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A PRELIMINARY PROPOSAL

SAFFORD VALLEY
GREENHOUSE COMPLEX

FOR

KENNECOTT MINERALS COMPANY

BY

GEO-AGRI-TECH, INC.

SEPTEMBER 22, 1981

FORWARD

Geo-Agri-Tech, Inc., an Arizona corporation with headquarters in Tucson, Arizona, is devoted to the development of innovative agriculture management for maximum production and profit. Unique marketing techniques and utilization of alternative and more economical energies under environmentally controlled conditions are some of the techniques used to achieve this.

Geo-Agri-Tech, Inc. accomplishes this through the practical application of technology developed over a period of thirty-five (35) years by several universities throughout the world, and applied commercially in worldwide operations by A. W. Gerhart and Gordon R. Wynne, two officers of Geo-Agri-Tech, Inc.

Geo-Agri-Tech, Inc. has selected the Safford Valley, and in particular, the area near a water well located in Section 7, Township 6S, Range 27E, Graham County, Arizona, as an ideal site for development of a greenhouse facility because of the following ideal conditions:

- 160°F. water producing 2300 gallons per minute.
- Favorable climate including favorable mean temperature.
- Suitable transportation facilities, including air, truck, rail and bus.
- Adequate agro-oriented labor supply.
- Educational facilities including junior college.
- Utility facilities.

PROPOSAL

Geo-Agri-Tech, Inc. proposes to Kennecott Minerals Company a joint venture program of controlled environment agriculture.

The joint venture would be incorporated under the laws of Arizona, with start up capital and operating expenses to be paid by Kennecott, and the construction, operation and expertise to be furnished by Geo-Agri-Tech, Inc.

The joint venture company would be called Saffco, Inc., or any other suitable name mutually agreed upon.

The technology developed would be documented in great detail, and all data would be available to both parties.

Precise location of the facility would be determined by mutual agreement following an on-site inspection by both parties.

Geo-Agri-Tech, Inc. recognizes that mining production is the ultimate and primary purpose of the Kennecott Minerals Safford Project. Therefore, it follows that Saffco would be a secondary function to be moved, modified, or terminated if that secondary function appeared to be detrimental to the mining function. Language to accommodate this could be incorporated into the corporate bylaws of Saffco.

FUTURE LONG RANGE BENEFITS TO KENNECOTT

- Means of carrying developing mining properties profitably prior to mineral production.
- Nursery potential and expertise for mine dump beautification.
- Means of demonstrating the long range potability of mine and waste water for beneficial and profitable agro-purposes.
- Environmental public relation benefits.
- A stabilized agro-labor intensive year round facility.
- Creating maximum utilization of past non-productive lands.
- Local increase in tax base.
- Geothermal depletion allowance.
- Forefront of innovative agro-technology that could be applied to other mining properties.
- Could be a useful laboratory for developing and marketing trace element by-products.
- Assist Kennecott in gaining expertise in a new and growing diversified business related to its resource development field but quite separate from the fluctuations so prevalent in the metal market.

CONTRIBUTIONS OF PRINCIPALS

Each company would supply to Saffco, Inc. the following:

From Kennecott Minerals Company:

- $1.5 Million working and start up capital
- Support for IDA tax-free bonding for $8.5 Million (as co-signer)
- Land (50 contiguous acres)
- Water (160°F. @2300 gals./min.)
- Legal

From Geo-Agri-Tech, Inc.:

- Personnel (Labor and Management)
- Consultants
- Operational Expertise
- Plans and Engineering
- R. & D. Technology
- Marketing

FACILITIES

The production facility would consist of a 5-acre greenhouse complex the first year, 15 additional acres the second year, and 20 additional acres the third year.

Construction

Each individual greenhouse unit consists of a metal frame wrapped by plastic, 2½ acres in size. Each unit is environmentally controlled for heat, light, water, and soil bedding condition to selectively control the growing requirements and maturity of each desired agro-product ideally timed to arrive at the marketplace on a year round basis.

A storage area, packing area, and truck loading and transportation distribution area, will be provided.

Other Considerations

Cooperation and an information exchange with the agro-technology departments of the State Universities and Junior Colleges will be encouraged and supported in order to develop a cadre of highly skilled permanent employees to constantly update the latest technologies available.

CONCEPTUAL ECONOMIC PROJECTION
PREPARED FOR KENNECOTT MINERALS
160^{o}F GEOTHERMAL GREENHOUSE FACILITY
LOCATED NEAR SAFFORD, ARIZONA

40 ACRES ($000)

Year	1981	1982	1983	1984	1985	1986	1987	1988
Construct.-Acres	5	15	20	–	–	–	–	–
Produce-Acres	0	12.5	30	40	40	40	40	40
Gross Sales	0	1,650	3,960	5,280	6,336	7,200	7,200	7,200
on Prod.#/Plant		11#	11#	11#	13.2#	15#	15#	15#
Operating Costs								
Rentals: Land	–	–	–	–	–	–	–	–
Equip't.	10	20	36	36	36	36	36	36
Packaging	0	130	255	340	406	463	463	463
Utilities @5¢/Kwh.	6	39	110	178	178	178	178	178
Heating 50¢/MM BTU's	19	75	150	150	150	150	150	150
Water @$32/A.F.	3	5	11	15	15	15	15	15
Supplies & Materials	40	200	480	640	640	640	640	640
Prod. Labor	132	334	900	1,047	1,047	1,047	1,047	1,047
Start Up	150	450	600	–	–	–	–	–
Insurance	5	25	60	80	80	80	80	80
Sub Total Prod. Costs	365	1,278	2,602	2,486	2,552	2,609	2,609	2,609
Indirect Costs								
Marketing	25	132	270	360	405	460	460	460
Overhead (Phone Fees, Mgr., Travel, Legal, etc.)	135	188	190	190	170	170	170	170
Sub Total Indirect Costs	160	320	460	550	575	630	630	630
Results of Operations & Marketing	(525)	52	898	2,244	3,209	3,961	3,961	3,961

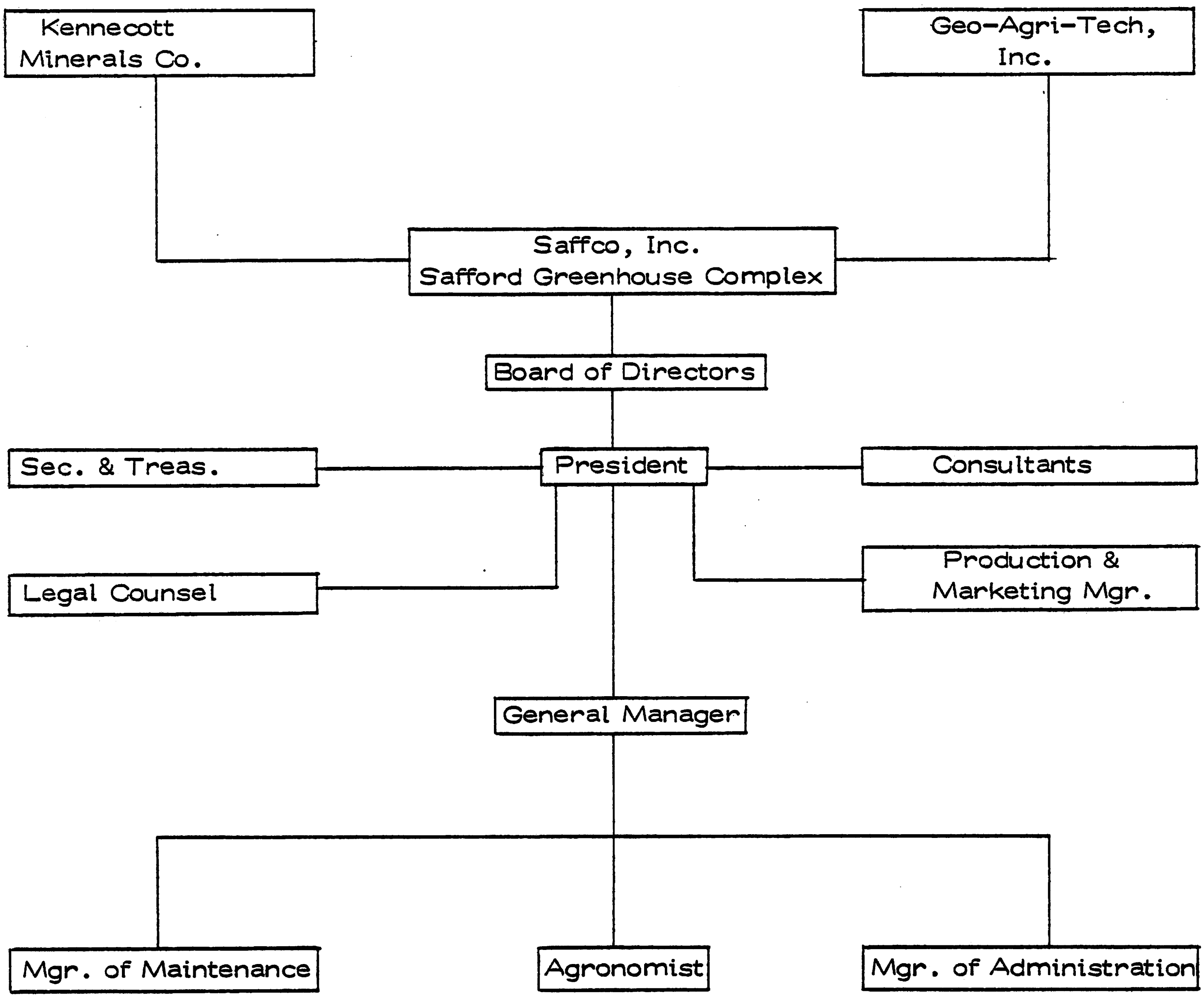
GRW/9-17-81

PRELIMINARY FINANCIAL ANALYSIS & CASH FLOW
PREPARED FOR KENNECOTT MINERALS
160°F GEOTHERMAL GREENHOUSE FACILITY
LOCATED NEAR SAFFORD, ARIZONA
40 ACRES ($000)

Year	1981	1982	1983	1984	1985	1986	1987	1988
Construct.-Acres	5	15	20					
Cash Provided by:								
Kennecott	1,500							
IDA Bonding	8,500							
Results of Operations	(525)	52	898	2,244	3,209	3,961	3,961	3,961
Cash Disbursed for:								
Construction Costs	1,634	3,123	4,000	$8,757 Total Construction				
Mortgage Payments 15% 20 Years	-	-	-	1,343	1,384	1,384	1,384	1,384
Total Cash Disbursed	1,634	3,123	4,000	1,343	1,384	1,384	1,384	1,384
Cash Flow								
Net Increase/Yr.	7,841	(3,071)	(3,102)	901	1,825	2,577	2,577	2,577
Cash on Hand Begin. Yr.	0	7,841	4,770	1,668	2,569	4,394	6,971	9,548
Cash on Hand End Yr.	7,841	4,770	1,668	2,569	4,394	6,971	9,548	12,125

GRW/9-17-81

ORGANIZATIONAL CHART



40 ACRE GEOTHERMAL (160°F.) GREENHOUSE

CRITERIA

USED TO DEVELOP THE CONCEPTUAL ECONOMIC PROJECTION

- 40 Acres by experience has proven to be the ideal management, marketing and growing unit.
- 60¢/# value of crop, 1981, F.O.B. Safford, 10,000 plants per acre, 2 crops/year.
- 4.5¢/# packaging cost.
- Utilities 40 HP/Acre.
- Water @$32/AF, 400 acre feet/year.
- One major chain grocery distributing center uses approx. 12,000,000#/year of tomatoes, which equals the normal production rate of a 40 acre greenhouse.
- Labor would approximate 120 people/40 acre unit.

ANNUAL COST OF HEATING 40 ACRES
(IN U.S. DOLLARS)

1970 – Old Design

Ohio	Natural Gas	$ 277,000	(12%)
Arizona	" "	$ 83,125	(4%)
Mexico	Fuel Oil	$ 240,000	(11%)

1977 – Old Design

Ohio	Fuel Oil	$1,600,000	(72%)
Arizona	Natural Gas	$ 320,000	(15%)
Mexico	Fuel Oil	$ 240,000	(11%)

1981 – New Design

Ohio	Fuel Oil	$2,216,673	(100%)
Arizona	" "	$ 665,000	(30%)
Mexico	" "	$ 125,000	(6%)

1983 – Geothermal/Solar

Ohio	Not Available
Arizona	$ 100,000 (Fixed)
Mexico	$ 100,000 (Fixed)

LIST OF PRINCIPALS (MAJOR)

Gordon R. Wynne, President, Geo-Agri-Tech., Inc., 1865 W. 36th Street, Tucson, Arizona 85713. Mr. Wynne is a world wide consulting Engineer with broad experience in geo-thermal operations, economics, planning, conceptual designing and management.

A.W. Gerhart, Director of Operations & Marketing Geo-Agri-Tech, Inc., Mr. Gerhart is President of Gerhart and Son Greenhouse, Inc., 6345 Avon Belden Road, North Ridgeville, Ohio 44039, and a respected world wide consultant in marketing and producing.

M.E. Cravens, Consultant, Geo-Agri-Tech, Inc., 2120 Fyffe Road, Columbus, Ohio 3210. Dr. Cravens is Professor, Department of Agricultural Economics and Rural Sociology, Ohio State University and an agriculture marketing expert.

Executive Director

E. Grover Heinrichs

Director of Finance

Howard Kincheloe

#4 Squire Sanders + Dempsey
Bruce Kelly
Bob Matria

O'Connor Cavanaugh
Dick Mitchell
Gus Rosenfeld.

