

THE DRY VALLEY DRILLING PROJECT
—AN EXERCISE IN INTERNATIONAL COOPERATION—
VIEWPOINT FROM THE UNITED STATES

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Abstract: Normally an acknowledgment appears as an addendum to a paper, obscured by all the facts, figures, theory, and philosophy that comes before. In this case, however, I feel that the acknowledgments tell the story of the project, which was one of international cooperation, in such a succinct way that it has become an abstract in itself and should therefore appear at the head of this article.

The author's position in DVDP, as U. S. Science Coordinator, was primarily as a focal point to receive and distribute communications on all facets of the project to the international science community and to individuals directly linked to the project. After the initial planning and development of the project into a 3-phase operation responsibilities were distributed to the various groups listed below:

Coordination

- | | |
|-------------|---|
| T. NAGATA | — Director, National Institute of Polar Research, Japan |
| T. TORII | — Executive Secretary, Japan Polar Research Association |
| R. THOMSON | — Superintendent, Antarctic Division, Department of Scientific and Industrial Research, New Zealand |
| D. KEAR | — Assistant Director General, Department of Scientific and Industrial Research, New Zealand |
| M. TURNER | — Program Director, Division of Polar Programs, National Science Foundation, United States |
| L. MCGINNIS | — Professor, Northern Illinois University |

Advisory Group

- | | |
|-----------------|---|
| E. S. BARGHOORN | — Harvard University |
| P. J. BARRETT | — Victoria University |
| C. R. BENTLEY | — University of Wisconsin |
| R. F. BLACK | — University of Connecticut |
| P. E. DAMON | — University of Arizona |
| S. S. GOLDICH | — Northern Illinois University |
| H. KURASAWA | — Geological Survey, Japan |
| M. MURAYAMA | — National Institute of Polar Research, Japan |
| N. NAKAI | — Nagoya University |

- R. F. ROY — Purdue University
 S. B. TREVES — University of Nebraska
 P. N. WEBB — Northern Illinois University
 H. E. WRIGHT, Jr. — University of Minnesota
 Y. YOSHIDA — National Institute of Polar Research, Japan
- Environmental Monitoring
 B. C. PARKER — Virginia Polytechnic Institute
 K. CARTWRIGHT — Illinois State Geological Survey
 M. G. MUDREY, Jr. — Northern Illinois University
- Logistics Planning, General Management, Operations, Bulletin Editing
 L. D. MCGINNIS — Northern Illinois University
 M. G. MUDREY, Jr. — Northern Illinois University
- Drill Superintendents
 J. HOFFMAN — Geophysics Division, Department of Scientific and
 Industrial Research
 L. OLIVER — Geophysics Division, Department of Scientific and
 Industrial Research
- Core Curation
 D. CASSIDY — Florida State University

The above responsibilities existed primarily as we saw them in the United States. Credit for the idea and initiation of the project ultimately rests with Phil SMITH of the National Science Foundation. In New Zealand R. B. THOMSON was instrumental from the beginning in planning and project design, both in the field and in New Zealand Government affairs. His efforts led to the formulation of the New Zealand drill team which was the key to project success. In Japan, T. NAGATA assembled federal support behind DVDP and opened up a long-term and continued collaboration with the U. S. and New Zealand by support of the laboratory facilities at McMurdo. In the Japan science community and as one of the first proposers of drilling in the dry valleys, T. TORII gave stimulus to the entire DVDP community of scientists. The U. S. Navy support facility at McMurdo must be commended for their role in giving us the mobility to move the rig into the valleys and for the innumerable back-up support at all project levels.

1. Introduction

The Dry Valley Drilling Project (DVDP) was a multi-national, interdisciplinary drilling program for geological research in Antarctica. It was sponsored by the Japan National Institute of Polar Research (NIPR), the New Zealand Antarctic Division, Department of Scientific and Industrial Research (DSIR), and the United States National Science Foundation (NSF), Division of Polar Programs. This report traces the evolution of DVDP from conception to completion through a review of Newsletters and Bulletins. A list of DVDP publications is added to make the reader aware of the broad, interdisciplinary nature of project studies.

