic Treaty Organization (NATO) came into being in 1949 as a U.S.-led security bloc for the defense of Western Europe against possible Soviet attacks. Such attacks were not forthcoming, but the launch of Sputnik led NATO to concentrate on international scientific collaboration among its member states. The Soviet satellite also hastened the creation of the

National Aeronautics and Space Administration (NASA) in 1958, and signaled the start of a space race between the United States and the Soviet Union to bring the extraterrestrial realm into their respective spheres of influence. With these new sources of funding, science in America took on new strength and new political dimensions.<sup>14</sup>

However, American scientific research did not become purely utilitarian as a result of its association with superpower politics. In fact, after 1945, scientific research became more and more a function of academia. Scientists and departments within American universities, as opposed to unaffiliated researchers or non-academic research institutions, were the preferred recipients of government science grants. Yet faculty and university administrators rarely thought of themselves as government employees, much less Cold Warriors. As academics, they were more likely to think of scientific knowledge as an end unto itself. Robert Rosenzweig, a longtime academic administrator who later became president of the Association of American Universities, recalled a prevailing attitude among his colleagues that federal funding was “ours because we deserve it.”<sup>15</sup> This view held sway even in the top ranks of government agencies. The NSF’s peer review process adhered to academic norms. The National Institutes of Health (NIH) predated World War II by over a decade, and the medical research it funded often lacked direct military application, but it rivaled the NSF in grant outlays during the first three postwar decades. The infusion of billions of government dollars into the NSF and NIH was a product of science’s heightened importance during the Cold War, but these agencies did not sacrifice academic principles.<sup>16</sup>

The new funding infrastructure benefited scientific facilities, such as the McDonald Observatory, that were affiliated with academic institutions. Private patronage had built and financed Lowell, the oldest astronomical observatory in the Southwest. But its independent funding model could not keep pace with newly flush academic observatories. The younger McDonald Observatory, on the other hand, had connections with two top-tier research universities, Chicago and Texas. After the war, McDonald astronomers received new equipment and made significant discoveries. At the close of the 1940s, Gerard Kuiper, a Chicago astronomer, used McDonald Observatory equipment to discover new moons around Uranus and Neptune. Between 1963 and 1967, NASA granted \$5 million to the observatory for the construction of a new reflector telescope with a 107-inch mirror, a substantial upgrade from its original 82-inch reflector.<sup>17</sup>

UT severed the McDonald Observatory’s ties with Chicago in the early 1960s by founding an astronomy department of its own. Texas

recruited Harlan J. Smith, a Yale astronomer, to chair the new department and head up the observatory. To the Harvard-educated Smith, leaving Yale for Texas was like entering an “astronomical wilderness.”<sup>18</sup> But Harlan Smith dreamed big, and saw opportunities where others saw impossibilities. For example, he spoke publicly and often of his desire to see humans colonize the moon and Mars. He imagined setting up an observatory on the far side of the moon, and eventually made hypothetical sketches of such an extraterrestrial installation. He also directed his energies toward more immediate projects. He convinced Yale to part with some of its equipment, touting west Texas’s “remote, flat, dry, spacious” environment as superior for astronomical observations.<sup>19</sup> Under Smith’s watch, the UT astronomy department and the McDonald Observatory matured in terms of research and teaching. In addition to overseeing the construction of the new, NASA-funded reflector, Smith won a NASA grant to refurbish the observatory’s two original telescopes. He also reached out to the general public by helping to create a syndicated radio program for astronomy news, *Stardate*, which still airs today on public radio stations nationwide. Smith was an active administrator throughout his long tenure.<sup>20</sup>

In 1971, Smith directed the observatory’s first international research expedition. This actually consisted of three simultaneous expeditions to Australia, India, and South Africa. Two astronomers at each location observed the planet Jupiter as it appeared to pass in front of a bright star. The light from the star interacted with Jupiter’s atmosphere and helped reveal the planet’s chemical makeup. However, two of the teams encountered cloudy weather that reduced their visibility. The third one enjoyed clear skies and made successful observations. In astronomy, multiple sites were often worth the extra cost.<sup>21</sup>

The following year, UT welcomed two new faculty members who would lead the McDonald Observatory into a still bolder undertaking. These new arrivals were Bryce DeWitt and Cécile DeWitt-Morette, both physicists. They had met in 1949 while both held postdoctorate positions at Princeton’s Institute for Advanced Study. Each led a fascinating life before arriving in Texas. Bryce was born Carl Bryce Seligman in 1923. He inherited the surname from his paternal grandfather, a German-Jewish immigrant. The name Seligman caused “repeated misunderstandings and false assumptions” as to the family’s ethnic and religious identity and made them targets of anti-Jewish discrimination in the United States, so Bryce’s father later encouraged him and his brothers to adopt the name DeWitt, a surname from their mother’s side.<sup>22</sup>

Growing up, Bryce was particularly close to his mother's parents, poor and "terribly pious" Presbyterian farmers in California's San Joaquin valley.<sup>23</sup> Though devoutly religious, Bryce's maternal grandfather believed in Darwinian evolution, much to his fundamentalist wife's chagrin. This grandfather also built amateur telescopes, working by lamplight because the farmhouse lacked electricity. Bryce cultivated an appreciation of both religion and physics, but as an adult he rejected the dogmatism of his grandparents in favor of agnosticism. "I know some physics, but there is much more to 'reality' than physics, and of that I am largely ignorant," he once wrote.<sup>24</sup> He entered Harvard at age 16 and earned a degree in physics. During World War II he worked on an aspect of the Manhattan Project, and joined the navy in 1944 but saw no combat. He resumed his academic work after the war, ultimately coming to the Institute for Advanced Study. Bryce yearned to go abroad, so he continued his studies in Zurich and Bombay. He and Cécile traveled to Paris, where they wed in April 1951.

Cécile's early life was, in her own understated words, "profoundly changed by World War II." A bit older than Bryce, she was raised in Caen, Normandy, on the northwest coast of France. She was in college during the German occupation, and received a degree in math, chemistry, and physics in 1943. She was not enamored with science, and wanted to go to Paris for "more exciting opportunities." Unfortunately, the German occupiers did not allow French citizens to move from Caen to Paris without a permit. Enrolling in graduate school at the Sorbonne was Cécile's surest route to this desired pass. She was at the Sorbonne on June 6, 1944, when the Allies stormed Normandy. It was an Allied bomb that destroyed her family's house in Caen, killing several members of her family. Cécile was 21. As she says, she "became an adult overnight."<sup>25</sup> Soon she took a laboratory job with Marie Curie's son-in-law. However, she felt she needed more education in order to understand recent discoveries and theoretical advancements in the field of physics. She studied in Dublin and Copenhagen before arriving at the Institute of Advanced Study, where Bryce was also studying, in 1948. She had grown to enjoy scientific research, and during this time she wrote, taught, and became "acquainted with the great physicists of this period." She also wished to contribute to science education in France. In 1951 she established L'École de Physique des Houches, or "Les Houches," in the French Alps. Over the next several decades Les Houches produced many influential alumni and earned acclaim from the international scientific community.<sup>26</sup>

The life Cécile and Bryce created together was no less exciting than the ones they had lived independently. They were academic physicists, tireless international travelers, and soon they became parents. They were in Bombay when Cécile gave birth to their first of four daughters in April 1952. The young family traveled between America, where Bryce was seeking employment, and Les Houches, where Cécile spent part of every year for the next two decades. Bryce found work at Livermore National Laboratory, a radiation and nuclear weapons research facility in California, and settled into a specialization in quantum mechanics and gravitation. In 1956 both of them accepted job offers at the University of North Carolina, where Cécile worked on topics relating to Einstein's general relativity theory. Although they were both professionally active and influential during their years at North Carolina, the school administration treated them disparately. Bryce reached full professor, but Cécile was demoted in 1967 based on dubious nepotism regulations. By 1971 the DeWitts were looking for a university that would hire them both as full faculty members.<sup>27</sup>

The University of Texas was poised to capitalize on the DeWitts' job search. The 1960s were the start of a "golden age of relativity," and UT was just one of many institutions competing for talented faculty in that field. A procession of young physicists came to UT, stayed a few years, then moved on to other, "more prestigious" universities. UT Physics could turn its considerable funds into prestige if it could attract a big name or two. Bryce and Cécile were well-known scholars in the middle of their careers, looking for a place willing to hire both husband and wife. The DeWitts were a coup for Texas, and Texas was an ideal fit for Bryce and Cécile. In January 1972, they both accepted professorships, though at first Cécile had to divide her time between the physics and astronomy departments to avoid the appearance of nepotism.<sup>28</sup>

Bryce and Cécile were of course aware that a solar eclipse was due to occur over Africa on the morning of June 30, 1973. From the moment the couple arrived in Texas, they were, in Harlan Smith's words, "all fired up to have astronomers observe the Einstein effect at this longest eclipse of the century." Doubtless the DeWitts understood the difficulties in controlling the variables in this kind of experiment. As seasoned travelers with experience in the developing world they had some idea of the challenges a scientific expedition would face in journeying to a remote region of Africa. But the possibility of resolving a decades-old physics debate, not to mention the opportunity to see Africa, was too enticing to let these obstacles stand in the way.<sup>29</sup>

The DeWitts had been in Texas only a matter of weeks when Bryce raised the idea with Smith. Smith had replied that “that type of activity was for eclipse chasers and amateurs,” but this comment was likely in jest.<sup>30</sup> Smith recalled the initial conversation in a letter to a colleague dated June 26, 1972. “We raised the usual objections,” Smith wrote, “of the exceeding difficulty of doing the necessary half order of magnitude [half of ten times] better than previous expeditions, the hazards of weather and sandstorms, the great expense, etc.” But Bryce and a like-minded astronomer at Princeton prevailed upon Smith “to take a hard look at the situation” and the rare opportunity the eclipse provided. Smith came to feel “that given enough support . . . the effort probably was worthwhile although it would be heroic.”<sup>31</sup>