FIELDNOTES
From The State Of Arizona
Bureau Of Geology And Mineral Technology

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THERMAL SPRINGS OF ARIZONA

by James C. Witcher

Identification of truly *thermal* springs is an indispensable aid in the assessment of a region's geothermal characteristics. Over the years numerous lists of thermal springs in Arizona have been compiled and we present yet another. Although the word thermal implies heat, there is considerable subjectivism or arbitrariness in its application. In geothermal work what is important is anomalous or unusual heat—something above a norm. A functional scheme has been devised that is useful in identifying those Arizona springs judged to be carrying anomalous heat. The method is readily applied to any new springs that may be encountered. The results of this updated version are shown in Table 1. Also, possible heat sources are briefly outlined in the text.

Defining Thermal Springs

Over the years, springs given the label "thermal" may or may not carry anomalous heat. Likewise, it is possible for springs not so labeled to be anomalously warm. The explanation for this is not difficult; it is to be found in Arizona's regional topographic-climatic variances.

Depending upon the season, the temperature of the earth down to 10 or 20 meters is slightly above or below the mean annual air temperature (MAT). Because springs are surface discharges of water contained in the pores and fractures of rock at very shallow depth, springs tend to have a temperature close to the MAT. Spring temperatures that are much higher than the MAT are thermal springs and their waters are heated by anomalously hot rock near the surface or by circulation through hot rock at much greater depths.

The MAT in Arizona ranges from less than 6°C to over 22°C, primarily because the surface elevation is quite varied; therefore, a similar range in spring temperatures is to be expected. Generally, a thermal spring at a high elevation will have a lower temperature than an equally significant thermal spring at a lower elevation where the MAT is higher. Thus, the MAT provides a baseline from which a thermal spring can be defined from place to place.

However, in order to actually classify a spring as being thermal, some comparisons, or temperature standard above the baseline temperature, is needed. This comparison temperature should fall somewhere between normal spring temperatures and those that are anomalously high and obviously thermal. The temperature distribution of Arizona's springs relative to the mean annual air temperature (MAT) is utilized to find this comparison temperature.

Spring temperatures measured during field work and reported in geologic literature covering Arizona were compiled. All available MAT data for Arizona were plotted and contoured on a map of Arizona in order to determine the MAT at the spring locations. The MAT for individual spring locations is subtracted from the individual measured spring temperatures and plotted on a frequency diagram in Figure 1. A mostly normal distribution of spring temperatures relative to the MAT is evident. The mean spring temperature is slightly above the MAT. This mean spring temperature relates to the average circulation depth of these waters below the surface.

TEMPERATURE DISTRIBUTION OF ARIZONA SPRINGS
RELATIVE TO MEAN ANNUAL AIR TEMPERATURE

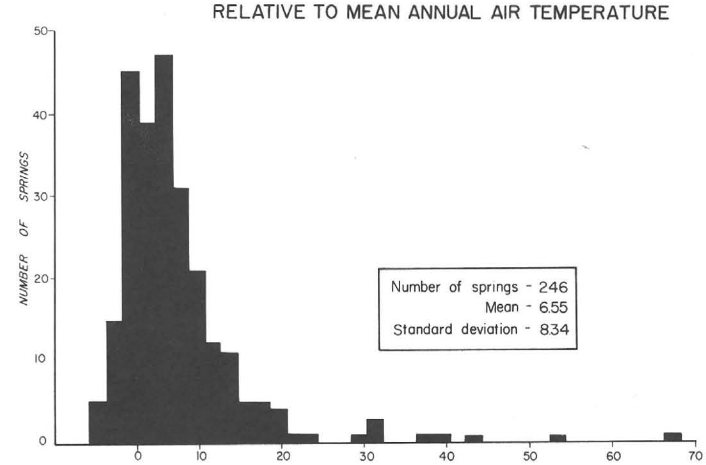
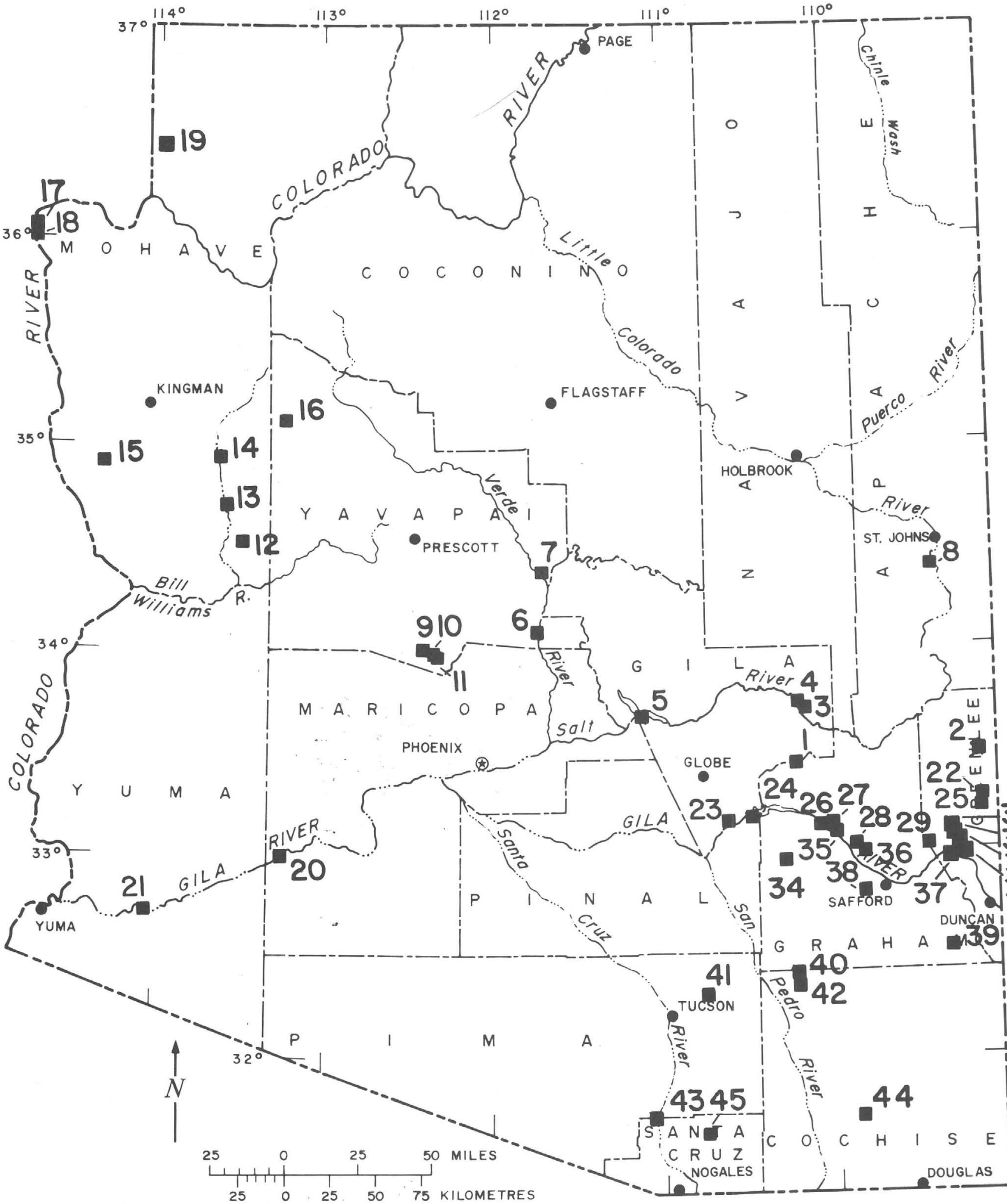


Figure 1. SPRING TEMPERATURE MINUS MEAN ANNUAL AIR TEMPERATURE (°C)

However, the distribution is not perfectly normal when all springs in Arizona are considered. Actually, the distribution appears to have two means with similar standard deviations. When the mean spring temperature of the Basin and Range province is compared to the mean spring temperature of the Colorado Plateau province (Figure 2), a bimodal mean spring temperature is evident, the former being the higher. If the same average circulation depth and average rock thermal conductivities are assumed for both provinces, the difference may relate to the higher conductive heat flow observed in the Basin and Range province. If this is true, the higher mean spring temperature of the Basin and Range springs is caused by a higher average subsurface temperature gradient. It should be pointed out that other explanations are plausible such as differences in surface vegetative cover, average spring flow rates, and seasonal recharge.

IN THIS ISSUE

THERMAL SPRINGS OF ARIZONA



The apparent deviation of spring temperatures below the mean , assuming a normal distribution, is believed to be caused by discharge from perched water tables close to recharge sources and not discharge from the static water table.

Thermal waters may be subdivided arbitrarily into "hot" and "warm." Hot springs for all of Arizona are here defined as those having temperatures that exceed the MAT by the sum of the mean spring temperature for all springs and the standard deviation (Figure 1). Thus, the comparison temperature used to define a *hot spring* is 15°C above a spring's MAT. In the Basin and Range province the comparison temperature used to define a "warm spring" is 10°C above the appropriate MAT. For the Colorado Plateau province 6°C above the MAT defines a "warm spring" (Figure 2). These definitions apply only to Arizona and may vary in

THERMAL SPRINGS OF ARIZONA

#	NAME	LOCATION	T°C	T-MAT°C
1	Warm Spring	A-1-20-12AC*	29.4	14.4
2	Hanna Creek Hot Springs	A-1-31-29AD	55.5	42.5
3	Warm Spring	A-4½-20-36CB*	24.4	10.4
4	White River Salt Spring	A-4½-20-35AD*	28.3	13.3
5	Roosevelt Dam Hot Spring	A-4-12-19DDB	48.0	28.0
6	Hot Spring	A-9-6-26AB*	36.6	17.6
7	Verde Hot Springs	A-11-6-3B	41.0	23.0
8	Salado Spring	A-12-28-17DCA	21.7	11.7
9	Henderson Ranch Spring	B-8-1-33BAC	30.3	11.3
10	Alkalai Spring	B-8-1-33DB	31.2	12.2
11	Castle Hot Springs	B-8-1-34CC	54.7	35.7
12	Kaiser Hot Spring	B-14-12-10AD	37.0	19.0
13	Cofer Hot Spring	B-16-13-25CAD	37.0	18.0
14	Warm Spring	B-18-13-25DB	28.3	10.3
15	Warm Spring	B-18-19-33DC	29.2	10.2
16	Spring	B-20-9-30CC	27.0	14.0
17	Hot Spring	B-30-23-15CBD	32.0	12.0
18	Hot Spring	B-30-23-26BBC	30.0	10.0
19	Pakoon Spring	B-35-16-24BD	28.0	10.0
20	Agua Caliente Spring	C-5-10-19AA	40.0	18.0
21	Radium Hot Spring	C-8-18-12CC	60.0	38.0
22	Spring	D-2-31-35ABB*	25.6	10.6
23	Mescal Warm Spring	D-3-17-20CBC	29.1	14.0
24	Coolidge Dam Hot Spring	D-3-18-17DC	36.6	18.6
25	Miguel Raton Spring	D-3-31-3ADC	26.7	11.7
26	Spring	D-4-23-21AA	27.2	10.2
27	Spring	D-4-23-21AD	31.5	14.5
28	Tom Niece Spring	D-4-23-22BD	28.3	11.3
29	Eagle Creek Hot Spring	D-4-28-35ABB	42.5	25.5
30	Clifton Hot Spring	D-4-30-18CCD	70.0	53.0
31	Clifton Hot Spring	D-4-30-18CDC	50.0	33.0
32	Clifton Hot Spring	D-40-30-19CAA	33.0	16.0
33	Clifton Hot Spring	D-4-30-30DBC	38.0	21.0
34	Warm Spring	D-5-19-23BDD	26.0	11.0
35	Indian Hot Springs	D-5-24-17AD	48.8	30.8
36	Spring	D-5-24-16CB	33.0	16.0
37	Gillard Hot Spring	D-5-29-27AAD	84.0	67.0
38	Spring	D-7-24-13DC	29.4	12.4
39	Spring	D-10-29-23DD	26.1	10.1
40	Spring	D-12-21-31CA	32.5	17.5
41	Agua Caliente Spring	D-13-16-20CDD	32.0	12.0
42	Hookers Hot Spring	D-13-21-6AAC	52.0	37.0
43	Agua Caliente Spring	D-20-13-13BA	27.0	11.0
44	Antelope Spring	D-20-24-21DC	25.5	10.5
45	Monkey Spring	D-21-16-3C	28.3	13.3

*Unsurveyed

other states having different geological terrains and subsurface geophysical properties.

Origin of Thermal Springs

Thermal springs, as herein defined, originate from a combination of special conditions. These conditions are basic elements in any geothermal system and they have to work in concert before a system can exist naturally. These elements are: (1) a heat source; (2) a recharge source; (3) a circulation framework or storage reservoir; and (4) a discharge mechanism.

The most basic element is the heat source because it alone separates geothermal spring systems from all others. In Arizona, igneous heat sources are tentatively ruled out because no Recent or Pleistocene silicic volcanism is known. Silicic magma is very viscous and tends to collect in large shallow storage sites. These bodies of magma contain enormous quantities of heat and may require several hundred thousand years to cool to ambient temperature, thereby providing significant heat to overlying rocks and contained fluids.