The concept of a tri-national effort for drilling in the dry valleys was formally reviewed by the participating nations at a meeting in Christchurch, New Zealand

on December 5, 1971. Those attending that meeting were T. TORII, M. MURAYAMA, T. HOSHIAI, R. THOMSON, R. WILLETT, A. WILSON, P. WEBB, W. SEELIG, and L. MCGINNIS. At that time it was agreed that a drilling project in the dry valleys region had sufficient science merit to warrant support from the three nations. It was proposed that the U. S. provide drilling equipment and logistics, New Zealand would provide drilling personnel, and Japan would furnish the necessary science equipment for an earth science lab at McMurdo Station. Those recommendations were subsequently put into effect and the national responsibilities remained intact throughout the lifetime of the project (1971–1979).

Prior to the Christchurch meeting of 1971 drilling projects in the dry valleys had been proposed by several investigators. In a December 31, 1969 memo from L. O. QUAM, then Head of the Office of Polar Programs, NSF, to P. M. SMITH, Deputy Head, it was suggested that three proposals to drill in the dry valleys be coordinated to make their support logistically more efficient. Several weeks later, in January of 1970 at McMurdo Station, SMITH explored the scientific merits of drilling in informal discussions with L. D. MCGINNIS, who had just returned from geophysical studies in the valleys. From these preliminary discussions it was decided that MCGINNIS would evaluate the technical feasibility of drilling at various sites in the dry valleys using only air support. A list of objectives for a tentative project was prepared and presented in San Francisco on January 31, 1971 to the U. S. National Academy of Sciences Committee on Polar Research, Geology and Geophysics Panel. At the meeting the panel requested MCGINNIS to canvass the science community in Japan, New Zealand, and the United States to determine the degree of interest and to fully explore a comprehensive list of science goals. Proceeding with this directive, a letter was sent to approximately 50 individuals on February 5, 1971, outlining a three-phase program to drill in the valleys and asking for suggestions regarding objectives and implementation. Most of the original 50 were from the U. S.; however, copies of the letter were also sent to antarctic agencies in New Zealand and in Japan. This letter was later dubbed DVDP Newsletter No. 1 and was to be the first of 23 which would ultimately be issued. Project history is outlined in the many newsletters that followed and they are briefly reviewed in the following section.

2. DVDP Newsletter Review

Viewed from an historical perspective the DVDP Newsletters provided the service necessary to maintain communication between several hundred individuals who were ultimately to become involved with the project. At the time the first newsletter was written on February 5, 1971, the NSF Office of Polar Programs had already made the decision, contingent upon a generally favorable response from the science community, to support a drilling program of fairly broad scope in the dry

valley region. This decision was clarified on 12 January 1971 in a letter from P. M. SMITH (NSF) to R. B. THOMSON, Superintendent of the Antarctic Division, DSIR and to M. MURAYAMA, Director, Polar Research Center, National Science Museum. Both THOMSON and MURAYAMA responded very affirmatively, THOMSON in a letter on 9 February and MURAYAMA on 28 January.

It was my responsibility via a series of letters to assure the science community that a drilling proposal should be taken seriously and that if scientists showed sufficient interest, support would be forthcoming from NSF. Although my position at that time was only as a correspondent I saw a high degree of enthusiasm for such a project in NSF and therefore I proceeded with optimism.

In Newsletter No. 1 the three phases of an "International Ice-free Valley Drilling Project" were described which included:

- I. Geophysical exploration
- II. Drill purchase and drilling at McMurdo
- III. Drilling in the valleys with all holes to be drilled at least to basement.

A questionnaire was issued in the letter which requested information on specific science objectives and drill sites. In addition, New Zealand and Japanese scientists were asked to initiate inquiries within their own countries on the degree and kinds of support they might expect to receive from their administrative leaders.

The response to the first newsletter was positive and almost immediate, permitting the circulation of Newsletter No. 2 on 12 April 1971 which included the results of the inquiries in the U. S. Of the 50 individuals contacted, 24 expressed high interest and 17 indicated a desire to take an active part in field operations and laboratory analyses. The range of disciplines represented was broad and included biology and microbiology, geophysics (borehole and exploration), geochemistry and isotope geology, glaciology, hydrogeology, general geology (stratigraphy, petrology, etc.), and site surveying. A drill rig capable of drilling to at least 300 meters was suggested to respond to the needs of the various proposals and 26 borehole sites were recommended.

