

ARID  
LANDS  
Commitments  
and  
Legacies

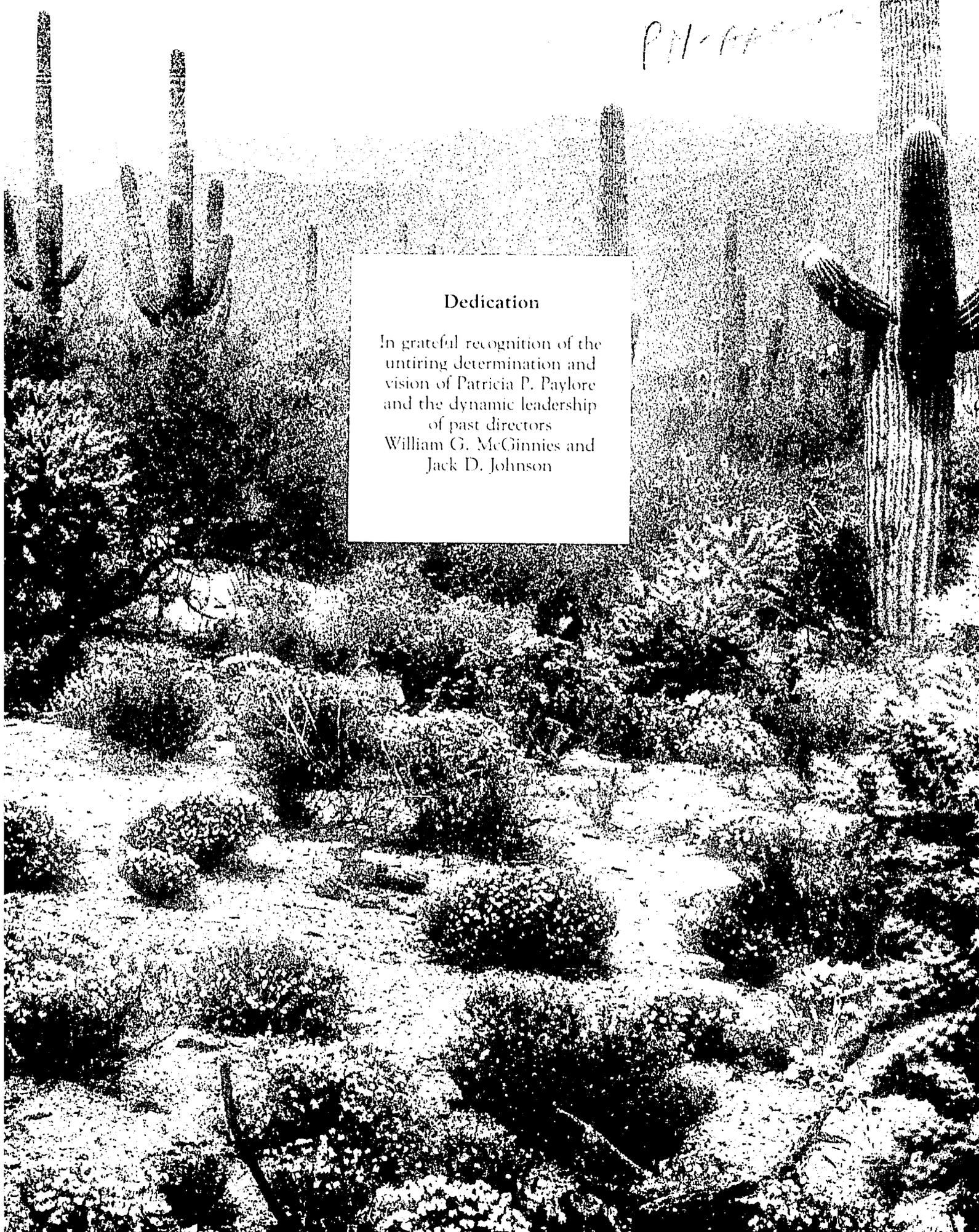
Office of Arid Lands Studies  
College of Agriculture  
University of Arizona  
Tucson, Arizona

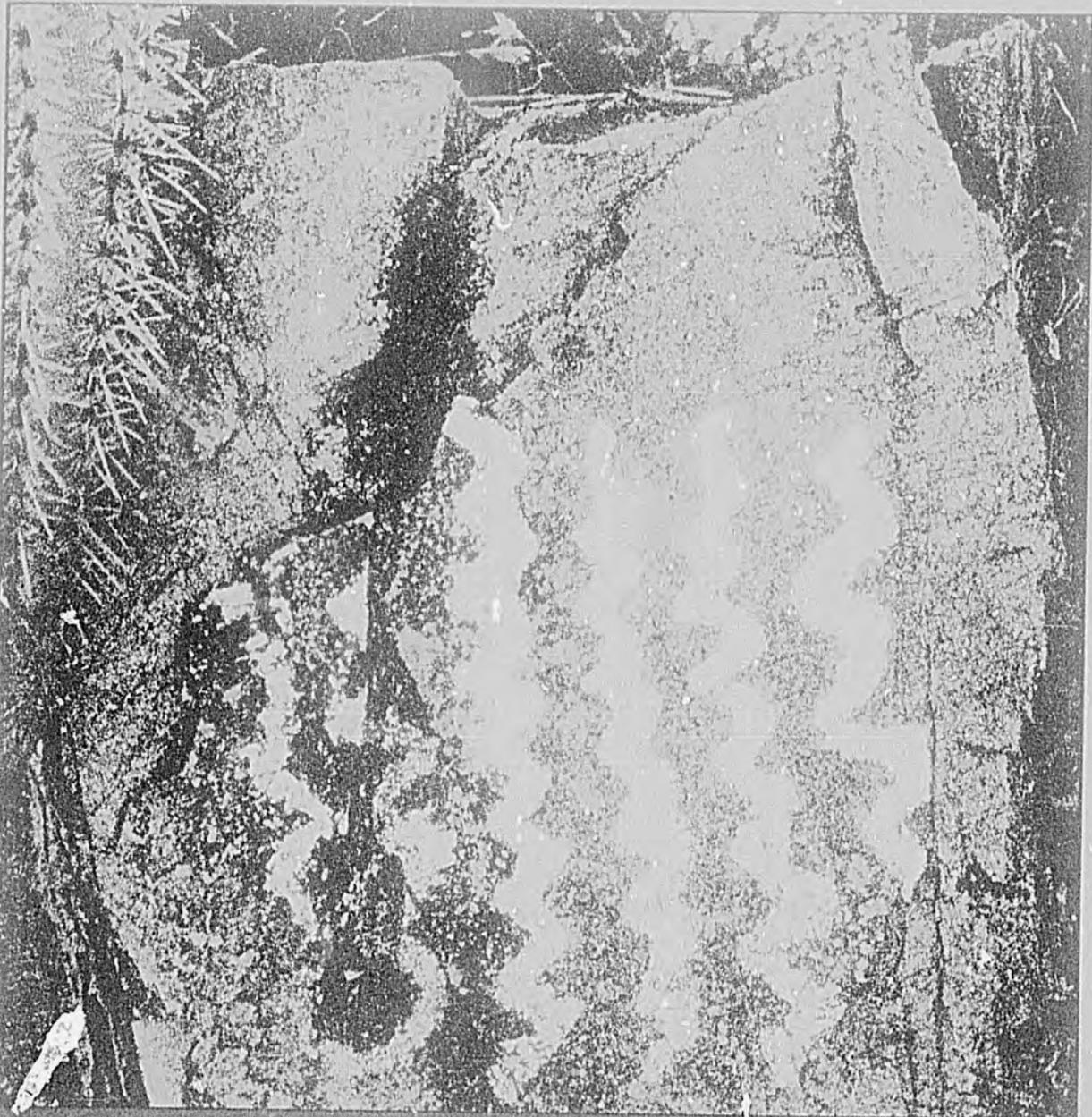
1985

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### Dedication

In grateful recognition of the  
untiring determination and  
vision of Patricia P. Paylore  
and the dynamic leadership  
of past directors  
William G. McGinnies and  
Jack D. Johnson