Recent and Pleistocene basaltic volcanism is known in Arizona; but intrusions related to this volcanism are small plugs, dikes and sills, because basaltic magma is very fluid. Small plugs, dikes and sills cool to ambient temperature in a few months or years and contribute only minor quantities of heat to the surrounding rocks.

A COMPARISON OF TEMPERATURE DISTRIBUTION OF SPRINGS IN THE COLORADO PLATEAU AND BASIN AND RANGE PROVINCES

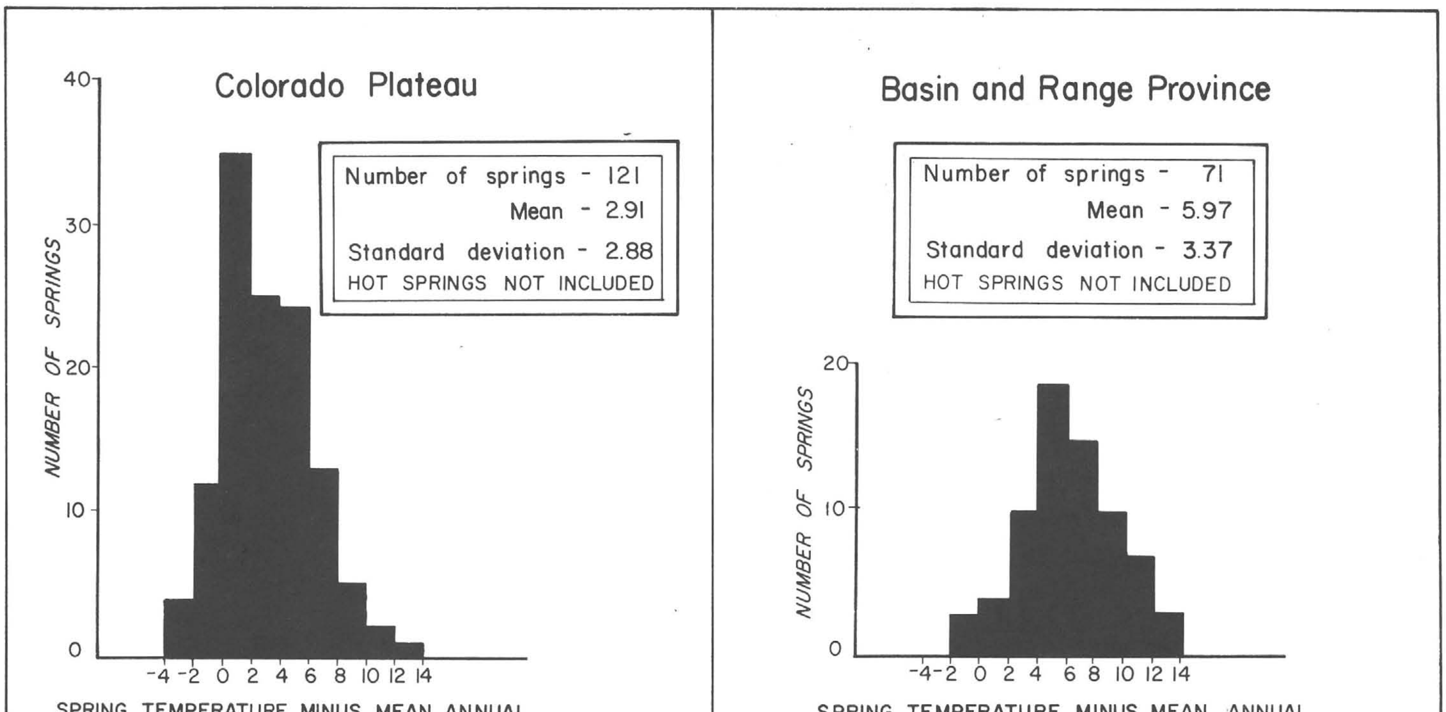


Figure 2.

The normal flow of heat from the earth's interior is probably the major source of heat for Arizona's thermal springs. The earth's internal heat flows or is conducted through rock toward the surface. Subsurface temperatures in Arizona generally increase at least 30°C for every kilometer of depth; therefore, water circulating deeper than 300 meters for a period of time will be heated by subsurface rocks a minimum of 10°C above the MAT. Provided little loss of heat occurs on the way back to the surface, these circulating waters will discharge as thermal springs.

The detailed mechanics and geologic conditions required for deep circulation of water are beyond the scope of this article. However, it is believed that forced convection accounts for Arizona's thermal springs because the vertical permeabilities in fault zones and Arizona's subsurface temperature gradients are too low for free convection. Free convection is buoyant flow of water caused by a temperature-induced vertical differential in water density. Forced convection is pressure-induced water flow caused by elevation differences between the recharge water table and the springs discharge elevation. Deep forced convection requires special structures, stratigraphic geometries and geohydrologic conditions.

Studies of Arizona's thermal springs are but a part of the Arizona Bureau of Geology and Mineral Technology's assessment and characterization of Arizona's geothermal resources. The entire study is being funded by the U.S. Department of Energy.

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GEOTHERMAL

On January 16, 1981, the Geothermal Project of the Bureau of Geology and Mineral Technology, Geological Survey Branch, received a one-year contract renewal to continue the low- to moderate-temperature geothermal site evaluation in the state of Arizona during 1981. Funds for this year's program, $274,918.00, again came from the U.S. Department of Energy, Division of Geothermal Energy.

This year is the final year for the program. Work, therefore, will focus on completing the statewide geothermal resource assessment and on closing down the program. All data and reports generated over the lifetime of the program will be indexed and catalogued into a format that is useful and easily accessible to future workers. Everything will be left on file at the Bureau of Geology and Mineral Technology. A final report on the geothermal resource potential of Arizona will be prepared.

Many areas with potential geothermal energy favorable for direct use have been identified in the state. It is hoped that development of these resources will be carried out by the private sector.

Claudia Stone, Geologist with the Bureau since 1977, has been selected Program Manager for the Geothermal Project. Claudia began geothermal study in 1975 when attending the University of Hawaii. She received a M.S. in Geology and Geophysics in Hawaii (1977) and a B.A. in Journalism from Marquette University (1961).

Starting as Research Assistant for the Tucson Geothermal Project, Claudia has developed various geothermal studies in the state, including the Papago Farm investigation. As Program Manager, she will oversee the final phases of the geothermal program in Arizona.

W. Richard Hahman, Sr., Principal Investigator and Program Manager of the Geothermal Project with the Bureau of Geology and Mineral Technology, left the Bureau in May 1981 to be a consultant and Chief Geologist for an energy and mineral company in Santa Fe, New Mexico.

Dick has been with the Bureau since May 1977, investigating and assessing geothermal resources in Arizona, through funds supplied by the U.S. Dept. of Energy and the U.S. Dept. of the Interior.

Hahman graduated with a B.S. in 1960 from American University and a M.S. in geology at West Virginia University (1963). During the last 20 years, he has developed expertise in the exploration of geothermal energy, porphyry copper, molybdenum, massive sulfide, Mississippi and East Tennessee-type deposits. Dick has worked as an independent consulting geologist in Arizona, California, Nevada, Oklahoma and Utah. He has also been employed by Cominco American Inc. (1970–74), North Carolina Division of Mineral Resources (1965–1970), The Bear Creek Mining Co. (1965), Duval Corp. (1964–65) and the Superior Oil Co. (1963–64).

OPEN FILE REPORTS

Open File Reports are being cataloged and indexed by Bureau staff. These reports were prepared by the U.S. Geological Survey, the Department of Energy and the Bureau of Geology and others. They are available for public review.

Bureau of Geology and Mineral Technology Staff

NEW STAFF

Meliton Garcia ("Mel") obtained his B.S. degree in Mining Engineering from the New Mexico Institute of Mining and Technology at Socorro in 1959, and his M.P.H. in Public Health from the University of California, Berkeley in 1963.

Mel joined the staff of the Bureau of Geology and Mineral Technology on October 1, 1980 as an Industrial Hygienist. He also serves as an Adjunct Professor at the College of Mines and is Assistant Director for Mine Safety and Health in the Department of Mining and Geological Engineering at the University of Arizona.

His work experience includes the following: Junior Mining Engineer at San Manuel Copper Corporation (now Magma), Field Technician in the Uranium Miners' Study by the State of New Mexico; Industrial Hygiene Engineer and Supervisory Industrial Hygiene Engineer with the Boeing Company, Commercial Airplane Division; Regional Industrial Hygiene Engineer with Gulf Oil Corporation; Manager of Occupational Health with Tenneco Inc.; Industrial Ventilation Engineer with Los Alamos Scientific Laboratory; and Manager of Safety and Health with Tenneco Automotive.

Tom L. Young, Research Metallurgist, has over 18 years experience in metallurgical processing. He has developed operational, engineering, research, design, consulting and managerial experience in nearly every phase of copper production, from the manufacture of flotation reagents to the application of copper and copper alloys in aerospace and electronics. Tom has been with the Bureau since September 1980 and is currently studying processes for the secondary recovery of precious and base metals from scrap, factors affecting the differential flotation of copper and molybdenum minerals, as well as the electrometallurgy of base metals in halide solutions.

Tom received a B.S. in Chemistry from the University of Oklahoma in 1959 and a M.S. in Metallurgical Engineering in 1964 from Iowa State University. He most recently worked as Chief Metallurgist of Concentrators at Phelps Dodge Corp. (1979–80). Prior to this, he was General Manager of Kerley Chemical Corp. (1977–79), Assistant Smelter Superintendent (1976–77) and Metallurgical Director (1970–76) at Magma Copper Co., Research Engineer with the Boeing Co. (1966–1970) and Assistant Research Engineer at Phelps Dodge (1965–66).

Stephen J. Reynolds began working at the Bureau on February 16, 1981 as a geologist. He received his undergraduate education in geology at the Colorado School of Mines and the University of Texas at El Paso (B.S. in 1974). In 1977 he completed his M.S. at the University of Arizona. Steve is currently finishing his Ph.D. in geosciences at the University of Arizona.

During the past eight years, Steve has worked for the University of Arizona, the U.S. Geological Survey, Conoco, Inc., and Homestake Mining Company. He has published over 20 geological articles and was recently a co-principal investigator on a U.S. Department of Energy subcontracted study entitled, "Cordilleran metamorphic core complexes and their uranium favorability." Steve has a wide range of geologic expertise, including tectonics, structure, geochronology, and mineral deposits of the western United States. His main responsibility with the Bureau is updating and revising the Geologic Map of Arizona.

Christopher M. Menges began full-time employment as a geologist with the Bureau on April 1, 1981. Chris has been associated with many research and teaching positions at the University of Arizona Geoscience Department since 1974 and at the Bureau since 1979. His scientific research has centered on Quaternary tectonics, tectonic hazard evaluation and analysis of complex fault systems. At the present time he is preparing a Quaternary map of Arizona with Dr. Roger Morrison directing the project, and co-investigating neotectonics in the state. Both projects are being funded by the U.S. Geological Survey.

Chris received his B.S. in Geology from the University of Washington and expects to receive a M.S. in Geosciences in 1981 from the University of Arizona.

FAREWELLS

William H. Dresher, Dean of the College of Mines and Director of the Bureau of Geology and Mineral Technology will be leaving his position at the University of Arizona in June to become president of the International Copper Research Association.

Dr. Dresher received a B.S. in Chemical Engineering from the Drexel Institute of Technology and his PhD in Metallurgy at the University of Utah. After working for 15 years with Union Carbide Corporation as a research manager in the nuclear, mining and metals divisions, Dr. Dresher was appointed Dean of the U of A College of Mines in 1971. During the past 10 years, he has encouraged the strengthening of various geologic and mineral-related programs, and has helped implement the development of the Mine Reclamation Center, the Mining and Mineral Resources Research Institute and the Geothermal Project.

Stanley B. Keith, Geologist, will leave the Geological Survey Branch of the Bureau in June to work as a private consulting geologist.

Stan obtained a B.A. in Philosophy in 1972 and M.S. in Geology in 1978 from the University of Arizona. Best known for applying plate tectonics to Arizona geology, he has specialized in the Laramide Orogeny and its porphyry copper deposits.

His contributions since starting at the Bureau in March 1978 include: conceiving and supervising a computer compilation of Arizona base and precious metals and molybdenum-reported production from Arizona mines. Keith also compiled a new Laramide outcrop map on Arizona (which includes parts of New Mexico, Northern Sonora and Southeastern California). This map is currently being edited for publication. Stan was a co-participant with Dr. Peter Coney and Stephen Reynolds in a DOE-funded grant, entitled, "Cordilleran Metamorphic Core Complexes and Their Uranium Favorability", which details the geochemistry and tectonic significance of exposed plutonic rocks, especially the documentation of peraluminous muscovite-bearing granitoids.

Keith has written numerous articles, given talks and led many field trips that emphasized mid-Mesozoic, Laramide and mid-Tertiary tectonics and mineral deposits in southeast and westcentral Arizona. He also charted progress on the "great southwestern overthrust oil and gas play".

Douglas J. Robinson, Metallurgist and Adjunct Associate Professor of Metallurgical Engineering at the University of Arizona, left the Bureau in April 1981. Dr. Robinson's area of responsibility included coordinating communications and cooperative research between engineers in industry.