Response to the first two Newsletters in New Zealand and Japan was also positive and very rapid. On April 26, 1971, P. N. WEBB, then a geologist at the New Zealand Geological Survey, submitted an evaluation of the proposal from the U. S. to D. KEAR, Survey Director. It was WEBB's recommendation that New Zealand become contributors to the project with full participation of New Zealand scientists. In the March-April, 1971 issue of the Antarctic Journal of the U. S. (p. 48), the project was officially announced for the first time and Japanese, New Zealand, and U. S. scientists interested in the project were asked to communicate with the DVDP Science Coordinator at Northern Illinois University, P. N. WEBB, New Zealand Science Coordinator, R. B. THOMSON, New Zealand Administrative Coordinator, T. TORII, Japan Science Coordinator, M. MURAYAMA, Japan Administrative Coordinator, and M. D. TURNER, U. S. Administrative Coordinator.

Newsletter No. 3 of 25 May 1971 briefly described the geophysical program to be initiated during the next antarctic field season and also indicated that the selection process for DVDP advisors was underway. In Newsletter No. 4 of September 24, 1971, U. S. advisors were named and included P. DAMON, University of Arizona, C. KISSLINGER, St. Louis University, R. BERGSTROM, Illinois State Geological Survey, R. BLACK, University of Connecticut, and H. WRIGHT, University of Minnesota.

Completion of most of Phase I (Geophysics) was announced in Newsletter No. 5 on March 5, 1972. Ground geophysical surveys were completed and about one-half of an aeromagnetic study was flown. Science groups from all three nations were directly involved in the field. In Newsletter No. 5 facilities at McMurdo were outlined which would provide project support. Repairs on the earth science lab were outlined and it eventually became the center for all DVDP activities.

Letter 6 of May 17, 1972 outlined the program for the 72–73 season. Drill equipment was to be sent to McMurdo by ship and drilling at McMurdo was planned for January 1973. Letter 7 of March 9, 1973 announced the successful drilling of holes 2 and 3 on Hut Point Peninsula. See Fig. 1 for the location of DVDP boreholes and Table 1 for hole specifications. The aeromagnetic survey was completed and a detailed bathymetry map was prepared during the 72–73 season in anticipation of a hole to be drilled from sea ice into sediments of McMurdo Sound. Letter 8, released on July 11, 1973 announced the availability of core from holes 2 and 3 and the soon-to-be issued DVDP Bulletin No. 2 which would contain core de-

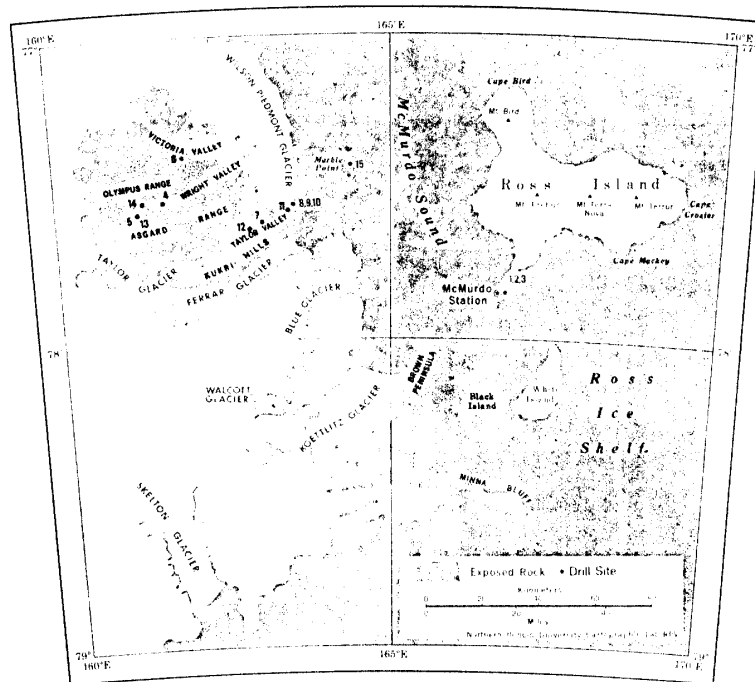


Fig. 1.