Smith initially thought in terms of two or three separate expedition teams in keeping with the Jupiter-viewing missions of a few years earlier. The more sites, the greater the chance that at least one would have good viewing conditions at eclipse time. Two of the three Jupiter teams, Smith recalled, experienced cloudy conditions. Three different sites would likely experience three different sets of technical problems. An internal McDonald Observatory memorandum used an analogy to explain the advantage of three sets of errors as opposed to two, not to mention one: “two clocks which disagree are confusing; three clocks which disagree usually point to the culprit.”<sup>32</sup> In other words, data from multiple locations could compensate for imperfections in the sensitive equipment. But Smith considered the Jupiter expeditions “trivial in comparison to this one—less than 10% the cost and difficulty.”<sup>33</sup> The Jupiter observations took place at extant astronomical facilities, whereas the Saharan nations in the path of the 1973 solar eclipse were largely devoid of scientific infrastructure. The southern Sahara was not quite the moon or Mars, places Harlan dreamed of exploring, but sending teams there to perform sensitive experiments was a task that would test the McDonald Observatory’s limits.<sup>34</sup>

Moreover, a second research team would have to visit Africa several months after the eclipse in order for the experiment to succeed. On the first trip, teams would photograph the eclipse itself: a darkened sun in the foreground with a few bright stars in the background. Because the purpose of the experiment was to discover how much the sun warped the light from the background stars, it was necessary to compare the eclipse images with images of the same stars, at the exact same angular position in the sky, without the sun. The apparent position of stars in the sky moves slowly westward each night, so stars that are overhead

during the day (and therefore invisible except during solar eclipses) will be overhead at night several months later. The stars that were almost behind the sun on the morning of June 30, 1973, would appear at the same position in the sky on November nights that same year. All telescopic equipment had to remain at the expedition sites, untouched, during the intervening period. Then a small team on a return trip could take a set of comparison images and dismantle the facilities. The necessity of two separate trips complicated an already daunting research agenda.<sup>35</sup>

Of course, government funding would be essential to so massive an undertaking. The nascent eclipse expedition team, with Smith and the DeWitts at its head, initially calculated the cost of three expeditions at around \$400,000. This figure included the cost of new telescopes with expensive lenses, special photographic plates to record telescopic images, two separate trips to three separate African sites, and analysis of the resulting data. Just a few decades previously, an expedition at this price would have been possible only for individuals or institutions with hefty private endowments. It would have been well outside the reach of a public university like Texas, situated on the country's scientific frontier. But thanks to the postwar revolution in federal science funding, money was available even to a school that, until recently, was described as "fledgling" at best and a scientific "wilderness" at worst.<sup>36</sup> Even still, time was short and financial prospects were uncertain. The eclipse was just over a year away when Smith approved the project around February 1972, and applying for grants was a long and arduous process.<sup>37</sup>

To complicate matters, federal funding for science was in the process of yet another historic shift. As the nascent eclipse team began drafting its proposals to the NSF, the NSF was submitting its own request to the United States Congress. The Foundation's requested budget for fiscal year 1972 was \$622 million, a record high. But the budget increase was not enough to compensate for recent rampant inflation. Using 1972 dollars as a baseline, federal funding for academic research grew by an average of 13 percent each year between 1953 and 1968. For the period of 1968 to 1974, the inflation-adjusted growth rate was zero percent. Economic problems, social turmoil, and the ongoing war in Vietnam, not unrelated phenomena, generated a push in Washington for fiscal austerity. In 1971 an academic observer noted that the NSF was becoming "more attuned to national priorities instead of the more narrow needs of science" and "more sensitive to the political winds that blow through Washington."<sup>38</sup> Scientists across the country worried that the Foundation's historic commitment to peer-reviewed research was eroding, and that

the agency was becoming too politicized. Grants for physics, chemistry, math, biology, and astronomy, all prestigious fields in the early Cold War, went into decline, and the social sciences took a larger share of the pie in response to domestic and international crises. Smith and the DeWitts may not have fully recognized the “course correction” that was under way in Washington when they began planning their costly expedition.<sup>39</sup>

By March 1972 there were six members of the expedition planning team. In addition to Harlan Smith, Bryce DeWitt, and Cécile DeWitt-Morette, there were David Evans, Alfred “Al” Mikesell, and Richard Matzner. Evans, a Welshman, was the eldest of the lot. In the 1930s he studied astronomy at Cambridge under Sir Arthur Eddington, one of the British observers of the 1919 eclipse expedition. Evans was a conscientious objector during World War II, after which he became an astronomer in residence at British observatories in South Africa. Smith recruited Evans to come to Austin in 1968. Mikesell, nearly the same age as Evans, was a retired U.S. Naval Observatory researcher. In 1958 he and another man ascended 40,000 feet in a balloon to report on daytime astronomical viewing conditions. This was long before the era of space-based telescopes like Hubble, so Mikesell was one of the first people to make observations from such thin atmospheric conditions. He and his wife, Marjorie, moved from Washington State to Austin to manage the logistics of the expedition. Matzner was an assistant professor of physics at UT. At 30 years old he was the youngest member of the team. Like the DeWitts, he had theoretical knowledge about the scientific problem at hand. At this early stage, the Texas team worked in combination with several members of Princeton’s astronomy department. Texas was the senior partner in the endeavor, and was to carry out the actual expedition. Princeton was to prepare some of the equipment before the trip and analyze data after the fact. The schools planned to divide their new lenses between their respective astronomy departments and observatories after the eclipse.<sup>40</sup>

Funding got off to a promising start in April when the Texas-Princeton team won a grant from the Research Corporation. The corporation was a private-sector foundation established in 1912, long before the federal government became the top patron of scientific research. The corporation’s original mission was “to fund serendipitous, courageous” research.<sup>41</sup> Sixty years later, an eclipse expedition to Africa fit this bill. Along with a check for \$20,000 dollars, the corporation’s vice president in charge of grants sent Smith an encouraging letter. “Now, it is up to you and

your colleagues to fight the calendar. Needless to say, you have our very best wishes,” it said. The grant was just 5 percent of the team’s maximum cost estimate, but it greased the wheels. The team cited the Research Corporation gift in all of its subsequent proposals in order to show that the mission already had some financing and was therefore more likely to succeed.<sup>42</sup>

Numerous defeats quickly overshadowed this one small victory. In April, the eclipse team was “stunned” when a third-party telescope lens manufacturer gave them a higher-than-expected quote for the equipment they hoped to commission.<sup>43</sup> The new worst-case cost estimate for the expedition was just over \$465,000. In May, grant applications for the amount of \$157,000 each went to the Office of Naval Research and the Air Force Office of Scientific Research. These two offices, like so many other federal science funding agencies, came into being after World War II in the context of the Cold War commitment to military readiness. The team considered making a \$157,000 request to NASA as well, but it is unclear whether they did. They did not expect to receive these amounts in full, but they hoped that “some combination of these sources” would provide sufficient funding for at least two expeditions. The response letters from these agencies apparently did not survive, but each rejection was final. The eclipse team received nothing from the navy, the air force, or NASA. The reasons, at this point, are speculative, but the slowdown in government science funding in the early 1970s may have been responsible.<sup>44</sup>

These rejections, though ominous, were not fatal to the expedition so long as the “patron saint” of academic science came to the rescue. This was, of course, the National Science Foundation. The Foundation, then in its twenty-second year, loomed large in the American scientific community. Research projects, even entire departments, lived and died by NSF grants. From the beginning, the Texas-Princeton expedition members pinned their hopes on the NSF to supply the bulk of their funds. On March 29, 1972, Smith had a long, informal talk with NSF staffer Ronald La Count. They talked about their respective organizations’ plans for the upcoming eclipse. The NSF, in addition to its usual role as a provider of funds, planned to act as an umbrella organization for all American eclipse teams in Africa. It would work in combination with the National Center for Atmospheric Research (NCAR), a quasi-governmental subsidiary of the NSF, to provide information, transportation, and housing for all U.S. institutions sending scientists to the Sahara, even those that were not recipients of NSF grants. After

Smith's conversation with La Count, he sent the McDonald Observatory's preliminary funding application to the NSF. By May, the team drafted a formal request for \$302,848. The team intended to spend over half of this amount on equipment purchases, with most of the rest going towards participants' salaries and travel expenses. The NSF grant review board took an average of six months to announce its decisions, so the team endured a long period of uncertainty as to the mission's financial viability.<sup>45</sup>

The same month the Texas-Princeton team submitted their proposal to the NSF, a meeting of the International Astronomical Union in Madrid revealed how much competition they faced. The purpose of the meeting in Spain "was to discuss the logistic situation" in Africa. Representatives came to Spain from the United States, the Soviet Union, England, France, Italy, the Netherlands, Switzerland, and Japan to discuss the planned expeditions from their respective nations. The McDonald Observatory sent an astronomer to report on the proceedings. The top U.S. representative in Spain was Ronald La Count, whose new title at the NSF was "U.S. Coordinator for the 1973 Solar Eclipse." La Count represented no fewer than twenty-five American universities and four government agencies that planned to set up shop in Africa during the eclipse. Only UT planned to use the eclipse to measure the Einstein light deflection. However, most of these groups probably hoped to receive NSF funding. The American delegation to the Madrid meeting anticipated that 100 to 200 scientists would make the trip from the United States to the Sahara. America's projected scientific contingent was larger than all other countries combined, but it paled in comparison to the thousands of amateur eclipse enthusiasts the International Astronomical Union expected would make the pilgrimage to Africa. If the Spain meeting was any indication, the 1973 solar eclipse was going to be the astronomical event of the century.<sup>46</sup>