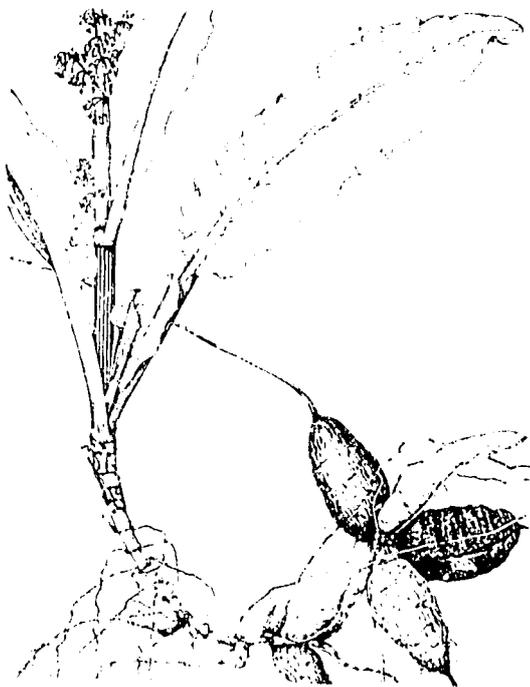


Prehistoric Hohokam petroglyph, Tucson Mountains, Arizona

*As soon as the chemical laboratory is equipped, which will be about the last of January (1891), we shall begin an examination of the waters of the several streams and of the wells in the Territory used for irrigation, and a chemical analysis of soils and other materials.*

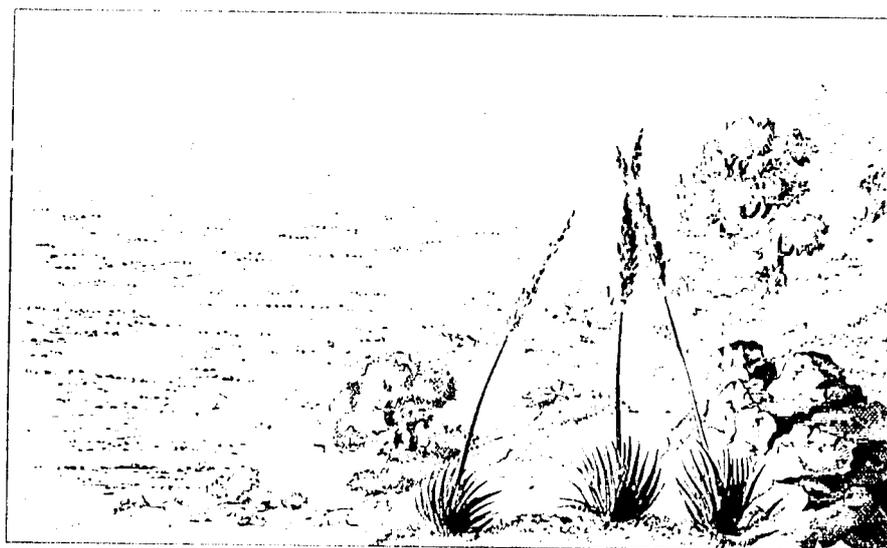
*F.A. Gulley*

**W**HEN F.A. GULLEY wrote that sentence in the first bulletin of the University of Arizona's Agricultural Experiment Station, issued December 1890, the University was not due to open its doors to the first students for another 10 months, yet soil and water research was about to begin. Despite his Michigan background, Gulley, first appointed director of the Agricultural Experiment Station and later our first dean of agriculture, set the tone and the pace for what was to be a continuing commitment to arid lands research at the University of Arizona.



Canaigre, *Rumex hymenosepalus*  
(illustration by Lucretia B. Hamilton)

Right: view from border line looking northwest toward 'Babuquibari' (sic). (from *Report on the United States and Mexican Boundary Survey*, by William H. Emory, Vol. I 1857)



FROM THE FIRST, most of the applied research at the University was arid lands research to serve the people of the state, since more than 90 percent of Arizona is semiarid or drier. Since this state's portion of the American Southwest has historically and currently attracted a greater variety of human activity than any other desert area, it is a useful one for drawing human-use analogies. Considering all factors, it is reasonable to believe that a large portion of arid lands research done by the University of Arizona during the last 100 years has been applicable to other dry regions of the world.

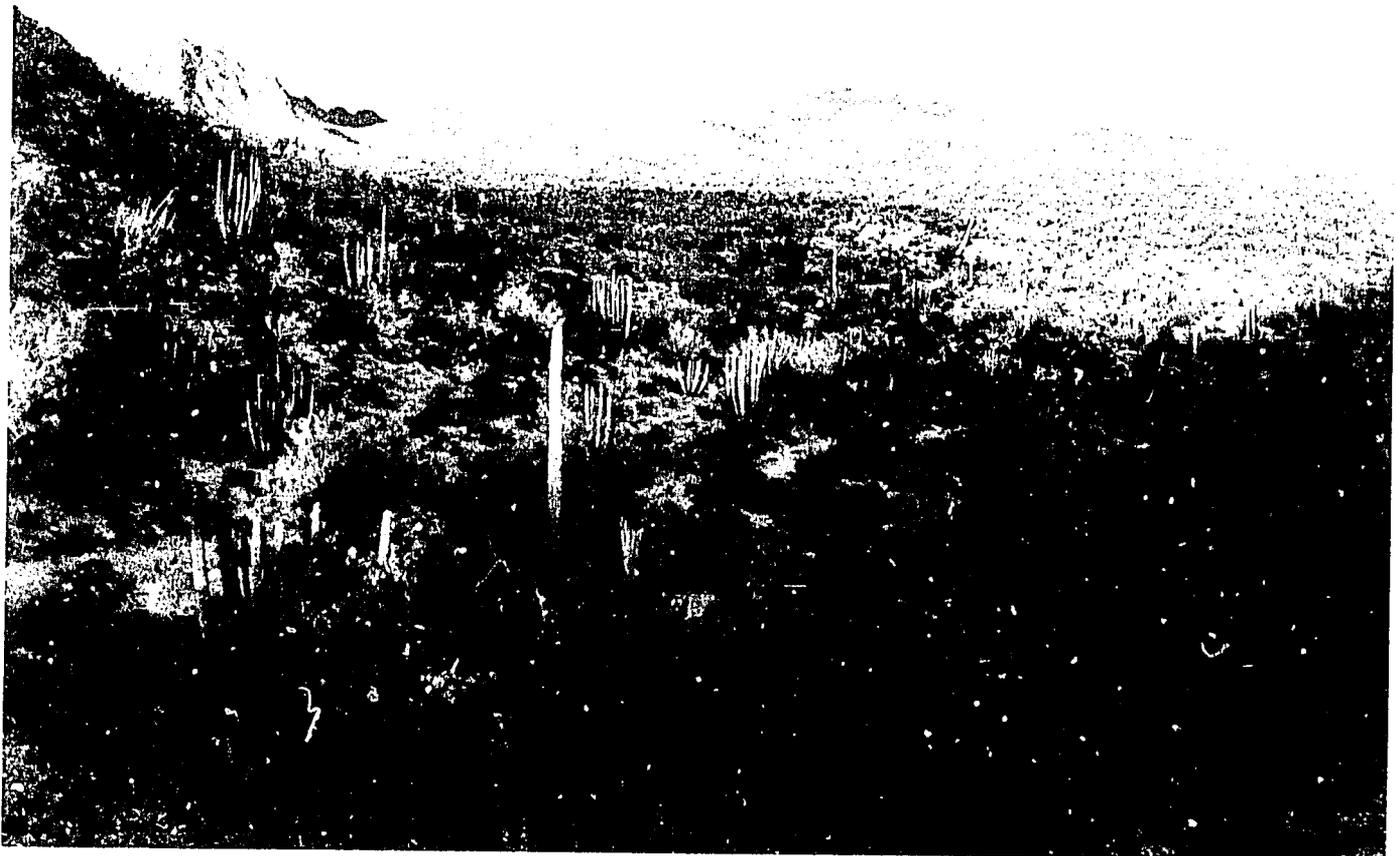
Following World War II, a widespread international activity in arid lands research was initiated by the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Arid Zone Advisory

Committee, the world's first attempt at a coordinated attack on the fundamental problems of arid land occupancy. Then, the American Association for the Advancement of Science took up the cause through a series of meetings of its Southwestern and Rocky Mountain Division, beginning in 1955 in New Mexico when the University of Arizona played key roles through the presence of a former president of the University, Dr. H.L. Shantz, who spoke on "The History and Problems of Arid Lands Development." Out of that particular meeting came the University of Arizona's determination to pull together the multidisciplinary approach to solutions to problems of aridity.

Although the University had been engaged in arid lands activities since its establishment, the first committee specifically designated for the advancement of such undertakings was appointed by University President Richard A. Harvill, on May 25, 1957, who charged its members "to consider the integration of ideas from all areas of the University and formulate programs designed to learn more about the problems and possible solutions to them." The Committee, under the chairmanship of Dr. David L. Patrick, prepared the report titled "The Utilization of Arid Lands: An Interdisciplinary Study," which became the basis for the program financed under a three-year \$208,000 grant from the Rockefeller Foundation (1958).