Table 1. DVDP drilling specifics.

DVDP borehole No.	Drill penetration	Collar elevation	Core recovery	Drilling dates	Log*	Geographic description
1	201m	66.9m	197m	Jan. 1973	3	McMurdo
2	179	47.6	171	Feb. 1973	1,4	McMurdo
3	381	47.6	341	Sep.-Oct. 1973	1,3,4	McMurdo
**4	17	84.0	17	Nov. 1973	3,4	Lake Vanda
5	4	116.7	3	Dec. 1973	-	Don Juan Pond
6	306	349.2	303	Dec. 1973	1,3,4	Lake Vida
7	11	18.5	3	Dec. 1973	-	Lake Fryxell
8	157	2.8	130	Jan. 1974	1,3,4	New Harbor
9	38	2.8	33	Jan. 1974	-	New Harbor
10	185	2.8		Oct.-Nov. 1974	1,3,4	New Harbor
11	328	80.2	328	Nov.-Dec. 1974	1,3,4	Commonwealth Glacier
12	185	75.1	184	Dec.-Jan. 1974-75	1,3,4	Lake Leon
13	75	118.4	68	Jan. 1975	1,2,3,4	Don Juan Pond
14	78	68.4	77	Jan. 1975	1,3,4	North Fork
***15	65	1.0	34	Nov. 1975	3,4	McMurdo Sound
	2231		2074 (recovery = 93%)			

*1: Gamma log.

3: Salinity and resistivity measured on core.

2: Resistivity and S. P.

4: Temperature (DECKER, 1978).

**DVDP #4 was drilled from lake ice in 70 m of water and into bottom 17 m.

***DVDP #15 was drilled from sea ice in 122 m of water and into bottom 65 m.

scriptions. During the 1972-73 field season, S. B. TREVES, a DVDP petrologist from the University of Nebraska recommended the lab be named after Edward C. THIEL, a noted polar geophysicist and Chief Scientist at the US-IGY Filchner Ice Shelf Station, who died in a plane crash at Wilkes Station in November 1961. The lab was dedicated and named in his honor during the 1973-74 field season.

Newsletters 9 to 11 provided commentary on the drilling progress in austral summer of 1973-74. Hole 3 was drilled near hole 2 at the Thiel Earth Sciences Lab. The rig was air-lifted for the first time into the dry valleys where holes were drilled at Lake Vanda, Don Juan Pond (aborted after 3.35 m of penetration), Lake Vida, Lake Fryxell (aborted after 11.13 m), and New Harbor. An environmental appraisal on the project was prepared by B. C. PARKER, R. E. CAMERON, K. CARTWRIGHT and M. G. MUDREY. A list of 40 scientists involved in the project was published in letter 9 along with 30 DVDP publications. The newly christened Japan National Institute of Polar Research under T. NAGATA assumed responsibilities for continuation of Japan's role in DVDP. Approval for the first DVDP seminar was received and the meeting was announced which would be held in Seattle on 29-31 May 1974.

Support for the meeting was obtained from the Japan Society for the Promotion of Science, NSF Office of International Programs and DSIR. Results of the meeting were supplied in Newsletter No. 12 (June 26, 1974). Thirty-eight papers were presented, 58 scientists registered, and plans for a last drill season were finalized. Plans were also discussed for a final DVDP volume to be published by the American Geophysical Union in their Antarctic Research Series and a second seminar to be held in Wellington was proposed.

Postponement of McMurdo Sound drilling was the primary news of Letter No. 13 (Sep. 19, 1974). A winter storm with subsequent ice break-up altered drilling plans for 1974–75. Sediment sampling at the Antarctic core storage facility at Florida State University was fully underway under the direction of D. CASSIDY. Summaries of drill holes 1 through 9 were listed in tabular form and preliminary plans for DVDP Seminar II to be held in Wellington were outlined. Letter 14 issued less than two months later (Nov. 8, 1974) gave word of commencement of drilling at New Harbor on October 28 and summarized the status of holes drilled the previous year. Much of the campsite at New Harbor was destroyed by winter storms; however, the drill rig survived unscathed. The winter break-out of sea ice in McMurdo Sound provided a unique opportunity to gather additional information on the configuration of sediments beneath the sound with seismic profiling. D. A. CHRISTOFFEL of Victoria University, Wellington and H. K. WONG of Northern Illinois University began preparations for the marine seismic study.