He obtained a B.S. in Metallurgy from the University of British Columbia in 1967 and a Ph.D. from the University of Sheffield, England in 1970. From 1970–1977, Dr. Robinson worked at Cominco Ltd. in British Columbia as a Research Metallurgist and pilot plant engineer. He was employed by Air Products and Chemicals, Inc. as Senior Process Engineer during 1978 and 1979, and the Bureau of Geology in 1979.

continued on p. 12

THINGS GEOLOGIC

No Rocks, No Ice Cream

by H. Wesley Peirce

No rocks, no ice cream? If you are an aspiring amateur ecologist, or even a professional, take a moment to reflect on this question. Obviously, this is an exercise in linkage—the essence of ecology. Just in case you haven't caught on, allow me to provide a hint so we can move on. The general chain of dependency is: rocks, minerals, soil, grass, cow, milk-cream, ice cream—no rocks, no ice cream. We could make this everlastingly complicated by adding all of the other requirements: people make ice cream, tools and materials are required, but each, in turn, follows a dependency chain back to rock and even beyond. Try this game with children at the dinner table or in the classroom. In fact, you might ask the question: "Is there any man-influenced thing in this room that you can see or touch that does not have rocks as a requirement for its existence?" The logic is simple enough and the message is profoundly fundamental and insightful. This ecological truth seems, almost universally, to go unrecognized in our modern technosociety. We appreciate sunlight as essential to life, as well as air, water and soil—but rocks?

Recently, I saw a conservation-oriented booklet produced for an Arizona program that states: "The earth is made up of two main parts—soil and plants." Nonsense! If we humans are to find a formula to sustain human existence on this planet, it is essential that we gain some common insights into what its real nature is. Most of us know little about our bodies and even less about the earth.

The non-living earth and all of its non-living parts, features (including the atmosphere and hydrosphere) and processes are "things geologic." Interpreting the geologic record indicates that the earth underwent a long preparation time before it was capable of sustaining even the simple forms of first life. All life is dependent, therefore, it is axiomatic that these dependencies pre-exist. The order of appearance on earth of the three major kingdoms, from older to younger is: Mineral, vegetable, animal—not the reverse. In this classification, "things geologic" could substitute for "mineral." It is therefore the earth—things geologic—that is in control, not humankind. Attributed to American philosopher, Will Durant, is the thought: "Civilization exists through geological consent, subject to change without notice." The insights inherent in this idea deal with an ecological truth that warrants further thought and investigation.

For several years I had the good fortune of being one of five instructors at an Arizona-based Institute of Desert Ecology for adults. I say good fortune for a number of reasons, one being that it gave me an opportunity to witness the reactions of people being intimately introduced to the earth for the *first* time in their lives. Once in a while, we had a distinguished visitor or two with time enough to visit but one of our five groups. They usually selected geology because they recognized that it was their weakest subject. One visitor, a well-known outdoor writer for an Arizona newspaper now includes a geologic tidbit in many of his articles.

It is true that the formal science of geology can be intimidating if a prerequisite to actually thinking, doing and feeling geology is the learning of a special language. If one wished to set out to discover new oil, it would help to know formal geology. However, to reflect upon the role that oil, a thing geologic, controlled by things geologic, plays in the everyday functioning of all techno-societies does not require a formal geologic education. Rather, it requires only a willingness to nurture a sense of curiosity.

The term *geologic* is especially useful if it can be made to convey four important earthly characteristics: 1) the idea of great antiquity or age, especially relative to humankind; 2) the concept of nonrenewability, limitation, depletion or finiteness; 3) the inequality in the distribution of things geologic (especially mineral-energy raw materials) within the earth; and 4) that most things geologic are beneath the earth's surface where they cannot be directly observed. Out of sight, out of mind? Some elaboration of these four ideas may be useful.

We use geologic time to mean thousands, millions, and billions of years. Almost everything we use that is of the earth has a geologic age for which most of us have little or no knowledge or appreciation. As an example, much of the crude oil being pumped from the earth is greatly in excess of 100 million years in age. So long to be formed and preserved—so quickly consumed. The next time you fill up at the gas station, try to recall the general antiquity of the diverse things that make a fill up possible. The ubiquitous metallic equipment might very well have originated from ores that are more than a billion years in age.

No doubt, if you live in Arizona, cement from this state was used in constructing your dwelling. The basic ingredient, limestone, is supplied by Arizona geologic units that generally exceed 300 million years in age. These are examples of how our daily lives are surrounded and supported by myriad products made possible by events of the distant geologic past. The contemplation of geologic time can indeed humble a person.

The concept of *nonrenewability-depletability* stems from the fact that for all practical purposes there is but one crop of mineral and fossil energy materials. There is but one basic crude oil supply, and it was here, in the earth, long before humans put in an appearance. The same could be said for most earth material resources. Many of Arizona's copper deposits were first emplaced in rocks at depth and moved closer to the earth's surface through diverse processes acting over a span of 50 million years or more. Actually, the large, generally mined out, copper deposit at Jerome is in excess of one billion years in age. Geologic time and nonrenewability go hand in hand.

The idea of nonrenewability-depletability is not new, although in this day of increasing environmental and ecological awareness, it is frequently invoked to convey a sense of impending doom akin to a herd of buffalo approaching a high cliff. The practical effect of the fact of nonrenewability is, at first, to induce change in ways often imperceptible. However, a belated appreciation for the realities behind the principle can lead to political actions that cause rude awakenings. Such is the nature of the world oil story. Representatives of the oil-rich Middle East, and others, decided to value more highly their prime wasting asset, oil. This induced the world community to begin to consider alternatives in preparation for the day when the nonrenewability factor becomes evident in declining production and even higher prices. Lead time is all important in a technological world if severe dislocations are to be avoided or minimized. The inability of supply to keep up with demand should be reflected in pricing, the first manifestation of change. Unless government artificially restrains costs, costs should get our attention long before the theoretical exhaustion of any given geologic raw material, including groundwater beneath Tucson.

The twin concepts of geologic vintage and nonrenewability, if generally recognized and appreciated, could reinforce the willingness of humankind to strive for moderation in the demands it makes of the earth. Sobering is the fact that modern civilization "rocks" along with very few ultimate answers in hand. Faith is very much a part of the human experiment. One thing we know is that at a time when many of the world's countries have rising expectations, the discovery of required additional geologic resources grows increasingly difficult. As we ask more of the earth, demands for more and better trained earth scientists should increase.

A most relevant and useful concept in understanding international and provincial human affairs is the geologic fact of *unequal* distribution of earth material resources around the earth. In a competitive, technological world, one can anticipate that attention will be focused wherever there are unusual concentrations of materials deemed valuable, useful, essential, critical or strategic. Middle East oil is a good example that illustrates the point. Governments recognize such "facts of life" long before their citizens do. No doubt many lives have been lost in wars waged for pragmatic reasons generally unknown to those making the ultimate sacrifice. We have all heard of the energy crisis. There are some in government and elsewhere who honestly feel that a mineral crisis is in the offing. For this, the scene includes those portions of Africa that are unusually endowed with varieties of metallic ore that are considered strategic or crucial to our country's military and industrial base. Zaire and Zambia supply two-thirds of the world's cobalt. The U.S. consumes 20 million pounds each year while producing none. Cobalt is vital to the aerospace industry where it is used in making high-temperature alloys. This part of Africa is to cobalt what the Middle East is to oil. We will not understand or even be able to mitigate the tensions in world affairs until we become better informed about things geologic that are frequently at the root of these tensions.

The last geologic idea that I would like to emphasize is the fact that most of the earth-derived materials that go into many of the material aspects of our modern techno-societies, are exploited from *beneath* the earth's natural surface. The deepest ventures are oil-gas wells, the shallowest are various rock-stone quarries and sand-gravel-clay pits. All others are of intermediate depths. Most persons seem totally unaware of where the materials they utilize come from or the problems associated with resource discovery, development and preparation. Let's face it, most of us are consumers, not producers.

Production, or lack thereof, has its consequences and tradeoffs. This is true for all industrial societies regardless of political philosophy. We still live in a competitive world where the competitors should be taken seriously. The level of competition now reaches far beyond national boundaries and is, therefore, global in scope. Many see little or nothing encouraging in the future of mankind. The root of our budding concern is the "carrying capacity" of the earth. Though this is an expression used by wildlife managers-scientists, the ecological realities apply just as well to humans. Although the principles are the same, the actual application to technological man is very complex. Just try to inventory the geologic resources involved in the support of a Phoenix lifestyle. Taking just food as an example, who knows where the soils are that, in part, grew the hundreds of food items that are transported and stocked daily? Most are not in Arizona. On the other hand, it is much simpler to directly inventory the food-soil factors that support a deer herd.

The destiny of humankind and human potential is circumscribed by an old and "shrinking" earth with a fixed endowment of unequally distributed, often hidden resources. It is by utilization of this inheritance of things geologic that increasingly complex human civilizations have been possible. Beyond the question of reserves of natural resources is the capacity of mankind to manage increasing complexity. Some are suspicious that man could fall victim to his own management inadequacies prior to actual debilitating resource shortages. Certainly, the roots of modern techno-societies are lengthy, complex and vulnerable. That the system continues to function is a credit to mankind. The industrial powers covet the same material resources, things geologic, vital to the continuance of a lifestyle to which much of the world has become accustomed. The problems and their solutions are global in scale. How to organize in order to seek peaceful solutions to a looming problem of world-wide resources management—that is the question. Remember: no rocks, no ice cream!

ANNOUNCEMENTS

The Utah Geological Association is sponsoring a 1982 field trip on the overthrust belt of Utah during September 20–22, 1982. Further information on the field trips and manuscripts for the guidebook will be announced at a later date.

Mr. William E. Allen is retiring from his position as Executive Secretary of the State Oil and Gas Conservation Commission June 30, 1980 where he has been employed since 1970. He will be succeeded by Mr. A. K. Doss, who has been Manager of the Minerals Section of the State Land Department for the past eight years. Mr. Doss begins his new job June 1, 1981.

Please note the following correction to "Desert Runoff: Hazards in Arizona" (DuBois and Parks) in Vol. 10, No. 4, p. 7, col. 1, line 8. The sentence should read: "Results of one study (Slezak, 1980) along the Rillito River in Tucson indicate that channels can migrate locally as much as *818 feet* horizontally during single high-flow events..."

An error also occurred in the "Selected Flood Summary and Cost Estimates in Arizona" chart, on page 2 of Vol. 11, No. 1. The numbers listed under "Losses (millions of $)" should contain periods, rather than commas. For example, the first entry, $6,636 should be $6.636.

PUBLICATION

Circular 21, *The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States—Arizona* was prepared by H. Wesley Peirce of the Arizona Bureau of Geology and Mineral Technology, in cooperation with the U.S. Geological Survey. Originally published by the USGS in 1979 as Geological Survey Professional Paper 1110-Z, this study offers a "historical review and summary of areal, stratigraphic, structural and economic geology of Mississippian and Pennsylvanian rocks in Arizona." Circular 21 is available from the Bureau of Geology and Mineral Technology for $2.50, plus 20% handling charge, if mailed.

NATIONAL/REGIONAL EVENTS

U.S. Geological Survey (Denver)—Cambrian System, 2d International Symposium with field trips, Golden, Colorado, August 9–13, 1981

Association of Engineering Geologists—Annual Meeting, Portland, Oregon, September 27–October 2, 1981

University of Nevada, Continuing Education, Mining & Engineering, Reno, Nevada:
- Zoning in Volcanic & Subvolcanic Mineral Deposits—Conference, October 5–8, 1981
- Volcanic Rocks & Their Vent Areas—Conference, October 5–8, 1981
- Fundamentals of Mining—Conference, October 5–8, 1981
- Mining Law—Conference, October 23–24, 1981

Society of Exploration Geophysicists—Annual Meeting, Tulsa, Oklahoma, October 12–16, 1981

Society of Mining Engineers of AIME—Annual Meeting, Denver, Colorado, November 18–20, 1981

Earth Science Information: State Agencies

Have you ever wanted information about some aspect of rock or other earth materials, earth processes, the geologic setting, mineral resources, or water resources but did not know who to ask? If so, then this summary may be helpful. This initial effort is restricted to State agencies. In a later issue we will prepare a similar summary of federal and other agencies. This is not an attempt to describe in detail organization structures, but merely to tell the basic mission and some of the services, products, and types of information provided. Some agencies such as the State Land Department and the Department of Water Resources are large and complex and, therefore, the summary given is admittedly incomplete.

State of Arizona
BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY
Tucson, Arizona
Director: William H. Dresher (602) 626-1401
Geology and Mines Building
University of Arizona
Tucson, AZ 85721

Geological Survey Branch: Larry D. Fellows, Assistant Director and State Geologist (602) 626-2733
845 N. Park Ave.
Tucson, AZ 85719

Mineral Technology Branch: William G. Davenport, Assistant Director (602) 626-1943
Geology and Mines Building
University of Arizona
Tucson, AZ 85721

PURPOSE: A scientific, investigative and information agency; conducts research and provides information about the following:

1. Earth materials and processes (geologic setting)
2. Origins and occurrences of mineral resources (metals, non-metals, mineral fuels, geothermal)
3. Impact of things geologic, including natural hazards, limitations and natural attributes.
4. Mineral technology

SERVICES AND PRODUCTS:
Geological Survey Branch (602) 626-2733
Consultation, assistance and information about
—the state's geologic setting
—geologic materials present at the surface and in the subsurface
—geologic origin and occurrences of mineral resources
—impact of the geological setting on land use in industrial, urban and agricultural sectors
—geologic hazards (seismicity, subsidence, landslides, etc.)
—published and unpublished geologic maps and reports
Publications for sale over the counter or by mail (price list available)
Geologic library includes periodicals, state and federal agency reports, maps, open-file reports, selected theses, etc.
Repository of rock cuttings and cores from petroleum and geothermal exploration drilling
Geology field trips
Talks on the geology of Arizona and related subjects
Geothermal Group (Geological Survey Branch):
Claudia Stone, Project Manager (602) 626-4391
Information about areas within Arizona that may have potential geothermal resources
Geothermal water temperature data
Library of maps and reports pertaining to geothermal resources
Reports on geothermal potential in portions of the state
Mineral Technology Branch (602) 626-1943
Information on metallurgical problems
Laboratory metallurgical research and testing on metallic and non-metallic mineral substances. Nominal fees are charged for some services.
Classification, free of charge, of mineral and rock specimens that originate within Arizona. Qualitative tests for the important chemical elements are made if appropriate. A $3.00 per sample charge is made for those samples originating outside of Arizona. Spectroscopic analysis and X-ray studies are done at established rates (a schedule of which will be furnished on request).