## *Early Arid Lands Research...*

Organ Pipe Cactus National Monument  
(photograph by George A. Grant, 1958)



*Only an office such as that finally created, the Office of Arid Lands Research, could coordinate the efforts of a wide spectrum of scientists from many fields in the attack on the problems of this single environment.*

The Committee subsequently was replaced by one known as The Arid Lands Program (1959), and still later by The Advisory Committee for Arid Lands Research. Their purpose originally was to carry out the Rockefeller Grant and to seek further funds thereafter.

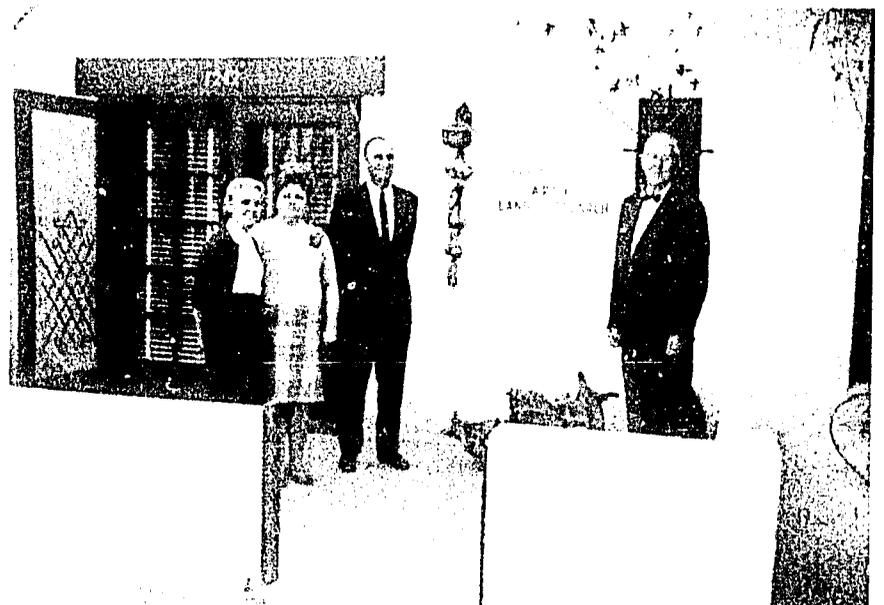
In 1964 the Advisory Committee reviewed an invitation to bid on a contract proposed by the Army Research Office for a Desert Environments Inventory. The outcome of these considerations was the preparation of a bid that resulted in a \$250,000 contract award that was carried out by what was to become known as the Office of Arid Lands Research, and later as the **Office of Arid Lands Studies**.

**T**HE BASIC RATIONALE for the creation of the Office of Arid Lands Studies in late 1964 was that the study of arid lands cannot by any definition or fiat be confined to agriculture or soils or water or wildlife or geochronology or solar energy or atmospheric physics or desalination, much less anthropology, Indians, developing countries, or any other conceivable component of the arid environment. Nor can it be circumscribed by geography.

The prime consideration in establishing the Office of Arid Lands Studies was a University-wide recognition of this basic fact: the interdisciplinary nature of arid lands studies, and the need to carry out the mandate that history itself had dictated should be centered at the University of Arizona because of seven decades of experience in addressing the problems and issues of our arid environment.

The perspicacity of the University administration in acknowledging that the time had come to offer that experience to a wider constituency was supported by the activities of the Arid Lands

Early staff members outside 1242 East Speedway Blvd., February 1966. Left to right: Patricia Paylore, Charlene Schultz, Bram Goldman and William G. McGinnies



Program, which drew from the University at large its arid lands experts from many disciplines. It was their conviction that only an office such as that finally created, the Office of Arid Lands Research, could coordinate the efforts of a wide spectrum of scientists from many fields in the attack on the problems of this single environment. They believed that the problems of the world's arid lands were many faceted and that it was necessary to bring to bear on them diverse aspects (economic, cultural, social, technical, scientific, informational) for consideration in tackling them. And such remains true now, 20 years later, as the international attack on arid lands problems accepts this broad concept and turns increasingly to the Office of Arid Lands Studies for the execution of contracts in this vein.

And so, on November 1, 1964, the Office of Arid Lands Research set up shop in a modest rented house at 1242 East Speedway, with some furniture and equipment obtained from University surplus necessary to support the initial staff of three: Dr. William G. McGinnies, Project Manager; Mr. Bram Goldman, Editor-Administrator; and Mrs. Charlene Schultz, Secretary.

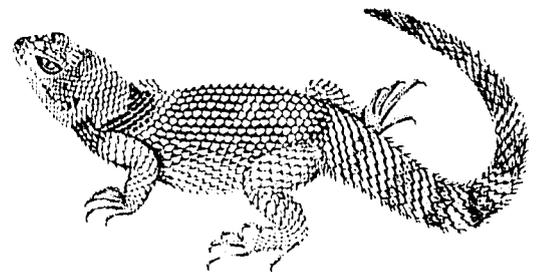
A support group to be known as the Deserts Environment Inventory Group was organized immediately and was composed of Office staff and the authors of what would become a compendium of the desert environment inventory. The first meeting of the support group, as it was faithfully recorded, occurred as early as November 10, 1964, and was attended by six members, including McGinnies and Goldman. Five weeks later, on December 14, 1964, the Office committed itself to the creation of the Arid Lands Information System.

To help develop this latter concept, President Harvill assigned Patricia Paylore to the Office staff as a research associate specializing in information and bibliographical services. To provide other Office needs, students came aboard shortly on an hourly basis, and other University personnel were added to the individual compendium staffs as the need arose.

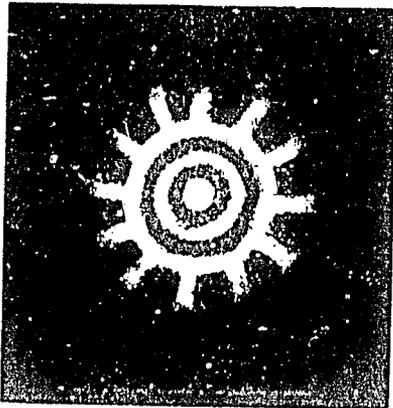
Already by the end of the first fiscal year, under which the Office had functioned by terms of the Army Research Office contract, two subject specialists were traveling abroad: Dr. Charles H. Lowe of the University's Zoology Department who had been assigned to the fauna area of the contract called for in the inventory; and Professor Lawrence K. Lustig of the University's Geology Department, assigned to cover the geomorphology and surface hydrology. These contacts and those to follow in the next two years with our scientists' counterparts throughout the world were to be maintained and expanded over time, while the immediate advantage to the Army Research Office contract was the opportunity to examine, at first hand, the terrain and life forms of the world's deserts.

Meanwhile, back home, voluminous correspondence with consultants throughout the world laid the groundwork for much of the publication effort required by the contract, and the first of a never-ending stream of visitors began arriving. By the end of the second complete fiscal year, July 1965 to June 1966, the Office had spent some

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SEVENTY-FIVE YEARS OF  
**ARID-LANDS RESEARCH**  
 AT THE UNIVERSITY OF ARIZONA



The Office's first publication, *Seventy-Five Years of Arid Lands Research at the University of Arizona*, released in 1966

*Deserts of the World*



Compendium editors (left to right) Patricia Paylore, William G. McGinnies and Bram Goldman (photograph by *Tucson Citizen*, August 3, 1967)

\$169,000 of its \$250,000 in contract funds. Much of the work on the compendium was near completion, a directory of institutions called for in the contract was well advanced toward publication, and the text for what was to become the Office's very first publication, *Seventy-Five Years of Arid Lands Research at the University of Arizona*, was in press.

The staff had expanded through the employment of some 20 graduate students, and faculty and staff scientists were increasingly involved as the interdisciplinary nature of the project became understood. Faculty from the Institute of Atmospheric Physics, Geography and Area Development, and the Laboratory of Tree-Ring Research were involved part-time. A number of highly qualified scientists at other institutions were contributing portions of the compendium.

Travel continued: Joseph F. Schreiber Jr. to Australia to begin an appraisal of research on desert coastal zones; Eugene S. Simpson to Europe and Algeria to investigate the state of research on groundwater hydrology in desert environments; and Patricia Paylore to the great documentation centers in Great Britain, Switzerland, Italy and France. Lowe and Lustig completed their extended tours worldwide.

The Office's annual report for this first year closed with the recommendation that the Office of Arid Lands Research should continue as a permanent unit of the University.

...We feel that a large expansion of our staff is neither warranted nor desirable, but that the office should continue as a small unit coordinating or managing large interdisciplinary arid lands programs involving cooperation among several departments or colleges of the University [one] uniquely suited to guide scientifically underdeveloped nations in their attempts to provide education, initiate useful research, and achieve economic stability in arid environments...Our staff hopes that...vigorous administrative support will be forthcoming for a UA program of world leadership in arid lands research.