A summary of the highly successful 1974–75 field season was contained in Newsletter No. 15 (Feb. 21, 1975). Five holes were drilled, three in Taylor Valley and two in Wright Valley. These holes have provided the most detailed record to-date on the Miocene to Recent history of the valleys. The Taylor Valley holes, especially, have laid the foundation for glacial stratigraphic studies in the McMurdo Sound region. Over 1500 km of marine seismic profiling was completed which prepared the way for the final drilling attempt into McMurdo Sound. DVDP personnel numbered 56 during the season, the largest staff the project had yet fielded.

Letter 16 (May 5, 1975) provided a comprehensive list of principal investigators studying core-related geology and geophysics. Letter 17 (July 17, 1975) summarized conferences on project review (DeKalb), drilling engineering (Minneapolis), and core sampling (Tallahassee). Final dates were set for DVDP Seminar II by meeting chairman Peter Barrett and an up-dated summary of drill holes and locations was provided.

Ice problems in McMurdo Sound were again of principal concern in Letter 18. Open water was observed in late winter near prime drill sites and a reconnaissance team embarked for McMurdo on a late winter flight. Letter 19 brought news of the successful completion of hole 15 in McMurdo Sound. The site was located on two meters of sea ice, over 122 meters of water, and was drilled and cored about

65 meters into the bottom sediment. Development of cracks in the sea ice and late season warming forced early evacuation from the site before full target depths could be reached; however, based on the core retrieved and depths reached the drill hole was considered successful and drilling for DVDP was terminated on November 21, 1975.

Proposals for an extension of DVDP and further drilling into McMurdo Sound were submitted at the Wellington Seminar and reported in Letter 20 (Dec. 12, 1975). In addition, other drill sites were recommended by many of the 70 participants at the meeting. Unresolved questions concerning the geologic history of Antarctica during the last 100 million years were put forth and K. KUSUNOKI of the Japan National Institute of Polar Research extended a formal invitation to DVDP for a final meeting in Tokyo.

Termination of all drilling for DVDP was officially announced in Letter 21 (May 18, 1976). Scientists were encouraged to prepare final papers for the Tokyo conference which was planned for mid-1978. Letter 22 (Sep. 3, 1976) announced the availability of core from holes 14 and 15 and described procedures to be followed for submission of papers for the DVDP volume to be published by the American Geophysical Union, Antarctic Research Series.

The last Newsletter of the DVDP series (Letter 23, March 5, 1977), issued six years after the first, gave the status of the DVDP holes and described their availability for logging and other studies. An editorial board for the AGU volume was recommended for consideration and papers were solicited for the final meeting to be held in Tokyo in June of 1978.

3. DVDP Bulletin Review

The DVDP Bulletins one through eight are summarized in the following pages. They provide preliminary science results of exploratory programs, abstracts of meetings, and core descriptions from which sample requests could be made by Principal Investigators. The bulletins provided an up-to-date record of current research and discoveries; whereas the newsletters were more involved with non-science affairs such as logistics, administrative decisions, and planning.

As of this writing eight bulletins have been issued by the DVDP. Bulletin No. 1, printed in December of 1972, contains a scientific plan, objectives, proposed drill sites, core retrieval procedures, and short abstracts on proposed studies. Twenty-five contributors to the bulletin were identified with 14 from the U. S., 6 from Japan and 5 from New Zealand. The PREFACE of Bulletin No. 1 briefly describes the rationale for the project as seen at that early stage and it is reprinted here:

Traditional surface or near-surface measurements used to reconstruct Antarctic prehistory often are limited and contradictory. Most clues to Antarctica's past have been skimmed from easily accessible surficial materials. The first deep, or intermediate depth, boreholes in sedi-

mentary and igneous rock will permit earth scientists to view the long but poorly known Cenozoic era immediately preceding our historical record. It was during Cenozoic time that Antarctica became established as earth's most extensive, ice-covered region.