ARIZONA DEPARTMENT OF MINERAL RESOURCES
Mineral Resources Building
Fairgrounds
Phoenix, AZ 85007
John H. Jett, Director (602) 255-3791
Tucson Office:
State Office Building
415 W. Congress
Tucson, AZ 85701 (602) 882-5399

PURPOSE: To aid in the promotion and development of the State's mineral resources. Provide technical assistance to prospectors and operators of small mines, with emphasis on individual properties.
SERVICES AND PRODUCTS:
Consultation, advice, field assistance;
Information about mineral commodities, mineral exploration, and mining processes, State and Federal mineral laws, land and mineral ownership status, and claim staking.
Studies of effects of economic problems and impact of governmental regulations on prospecting and mining.
Library of technical books, reports, and maps on minerals, mining and processes.
Files on individual mines and mineral occurrences.
Mine map repository.
Publications—mineral reports, directories, information circulars, maps of mineral occurrences (list available)
Mineral museum—school and group tours with programs (no charge); talks on minerals; assistance in mineral identification.
Monitor prospecting and mining activities.
Conduct seminars on prospecting and other aspects of mineral resources in outlying areas of the state.

ARIZONA STATE LAND DEPARTMENT
1624 West Adams St.
Phoenix, AZ 85007
Joe T. Fallini, Commissioner (602) 255-4621
Robert K. Lane, Deputy Commissioner (602) 255-4621

PURPOSE: To manage State Trust Lands for the benefit of common schools and other state institutions.

SERVICES AND PRODUCTS:

Minerals Section (602) 255-4628

Provide information about state mineral statutes, rules and regulations and Department policies relative to minerals.

Investigate and record mineral occurrences on State Trust Lands.

Issue leases for mineral (metals), oil and gas, common minerals (sand and gravel, limestone, decomposed granite, etc.) and geothermal.

Issue permits for mineral exploration.

Leasing Section (602) 255-4602

Maintains tract book records of all activities (including grazing, agriculture, mineral leases, and others), past and present, on State Trust Lands.

Information Resources Division (602) 255-4061

Serves as the Arizona affiliate of the National Cartographic Information Center (NCIC).

Make available the following maps and imagery prepared by the U.S. Geological Survey (USGS) and other agencies:

USGS topographic maps

Land status maps showing State Trust Lands and BLM National Resource Lands

USGS slope maps, flood prone area maps, and urban area study maps.

Assist in determining availability of imagery from LANDSAT, manned Spacecraft, NASA, and USGS aerial photography.

Maintain and provide equipment for viewing and interpreting air photos and imagery.

Packet showing maps available.

ARIZONA DEPARTMENT OF WATER RESOURCES

99 E. Virginia St.
Phoenix, AZ 85004
Wesley E. Steiner, Director (602) 255-1550

PURPOSE: To manage the State's water resources, in accordance with the Groundwater Management Act, signed by Governor Babbitt, June 12, 1980.

SERVICES AND PRODUCTS:

Water Rights Division (602) 255-1581

Provides information on water well drilling and the legal aspects of water rights.

Issues permits for drilling water wells.

Serves as repository for drillers reports.

Hydrology Division (602) 255-1586

Information about availability of water.

Participates in cooperative program of data collection with U.S. Geological Survey (USGS):

USGS maintains stream gaging stations and records.

Dept. of Water Resources maintains groundwater index (observation) wells and records (quality and quantity)

Issues reports on groundwater conditions

a. Annual summary based on index wells.
b. More detailed reports on individual groundwater basins.

Dam Safety Division (602) 255-1541

Responsible for all non-federal dams above a certain size.

Answer questions about construction of dams.

Issues permits to build dams.

Flood Control Branch (602) 255-1566

Answer questions about flood insurance, based on 100-year flood maps.

Flood control projects.

OIL AND GAS CONSERVATION COMMISSION

1645 W. Jefferson
Phoenix, AZ 85007
A. K. Doss, Executive Director (602) 255-5161

PURPOSE: Encourage the development of and prevent waste of oil, natural gas, geothermal, and helium resources on *all lands within the state*.

SERVICES AND PRODUCTS:

Information about drilling activities.

Oil, gas, geothermal, and helium production statistics and records of past drilling activities.

Maps showing well locations and oil pools.

Geological reports and cross sections on specific areas (list of publications available).

Well temperature data.

Issue permits to drill exploration and development wells.

Supervise the drilling, operation, maintenance and abandonment of wells.

AVAILABLE INFORMATION ON MINERAL PROSPECTING

Several 8½" x 11" fact sheets and other documents that describe various aspects of prospecting are available from the State Department of Mineral Resources, Mineral Resources Building, State Fairgrounds, Phoenix, AZ 85007 (602/255-3791). Titles of these items, available at no charge, are listed below:

Arizona Land Ownership Status (Circular No. 2)
Laws and Regulations Governing Mineral Rights in Arizona
Prospects and Prospecting
Maps and Books for Arizona Gold and Gold Prospecting
Severed Mineral Rights
Patenting a Claim
Sample Location Notice (Lode)
Sample Location Notice (Placer)
Claim Map—Instructions
Assayers and Assay Offices in Arizona
Elements of Mining Ventures—Possible Indications of Fraud
Heap Leaching Gold—Why so many Failures?
Gold and Silver Cyanide Leaching Checklist
Useful Units of Measure for the Prospector

The Department of Mineral Resources also has other publications. A list is available at no charge.

POSITION ANNOUNCEMENT

Geologist (Economic/Structural)
Bureau of Geology and Mineral Technology
Geological Survey Branch
Application Deadline: July 31, 1981

Responsibilities: Conduct independent geologic field observation, analysis and mapping; Conduct original research on various aspects of mineral and energy resources; Write proposals for outside funding and serve as principal investigator on funded projects; Prepare reports at various levels; Provide information services about Arizona geology to agencies and members of the community.

Qualifications: M.S. required, Ph.D. desirable in geology, with specialties in economic and/or structural geology; prior economic geology experience in Arizona and/or other southwestern states; documented proficiency in geologic mapping; demonstrated ability to conceive and complete original geologic research; prior experience in publication of geologic reports is desirable.

Send letter of application, availability date, resume or vita, and published or unpublished geologic maps or reports to Dr. Larry D. Fellows, State Geologist, Bureau of Geology and Mineral Technology, Geological Survey Branch, 845 N. Park Ave., Tucson, AZ 85719 (602/626-2733).

NEW LEVELING ACROSS ARIZONA

by

Carl C. Winikka

This past winter season, the National Geodetic Survey (NGS) continued its field survey operations in Arizona to complete another segment of their transcontinental precise leveling network. Field work shifts seasonally from northern to southern United States each year. In this 1980–81 season, levels were run to extend the previous season's work westerly from Picacho Peak along the Southern Pacific Railroad through Gila Bend to El Centro, California. Levels were also run westerly from Roosevelt Dam through the metropolitan Phoenix area to Tonopah with a connection south to Gila Bend.

The level network being run across the United States is Second Order, Class I, with results usually within First Order allowable limits. New benchmarks, and replacements for old marks which had been destroyed, are quite different from the familiar benchmarks formerly used where bedrock is not available. These marks consist of threaded sectional metal rods topped with a small stainless steel cap. The upper several feet of the new mark are within a five inch diameter, schedule 80 PVC pipe section which is fitted with a protective aluminum logo cap cover.

Original plans for the level line through the Phoenix area were along an east-west line between Apache Junction and Buckeye. Subsidence occurring in the greater Phoenix area is of concern to a number of local agencies. For this reason, a longer level line, with added benchmarks in bedrock (Figure 1), was requested to provide a basic indication of the amount of subsidence which has occurred since the line was last leveled in 1967. The NGS was responsive to the request for a longer level line because the additional cost was shared among local agencies. Those participating agencies were the cities of Phoenix, Scottsdale and Glendale, Maricopa County, Arizona Department of Transportation, Arizona Department of Water Resources, Luke Air Force Base and the Salt River Project.

The field work was completed on schedule. Although interim results will be available, final adjusted elevations will await the transcontinental adjustment after completion of all field surveys.

Carl Winikka is the Assistant State Engineer, Location Section, Arizona Department of Transportation.

The National Geodetic Survey, formerly known as the U.S. Coast and Geodetic Survey, is now a part of the National Oceanic and Atmospheric Administration.

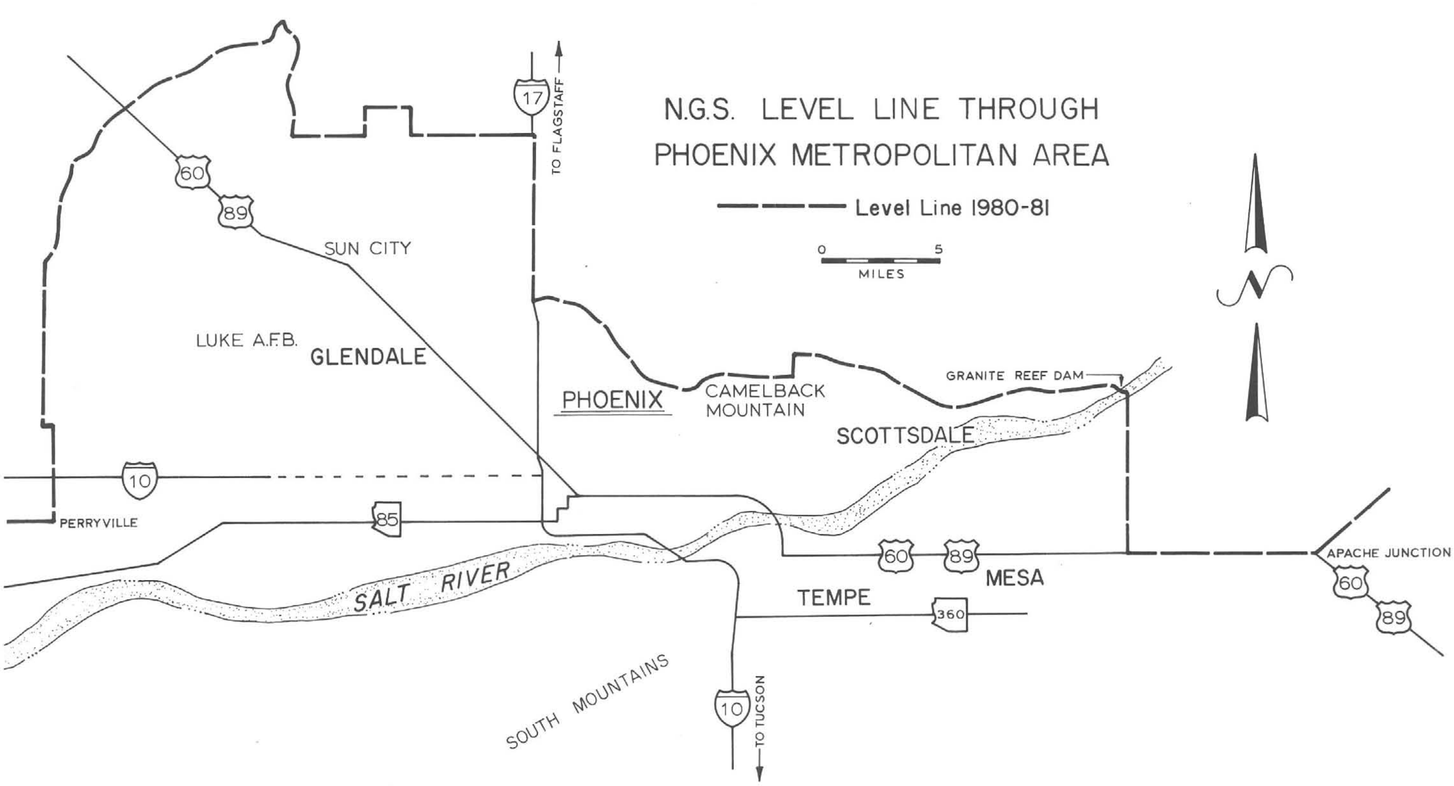

Figure 1.

Leasing Activity in Arizona: Energy Resources

by Don Whittaker, former Director of Enforcement with the Oil and Gas Conservation Commission.

OIL AND GAS

Leasing activity continued at an accelerated pace throughout 1980. Of the 9,582,000 acres of state trust lands (13% of the state), 7,790,000 acres were under lease for oil and gas exploration. In addition, the Bureau of Land Management, which administers the federally owned lands within the state, issued leases covering 4,245,286 acres. Throughout the year, five to eight geophysical crews worked within the state.

Thirteen permits for oil and gas exploration were issued in 1980. These are listed in Figure 1.

At the year's end, drilling was continuing below 17,000 feet at the Phillips (Anschutz-Texoma) well in Pinal County. This well, which was plugged and abandoned at 18,013 feet in February 1981, holds the depth record for Arizona.