Several newly independent African nations would play host to this international swarm of eclipse chasers. Mauritania was due to fall under the eclipse's shadow on the morning of June 30, 1973, followed by Mali, Niger, Chad, Sudan, and finally Kenya. The first four countries had become independent from France in 1960. Sudan shook off the British and the Egyptians in 1956, and Kenya remained under the Union Jack until 1963. Each country in the path of the eclipse was a member of the 12-year-old Non-Aligned Movement, a coalition of nations that claimed neutrality in the Cold War and solidarity against lingering imperialist ambition among "great" powers. For these young nations, the eclipse offered a chance to showcase what they had achieved for themselves in

just over a decade of independence. At the same time, the eclipse presented serious logistical challenges regarding foreign scientists' housing, communication, and transportation needs.<sup>47</sup>

Only two of the eclipse nations, Mauritania and Sudan, sent representatives to the meeting in Madrid. The Mauritanian spokesperson, Mrs. Ould Cheikh Abdallahi, gave a balanced appraisal of her country's capacity to host eclipse teams. Several ministries in her government were working on eclipse planning. Scientists could bring astronomical equipment into the country duty free, as long as they took the equipment back with them or donated it to Mauritania after the eclipse. The state had constructed a new road directly in the path of the eclipse to facilitate transportation, and scientific teams would receive priority over amateurs at observation sites. But, Abdallahi cautioned, the weather in Mauritania in June was extremely hot, the desert was potentially deadly to inexperienced travelers, and there was virtually no permanent housing for scientists. Despite Abdallahi's carefully tempered report, the Mauritanian government was eager for eclipse teams to choose observation sites in Mauritania. Thousands of eclipse watchers might strain the Mauritanian infrastructure, but they would also bring money and international recognition to the nation. Abdallahi's presentation made a more favorable impression on the McDonald Observatory's attendee than the subsequent Sudanese report. The UT observer concluded that Sudan's capacity to host eclipse teams was "less well developed" than Mauritania's.<sup>48</sup>

Mauritania offered several advantages to scientists in the French academic community. For several years after independence, Mauritania depended on France for economic aid as well as military protection from Morocco, with whom the country had a territorial dispute. The Mauritanian government chose to retain French as its official language even after independence because the *lingua franca* was a commonality between the country's rival ethnic groups. French citizens still lived throughout Mauritania and had detailed geographic information about the country. In early 1971, French eclipse expeditions asked for, and received, permission to base their science teams at the old French army barracks in Atar, Mauritania. Mauritania asked only that they help restore the dilapidated structure while they were there. In contrast to this French head start, the Americans were still racing the clock to find observation sites over a year later. In many ways, the long-term consequences of French imperialism benefited eclipse teams with French connections.<sup>49</sup>

Among McDonald team members, it was the Welshman David Evans who got the first look at the eclipse area. This he did on May 21 from

the window of an airplane bound for South Africa, where he had business at his former observatories. The pilot, whom Evans remembered as “a surprisingly unimpressive gentleman with granny glasses,” allowed the astronomer to sit in the cockpit and take photographs of the ground below.<sup>50</sup> Unfortunately, Evans rarely spotted the ground due to tall, heavy clouds and huge, red dust storms. What little ground he saw looked “rather like the transpecos [a region of west Texas] with all the roads and villages boiled off.” But it was the visibly poor atmosphere that preoccupied Evans. The pilot told him that the clouds were part of the Intertropical Convergence, an “extremely widespread” seasonal weather pattern that stirred up dust and blocked visibility all along the eclipse path. “I am seriously disturbed about the whole thing,” Evans wrote in a letter to Al Mikesell the next day from Pretoria. “I believe this information should cause us to question the whole philosophy” of the expedition, he added.<sup>51</sup> He thought Kenya might make a better site than anywhere in western Africa.<sup>52</sup>

While Evans’s letter made its way from South Africa to Austin, Bryce and Cécile prepared to tap the Research Corporation funds for a month-long fact-finding trip to Africa. From an early stage, Cécile had contacts in high places in Mauritania. One of Cécile’s friends, a French doctor in Morocco, was acquainted with the wife of the Mauritanian president. Cécile remembered that this event helped her form friendly relations with Mauritania’s leaders. In the spring of 1972, Cécile had met Turkia Ould Daddah, Mauritania’s ambassador to the United Nations and the sister-in-law of its president. The ambassador told Cécile about a small oasis town named Chinguetti near the center of the eclipse path. Armed with this inside information, the DeWitts determined to visit Chinguetti. They had the impression that they should keep Mrs. Ould Daddah’s recommendation to themselves. Unbeknownst to them, the Chinguetti oasis was already part of NSF-NCAR’s scouting agenda. Harlan Smith, for his part, preferred Niger because he believed its higher altitude provided the best chance for a clear, dark sky. The DeWitts and NSF-NCAR planned to scout locations there as well.<sup>53</sup>

The DeWitts knew that the success of the expedition depended not only on choosing the right site, but on the goodwill of local residents as well. The McDonald team would need to spend several weeks on site during June and November 1973, setting up equipment and making observations. Historians have described some past eclipse expeditions as extensions of imperial authority that aroused resentment among native populations in observation areas. This seems to have been true of some

late nineteenth-century British expeditions to India, Africa, and elsewhere. The astronomers and physicists who comprised the UT expedition to the Sahara were not necessarily aware of this long historical context. They viewed their mission as one of scientific discovery, not as an exercise in foreign policy or cultural diplomacy. Yet the worldly DeWitts understood what it meant to be guests in a host nation. In addition to their own travels, they had arranged foreign homestays for their young children in order to expose them to a variety of cultures. Cécile likened international travel to being a houseguest in another person's home; propriety, respect, and common courtesy were tenets of good guests and good travelers alike. The DeWitts showed "very great concern" to form good relations with the African citizens who would host them during their research.<sup>54</sup>

Bryce and Cécile began their scouting trip, and their acculturation, on May 31 at the Washington, D.C., home of the Mauritanian ambassador to the United States. There they sat on plush cushions and dined on a North African meal of mutton, semolina (a wheat by-product), and fruit with the ambassador's family and a visiting Mauritanian doctor. After the meal, the DeWitts and their hosts talked over glasses of Mauritanian mint tea, a customary social drink. Bryce summarized the key points of the conversation in a travelogue he kept throughout his and Cécile's trip. Most of the advice they received was of a cultural nature. Bryce recorded the doctor's estimate of the odds of encountering a poisonous scorpion or snake in the desert as "about as likely as getting hit by a car when walking around Washington. It is one of the hazards that natives accept," and expedition teams would do well to accept it too. The ambassador encouraged the DeWitts to purchase and wear customary Mauritanian garments to help ward off the heat. He also hoped that the DeWitts would disseminate scientific information about the eclipse to the Mauritanian citizenry, perhaps by radio broadcast. Cécile expressed a desire to give some astronomy lectures at local schools, should the McDonald team choose a site in Mauritania. The ambassador, like the DeWitts, felt that the success of Texas's mission depended to some degree on integration into the local community.<sup>55</sup>

Before the DeWitts left the United States, they spoke with La Count at NSF headquarters. Bryce recorded that La Count was "sore" and "distressed" and felt that Bryce and Cécile were circumventing his authority as site coordinator for American eclipse teams. He resented the "secrecy" with which they had planned their trip to Chinguetti, a location his NCAR scout had just the other day characterized as

unfavorable due to poor roads. Bryce regretted the unintentional offense and did his best to get “on excellent terms” with La Count, whom he considered a “very helpful” person. Despite this rocky start, Bryce was pleased to note that La Count shared their interest in cultural diplomacy. La Count, he wrote, “wants very much to do something for the Nigerians, Mauritians and/or Malians in return for their hospitality.” In service of this objective the NSF planned to produce a pamphlet about the eclipse in French and Arabic to distribute among local citizens. La Count was also “worried about the few bad eggs . . . among the many Americans who will be in Africa for the eclipse.” Even one or two culturally insensitive travelers, La Count knew, could “create bad feelings or, at the very least, misunderstandings that have to be smoothed over.” As the ranking member of the U.S. government in charge of eclipse planning, it was La Count’s responsibility to minimize embarrassing international incidents. The eclipse notwithstanding, it was not in America’s national interest to alienate the people of Saharan Africa.<sup>56</sup>

The DeWitts hopped from airport to airport until they arrived at Nouakchott, Mauritania, on June 12. From the air, Bryce thought “the town looked like some hard bitten desert town way to hell and gone out in some spot in the California of Nevada deserts.” Since Nouakchott was the capital of Mauritania and its largest city, this observation did not bode well for the much smaller settlement of Chinguetti. The DeWitts soon made contact with Mr. Brahim Danabja, a travel agent whose name they got from Turkia Ould Daddah. Danabja told Bryce and Cécile that he could provide “transportation, housing (with tents), water, electricity” and other necessities for a McDonald Observatory team at Chinguetti. Contrary to what La Count’s man at NCAR reported, Danabja said the roads to the village were serviceable.<sup>57</sup>