Specific areas recommended for expansion included information services; an arid lands journal to replace the defunct United Nations arid lands publication; and instruction with emphasis on foreign conditions through the use of fellowships with returning Peace Corps workers, with foreign students from arid countries enrolled in the University, and with technical translators who might engage in these activities for credit. Seminars in the fields of interest to the arid lands program, it was hoped, would be encouraged to take advantage of the experience of available faculty, staff and students on campus. And an "Elder Brother" plan might be devised to provide interchangeability of credits so that a student at a foreign institution as a matter of course could come to Arizona for his fifth year without accreditation difficulties.

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**A**CHIEVEMENTS in 1966-1967 and 1967-1968 were significant in determining the direction the Office was to take. All individual chapters of the compendium had been completed and printed separately for the Army Research Office, and the University of Arizona Press Book, *Deserts of the World*, reviewed and edited for this more general type publication from the individual Army Research Office chapters, had been printed and received worldwide recognition and praise. In addition, the *Arid Lands Research Institutions: A World Directory* was completed and issued also by the University of Arizona Press. Because of its wide use and the fast-changing nature of world desert research, a revised updated edition was issued a decade later, still under the auspices of the Office of Arid Lands Studies. Both *Deserts of the World* and the *Directory* were officially designated U.S. contributions to the International Hydrological Decade by the National Academy of Sciences' National Research Council. Concurrently with preparation of the *Directory*, the Office accepted the first of a series of grants from the U.S. Army Natick Laboratories, to which the initial Army Research Office contract had been transferred in late 1965, to collect and analyze current information on world desert research. This contract, in effect, provided a continuing update of the more than 5,000 basic references that formed the bibliographic support for the compendium and became the basis for the Arid Lands Information System.

At the beginning of the year 1967-1968, the Office of Arid Lands Research became part of the newly organized School of Earth Sciences and its name was changed to the Office of Arid Lands Studies, by which title it continues to function some 18 years later. In this new academic environment the Office saw expanded information activity as execution of grants from the National Science Foundation and the U.S. Office of Water Resources Research got underway, and the Natick contract was extended.

By 1968-1969, the Advisory Committee for Arid Lands Research recommended and received approval of a graduate program offering the Ph.D. degree in Arid Lands Resource Sciences, designed for advanced students with a strong background of demonstrated competence and involvement in the problems of the development of arid lands and whose research interests showed promise of giving special insights into the solution of such problems.

The National Science Foundation grant for \$55,200 in new funds during 1968-1969, the first of several to follow, brought to the table the actual implementation of that early commitment to establishing an arid lands information center. The grant supported our proposal to prepare a prototype interdisciplinary arid lands information storage and retrieval system that was hoped might become a cooperative enterprise with all western U.S. arid lands centers. We would coordinate acquisitions of world arid-lands publications, keep the information current, and provide for their electronic access. Paylore spent much time in the Washington, D.C., area investigating the state-of-the-art,

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Gary P. Nabhan, Arid Lands Resources Sciences graduate, conducted research on traditional farming systems in the Pinacate area, in northern Sonora, Mexico. (photograph by Charles Bowden, *Tucson Citizen*, September 25, 1982)



On December 7, 1971, Tucson received a historic 7-inch snowfall. United Press International ran this photograph of staff members Cecilia Gonzalez (left) and Mercy Valencia (right) in 16 U.S. newspapers. Photograph taken on the lawn at 1201 East Speedway Blvd

ARID LANDS NEWSLETTER



The Arid Lands Newsletter, published by the Office since 1975

then upon returning to campus, left again to visit other arid lands institutes in Riverside, Reno, Denver and Lubbock.

In June 1969 the American Association for the Advancement of Science accepted the Office of Arid Lands Studies' invitation to hold their International Conference on Arid Lands in a Changing World at the University of Arizona. It was attended by more than 250 delegates from 23 countries, including Argentina, Australia, France, Israel and the Soviet Union. Co-sponsored by UNESCO, the American Association for the Advancement of science published the proceedings later as its publication number 90, *Arid Lands in Transition* (©1970).

On June 30, 1969, McGinnies retired from the directorship of the Office and Paylore assumed the position in an acting capacity until early 1971 when the new permanent director, Dr. Jack D. Johnson, arrived. During this interval (in April 1970) the Office moved across the street to 1201 East Speedway Blvd. to a large two-storey building that more than tripled the working space. We remained there until the move in the summer of 1974 to our present quarters at 845 North Park Avenue.

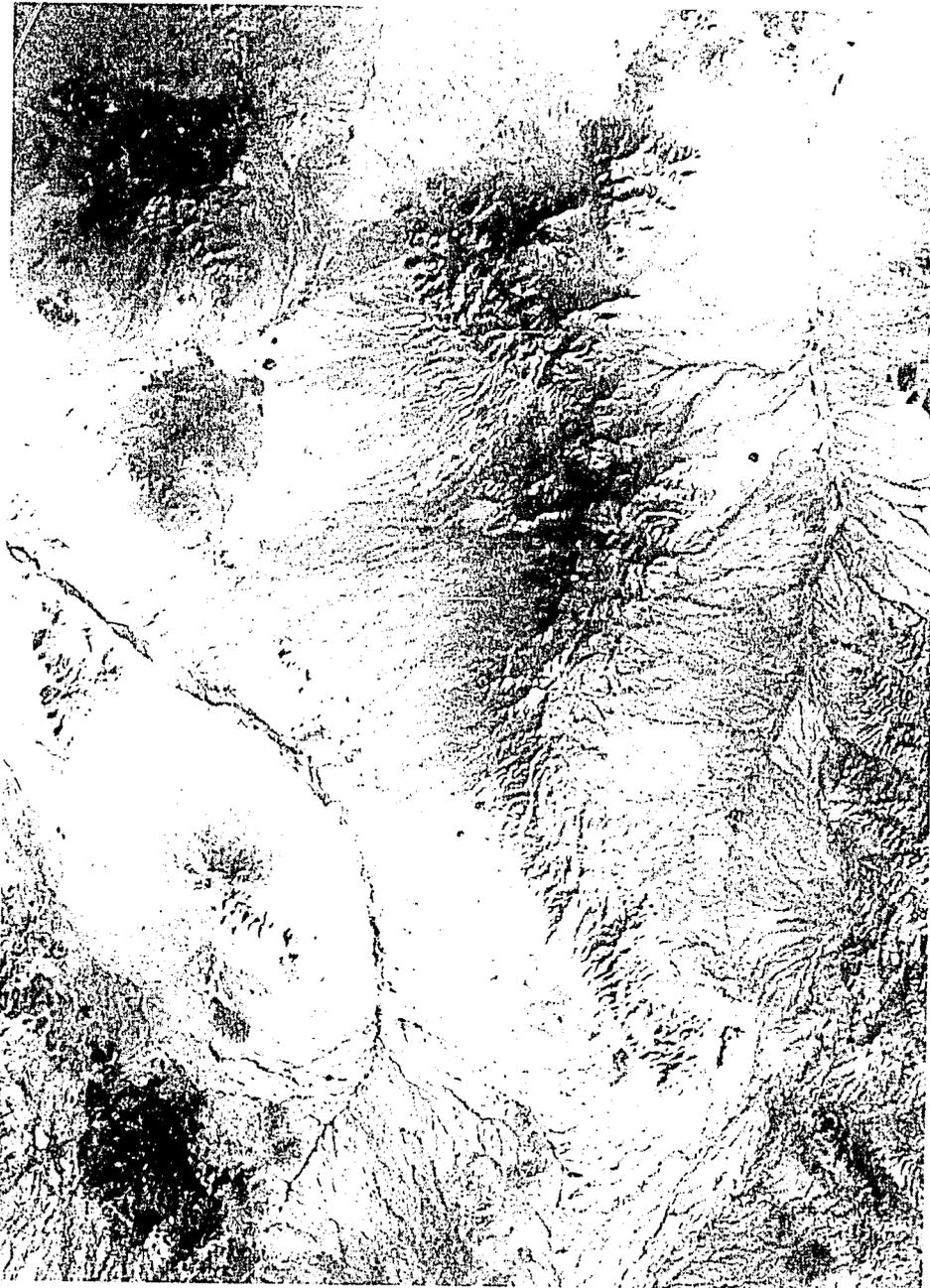
In the meantime, we accepted contracts with the National Park Service to do a bibliographical survey on the natural resources of the Saguaro and Organ Pipe Cactus national monuments; with the U.S. Army Corps of Engineers for environmental impact studies on the Gila River below Painted Rock Dam; with Natick Laboratories for preparation of a *Thesaurus of Arid Lands Terminology*, as well as continuation of identification of arid lands research publications following *Deserts of the World*.