During 1980, 32 wells produced 405,943 barrels of oil and 357,441 million cubic feet of gas. Total production in 1979 was 471, 836 barrels of oil and 348,280 million cubic feet of gas. These wells are located on the Navajo Reservation in northeastern Apache County.

The Arizona Legislature passed a bill that increased yearly rentals from oil and gas leases from 25 cents per acre to $1.00. The bill also provided for the formation of exploratory drilling units that will permit combinations of state, federal and fee lands.

GEOTHERMAL

State trust lands under lease for geothermal exploration totaled 34,356 acres. The BLM issued leases covering 21, 541 acres of federally owned land. Drilling was limited to one thermal gradient test hole.

UNDERGROUND GAS STORAGE

Two underground storage facilities for liquified petroleum gas (LPG) were in operation in 1980. The Cal-Gas facility, located in Maricopa County near Luke Air Force Base, uses three wells for the injection and removal of the LPG products, which are stored in a cavity created in the underlying salt body. The Buckeye Gas Products facility is located at Adamana, approximately 15 miles east of Holbrook. Eleven wells are used in their operation. Storage is in a cavity made by dissolving salt beds.

The LPG products, primarily propane and butane, are used largely in the gasoline refining process. Some is used locally for industrial and residential heating and in lesser amounts as engine fuels.

Figure 1.

PERMIT NUMBER	COUNTY	LOCATION	OPERATOR, NUMBER AND LEASE	STATUS *	ROCK UNIT AT TOTAL DEPTH
702	Pinal	7S-10E-2 NW SE	Phillips Petroleum (Anschutz Texoma) A-1 State	Drilling at 17,575 ft.	Confidential
703	Coconino	41N-1W-24 NE SW	Travis Oil 1-24 Federal	Dry and abandoned T.D. 900 ft.	Permit (Permian)
704	Mohave	41N-9W-33 NW NW	Pyramid Oil Rock Creek 2 Federal	Location staked, Waiting on rig	
705	Mohave	38N-10W-17 SW NE	Home Petroleum 17-1A Federal	Dry and abandoned T.D. 3120	Confidential
706	Mohave	36N-9W-30 NE SW	Gulf Oil 1 Federal	Dry and abandoned T.D. 5961	Confidential
707	Santa Cruz	20S-17E-12 NE NE	Ralph Whitmore et al 1 State	Operations suspended at 2002 ft.	
708	Yuma	10S-23W-23 SE SE	An-Son 1 State	Dry and abandoned T.D. 2833 ft.	Granite wash-volcanic detritus
709	Pima	12S-6W-9 SE NE	NANO'LTEX JPA 1 Federal	Dry and abandoned T.D. 1044	Volcanic
710	Pima	12S-6W-9 SW SE	NANO'LTEX JPA 2 Federal	Permit expired	
711	Pima	12S-6W-9 NW NE	NANO'LTEX JPA 3 Federal	Permit expired	
712	Mohave	38N-6W-19 SE NW	Copaquen Upper Clayhole 1-19 Federal	Location staked, Waiting on rig	
713	Mohave	39N-5W-10 NW NE	Copaquen Pipe Valley 1-10 Federal	Location staked, Waiting on rig	
714	Cochise	23S-30E-8 NE NW	Union Oil 80-1 State (Geothermal)	T.D. 715	Confidential
715	Coconino	41N-1W-24 NW SE	J. M. Shields 1-24 Federal	Oil show. Will attempt completion after January 1, 1981 T.D. 470 ft.	Kaibab (Permian)

*December 31, 1980

Farewells continued

David Rabb, Mining Engineer and University of Arizona lecturer for the past decade, retired from the Bureau last September 1, 1980.

Since graduating from the University of Arizona with a B.S. in Mining Engineering (1937) and M.S. in Metallurgy (1939), Rabb has acquired an enviable expertise in the fields of solution mining, leaching, mineral benefication and assaying, as well as in radiation, waste disposal and cryogenics.

After the second world war, Rabb was employed as a metallurgist by Battelle Memorial Institute for over six years, was assigned to the Inspector General's Department for five years, and worked 14 years as a mining engineer at Lawrence Radiation Laboratory.

Currently, Dave derives pleasure in his retirement by managing his own consulting services in metallurgy and solution mining.

ABSTRACTS

Over 2,000 abstracts on the geology of Arizona and surrounding areas of the Southwest have been filed and indexed at the Bureau of Geology Library. These abstracts are now available for review.

ANNOUNCEMENT

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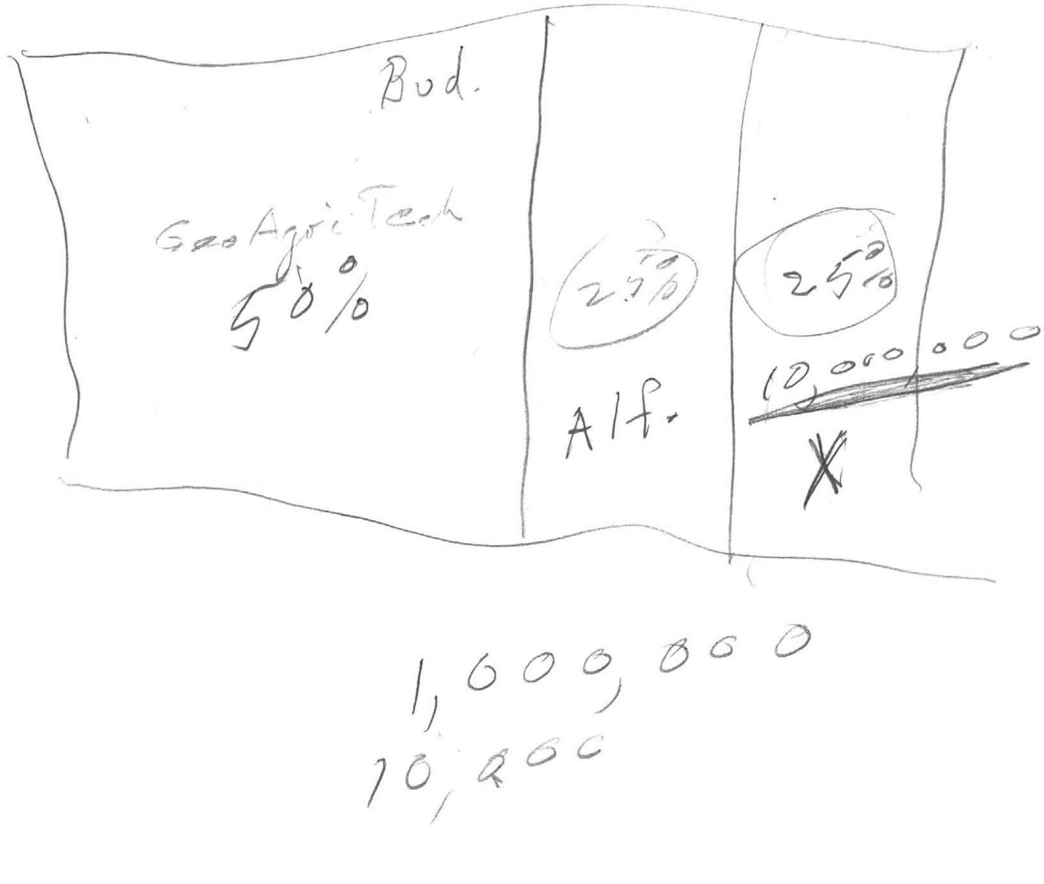
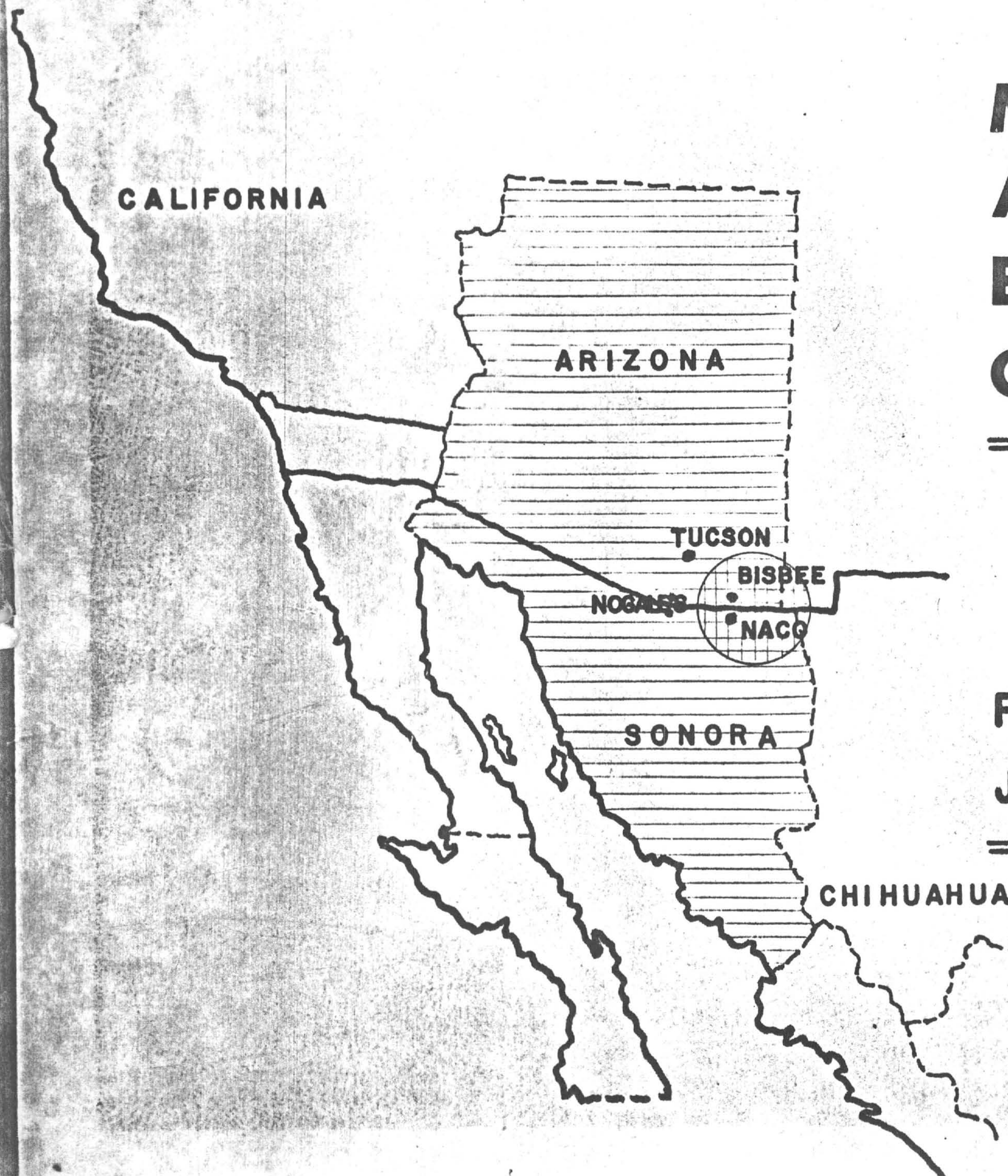




METODO DE AGRICULTURA EN AMBIENTE CONTROLADO

PROYECTO PRESENTADO POR:
JOHNNY KOSTOLIAS.

METODO DE AGRICULTURA EN AMBIENTE CONTROLADO

CONTENIDO

INTRODUCCION.

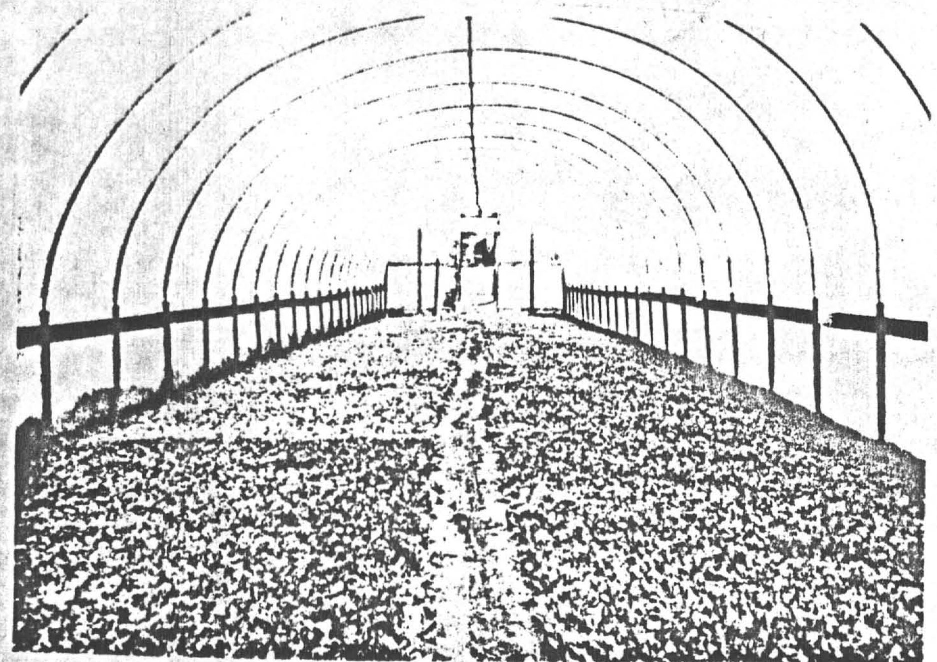
La agricultura es de interés primordial en todo el mundo. Es la industria más importante en los Estados Unidos. La agricultura dispone de la mas avanzada tegnología, sin embargo, es el area más atrasada en reconocer, aceptar y utilizar los nuevos avances tecnológicos que están a su disposición.