Danabja was the subject of the DeWitts’ first awkward cultural conflict in Mauritania. At the Tourism Ministry, the three of them met with Ould Cheikh Abdallahi, the woman who represented Mauritania at the Madrid conference in May, and her secretary, a Belgian or French woman named Jacqueline Ritter. When these government employees heard of Danabja’s plans, they “scoff[ed] at the idea that Mr. Danabja could handle” a large group at Chinguetti. They claimed the road was “terrible” and that Danabja’s trucks could not safely transport scientific equipment along it. Although Danabja was present in the room, Abdallahi and Ritter recommended that the DeWitts take their business to a rival travel agent, an “old, established” Frenchman named Lacombe. Danabja was furious, and it was clear that the DeWitts had “fallen into the midst of a local

squabble.” This was precisely the kind of problem Bryce, Cécile, and the NSF wanted to avoid. The DeWitts did not ponder the problem long. They thought it obvious that Danabja, not Lacombe, had “the support of the local population,” and on that basis they decided to “deal with Danabja. We shall regard it as a test to see how he performs.” The decision to ignore a recommendation of the Mauritanian government reflected the DeWitts’ sincere desire to pursue smooth relations with locals at almost any cost.<sup>58</sup>

Danabja provided a driver to take Bryce and Cécile to Atar, the site of the French barracks, on June 14. Though the landscape was “very flat,” the car bounced around wildly. Bryce thought the road was “a little better (at least straighter) than the road which crosses Big Bend National Park from east to west close to the Rio Grande,” but he worried about the need to transport breakable items like telescope lenses and photographic plates. There was also pervasive dust, and the temperature reached 100 degrees Fahrenheit. It took five and a half hours to reach Atar, where they stayed overnight and had a French breakfast in the morning.<sup>59</sup>

The DeWitts’ driver, Mahmoud Ould Amar Cheine, spoke French and owned a car, but he was not a member of the country’s social elite or governing class. When he met a social superior, he exchanged formalized greetings that sometimes lasted several minutes. He observed the daily Muslim prayer schedule, stopping the car periodically to kneel in the direction of Mecca. Near Atar, Mahmoud invited Bryce and Cécile to his family’s home for tea. They were surprised at the poverty of the home, which had a dirt floor, though Mahmoud’s family was possibly better off than the country’s many nomadic families. The DeWitts appreciated Mahmoud’s hospitality, and in return they gave his children some kaleidoscopes they brought as toys for local children. Mahmoud then drove the DeWitts the final leg of the journey to Chinguetti.<sup>60</sup>

Bryce thought the town was “right out of Hollywood: the oasis, the sand-colored buildings, the palm trees and the enormous dunes forming a backdrop to it all.”<sup>61</sup> Chinguetti had, by one estimate, a population of 3,000. It was literally a sleepy town; following Saharan custom, the residents slept through the hottest part of each afternoon, when temperatures sometimes rose above 110 degrees. But the village’s small size and quietude belied its historic importance in the Islamic world. Chinguetti was the seventh holiest city in Islam. Its origins dated to the third century A.D. when it was a major commercial center along a caravan route. In the sixteenth century a massive mosque complex arose there, with a large minaret made of local rock. Regional economic changes

plunged Chinguetti into decline in later centuries, but the oasis was still a popular embarkation point for North African Muslim pilgrims en route to Mecca.<sup>62</sup>

Chinguetti offered wonders to scientifically minded travelers as well, though the DeWitts did not know of them beforehand. Chinguetti was not far from Richat, a wide, rocky structure in the Saraha that puzzled geologists well into the twentieth century. Some scientists thought it was the remnant of an ancient meteor crater, while others believed it was an unusual tectonic stress phenomenon. During World War I, a French army officer reported a large meteorite somewhere in the dunes near the oasis. He named it the Chinguetti meteorite, but he could not remember its precise location. Decades later it remained lost, but rumors still circulated among some in the astronomical community. Now, the storied town was directly in the path of one of the greatest solar eclipses of the twentieth century. The Chinguetti mosque library contained many unique texts, some of them scientific in nature, from a time when the Arab world was at the cutting edge of astronomy. Although the town had no scientific instruments or facilities in the early 1970s, the DeWitts found the local population eager to learn about astronomy. On their first night they invited local children and adults to look through a small telescope they carried with them.<sup>63</sup>

The children of Chinguetti revealed much about local culture. Youngsters often hounded the pair in pursuit of *un cadeau*, a gift. Cécile thought the best way to address this situation, if the Texas-Princeton team chose Chinguetti for the eclipse site, would be to distribute gifts to the town's children en masse at the end of their school year, June 20. The behavior of children also revealed some of the stratifications in Mauritanian society. They visited the home of an "aristocratic" boy and witnessed him bossing around his female relatives while his father was away. His interaction with local boys also took place on uneven terms. He allowed other youths to look through the kaleidoscope the DeWitts gave him, but light-skinned boys went first and those with darker skin got "the short end of the stick." Twentieth-century Mauritanian society divided along class, gender, and skin color lines.<sup>64</sup>

At the conclusion of their stay in the oasis, Bryce summarized the advantages of Chinguetti as an expedition site. There was an airstrip several kilometers north of town into which the team could fly supplies. Bryce estimated that the local community center, where eclipse visitors could sleep, had room for twenty scientists. Local fare consisted of couscous, mutton, semolina, a few tomatoes and onions, and mint tea,

and Bryce wrote that anyone who did not wish to dine in local fashion for several weeks should not come. He and Cécile, however, felt “thoroughly at home in Mauritanian style of life: sitting on the floor, small windows at ground level for ventilation, eating with our hands, washing hands after meals rather than before.” Even the squat-style toilets, common throughout much of the developing world, did not occasion complaint. Bryce praised them in his journal for being “virtually odor free.” The DeWitts concurred with Danabja that it was possible to establish an observation site at the Chinguetti oasis.<sup>65</sup>

On the return trip to Nouakchott, the DeWitts stopped at the complex of a French mining company called SOMIMA (*Société Minière de Mauritanie*). The company was nationalized in 1975, but at the time of the DeWitts’ trip it was still under the complete control of the French. Although the French, Canadian, and American employees lived in the country on a nearly full-time basis, they knew little beyond the walls of their compound. The couple who ran the SOMIMA restaurant was “slightly astonished” that Bryce and Cécile “had been out in the back country with a native chauffeur.” Bryce found their “colonialist” attitudes simultaneously amusing and “a bit sad.” He returned their shock when he learned that they had been in the country for 18 years and never been to Chinguetti. Although the DeWitts had not purchased local clothing, they had made more contacts and assimilated more into the culture in a few days than the SOMIMA camp residents had in the better part of two decades.<sup>66</sup>

Back in Nouakchott, Bryce issued his verdict on Danabja’s service as a travel agent. His “performance on our behalf” was “superb,” Bryce wrote. Mahmoud’s driving had been skillful, particularly given the condition of the roads. All told, Bryce reckoned that the decision to use local entrepreneurs rather than French agents probably saved them 40 to 50 percent in expenses. However, there was one French resident of Mauritania who impressed Bryce with his knowledge of the country. This was a “soft spoken” army pilot named Galluedec, who was approaching his third decade in Mauritania and knew “every rock in the desert.” Galluedec helped seal the deal for Chinguetti. He told Bryce that the oasis “almost always has the best visibility” of anywhere in the nation. Although the DeWitts still had to scout Niger at the behest of Harlan Smith, their generally positive appraisal of Chinguetti made its selection nearly a foregone conclusion.<sup>67</sup>

Bryce and Cécile did not have as much success in Niger, where they arrived on June 20. They both suffered from physical exhaustion and

intestinal illness. They found the locals less welcoming than the Mauritians and failed to make close connections with the population. They met up with some NCAR staffers with whom they scouted possible observing locations, but experienced “strained relations” with these American officials. Bryce felt that the ranking NCAR official was a bit bureaucratic, concerned more with “the success of the logistics rather than success of observations.” He also misused some key astronomical terminology, which raised doubts in Bryce’s mind as to his competency to judge eclipse sites on behalf of the NSF. Cécile took a prearranged flight to Paris on June 23, and Bryce followed suit on July 1 after visiting several sites with rather poor visibility.<sup>68</sup>

Bryce closed his travelogue with a passage that reveals his awareness of the political dimension of the forthcoming American undertaking. He feared that a horde of American scientists would alienate local communities and swamp the local infrastructure. “The American effort . . . will be totally unlike the other national groups in its sheer size, in its approach to logistics problems and, above all, in its basic outlook,” he wrote. In contrast to his and Cécile’s careful approach, Bryce predicted that the aim of other American teams would be “to provide an American environment in the desert, largely insulated from the surrounding country and population, like SOMIMA in Mauritania.” This would reflect poorly on American visitors. Bryce worried that the local population would see only “an expedition mounted like a military operation, backed by lots of money.” He wrote, “The analogy to logistics operations in Vietnam will not go unremarked.” Bryce then expressed his wish that only “those groups that are capable of mounting expeditions entirely on their own [emphasis in original]” would receive NSF funds, so that only “persons who thoroughly understand the problems of operating in the field and who are able to cooperate effectively” would come to Africa. For cultural and logistical reasons, Bryce believed that the Texas expedition should stand apart from the rest of the American teams. “I recommend most strongly that one of our sites be . . . Chinguetti,” he concluded. A site in Niger could make a good backup, he added, if enough funding became available.<sup>69</sup> Bryce sent his completed journal to Al Mikesell in Austin, who trimmed it for length and content and circulated it among the eclipse team. The DeWitts’ firsthand observations carried great weight with the rest of the Texas-Princeton team.<sup>70</sup>

Bryce and Cécile spent the next several weeks at Cécile’s school, Les Houches, where they received a disconcerting letter from Austin. The letter bore the signatures of Smith and Mikesell, and concerned La