The Dry Valley Drilling Project, truly international in its management, support, and participation of scientists, has been stimulated through interest expressed by scientists from Japan, New Zealand, and the United States. It is being funded principally by the United States National Science Foundation, Office of Polar Programs, the Japanese National Science Museum, Polar Research Center, and the New Zealand Department of Scientific and Industrial Research. Additional amounts are being contributed by universities and private organizations.

It is hoped that distribution of the enclosed summaries of selected research proposals and the results of preliminary exploratory studies will stimulate further supplementary and/or complementary investigations. Distribution of these summaries at this time should make readers aware of the scope of the intended research. Where overlap among investigators is detected individuals are urged to initiate or continue communication aimed at more thorough and productive research. Where gaps seem apparent, new research proposals are encouraged.

Bulletin No. 1 is the first of a series to be issued as DVDP proceeds. We expect to begin preparation of Bulletin No. 2 after this drilling season on Ross Island. Bulletin No. 2 will include preliminary descriptions of Ross Island core and physical and chemical descriptions of the subsurface. In addition, it will contain abstracts of research proposals planned for the following season (1973-74) which will begin with the McMurdo Sound hole.

Project Coordinators

Drilling for geological research had not been done in Antarctica prior to DVDP, therefore, in order to design a drilling program and to aid individuals in preparing research proposals, the geophysical results obtained during the 1971-72 field season were printed in the first bulletin. Geophysical studies included seismic refraction investigations and electrical depth sounding at or near proposed drill sites and an aeromagnetic survey over the Ross Island and Taylor Valley Quadrangles. The aeromagnetic program eventually covered all of Ross Island, McMurdo Sound, and Taylor, Wright and Victoria Valleys with two kilometer interval, east-west flight-lines tied with three north-south flight lines. In addition to the geological and geophysical field programs, Roy CAMERON and Frank MORELLI described their techniques and procedures utilized in accomplishing the first environmental monitoring program. Their operations involved both air and soil sampling before, during, and after a geophysical base camp had been established. These studies would establish long-term base lines for comparison with the levels of microbiological and chemical alteration in the post-DVDP environments.

Bulletin No. 2, issued in June 1973, contained reports of the first two boreholes drilled by DVDP which were located on Ross Island on Hut Point Peninsula near McMurdo Station. Contributions to DVDP Bulletin No. 2 were received from 18 scientists, 15 from the United States, 8 New Zealand, and 5 Japanese.

With the acquisition of core, which was shipped to the freezer core storage facility at Northern Illinois University, a core sample distribution policy and a sample request form were included in the bulletin. The core was described by TREVES and KYLE from the two sites and several photographs of the volcanic core

were printed for the readers. A new list of proposals was also circulated in the bulletin. It was thought that by publishing summaries of the principal objectives of the proposals, undue duplication would be eliminated and gaps in the science program would be recognized. In general, this policy served its purpose.

The second year of drilling resulted in publication of Bulletin No. 3 in May 1974. Twenty-six individuals contributed to the volume including eleven from the United States, eight Japanese, six New Zealanders, and one Australian. Seven holes were drilled for total penetration of 1000 meters. Core recovered totaled 830 meters for a recovery rate of 83 percent. Inexperience and environmental constraints imposed in the operations plan for the 1973-74 season caused serious problems with core recovery and penetration at Don Juan Pond, Lake Fryxell, and at New Harbor. Water under hydraulic head began to rise up the hole at Don Juan Pond forcing shut-down after drilling only 3.5 meters. At the Lake Fryxell site an attempt was made again to use a CaCl solution as the drill fluid. Bonded permafrost was destroyed, seepage from the hole could not be controlled, recovery was very poor (26 percent), and the hole was ultimately abandoned after drilling to only 11.1 meters. The rig was moved to New Harbor to DVDP No. 8 where a final attempt at drilling with CaCl was aborted because of thawing and slumping of sediment at 36 meters. Drill fluid was changed to DFA and hole 9, adjacent to hole 8, was successfully drilled. Drilling terminated when circulation was lost at 157 meters depth. The core at New Harbor was found to contain macrofauna (*Adamussium colbecki*) at 23 to 24 meters. Preliminary microscopic examination revealed an abundant microfaunal assemblage. The drill rig was winterized at New Harbor on 23 January 1974 in preparation for drilling through sea ice into McMurdo Sound during the 1974-75 field season.