Mexico cuenta con los elementos basicos para convertirse en el pais numero uno del mundo: energéticos, mano de obra y tecnología. La compañia "Demerutis, Inc.", ha sido organizada por un grupo de profesionales con el fin de unir a la nueva tecnología con la productividad agrícola; A lo académico con lo operacional; A la teoría con la práctica.

La imagen de Mexico como productor agrícola capaz de abastecer tanto a si mismo, como a los Estados Unidos, Canada y demás paises, es posible. El hecho de que Mexico pueda dar empleo y alimentar a su población, es una realidad.

La aportación del sector privado es el elemento más práctico y esencial para la implementación de este programa, de ahí que "Demerutis, Inc.", respalda al proyecto presentado por el sr. Johnny Kostolias, el cual como objetivos tiene lo siguiente:

OBJETIVOS.



1.) Organizar a traves del sistema de invernaderos la producción de floricultura, hortalizas y fruticul-tura para cubrir las necesidades de Mexico y demás paises, con base a lo largo de la frontera Sonora-Arizona.

2.) Capitalizar la abundante y experimentada mano de obra agrícola de Mexico, asi como los combustibles, la luz solar y el agua disponibles, y tambien la sobrepro-ducción de trigo y maiz de Canada y Estados Unidos (ali-mento para Mexico.)

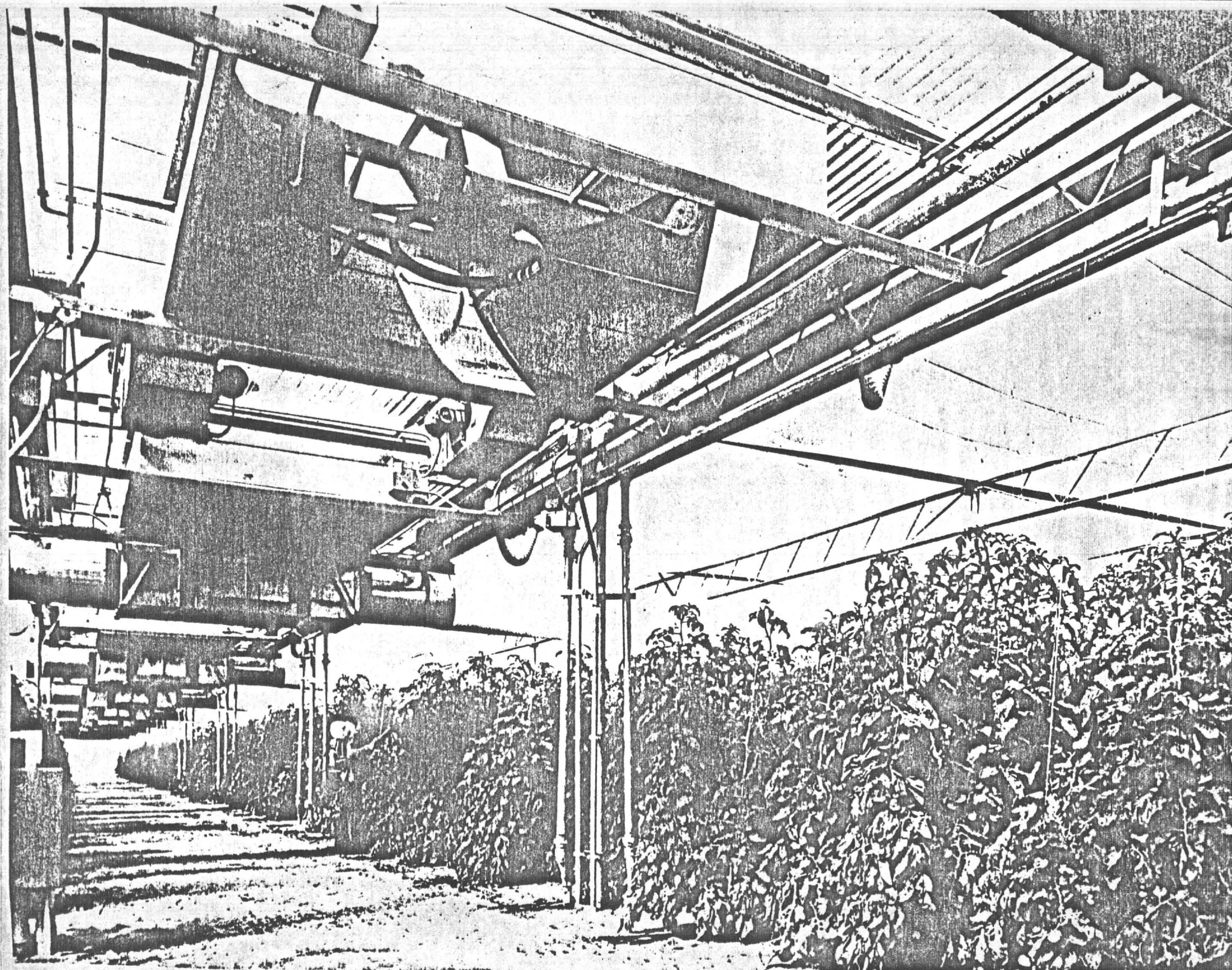
3.) Introducir al beneficio agrícola de Mexico, los avances tecnológicos del resto del mundo.

4.) Obtener utilidades, este es probablemente el elemento más importante y productivo de todos.

El proyecto es el de convertir a los anticuados sis-temas agrícolas en los modernos métodos computarizados de cultivos en ambiente controlado bajo este sistema, la producción podrá ser programada y planeada para no estar sujeta a las temporadas de lluvias o de secas; De frio o de calor, es decir, reguladas por la naturaleza para

producir las necesidades del hombre. Los cultivos en invernaderos son asegurables.

Este proyecto ha sido extensamente estudiado y comprobado a nivel mundial, y está listo para ser aplicado en la ideal y poco desarrollada zona de Naco, Sonora, Mexico. Existen todos los elementos: el mercado, los energéticos, la mano de obra, y sobre todo, los beneficios económicos. La empresa "Demerutis, Inc." cuenta con el personal experimentado en todas las disciplinas requeridas para el éxito completo de este proyecto. Uno de los integrantes de dicha empresa, es el Ing. Gordon R. Wynne autoridad máxima en invernaderos. El Ing. Wynne ha trabajado durante 34 años en proyectos similares en varias partes de los Estados Unidos y otras partes del mundo. Su extensa experiencia en estudios, investigaciones y desarrollo de proyectos de Ingenieria Geo-Térmica estando a cargo de la administración, diseño de plantas, pozos geotérmicos, etc., harán de este proyecto un éxito absoluto.



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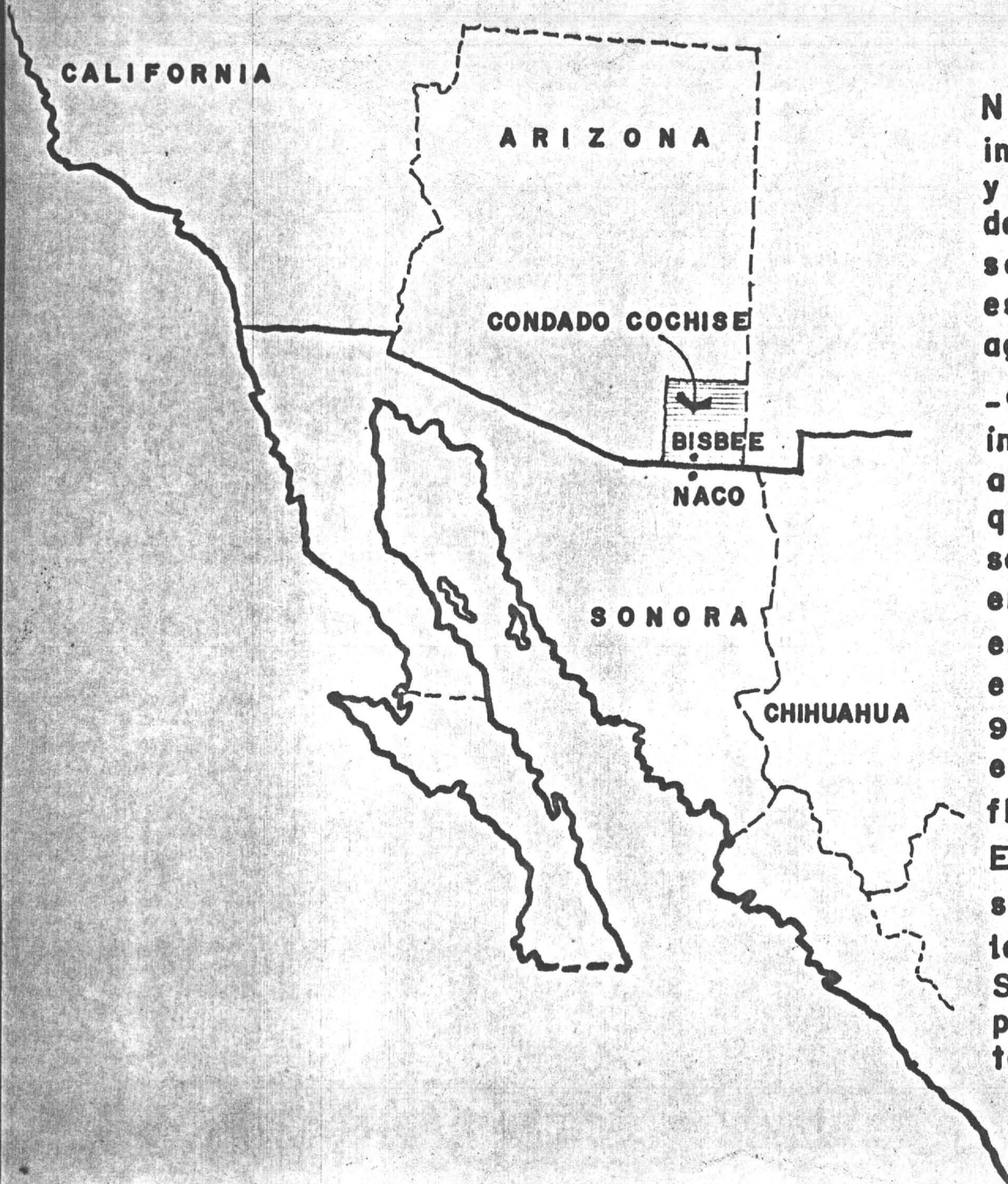
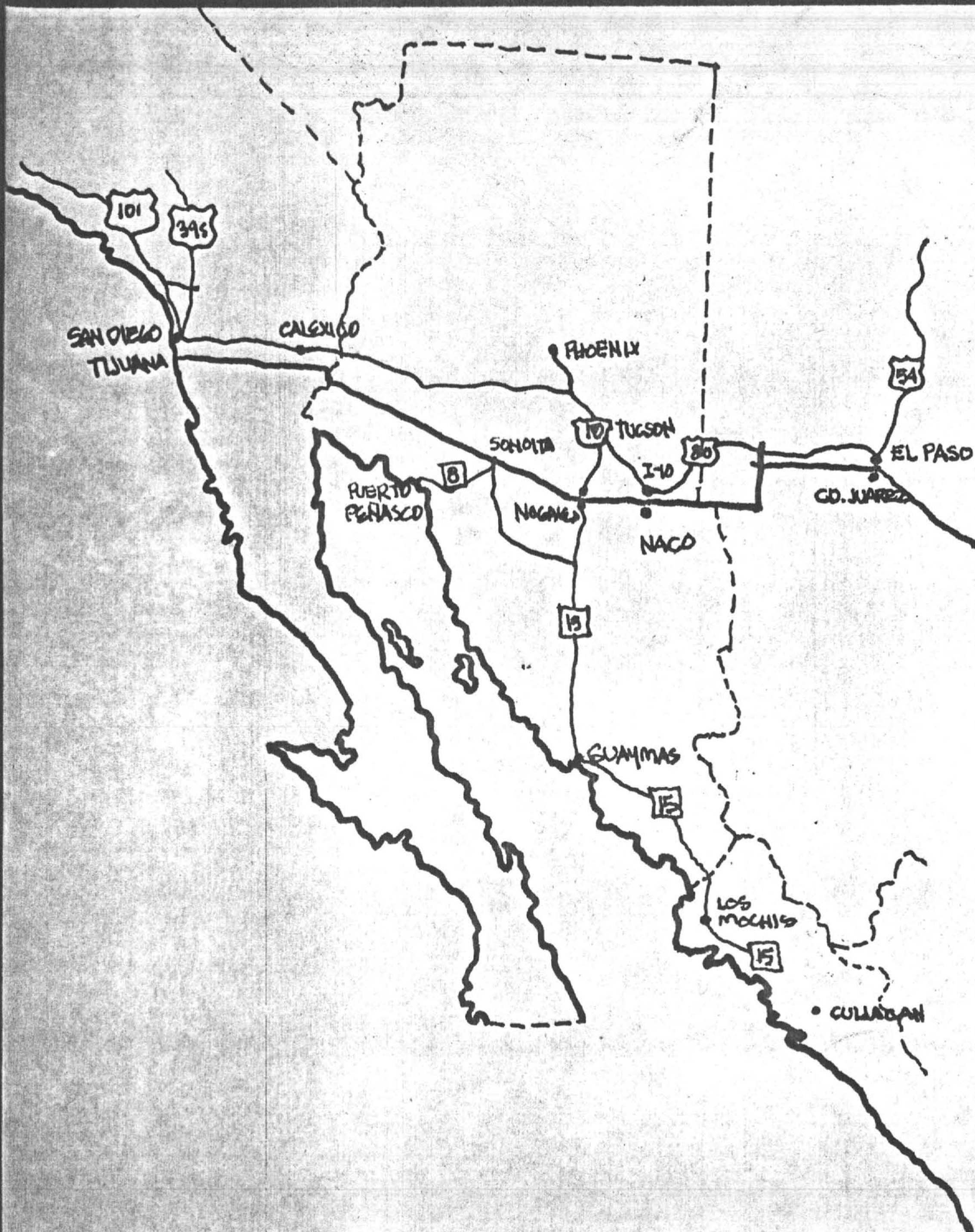


PORQUE NACO.