Count. They believed, based on recent conversations with La Count, that the NSF administrator still saw the DeWitt scouting trip to Mauritania and Niger as “meddling, spying, disruption, or even [a] threat to his authority.” Smith and Mikesell’s solution to this problem was further secrecy. They asked Bryce to withhold his full journal from La Count. It was important to tread cautiously regarding La Count, they felt, since “he is in both the driver’s seat and the hot seat of responsibility for a very large number of groups.” The journal contained some passages which they feared La Count or others might misconstrue as advocating “interfering with foreign affairs.” But Smith and Mikesell agreed with Bryce that it might be advisable for UT to set up its own operation at Chinguetti with only limited NSF assistance, and they gently broached this issue with La Count.<sup>71</sup>

In September 1972, Smith received a form letter from the NSF bearing the worst possible news: the Foundation had rejected the grant application. In retrospect, this was not a surprising outcome because the requested amount of \$302,848 was unrealistic in the current funding climate. From June 1970 to March 1971, NSF received 20,000 grant requests for a total sum of \$2 million. Of these, the Foundation approved less than 7,000 and distributed only \$320,000 to new projects. The heady days of the 1950s and 1960s were over, and the McDonald expedition was a casualty of the stalling federal commitment to science in the early 1970s. Princeton, always a junior partner, dropped out of the project. But the McDonald team had already spent too much time and treasure to accept defeat.<sup>72</sup>

The team’s new goal was to secure enough last-minute funds to send one team to one site. Chinguetti would be that site based on the DeWitts’ strong recommendation. To “cut costs to the absolute minimum consistent with a good probability of success,” the team borrowed a high-quality telescope lens from the Paris Observatory and scrapped plans to commission an expensive new one.<sup>73</sup> But for even a bare-bones expedition, the cost hovered in the vicinity of \$100,000. The \$20,000 Research Corporation grant, some of which the DeWitts spent to go to Africa, was not nearly sufficient. To begin to close the gap, the team turned to the University of Texas, which in October was “pleased” to award them \$1,000.<sup>74</sup> This almost inconsequential amount underscored the utter dependence of academic research on government largesse.<sup>75</sup>

NATO was a potential source of funds, but the security organization had unique restrictions on its scientific research grants. Smith, Mikesell, and the DeWitts contemplated a NATO grant application even before the NSF rejection. As early as March 1972, they perused a copy of the

NATO guidelines for research grants, which heavily emphasized the necessity of international cooperation. “The main aim” of the NATO Scientific Research Grants Programme, they read, “is to stimulate the international collaboration among scientists working on research in different NATO countries.” NATO required that every application clearly describe “the type of collaboration between scientists in different countries” and ensure that “the expertise, technique, [and] facilities particular to each participating group should play a very important role in the project.” Every participating nation in a NATO-funded project had to play an “essential” role; none could occupy a clearly subordinate position, as Princeton had in the early stages of the Texas mission. NATO did not disguise its purpose in facilitating international scientific collaboration. “It is hoped,” the guidelines stated, “that the liaison among the laboratories will continue far beyond the duration of the grant.”<sup>76</sup> Scientific cooperation was a component of NATO’s larger mission to foster harmony and mutual dependency among its member states.<sup>77</sup>

The end of Texas’s collaboration with Princeton was a blessing in disguise, because it opened a position on the team for a foreign-based scientist. Originally, Princeton’s role in the mission was to analyze the photographic plates after the eclipse. Texas outsourced this task once again when it enlisted the services of Burton F. Jones, a specialist in photographic plates as well as computers. Jones was an American, but he worked for the Royal Greenwich Observatory at Herstmonceux Castle in East Sussex, England. Cécile, though a French citizen and the founder and director of a French science institution, presumably did not qualify as an international collaborator for NATO’s purposes because she worked primarily at an American university. By the same token, the foreign-based Jones counted toward the NATO requirement despite his American citizenship. Unlike the erstwhile Princeton collaborators, Jones would accompany the McDonald team to Chinguetti. In a communication with NATO in October 1972, Harlan Smith wrote of Jones’s “special responsibility” for photographic plate analysis and emphasized the importance of the Royal Greenwich Observatory’s analytical machines.<sup>78</sup>

NATO quickly approved Smith’s funding request “on condition that you obtain the additional funds necessary for the project from other sources.” The North Atlantic Treaty Organization promised the considerable sum of 270,000 Belgian francs. Somebody scrawled a calculation on the margins of the approval letter from NATO: 270,000 Belgian francs at the going rate of 2 American cents per franc came to \$5,616.<sup>79</sup> This was on par with the average NATO research grant in this

time period. It went farther than UT's nominal contribution, but not far enough. To claim the NATO funds, the team still needed to find several tens of thousands of dollars from another source.<sup>80</sup>

They turned once more to the only organization capable of supplying such an amount. The NSF's rejection letter had contained the optimistic disclaimer that "even though we are unable to support this proposal, we would be pleased to consider other research proposals which you might wish to submit."<sup>81</sup> After the rejection, Smith had remained in contact with La Count, who continued to oversee the NSF's logistic support to all American teams regardless of their funding arrangements. Smith reported that La Count "was still planning on our expedition as a major one and hoping we would be there."<sup>82</sup> With this encouragement, Smith submitted a new proposal to the NSF for \$65,000. UT received official notification of NSF approval on December 19, 1972. With this windfall, the McDonald mission to Mauritania was truly a go.<sup>83</sup>

But the astronomers and physicists could not yet devote the entirety of their energies to scientific and technical questions. As Bryce warned in his travelogue, it would be a mistake for American scientists to assume that "they will be able to devote 9/10 of their time to purely scientific matters" while in Africa. On site there were local relationships to maintain and a desert environment to contend with. The scientists had to prepare for their roles as *de facto* ambassadors and prepare to assimilate into Mauritanian culture. The great strength of the DeWitt trip and journal was that it helped team members know what to expect in this regard.<sup>84</sup>

NSF-NCAR also imparted information about African society and Islamic culture. In late December 1972, NCAR sent out its first of several communiques to American eclipse teams. These communiques dealt with logistic issues such as transportation of equipment, applications for visas, proper vaccinations, and communication lines from remote sites, but they also imparted a great deal of information about conditions at designated eclipse sites. The pamphlets contained information about sites to see, clothes to wear, and souvenirs to buy. Despite NCAR's early negative assessment of the roads near Chinguetti, the oasis was so desirable in other ways—it had an airstrip and its air quality was decent—that the NSF and NCAR selected it as an official expedition destination. Bryce received from NCAR a copy of the State Department's "Background Notes on the Islamic Republic of Mauritania," which NCAR called its "best source of general information" on the country.<sup>85</sup> The Texas team asked the NSF for items such as an Islamic religious calendar and an Arabic phrasebook. The McDonald team had a leg up on this kind of

information thanks to the DeWitts' travelogue, but NSF-NCAR proved a valuable source of information as well as funds.<sup>86</sup>

The Texas team increased its international profile with the addition of a Mauritanian astronomer, Dr. Alassane Sy, whose expenses they paid with a grant from the National Geographic Society (NGS). Alassane Sy, who lived and worked in France, had "intimate knowledge of Mauritania and her government officials," but Texas could not afford to pay for his services with NSF funds. They therefore sought the assistance of the National Geographic Society, a heretofore untapped resource. National Geographic, like NATO, had specific interests and requirements attached to its grants. In particular, the NGS wanted dramatic stories it could feature in its monthly magazine. The grant Bryce submitted to the NGS emphasized the exoticism of the research location in Chinguetti. "We have given much sober thought to the importance of maintaining the very best possible relations with the population of Chinguetti," he wrote.<sup>87</sup> Bryce described the oasis in almost poetic terms, as "a caravan stop at the edge of a great sea of sand. It contains a 13th Century Mosque and is the seat of an even older Moslem university, with its library housing ancient manuscripts."<sup>88</sup> The Society took the bait. NGS granted the team over \$4,000, nearly twice the amount Bryce requested. In exchange, *National Geographic* magazine received "first opportunity for popular publication" of all images and stories from the expedition. This was the usual arrangement between NGS and its grant recipients.<sup>89</sup>

The final roster of the Texas eclipse expedition consisted of new and old faces. In addition to Alassane Sy and Burton Jones, two other men had joined the expedition team since its inception nearly a year previously. These were Richard "Dick" Mitchell of the UT astronomy department and Charles "Chuck" Cobb of the McDonald Observatory. Each would travel to Chinguetti to assist with technical aspects of the eclipse observation. These relative newcomers would join old hands Bryce, Cécile, and Matzner in Chinguetti for the eclipse. Smith, Evans, and Mikesell were alternates in case of unexpected illness or other emergency, but Evans and Mikesell would comprise part of the return team in November to finish the observations and dismantle the equipment. Bryce, the leader of the initial expedition, sent a predeparture memorandum to each team member. The subject of the memo was "life and work at Chinguetti," and Bryce made a point of the behavior he expected of all team members, including himself. "I must ask you to conduct yourselves, on site, with quasi-military discipline," he said. "I wish I could say that discipline can be forgotten during off-duty hours. But even then we shall

have a responsibility to our hosts, the people of Chinguetti, in whose care we shall be leaving our equipment . . . until the follow-up team arrives in November.”<sup>90</sup> An internal document reveals a particular concession to morale which the team wished to address before arriving *in situ*: given that Mauritania was an Islamic country, could they “sneak in beer”?<sup>91</sup> In the end no sneaking was required, and beer and champagne were readily and legally available to eclipse teams in Mauritania as well as Niger.<sup>92</sup>