Characterizing the year as a "watershed," the annual report for 1969-1970 noted that the Office had been singularly fortunate up to that time "...in that all our grant and contract funding had created not only the base but actually built the structure within which our broader activities are undertaken. The University role in the maintenance of this structure and its growth potential needs now to be determined. The OALS is more than a collection of assorted persons carrying out specific assignments. It has become a dynamic unit, motivated by a sense of creativity, challenged by the variables in our situation, and confident of our ability to attain our long-range goals through mobilization of appropriate University resources to this end."

In the spring 1974, the University received a 5-year \$1,045,000 grant from the U.S. Agency for International Development to increase the institution's response capability in planning and managing natural resources in arid developing countries. Director Johnson served as the program director and Office staff provided logistic and administrative support. In addition, the Office was allocated part of the total funding to create a Centralized Information System that would provide for international expansion of the documentation resource already programmed and functioning. By 1975 the Office had used this funding to underwrite publication of the *Arid Lands Newsletter* (number 1, March 1975 to date), which continues to be edited by Paylore.

**D**URING THE YEARS from its founding until the mid-1970s, the Office evolved from a mission-oriented type of administrative unit to a broad academically based research unit with close interactive ties to Arizona resource and planning agencies and to international arid lands research organizations. A vigorous and dynamic publications program gave the Office great visibility, and the development of the computerized information programs provided a springboard for active services to the University, state and federal agencies. An example of this expanding service role was realized in 1972 with the formal organization of what is now the Arizona Remote Sensing Center under a grant from the National Aeronautics and Space Administration (NASA).

*Now from  
the perspective of two  
decades, we can see which  
and how many  
of these naive and  
youthful dreams came  
to pass...*

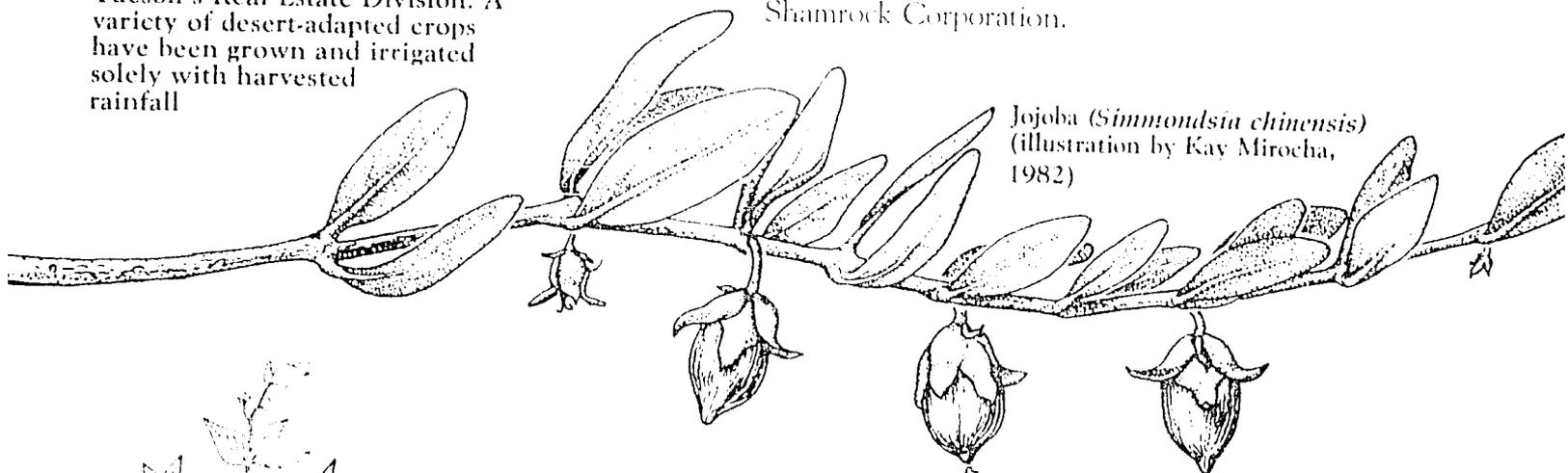


Landsat-4 Thematic Mapper satellite image of the Baboquivari Mountains west of Tucson. The Mexican border runs diagonally across the bottom



An agricultural water harvesting system was developed on abandoned farmland in Arizona's Avra Valley by Office staff with the College of Agriculture's Department of Soils, Water and Engineering, and the City of Tucson's Real Estate Division. A variety of desert-adapted crops have been grown and irrigated solely with harvested rainfall

Our involvement in economic botany research, which moved forward in 1972 with a grant from the U.S. Office of Economic Opportunity to disseminate information on the oil-producing plant jojoba (*Simmondsia chinensis*), became the catalyst for a variety of other programs that have since been realized. Other crops were studied for their economic potential -- tepary bean (*Phaseolus acutifolius*) for food products, guayule (*Parthenium argentatum*) for rubber, Russian thistle (*Salsola kali*) for solid fuel, and other species for solid, liquid and gaseous fuels, resins and specialty chemicals. Research, as a matter of course, was augmented with vigorous efforts to collect and document all the available literature on these crops. Comprehensive jojoba and guayule literature collections are still maintained within the Arid Lands Information Center. The Office subsequently directed state-of-the-art studies and technology assessments of the commercialization of both guayule and jojoba. The interdisciplinary expertise focusing on arid lands plants was formalized in 1981 with establishment of the Bioresources Research Facility with primary funding from Diamond Shamrock Corporation.



Jojoba (*Simmondsia chinensis*) (illustration by Kay Mirocha, 1982)



Desert adapted Tepary bean (illustration by Paul Mirocha)

The Office's association with Indian tribes also began in the early 1970s in conjunction with our jojoba research when the Office of Economic Opportunity began investigating the possibility of establishing jojoba-based industries on southwestern Indian reservations. The Office supervised the collection of more than 40,000 pounds of jojoba seed by Arizona Indian tribes in the summer 1972, and through 1978 assisted in establishing a jojoba plantation and tribal enterprise on the San Carlos Indian Reservation, Arizona. One thing leading to another, the Office began offering technical assistance to other western tribes through the Laboratory of Native Development, Systems Analysis and Applied Technology in 1976 under a contract with the U.S. Department of Commerce's Economic Development Administration and continues to do so with W.K. Kellogg Foundation support.

In the fall 1981, the Office was placed administratively within the College of Agriculture. This move, negotiated by Director Johnson and College of Agriculture Dean Bartley P. Cardon, would be mutually

beneficial — the interdisciplinary capabilities of the College would be strengthened while the Office's opportunities for logistical and funding support would be broadened.

Johnson, who subsequently resigned the directorship in 1983, was replaced by Dr. Kenneth E. Foster, the Office's associate director since 1975. Under Foster's vigorous direction the Office has increasingly seen its role in the College of Agriculture, as well as throughout the University community, as a catalyst whereby the institution can be flexible enough to meet contemporary demands for amelioration of crucial issues to which it is uniquely capable of contributing. Only a unit such as the Office of Arid Lands Studies, young enough still to be free of historical encrustation, old enough to be experienced in the very teamwork approach to problems that the future will require of us, can meet the required criteria.

The Office's history demonstrates in a dramatic way how an intellectual concept can be capitalized for the benefit of a widening circle of need. We believe we have served as a focal point for the several academic disciplines that must be coordinated to best understand and deal with the world's arid lands. Our international ties provide opportunities for travel, collaboration, exchange of personnel, and leadership. The university recognition that the world's arid lands are on the threshold — in some areas, over the threshold — of vast developmental processes gives us reason to believe that the competence we have built into the Office of Arid Lands Studies during its two decades will continue to be called upon in many ways, underwriting with scientific and technical skills the means by which arid lands resources can best be used and not misused, can best be developed for future generations and not exploited for immediate consumption.

We are comfortable in our status as a free-wheeling group, willing to take risks, unafraid of the new, adaptable to change, and above all, imbued with a sense of urgency and dedication.

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Leslie Rawles (left) and Wilkie Nash (right) direct the planting of jojoba on the San Carlos Indian Reservation, June 1976



Continuing a tradition of dynamic leadership are, left to right, Associate Director Charles F. Hutchinson, Director Kenneth E. Foster, and Assistant Director Joseph J. Hoffmann, May 1985

## ARID LANDS INFORMATION CENTER

FROM ITS EARLIEST DAYS, an important aspect of the development of the Office was the emphasis on information and documentation, which is now carried out by the Arid Lands Information Center. As soon as the more than 5,000 citations included in *Deserts of the World* were identified, the National Science Foundation supported an experimental study that resulted in a prototype machine-readable subject index for information on desert environments. Research associate Patricia Paylore initiated the work in the summer 1968 with the idea of computerizing about 30,000 prime references on arid lands research already compiled by the Office. To this end Paylore constructed a design model for electronic control and retrieval of this specialized material.