Naco, Sonora, Mexico, es un sitio de primordial interés. El clima es óptimo. Naco posée veranos secos y frescos, y los inviernos son templados. Los días son de claridad solar que estimula el crecimiento agrícola, son como en pocas partes del mundo. La latitud de Naco es de 32°, ideal mundialmente para la floricultura y la agricultura. Israel está en la misma latitud, y aun con energéticos caros, tiene 8,400 acres de floricultura en invernaderos, cuya producción está destinada por completo al mercado de Inglaterra. El Japón, con grandes masas que alimentar, cuenta con 75,000 acres, bajo condiciones severas de clima y latitud, además del alto costo de los energéticos. El estado de Ohio, la capital de los invernaderos en los Estados Unidos, obtiene costos de combustibles en exceso de $100,000 dls./acre/año, y ha perdido el 95% de esta industria desde la crisis mundial de energéticos en 1973. La más fuerte amenaza a la industria de la floricultura ha sido y es la crisis mencionada.

En Mexico no existe ese problema. Ademas, "Demerutis Inc." siempre ha considerado otras fuentes de energía, principalmente la energía solar y geo-térmica que existen en la región Sonora - Arizona. Se conocen más de 30 yacimientos y pozos geo-térmicos en el condado de "Cochise", Arizona, todos adecuados para proveer la calefacción a los invernaderos.

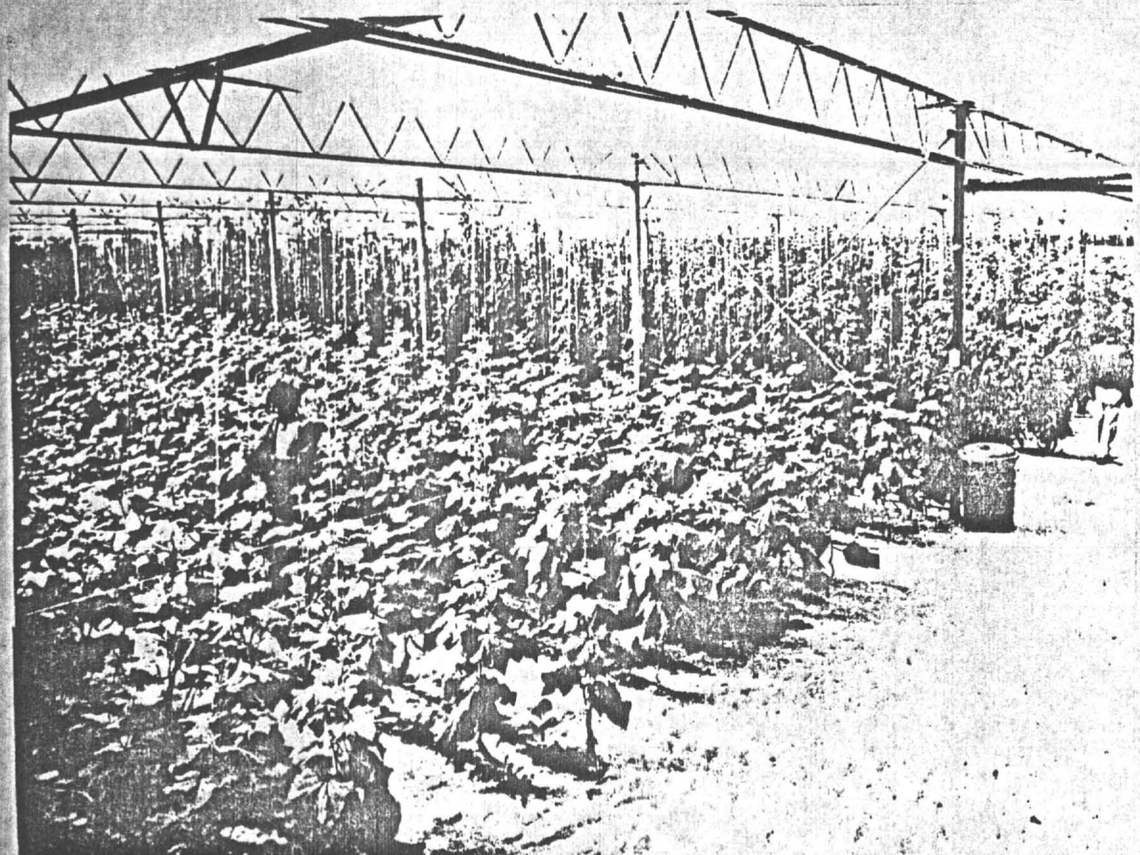


En el estado de Sonora se conocen bastantes sitios similares, sin mayor exploración. Las posibilidades solares son como las mejores que pudieran existir en el mundo.

Naco está situado cerca de la carretera I-10 y es proba--blemente uno de los mejores puertos de entrada para productos mexicanos a los Estados Unidos y Canadá. La floricultura como industria, en California sobrepasó los 500 millones de dls. al año. En Florida, la cifra es similar, y en Colorado es entre 250 millones de dls. anuales. La planicie del desierto de Sonora, con su altura de 4000 pies produce las mejores y más grandes rosas del mundo. La mayor amenaza a la industria de floricultura en Estados Unidos es la crisis de energéticos.

ALCANCES DEL SISTEMA DE INVERNADEROS.

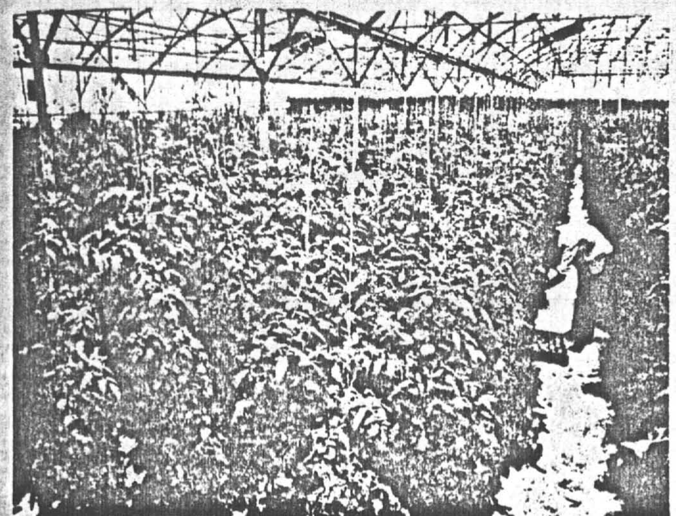
Bajo el sistema de invernaderos, el rendimiento anual en el cultivo de tomate es 14 veces mayor que por métodos convencionales; Ademas, el producto será de mejor calidad y de mayor precio. También, la cosecha en los invernaderos es asegurada por intermedio de la compañia de seguros.



UTILIDADES Y COSTOS.

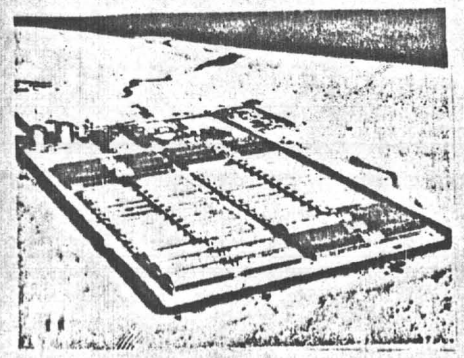
Nuestros estudios muestran que el cultivo del tomate de invernadero en Naco generaría una utilidad neta de 39.2 %, muy superior a las regiones de Guaymas y Culiacán. La inversión por acre en invernadero es entre $100,000 dls., y la productividad es $150 a $ 200,000 dls. por acre. El ambiente controlado dentro de la producción agricola en invernadero es programable y planificable a lo largo de todo el año a un costo fijo, con un producto manufacturado predecible, asegurable, cuyo costo y programa de entrega pueden ser determinados con un año de anticipación.

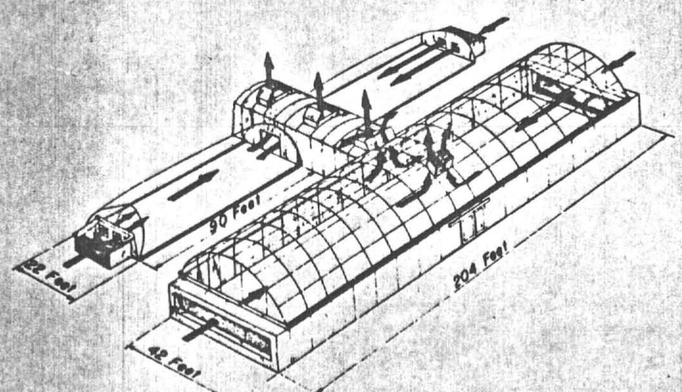
"Demerutis Inc." ha determinado que las ganancias óptimas son logrables en un proyecto de 40 acres (16 hs.) de invernaderos. Estos generarían ingresos brutos de 6. millones de dls. con el cultivo del tomate. La utilidad neta en esta operación sería de 3.164 millones de dls. anuales. La inversión total en construcción y capital de trabajo inicial será de 6.714 millones de dls. El plan de operación es un programa de construcción y arranque de 3½ años consistente en 2½ acres el primer 1/2 año, con inversión de $1.5 millones de dls., 17½ acres el segundo año, con inversión de $ 3.331 millones de dls., 10 acres el tercer año, con inversión de $ 1.040 millones de dls. y $843,000 dls. para los ultimos 10 acres. El flujo de caja



indica ingresos superiores a los 25 millones de dls. generados de 10 años de operación sobre 40 acres, con intereses del 15 % amortizados a 10 años sobre el financiamiento inicial de 6.7 millones de dls. No hay dudas sobre la utilidad y seguridad de esta empresa. Todos los aspectos financieros y económicos han sido cuidadosamente elaborados y están disponibles.

"Demerutis Inc." considera a esta unidad de 40 acres como una planta piloto. Si se pueden demostrar los beneficios económicos y se piensa en la diversificación de cultivos hacia pepinos, esparragos, fresas, melones, flores, plantas de ornato, lechugas, etc., no hay razón para no llegar a los 8000 acres de invernaderos(como Israel) o en los 75,000 acres (como Japón) dentro de 10 o 15 años, o en 200,000 acres en 20 a 25 años. Con la crisis del agua que ha ocurrido en Estados Unidos y Mexico, y con la agricultura consumiendo el 90% del agua disponible, nuestro proyecto llega muy a tiempo. Puesto que la agricultura es la industria basica de Estados Unidos y de Mexico, tenemos que considerar al sistema agricola en ambiente controlado para combatir los actuales y crecientes problemas de la agricultura convencional.





La empresa "Demerutis Inc." está integrada por profesionistas en varias disciplinas. Sus asociados están técnica y académicamente orientados en la Administración de Empresas, Ingeniería Industrial, Diseño Arquitectónico y Construcción, Mercadotecnia, Ingenieria Agrícola y Geo-Térmica, Estudios y Desarrollo. Todos poseén experiencia internacional, la mayoría con más de 35 años de práctica mundial. "Demerutis Inc." sostiene que las metas de este plan piloto podrán lograrse solo si la compañia mantiene el control de operaciones del proyecto. El mundo está lleno de fracasos ocasionados por el manejo inexperto en los negocios. La agricultura en ambiente controlado, aunque bien címentada, es especialmente sujeta al éxito o al fracaso a traves de su administración.

COSTOS ESTIMADOS DE PRODUCCION 1980-81 INCLUYENDO FLETE Y DERECHOS DE IMPORTACION.

1976-1977 COSTOS DE PRODUCCION

CLEVELAND, OHIO	44.8 ¢ / LIBRA		
NEW JERSEY Y	49.4 " "		
TUCSON, ARIZONA			
10 ACRES	35.0 " "	ESTIMADO	
20 ACRES	30.7 " "	ESTIMADO	
30 ACRES	28.3 " "	ESTIMADO	
40 ACRES	26.9 " "	ESTIMADO	

COSTOS ESTIMADOS DE PRODUCCION L.A.B., E.U.A. INCLUYENDO FLETE Y DERECHOS DE IMPORTACION.

INVERNADEROS	NACO (MEXICO)	18.13	¢/#	L.A.B.	NACO E.U.A.
CAMPO, REGION	GUAYMAS	24.4	"	"	NOGALES "
" "	CULIACAN	26.7	"	"	" "
INVERNADEROS	BISBEE	27.1	"	"	BISBEE "
"	TUCSON	34.1	"	"	TUCSON "
"	OHIO	58.3	"	"	OHIO "
"	NEW JERSEY	62.9	"	"	N. JERSEY "

SOBREPRECIO POR TOMATE DE INVERNADERO

14.00 ¢ A 22.00 ¢ / #

FLETE A CLEVELAND ± 7 ¢ / #