Bryce, Cécile, and Burton Jones arrived in Mauritania in mid-May, along with six tons of the team’s equipment. NCAR was responsible for getting the freight to Chinguetti, and the team members would travel separately. On their first full day, Bryce bought a “complete native costume” at a market in Nouakchott, abiding by the Mauritanian ambassador’s recommendation from the previous year.<sup>93</sup> The outfit was a *boubou*, a flowing robe ideal for the desert heat. The DeWitts quickly contacted Danabja and asked to hire Mahmoud, their old driver. But once again the Mauritanian government complicated their efforts to hire local individuals of their choice. In the time since the DeWitts’ previous trip, the government had given certain travel agencies exclusive rights to transport eclipse visitors. Mahmoud was not among the lucky few with an eclipse permit, and could not legally drive scientists to Chinguetti.<sup>94</sup>

The DeWitts soon found a loophole that allowed them to use the services of their old friend. In Nouakchott, Cécile met Mr. Moukhtar Ould Hamidou, a scholar of Arabic scripts. He knew of the library and mosque in Chinguetti and badly wanted a copy of some of the items there. He asked Cécile to visit the ancient library of Chinguetti and photograph every page of a rare, eleventh-century religious treatise there. This provided the DeWitts the excuse they needed to hire Mahmoud as a driver. It was legal for Mahmoud to transport tourists for non-eclipse purposes, so they decided to hire him on the pretense of going to Chinguetti to look at the Arabic manuscripts. The DeWitts used their own money to pay Mahmoud because the arrangement was not entirely aboveboard, but they anticipated that the National Geographic Society would reimburse them. The Society’s approach to funding and logistics was more lenient than the NSF’s, and the DeWitts thought the magazine editors might enjoy pictures from the historic mosque. They and Jones met Mahmoud at the halfway point between the capital and Chinguetti.<sup>95</sup>

Bryce, Cécile, and Jones spent the next few weeks at Chinguetti preparing the site. The oasis town was an official NSF-NCAR site, so Texas was not the only team there. They shared Chinguetti with five other institutions: the Universities of Florida, Hawaii, and New Mexico;

Harvard; and the U.S.-government-owned Kitt Peak National Observatory in Arizona. Jones and the DeWitts constructed the telescope and a makeshift observatory, really more of a “precision chemistry laboratory.” They jokingly dubbed the structure “McDonald Observatory East.” On it they hung a banner 12 feet long and 2 feet high, with Arabic writing that meant, “The University of Texas is grateful to the people of Chinguetti for their renowned hospitality to those who come in search of the secrets of the Universe.” The president of Mauritania himself, Mokhtar Ould Daddah, expressed approval of the sign when he visited Chinguetti to tour the NSF eclipse site. Some time later the McDonald team hoisted an unofficial McDonald Observatory flag with a crest that featured, in lighthearted juxtaposition alongside more *apropos* symbols, a can of Coors Light.<sup>96</sup>

After raising the observatory, Jones, Bryce, and especially Cécile devoted significant time to meeting people in the village. For several weeks, they were part-time scientists and full-time cultural liaisons. The trio paid their respects to local notables and dined with several families. They attended a performance, a dance that “depicted local life.”<sup>97</sup> Cécile, who in her youth in France had wanted to become a doctor, made a house call to treat a child’s infected eye with a vial of medicinal drops she carried with her. The medicine was such a novelty that even healthy villagers asked to receive the eyedrop elixir. Cécile, in her capacity as self-described “school marm at Chinguetti,” taught basic astronomy classes and gave each class of schoolchildren a tour of the observatory.<sup>98</sup> Each child in the village received a T-shirt, a pen, and a button, most of which advertised the UT McDonald Observatory. The total value of these gifts totaled nearly \$1,000. The Texas team was a constant presence in the Chinguetti community during the month of June, and made an effort to give generously of their time and resources.<sup>99</sup>

As the day of the eclipse approached, the team members increasingly devoted their energies to the scientific research at hand. The team reached its full complement in the second week of June when Matzner, Sy, Cobb, and Mitchell arrived at Chinguetti. In the buildup to “E-Day,” their shorthand term for the imminent solar blackout, the team ran countless technical tests and a few dry runs.<sup>100</sup> But the weather was consistently uncooperative. When the morning of June 30 finally dawned, nobody was surprised that “a raging sandstorm” was blowing through the oasis. Each member of the team took his or her position, with Cécile on the roof and the rest in the observatory. “With heavy hearts” they prepared “to go through the motions,” despite the obvious futility of stargazing in a sandstorm.<sup>101</sup>

The storm vanished ten minutes before totality. It was a “miracle,” Bryce wrote afterward. By way of elaboration, he added, “the great lunar shadow, one hundred and fifty miles wide, approaching at eleven hundred miles an hour, was having a profound effect on the local atmosphere.” The telescopic observations and photographs went off without a hitch during the eclipse’s totality phase, which was an impressive 7 minutes, 4 seconds from positions situated perfectly under the path, a duration not to be surpassed until June 25, 2150. The DeWitt team’s location in Chinguetti was about 9 miles to the north of the path’s center. Bryce started his stopwatch when totality began over Chinguetti and stopped it when the team closed the telescope shutter for the third plate. When totality ended, the sun peeked out from behind the moon and shone a sliver of light on the oasis of Chinguetti. The stars faded as daylight returned. Inside the makeshift observatory in the desert were three of the most valuable photographic plates in the history of astrophysics, which Matzner and Jones developed that evening in a closet-sized dark room. The first of these plates they dubbed “the \$100,000 plate” in reference to the approximate amount of financial support the team had received from all of its sponsors. With eclipse day finally behind them, the colleagues celebrated the conclusion of their portion of the experiment.<sup>102</sup>

At the end of the team’s six-week stay in Mauritania, all that remained was to tie up loose ends and say goodbye to Chinguetti. In most cases, the farewell was final. Sy and Jones would return in November with Evans and the Mikesells to take the final set of star images and dismantle the telescope. But for Bryce and Cécile, whose brainchild the expedition was and whose labors made it a cultural as much as a scientific event, the adventure was nearly at an end. Bryce broadcast a message of thanks over the radio to the people of Mauritania. Cécile gave her vial of eye medication to the family of the ailing child. As one of his last acts in Chinguetti, Bryce gave a pith helmet to a local boy to whom he had grown “particularly attached.”<sup>103</sup> Bryce had owned the helmet since he was a young man in the late 1940s, so this was no small gesture.<sup>104</sup>

Over the next few days, the team boarded up “McDonald Observatory East.” Unlike the other expeditions at the site, UT had to keep its sensitive equipment in place for several months. They hired an elderly local man, Bah Ould Soueidi, to keep watch over the structure until the arrival of the November follow-up expedition. Much later, Evans expressed the team’s feeling that “the known high standards of ethical conduct in this Islamic state meant that nothing worse than boyish larking might be a danger” to the delicate equipment inside the hut, but all the same they

thought it prudent to hire the guard.<sup>105</sup> They left the fruits of their labor in the hands of the people of Chinguetti. As the team left the oasis, someone said to them in the local dialect, *ouadana'k' moulana*: “we leave you in God’s hands.”<sup>106</sup>

The team transported the three irreplaceable photographic plates back to the United States in a metal case, then shipped them to Burton Jones in England for analysis. The quality of the images was affected by atmospheric dust from the sandstorm that ended just before totality, but otherwise they looked promising. In July, Mikesell wrote to Smith that the “plates look good [emphasis in original]: The dust level is not unpleasant.”<sup>107</sup> Smith wrote to La Count the next month, thanking him for the NSF-NCAR support and informing him that “we got the desired results: three plates with proper exposures . . . which are far better than those from any previous ‘Einstein’ expedition, and which may contain enough information to lean significantly toward one of the competing theories of relativity.”<sup>108</sup>

In November, Evans led the follow-up expedition to Chinguetti to take the necessary comparison images and dismantle the telescope. The DeWitts did not make the journey this time, but Evans’s team reported no difficulties. Few documents from the November trip survive, but Evans later remembered his positive experiences at the oasis and his group’s successful telescopic observations. When the November group returned to Austin, it was time to find out if the expedition’s results justified all the effort. The McDonald scientists compared the star positions in the three eclipse plates with the positions of the same stars in the November plates. They needed to measure the differences with extreme precision in order to determine which theory of relativity best predicted the gravitational deflection of light.<sup>109</sup>

The results confirmed Einstein’s predicted value within a margin of error that was somewhat wider than team members had initially hoped. The photographic plates contained minute imperfections, in part due to lingering dust from the sandstorm and in part to the inherent resolution limitations of the plates. Yet the McDonald data were precise enough to lend further credence to Einsteinian relativity. In the years after the expedition, radio astronomy and space-based telescopes surpassed ground-based observations in many areas of astrophysics research. Observations have continued to support, with ever-greater accuracy, a value for light deflection consistent with Einstein’s predictions. In the 1990s the European Space Agency’s Hipparcos satellite measured the

distances between stars with unprecedented precision using Einstein's light deflection value to account for the gravitational distortion of Earth and the sun. As recently as May 2011 NASA announced new satellite observations of Earth's gravitational field that "confirmed two key predictions derived from Albert Einstein's general theory of relativity," albeit predictions unrelated to the gravitational deflection of light. Research continues more than a century after the great scientist shared his ideas with the world, though it typically takes very different forms from the type of field research McDonald Observatory scientists conducted in the Mauritanian desert in 1973.<sup>110</sup>

In its human dimensions the McDonald endeavor was a lasting success. Decades after the event Cécile recalled how at "home" she felt in Mauritania. The survival of the French language in the ex-colony enhanced her ability to communicate with Mauritians of many walks of life. The friendships she and Bryce developed were sincere. The pair respected local customs, spoke a language familiar to locals, distributed goods when appropriate, paid for services, and accepted gifts graciously. Their efforts enabled the McDonald team to fit into, rather than roll over, the Mauritanian culture that hosted them. When *National Geographic* magazine had exercised its right of first refusal and opted not to run a feature on the story, Bryce, Matzner, and Mikesell coauthored a piece for the popular astronomy magazine *Sky & Telescope*. They recounted the mission and wrote that "to a very great extent the success of the expedition was due to the assistance of the Mauritanian government and to the helpfulness of the people of Chinguetti. We made many friends there."<sup>111</sup> Much later, Evans concluded his memoir of the event with the remark that "it was all great fun and has left all the participants with happy memories."<sup>112</sup>

The expedition was also a triumphant display of the University of Texas's ability to finance and execute high-quality scientific research in challenging field conditions. Cold War security concerns produced an American science bureaucracy that changed the face of American scientific research and transformed the UT McDonald Observatory from a promising but backwater facility into a multinational institution with a global reach and an ambitious research agenda. The 1973 solar eclipse mission to Chinguetti is perhaps the most dramatic example of these closely related changes.