Concurrently with this grant, the Office was awarded an additional one-year grant from the U.S. Department of the Interior's Office of Water Resources Research, to produce abstracts on important worldwide publications dealing with water resources in arid lands. With additional funding for 1968-1969 the Office embarked on a program to make this information resource available internationally.

And so in late 1971 a Regional Arid Lands Information Network (RALIN) was created with a National Science Foundation grant. The Network was designed to include five other western research centers who planned

RALIN's future based on the examples already prepared for the Office's fully functioning system, the Arid Lands Information System (ALIS). With this framework complete, implementation of the design was a commitment each representative pledged, to develop RALIN into a full-blown system capable of fulfilling a national and international need at a critical time when environmental issues were paramount in our priorities. Regrettably, the "partners" dropped off, one by one, as federal funding was discontinued, but the Office carried on alone, from then to now, ready and willing to contribute to the advancing "state-of-the-art."

During the three years of National Science Foundation grant support, a thesaurus of arid lands terminology was constructed as a prototype to provide vocabulary control of indexing to be applied to the substantial information bank created in support of academic research at the University of Arizona. Paylore continued to strengthen the bibliographic base at the heart of the system, while supervising the work of two graduate research assistants in modifying the program to fit our changing requirements and in preparing for reproduction of two issues of a prototype abstract journal called *Arid Lands Abstracts* (its life span: number 1, 1972 to number 8, 1976) that would demonstrate the potential capabilities of the system.



Meantime, with support from the Water Resources Scientific Information Center, the Office in its fourth year of abstracting for this agency was established as one of its Centers of Competence. We contributed 500 abstracts on the topic for publication in the Agency's *Selected Water Resources Abstracts*. 1972 saw the first two of 14 U.S. Department of Interior-funded *Arid Lands Resource Information Papers* (life span: number 1, 1972 to number 14, 1979). Many of the information papers are now classic sources. Each used the computerized Arid Lands Information System and also contributed to it with accompanying bibliographic information and computer-formatted indexing based on the thesaurus.

In the fall 1976 the U.S. Forest Service contracted with the Office to establish a cooperative program with the colleges of Mines, Agriculture, and Architecture, to investigate the effects of mining on surface environments in the United States west of the 100th meridian. SEAMALERT was the periodic publication derived from the computerized information system that supported this project (carried through its lifespan from 1977 through 1981).

During this period the Office was designated as a RECON terminal for Arizona and nine other western states. RECON is a computerized information retrieval system relating to natural resources and energy and is based at the Oak Ridge National Laboratory, Tennessee. And, earlier in 1978, the Office received a U.S. Agency for International Development grant to expand the information it had been acquiring from us, with

emphasis on a database having an international focus.

The Arid Lands Information Center, as it was now designated, expanded its activities to include a cooperative project with the National Agricultural Library in 1983. Under the supervision of Elaine Cook, all computerized database tapes would be converted to a common format so that the records could be incorporated into the National Agricultural Library's Agricola database. In 1984, the Center began indexing more than 200 agricultural journals for the Library, preparing input forms that will be included in the Agricola online database and the *Bibliography of Agriculture*. From 1980 to 1983 the Center researched and compiled extensive environmental profiles of 51 developing countries, many of them arid, in a project supported by the U.S. Committee for Man and the Biosphere.

Although many changes have occurred during the nearly two decades since the Arid Lands Information Center was created, quality control is still the lodestar by which the world's arid lands researchers have sought us out. As an example, the United Kingdom's Commonwealth Agricultural Bureaux solicited the Center's cooperation in support of the publication *Arid Lands Abstracts*, negotiated in 1979. A total of some 5,000 documents were abstracted annually throughout the three-year life of this contract. Even though the *Abstract* connection with CAB was discontinued, the Center continued to act as the Bureaux's representative in North America.

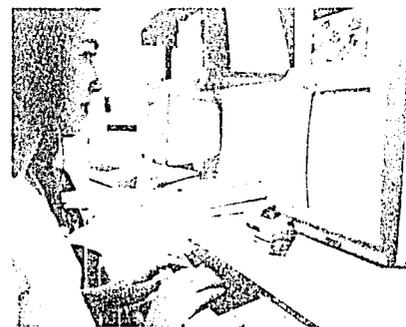
Beginning in 1982, the Arid Lands Information Center began providing technical assistance for

the establishment of a Documentation and Learning Resources Center (DLRC) for the Yemen Arab Republic's Ministry of Agriculture and Fisheries. The DLRC will house a complete collection of documents generated by the Ministry and by other agencies concerned with Yemen's agricultural development.

Operationally the Arid Lands Information Center is a unique, sophisticated service. The focus, largely on a single environment, with its concomitant recognition of the many disciplines that impact on that environment is one of the characteristics that has marked it for recognition throughout the arid world. The communications network that provides much of the input to the Center from colleagues from Windhoek to Kabut, from Quetta to Alice Springs, is one to which the Office has an obligation. There are no comparable services anywhere. Hookups via satellite eventually will provide an international consortium of arid lands research institutes worldwide with the capacity for shaping the information resource that the Office created and maintains and to this we are committed, and ready.

— Patricia Paylore

Emily Whitehead at computer, Summer 1982



## ARIZONA REMOTE SENSING CENTER

THE ARIZONA REMOTE SENSING CENTER was formally established within the Office of Arid Lands Studies in 1972 with a \$50,000 grant from the National Aeronautics and Space Administration (NASA). The Office, however, had taken an active interest in remote sensing technology several years earlier.

In 1970, the Natick Laboratories funded a comprehensive review of the application of remote sensing in identifying desert terrain and inventorying desert resources. The Arizona Regional Ecological Test Site (ARETS), which was sponsored by the U.S. Geological Survey, was managed and coordinated within the Office under the direction of Dr. Larry K. Lepley. ARETS eventually provided agriculturalists, planners, ecologists, hydrologists and many other professionals with a continuing source of remote sensing imagery for use in monitoring and/or planning for many of the state's resources.

In the years following, the Earth Resources Technology Satellite (ERTS, now Landsat) program, became NASA's major effort. The Office, as a coordination center, thus acquired considerable instrumentation and imagery for use in analyzing data on behalf of various state and local government agencies. Following the original NASA grant, outside funding for the Arizona Remote Sensing Center increased from more than \$100,000 for fiscal year 1974 to an average annual figure exceeding \$250,000. The decade's total is

nearly \$4 million. The Center now provides the focus for remote sensing activities within the College of Agriculture, and houses a centralized laboratory for remote sensing interests within the University community.

Cooperative demonstration projects were a major thrust of work done under the founding NASA grant, and they continue to be important. In these projects the Center applies remote sensing techniques to specific problems in response to requests from local, state and federal agencies.

Recently, the Center has worked with the Arizona Department of Health Services to demonstrate the use of current and historical aerial photography in mapping land use changes that may affect local water quality. In addition, the Center has worked with the Arizona State Land Department to develop a system for estimating fuelwood volumes in the mesquite and piñon-juniper woodlands of Arizona using digital satellite images. Based on the success of this project using the mapping of these low-density woodland resources, the State Land Department has adopted the technique for use in a statewide inventory of land cover that uses Landsat satellite data.

Other local, state, federal and international agencies and organizations routinely contract with the Arizona Remote Sensing Center to develop remote sensing techniques to solve specific problems of inventorying and monitoring natural resources. As

an example, in 1977 the Center accepted a contract with the National Park Service in Grand Canyon National Park. This 5-year project culminated in the creation of the first detailed vegetation map of the Park. The mapping system that was developed for this project was based on the relationship between vegetation and terrain and was determined through intensive field study. The map has provided baseline information for managing the park and for monitoring environmental change.

In another project, with Dames & Moore Inc. in 1982, the Center developed a land capability classification map of the Sinai Peninsula using Landsat and published map information. The map has since been used in formulating a development plan for the Sinai. Other projects have included wildlife inventories, analyses of dust hazards, environmental sampling, evaluations of floodwater farming and land resources inventories.

Since 1982, under a grant from the U.S. Department of Agriculture's National Crop Loss Program, Dr. Michael Parton has been developing a technique for estimating yield reductions in cotton resulting from *Phymatotrichum* root rot. This technique used measurements of reflectance in the red and infrared part of the spectrum to identify areas affected by this disease. Estimates of reduced cotton yield within a field were developed from ground sample data gathered within the diseased areas. Similar

projects are under way for developing computer programs for monitoring on-farm energy consumption. And parallel to these activities, The Center continues to develop low-cost systems for general purpose remote sensing that rely on both large-scale small format aerial photography or aerial video, using systematic sampling combined with small-scale Landsat data.

The Center's current director, Dr. Charles F. Hutchinson, with staff members, Parton, Dr. Robert A. Schowengerdt and Mr. Peter Warren, handle the Office's extensive mapping activities. These include the Geographic Information System (GIS), a tool for storing, displaying and analyzing spatial information; and image processing facilities to provide personnel training and system access support of the U.S. Department of Agriculture's Soil Conservation mapping mission on several Arizona Indian reservations.

Education, outside the degree formality, generally continues to be an important part of the Center. Since 1980, in addition to formal courses taught by the Center's staff within various departments of the University, the Center has presented a basic training course in remote sensing for land managers. Similar courses continue to be scheduled annually. Hutchinson also has served as a remote sensing consultant in Pakistan and in the Peoples Republic of China.

Several workshops have been sponsored such as the one for resource management personnel from Mauritania, and another on

digital processing techniques for soil mapping. In 1984, the Center hosted a conference on the application of remote sensing to agricultural problems for Arizona's agricultural and natural resource management community.

In 1983 the Center installed a PDP 11-24 minicomputer system, a gift to the College of Agriculture from the Digital Equipment Corporation. The Center has since acquired the Earth Resources DATA Analysis Systems image processing System (ERDAS) and other supportive image processing and geographic information systems software and hardware. The complete system is and will continue to be a vital component of the Center's research and teaching program.

**Charles F. Hutchinson**  
*Director, Arizona Remote Sensing Center*

Arizona Remote Sensing Center  
Research Assistant Karen  
Reichhardt measures the slope  
of a study area with a Brunton  
hand transit near the Tortolita  
Mountains, Spring 1982



Oblique infrared aerial  
photograph of the Sierrita  
Mountains, Arizona, used for  
study of riparian mesquite,  
October 1981



## BIORESOURCES RESEARCH FACILITY

THE OFFICE OF ARID LANDS STUDIES formally demonstrated its commitment to developing new crops for arid lands in 1978, when it entered into a research agreement with the Diamond Shamrock Corporation. The project, involving the oil-bearing plant *Euphorbia lathyris*, was a pioneer test of the concept of "hydrocarbon plantations," which would produce renewable supplies of crude oil. In the summer 1978, project botanist Dr. Steven McLaughlin moved his office into the former Sunnyside Junior High School building, and with the help of a small staff, eventually transformed the abandoned playing fields into experimental growing plots. Thus began what was ultimately to become the Bioresources Research Facility.

Within three years, this single project had given rise to a variety of related studies, including Dr. Martin Karpisek's feasibility study on tumbleweed (*Salsola kali*) as a potential new energy crop for the desert, research on a salt-tolerant, hydrocarbon-yielding green alga (*Donalialla*), and an expanded, multimillion dollar "Chemicals from Biomass" program still funded by Diamond Shamrock. The former junior high school had by this time been retrofitted with a new interior that included chemistry and botany laboratories, pilot-scale densification and chemical extraction equipment, a library and conference room, and office space for a staff of 25. Under

the direction of Dr. Joseph Hoffmann, named head of the research unit in 1981, the Bioenergy Research Facility was formally dedicated in November 1981.

The facility expanded its research capabilities in March 1983 to include a fermentation laboratory, and entered into the important new field of biotechnology with a project funded by the Bio-Energy Council. This project, which assessed the potential of several desert-adapted plants as sources of ethanol fuels, represented an entirely new area of endeavor for the new crops program. Later the same year, Facility investigator Dr. Barbara Timmermann received a grant from the National Science Foundation to study the chemistry and possible commercial utility of a large number of southwestern plant species in the genus *Grindelia*. In addition, the "Chemicals from Biomass" program was greatly expanded with funding from Hercules Inc., placing particular emphasis on the desert plant *Grindelia campoman*, which produces large quantities of resins identical to those used in the naval stores industry.

As a result of these diversified interests and objectives, the research unit was rechristened the "Bioresources Research Facility." The new name more accurately described a course of research that no longer placed sole importance on producing liquid and solid fuels, but rather, sought to develop a





wide array of resources from desert plants, including also biomass-derived chemicals, foods, animal feed, pharmaceuticals, and other valuable products. While energy production remained a central pursuit, it was now to be considered only one aspect of a well-integrated system for the effective and economical use of the plant resources available in arid lands.

This research perspective has persisted into the present, with the ongoing investigation of industrial resins from *Grindelia*, and a variety of other projects. The biotechnology laboratory was again upgraded in the summer 1984 when Dr. Eunsu Punnapayak came to the Facility, bringing his research on the xylose-fermenting microbe *Pachysolen tannophilus*, and introducing new capabilities for using the Simultaneous Saccharification and Fermentation process to convert plant material, through enzymatic and microbial transformation, into ethanol and

other products.

The newest area of investigation at the Facility is the search for plant-derived pesticides, fungicides, antibiotics, and other biocides. Many plants native to the U.S. southwest contain complex arrays of chemicals they manufacture as adaptations to the extreme conditions of heat, desiccation, and herbivory to which they are exposed in the desert; some of these chemicals are known to be toxic to economically important crop pests. Bioresearch Facility researchers have now begun an exploratory study of this rich, largely unexploited source of new pesticides. Since it has become evident that the future of agriculture will depend to some extent on the development of more specific, less environmentally disruptive methods of pest control, the search for naturally occurring pesticides is a very practical endeavor.

The Bioresearch Facility now has several acres of active experimental plots, more than 3,000 square feet of greenhouse space, a wide variety of analytical and processing capabilities, and a growing staff of research personnel and graduate students. While constantly diversifying the scope of its inquiries and areas of technical expertise, the research unit has maintained its original commitment to the development of marketable new crops for arid, marginally arable lands in the U.S. southwest and elsewhere in the world.

— Barbara Kingsolver  
Information Specialist,  
Bioresearch Research Facility



Project Botanist Stephen  
McLaughlin in *Grindelia*  
demonstration plot at the  
Bioresearch Research  
Facility, May 1984

## INDIAN PROGRAMS

ESTABLISHED IN 1976 through funding from the Economic Development Administration (U.S. Department of Commerce) and the Bureau of Indian Affairs (U.S. Department of the Interior), the Laboratory of Native Development, Systems Analysis and Applied Technology (NADSAT) is a technology transfer program designed to assist American Indian tribes in developing their natural resources. Originally oriented toward management assistance to tribes in Arizona, New Mexico, California and Nevada, it has since extended its interest and assistance to reservations in the Pacific northwest. With a staff having international experience, NADSAT has concentrated on American Indian reservations having many of the same characteristics as other overseas nations.

During the years since its establishment NADSAT staff members have developed an operational philosophy that distinguishes it from other programs through its allegiance to the goals of securing self-sufficiency and self-determination in ways that are harmonious with local cultures. The guiding principles that have ensured the success of NADSAT are four: 1) NADSAT will not initiate projects, but only responds to expressed needs for help; 2) those who seek help must understand that NADSAT's role is not to provide solutions to problems but to help the tribal group to find its own solutions within its own frame of reference; 3) the tribal group must use its own internal resources. NADSAT provides only external professional technical expertise that might not be available internally; and 4) NADSAT will function in such a way as to lessen a tribe's need for outside help, so that decisions or

actions are the responsibility of the tribe.

Some of these cooperative projects have included land use planning, natural resource surveys and development, agricultural potential assessments, commercial mining feasibility studies, and enterprise management assistance. Approaches are tailored to fit into the local situation and the constraints of available natural and human resources for development. In addition to the federal support, occasional funding for specific projects has come from the tribes or nations involved. Since 1979, overall program funding has been provided by the W.K. Kellogg Foundation.

Early NADSAT work focused primarily on natural resource and enterprise development under project directors Mr. Michael E. Norvelle and Dr. Kenneth E. Foster. One of the first projects was a cooperative natural resource inventory for the Papago (Tohono Oodham) Indian Tribe, Arizona. NADSAT and Arizona Remote Sensing Center staff mapped and inventoried the reservation's boundaries, contours, land uses and water systems. The inventory provided information for the tribe's long-term land and water management plan. Other natural resource information surveys were performed for the Hualapai and Hopi Indian tribes, Arizona, and alternate land-use studies were performed for the Cabazon Band of the Mission Indian Tribe, California, and for the San Carlos Apache Tribe, Arizona.