When Bryce arrived stateside in July 1973, he sent a note to the team. Its lighthearted tone captured the sense of adventure and accomplishment

he felt about the enterprise. “How many of you would like to have another go at it?” Bryce’s note began. “This time we’ll take a dozen camels (enough to carry food, bedrolls and tents) and leave Chinguetti at sundown with a moon four days from full. After exploring the secrets of Richat we shall head southward, across the trackless desert, six hundred miles . . . , remembering always to keep one eye on the lookout for the Chinguetti meteorite.” He was joking, but the fantasy revealed his profound sense of admiration for the place. Bryce penned an addendum to the note in which he admitted, “actually, I’m half serious about the camel journey.”<sup>113</sup> ❖

## NOTES

<sup>1</sup> Bryce DeWitt, “The Story of McDonald Observatory East,” page 9, folder “Eclipse Files: Reports—Reports, Articles and Related Correspondence,” box 4RM183, DeWitt (Bryce S.) Papers, Briscoe Center for American History [hereafter CAH], University of Texas at Austin [hereafter UT]; David S. Evans and Karen I. Winget, *Harlan’s Globetrotters: The Story of an Eclipse* (N.P.: Xlibris Corporation, 2005), 297, 300.

<sup>2</sup> Evans and Winget, 182.

<sup>3</sup> *Ibid.*, 36, 39–40.

<sup>4</sup> *Ibid.*, 34, 43–48.

<sup>5</sup> *Ibid.*, 297, 300–301; “Eclipse Schedule,” undated, folder “1973 Eclipse Expeditions National Center for Atmospheric Research (NCAR) File,” box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT; Bryce DeWitt, “The Story of McDonald Observatory East,” 10 (see note 1).

<sup>6</sup> David S. Evans and J. Derral Mulholland, *Big and Bright: A History of the McDonald Observatory* (Austin: University of Texas Press, 1986), 168.

<sup>7</sup> *Ibid.*, 11.

<sup>8</sup> *Ibid.*, 5–9, 23–24.

<sup>9</sup> George E. Webb, *Science in the American Southwest: A Topical History* (Tucson: University of Arizona Press, 2002), xix–xx, 82–83.

<sup>10</sup> *Ibid.*, 82, 93, 119, 133, 152–153.

<sup>11</sup> Robert M. Rosenzweig and Barbara Turlington, *The Research Universities and Their Patrons* (Berkeley: University of California Press, 1982), 16; James D. Savage, *Funding Science in America: Congress, Universities, and the Politics of the Academic Pork Barrel* (Cambridge: Cambridge University Press, 1999), 35, 38; Webb, 134.

<sup>12</sup> Rudy Abramson, “National Science Foundation: Patron on the Potomac,” *Change* 3, no. 3 (May–June 1971): 39; Savage, 5, 38.

<sup>13</sup> Abramson, 38.

<sup>14</sup> William A. Nierenberg, "The NATO Science Program," *Bulletin of the Atomic Scientists* 21, no. 5 (May 1965): 45.

<sup>15</sup> Rosenzweig and Turlington, 17.

<sup>16</sup> *Ibid.*, 3, 87; Abramson, 39.

<sup>17</sup> Webb, 132–133, 146.

<sup>18</sup> Siva Vaidhyanathan, "Harlan Smith Dies, headed observatory," *Austin American-Statesman*, October 18, 1991, B1, B back page.

<sup>19</sup> "Radio Astronomy at Yale," page 10, no folder, box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT.

<sup>20</sup> Bill Hobby, "Harlan Smith Eulogy," October 23, 1991, untitled folder, box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT; "UT astronomer to receive coveted NASA medal," June 17, 1991, untitled folder, box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT; Vaidhyanathan, B back page (see note 18).

<sup>21</sup> Evans and Winget, 57.

<sup>22</sup> "In Memoriam: Bryce Seligman DeWitt," the University of Texas at Austin Faculty Council, Index of Memorial Resolutions and Biographical Sketches, accessed April 10, 2011, <http://www.utexas.edu/faculty/council/2006-2007/memorials/dewitt/dewitt.html>.

<sup>23</sup> Bryce DeWitt, "God's Rays," *Physics Today* 58, no. 1 (January 2005): 32.

<sup>24</sup> *Ibid.*, 33.

<sup>25</sup> Unrecorded interview between Cécile DeWitt-Morette and author, August 2011.

<sup>26</sup> Cécile DeWitt-Morette, faculty profile page, University of Texas, Department of Physics, accessed April 10, 2011, [http://www.ph.utexas.edu/person/dewitt\\_cecile](http://www.ph.utexas.edu/person/dewitt_cecile); Emily Mitchell, "Senior Women Web Interviews: Cécile DeWitt-Morette," Senior Women Web, accessed April 10, 2011, <http://www.seniorwomen.com/articles/articlesIntCecile.html>.

<sup>27</sup> "In Memoriam: Bryce Seligman DeWitt" (see note 22).

<sup>28</sup> *Ibid.*; Evans and Winget, 60–61.

<sup>29</sup> Harlan Smith to Zdnek Kopal, June 26, 1972, folder "1973 Eclipse expeditions, Instrument and site selection," box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>30</sup> Karen Winget to David Evans, March 27, 2000, folder "Harlan Smith Correspondence," box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; unrecorded interview between Cécile DeWitt-Morette and author, August 2011.

<sup>31</sup> Harlan Smith to Zdnek Kopal (see note 29).

<sup>32</sup> "Some Comments on Experiment Design for the Einstein Bending Experiment," page 9, folder "misc," box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>33</sup> Harlan Smith to Hal Ramsey, March 19, 1972, folder "Research Corporation," box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>34</sup> Harlan Smith to Zdnek Kopal (see note 29).

<sup>35</sup> “A Proposal for an Improved Measurement of the Einstein Light-Deflection Effect,” page 8, folder “Proposals NSF,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>36</sup> Evans and Winget, 56; Vaidhyanathan, B back page (see note 18).

<sup>37</sup> “Some Comments on Experiment Design for the Einstein Bending Experiment,” page 9 (see note 32).

<sup>38</sup> Abramson, 38–39, 43.

<sup>39</sup> Abramson, 39; Rosenzweig and Turlington, 17.

<sup>40</sup> “In Memoriam: David Stanley Evans,” the University of Texas at Austin Faculty Council, Index of Memorial Resolutions and Biographical Sketches, accessed April 12, 2011, <http://www.utexas.edu/faculty/council//2004-2005/memorials/evans/evans.html>; A. H. Mikesell, “Star Visibility in Daylight at High Altitudes,” *Journal of the Optical Society of America* 50, no. 1 (January 1960), 85; Al Mikesell to Henry Giclas, April 26, 1972, folder “1973 Eclipse expeditions, Instrument and site selection,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Bryce DeWitt to National Geographic Society, page 5, folder “National Geographic Society,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Bryce DeWitt to Eclipse Team, “Subject: Decisions and agreements reached at meeting on Saturday, 30 September 1972, at Princeton,” folder “Princeton Correspondence,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Evans and Winget, 61, 168, 179.

<sup>41</sup> “Archives and History,” Research Corporation for Science Advancement, accessed April 12, 2011, <http://www.rescorp.org/archives-and-history>.

<sup>42</sup> Harlan Smith to Hal Ramsey, March 19, 1972; Sam Smith to Stephen Spurr, April 17, 1972, folder “Research Corporation,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Sam Smith to Harlan Smith, April 17, 1972, folder “Research Corporation,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>43</sup> Bryce DeWitt to Robert Dickman, April 5, 1972, folder “Office of Naval Research,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>44</sup> Two drafts of “A Proposal for an Improved Measurement of the Einstein Light-Deflection Effect,” page 3, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; the wording is different in the two drafts of this document.

<sup>45</sup> Ronald La Count to A. H. Mikesell, August 9, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Harlan Smith to Ronald La Count, March 29, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; “Application for Review and Approval of Proposal for Grant or Contract,” folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Abramson, 38, 42.

<sup>46</sup> J. D. Mulholland, “Summary Report: IAU Eclipse Planning Meeting, Madrid,” May 15, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Evans and Winget, 54.

<sup>47</sup> Evans and Winget, 62.

<sup>48</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” July 6, 1972, pages 9–10, folder “1973 Eclipse expeditions, Instrument and site selection,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; J. D. Mulholland, “Summary Report: IAU Eclipse Planning Meeting, Madrid” (see note 46).

<sup>49</sup> William Eagleton Jr., “The Islamic Republic of Mauritania,” *Middle East Journal* 19, no. 1 (Winter 1965): 50–52; Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 6, 14 (see note 48).

<sup>50</sup> Evans and Winget, 75.

<sup>51</sup> David Evans to A. Mikesell, May 22, 1972, folder “1973 Eclipse expeditions, Instrument and site selection,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>52</sup> David Evans to A. Mikesell, August 8, 1972, folder “Planning Solar Eclipse 1973,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>53</sup> Evans and Winget, 67–68, 250; J. D. Mulholland, “Summary Report: IAU Eclipse Planning Meeting, Madrid” (see note 46); Bryce DeWitt, “The Story of McDonald Observatory East,” 8 (see note 1); Harlan Smith to Zdenek Kopal (see note 29); unrecorded interview between Cécile DeWitt-Morette and author, April 27, 2011.

<sup>54</sup> Alex Soojung-Kim Pang, *Empire and the Sun: Victorian Solar Eclipse Expeditions* (Stanford University Press, 2002), 3; Bryce DeWitt, “The Story of McDonald Observatory East,” 2 (see note 1); Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 5 (see note 48); unrecorded interview between Cécile DeWitt-Morette and author, April 27, 2011.

<sup>55</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 2–3, 5 (see note 48); unrecorded interview between Cécile DeWitt-Morette and author, April 27, 2011.

<sup>56</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 1, 4–5 (see note 48).

<sup>57</sup> *Ibid.*, 8–9.

<sup>58</sup> *Ibid.*, 10.

<sup>59</sup> *Ibid.*, 12–13.

<sup>60</sup> Evans and Winget, 86.

<sup>61</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 14 (see note 48).

<sup>62</sup> Anthony G. Pazzanita, *Historical Dictionary of Mauritania*, Historical Dictionaries of Africa 110 (Lanham, MD: Scarecrow Press, 2008), 110–111; Evans and Winget, 68; Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 15 (see note 48); Charles Cobb, “Introduction,” folder “From Chuck Cobb,” box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT.

<sup>63</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and

Niger for the June 1973 Eclipse,” 16 (see note 48); Evans and Winget, 236, 280.

<sup>64</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 16 (see note 48).

<sup>65</sup> *Ibid.*, 17–20.

<sup>66</sup> *Ibid.*, 19.

<sup>67</sup> *Ibid.*, 22–24.

<sup>68</sup> *Ibid.*, 25–27.

<sup>69</sup> *Ibid.*, 39, 40–41.

<sup>70</sup> Evans and Winget, 67.

<sup>71</sup> Harlan Smith and Al Mikesell to Bryce DeWitt, August 10, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>72</sup> Andrew Swago to Harlan Smith, September 11, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT; Abramson, 42; Evans and Winget, 168.

<sup>73</sup> Harlan Smith to Mario di Lullo, October 16, 1972, folder “NATO,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>74</sup> Thomas Griffy to Richard Matzner, October 17, 1972, folder “University of Texas,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>75</sup> “Some Comments on Experiment Design for the Einstein Bending Experiment,” page 9 (see note 32).

<sup>76</sup> Mario di Lullo, “NATO Research Grants Programme,” March 1972, folder “NATO,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>77</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 40 (see note 48); Harlan Smith and Al Mikesell to Bryce DeWitt, August 10, 1972 (see note 71).

<sup>78</sup> Harlan Smith to Mario di Lullo, October 16, 1972 (see note 73); Evans and Winget, 61–62.

<sup>79</sup> Mario di Lullo to Harlan Smith, November 15, 1972, folder “NATO,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>80</sup> Mario di Lullo, “NATO Research Grants Programme,” March 1972 (see note 76).

<sup>81</sup> Andrew Swago to Harlan Smith, September 11, 1972 (see note 72).

<sup>82</sup> Harlan Smith to eclipse team, November 2, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>83</sup> Wilbur Bolton to Stephen Spurr, December 14, 1972, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>84</sup> Bryce DeWitt, abridged “Journal of Site-Examination in Mauritania and Niger for the June 1973 Eclipse,” 39 (see note 48).

<sup>85</sup> Nelder Medrud to Bryce DeWitt, “1973 Solar Eclipse Communication No. 4-A,” January 17, 1973, folder “1973 Eclipse Expeditions National Center

for Atmospheric Research (NCAR) File,” box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT.

<sup>86</sup> George Wm. Curtis, “1973 Solar Eclipse Communication No. 1,” December 26, 1972, folder “1973 Eclipse Expeditions National Center for Atmospheric Research (NCAR) File,” box CDL 3 2005-102/1, UT McDonald Observatory Records, CAH, UT; “Questions to NSF,” undated, folder “NSF Proposals,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>87</sup> Bryce DeWitt to Leonard Carmichael, February 16, 1973, folder “National Geographic Society,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>88</sup> Bryce DeWitt to Edwin Snider, January 26, 1973, folder “National Geographic Society,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>89</sup> Leonard Carmichael to Bryce DeWitt, April 12, 1973, folder “National Geographic Society,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>90</sup> Bryce DeWitt to eclipse team, April 16, 1973, folder “1973 Eclipse expeditions, Instrument and site selection,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>91</sup> “Questions to NSF,” undated (see note 86); Evans and Winget, 152.

<sup>92</sup> Evans and Winget, 280, 300.

<sup>93</sup> Evans and Winget, 190.

<sup>94</sup> Bryce DeWitt, “The Story of McDonald Observatory East,” 8 (see note 1); Evans and Winget, 190.

<sup>95</sup> Evans and Winget, 191, 194–195.

<sup>96</sup> *Ibid.*, 54, 177, 180, 209, 232–234.

<sup>97</sup> Charles Cobb, “Introduction” (see note 62).

<sup>98</sup> Cécile DeWitt to eclipse team, August 13, 1973, folder “Eclipse Follow Up,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>99</sup> Cécile DeWitt-Morette, faculty profile page (see note 26); Cécile DeWitt to eclipse team, August 13, 1973 (see note 98); Evans and Winget, 217.

<sup>100</sup> Evans and Winget, 238–249.

<sup>101</sup> Bryce DeWitt, “The Story of McDonald Observatory East,” 9 (see note 1).

<sup>102</sup> *Ibid.*, 10; Evans and Winget, 301; unrecorded interview between Richard Matzner and author, April 2012.

<sup>103</sup> Bryce DeWitt, “The Story of McDonald Observatory East,” 12 (see note 1).

<sup>104</sup> Evans and Winget, 299.

<sup>105</sup> *Ibid.*, 175, 298, 303.

<sup>106</sup> Bryce DeWitt, “The Story of McDonald Observatory East,” 12 (see note 1); Evans and Winget, 299.

<sup>107</sup> Al Mikesell to Harlan J. Smith and Bob Dicke, July 9, 1973, folder “1973 Eclipse expeditions, Instrument and site selection,” box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>108</sup> Harlan J. Smith to Ronald R. LaCount [sic], August 3, 1973, folder "Proposals NSF," box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT.

<sup>109</sup> Evans and Winget, 336.

<sup>110</sup> Karen Winget to David Evans, March 27, 2000 (see note 30); Evans and Winget, 339; NASA, "NASA's Gravity Probe B Confirms Two Einstein Space-Time Theories," May 4, 2011, accessed May 12, 2011, [http://www.nasa.gov/mission\\_pages/gpb/gpb\\_results.html](http://www.nasa.gov/mission_pages/gpb/gpb_results.html); unrecorded interview between Richard Matzner and author, April 2012.

<sup>111</sup> Unrecorded telephone conversation between Cécile DeWitt-Morette and author, April 15, 2010; Bryce S. DeWitt, Richard A. Matzner, and A. H. Mikesell, "A Relativity Eclipse Experiment Refurbished," *Sky & Telescope* (May 1974): 306.

<sup>112</sup> Evans and Winget, 345.

<sup>113</sup> Bryce DeWitt to eclipse team, July 12, 1973, folder "1973 Eclipse expeditions, Instrument and site selection," box CDL 3 2005-102/3, UT McDonald Observatory Records, CAH, UT

#### SELECTED WORKS CITED

- Abramson, Rudy. "National Science Foundation: Patron on the Potomac." *Change* 3, no. 3 (May–June 1971): 38–43.
- Eagleton, William, Jr. "The Islamic Republic of Mauritania." *Middle East Journal* 19, no. 1 (Winter 1965): 45–53.
- Evans, David S., and J. Derral Mulholland. *Big and Bright: A History of the McDonald Observatory*. Austin: University of Texas Press, 1986.
- Evans, David S., and Karen I. Winget. *Harlan's Globetrotters: The Story of an Eclipse*. N.P.: Xlibris Corporation, 2005.
- Nierenberg, William A. "The NATO Science Program." *Bulletin of the Atomic Scientists* 21, no. 5 (May 1965): 45–48.
- Pang, Alex Soojung-Kim. *Empire and the Sun: Victorian Solar Eclipse Expeditions*. Stanford: Stanford University Press, 2002.
- Pazzanita, Anthony G. *Historical Dictionary of Mauritania*, Historical Dictionaries of Africa 110. Lanham, MD: Scarecrow Press, 2008.
- Rosenzweig, Robert M., and Barbara Turlington. *The Research Universities and Their Patrons*. Berkeley: University of California Press, 1982.
- Savage, James D. *Funding Science in America: Congress, Universities,*

*and the Politics of the Academic Pork Barrel.* Cambridge: Cambridge University Press, 1999.

Webb, George E. *Science in the American Southwest: A Topical History.* Tucson: University of Arizona Press, 2002.<\>

## COLLECTIONS

At the Briscoe Center for American History, University of Texas at Austin:

UT McDonald Observatory Records

DeWitt (Bryce S.) Papers