During the summer 1977 NADSAT and Arizona Remote Sensing Center staff conducted an environmental impact assessment under contract with the Havasupai



Donald J. Percious examines a soil profile as part of the Havasupai environmental impact assessment, June 1977



Michael E. Norvelle, Donald J. Percious and Bahé Bill examine a plowed field at the Navajo Agricultural Project, Inc. April 1978

Tribe, Arizona, which was coordinated by Mr. William H. Brooks. The assessment included a look at short- and long-term effects of development on the existing human environment in terms of physical, biological and cultural resources.

Early in 1977 the U.S. Bureau of Indian Affairs contracted with NADSAT to expand its scope by responding to technical assistance requests by Indian tribes under provisions of public Law 93-638, the Indian Self-determination and Education Assistance Act of 1975. In this capacity, NADSAT organized and conducted an Indian self-determination systems workshop and conducted several accounting and business management training sessions. Enterprise development assistance has since been provided to Nevada's Pyramid Paiute-Shoshone Indian Tribe, to Oregon's Warm Springs Confederated Tribes, among other, under the Kellogg grant. This is only a sampling of specific undertakings for the nearly 40 tribes now offered NADSAT's assistance.

Under project director John Little, the NADSAT program now is directing its efforts toward stimulating and helping Indian managers and tribal leaders become more self-reliant in their search for new and different solutions to their development problems. Recent activities have included designing and teaching a graduate-level University course on American Indian management, and publishing various monographs on topics such as tribal taxation and economic development, farming opportunities on Indian reservations, adoption of the Uniform Commercial Code by Indian tribes, development of financing alternatives on tribal lands, and operational

considerations in Indian business enterprises. NADSAT also has provided the forum for organization of the Indian Management Association that is now being incorporated.

Current objectives include developing a strategy to identify, define and resolve the key problem: What major force needs to be brought into play to reverse the long-term increasing lag in social and economic development on Indian reservations? NADSAT is identifying and assembling a group of able, thoughtful, and concerned young Indians with varied backgrounds and interests and is providing the setting, support and rationale for them to come together to share their experiences, conclusions and views of problems facing their respective tribal groups. In addition, NADSAT is seeking to provide the stimulus and atmosphere to foster their discovery of new principles of Indian business leadership, and the professional technical resources to promote further personal growth through the design and development of new learning experiences for other Indian groups.

Initial progress has been promising, with exploration of a wide range of business opportunities, agriculture and forestry, retail and service business, handicrafts and light manufacturing, the relationship between tribal bureaucracies and tribal enterprises, negotiation skills and financial management. NADSAT has supported this beginning to formalize and document this group's rich fund of insights and the embodiment of these principles in further training opportunities.

— John Little  
Project Director, NADSAT



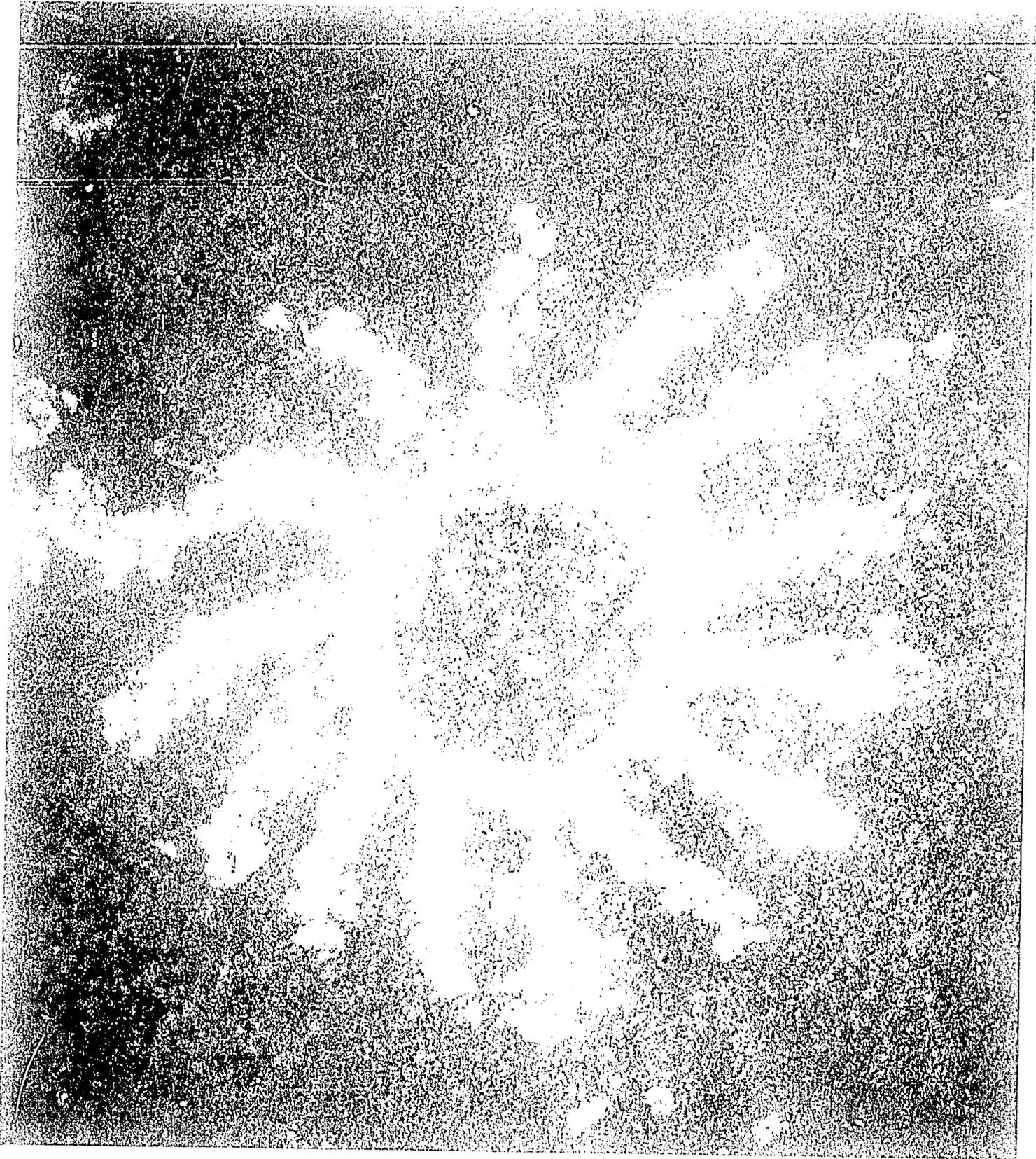
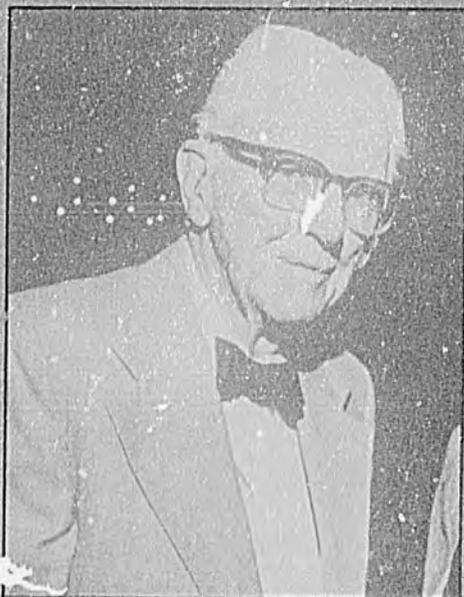


Figure 1. A large, bright, irregularly shaped object, possibly a biological specimen, against a dark background.

# Office of Arid Lands Studies Directors 1964-1985

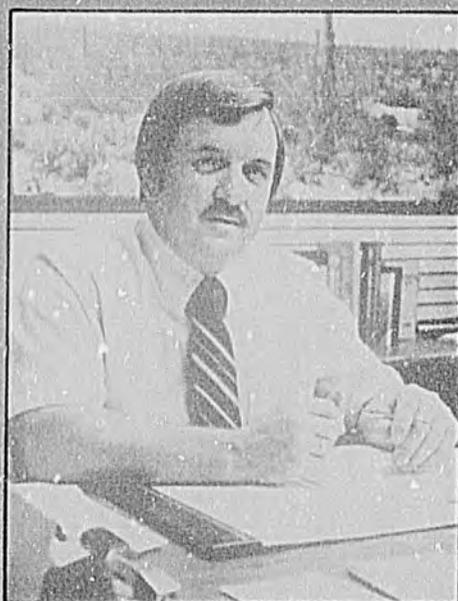
William C. McGinnies  
1964-1969



Patricia Paylore  
1969-1971



Jack D. Johnson  
1971-1983



Kenneth E. Foster  
1983-present