Shortly after the 1973-74 field season, in May 29-31, the first of three planned DVDP seminars was hosted by the Quaternary Research Center at the University of Washington, Seattle. The seminar was supported by the National Science Foundation-Office of International Programs, the Japan Society for the Promotion of Science and the Antarctic Division of the New Zealand Department of Scientific and Industrial Research. A report on the seminar is contained in Bulletin No. 4 (May 1974). Prof. A. L. WASHBURN, meeting chairman, opened the sessions during which 36 scientific papers were presented. Nineteen papers were from the United States, 10 from Japan, and 7 from New Zealand. Reports of this meeting were summarized in EOS (MCGINNIS *et al.*, 1975).

Not surprisingly, several firsts for Antarctica were reported at the meeting. Viable microorganisms were found in permafrost core over one million years old by Frank MORELLI and Roy CAMERON. Magnetic stripes attributed to reversely and normally magnetized basalts were reported on Ross Island by MCGINNIS and others while Decker observed for the first time the abnormally great thickness of permafrost on Ross Island along with the abnormally high values of heat flow.

The debate regarding the origins of mineralization in waters in the dry valley lakes continued, with Mike MUDREY claiming a local origin, Irving FRIEDMAN and G. I. SMITH arguing for a marine origin and N. NAKAI claiming evidence for both. Keros CARTWRIGHT further muddied the waters by suggesting evidence for ground water movement into the lakes.

Bulletin No. 5 (August 1975) contains reports, geologic logs, and core photos resulting from drilling during the 1974–75 field season. Twenty-three individuals contributed to the bulletin with ten from the United States, five from New Zealand, seven from Japan, and one from Australia. Five boreholes were drilled for a total penetration of 872 m. A total of 842 m of core was recovered for a recovery rate of 97 percent. Locations of boreholes include New Harbor, Commonwealth Glacier, Lake Leon, Don Juan Pond, and North Fork. The 1974–75 DVDP program included 14 field personnel in core logging and processing, 18 on the drill team, 6 environmental monitors, 2 measuring heat flow, 3 studying valley hydrology, 4 in limnology, 5 on the USCGC Burton Island marine seismic program, and 4 in project operations.

A final attempt was made to drill to basement at New Harbor but had to be given up when bonded permafrost was penetrated at 185 m permitting ground water to rise up into the hole. The water was sampled before freezing and the salinity was found to be twice that of sea water. The rig was moved up valley several kilometers to Commonwealth Glacier where the deepest hole on the Antarctic Continent was drilled to 328 m. Again bonded permafrost was penetrated; however, since the ground elevation is 80 m above that at New Harbor the hydraulic head produced by the 80 m column of DFA caused excessive fluid loss down-hole. During extraction of the drill rod from the hole the drill mast collapsed producing the first and only serious mishap to equipment during the course of the drill program. The mast and hydraulic hoists were air lifted to McMurdo for repair. New hoists were flown in from the United States and drilling was resumed after three weeks at Lake Leon (Lake Chad) further up Taylor Valley on the west side of Canada Glacier. This hole was drilled successfully into basement to 185 m depth. The rig was then moved to Don Juan Pond where another attempt at drilling to basement was ultimately successful. The final hole of the season was drilled in the North Fork of Wright Valley where, again, basement was reached and the project was shut down for the season.

A marine seismic study by a team of geophysicists from Victoria University in Wellington, New Zealand and Northern Illinois University in DeKalb, Illinois was successfully completed in McMurdo Sound. The single-channel, air-gun and refraction sonobuoy data provided sub-bottom information near the proposed McMurdo Sound drill hole. Good and continuous reflectors provided sufficient information for subsurface stratigraphic correlation if a successful hole could be drilled.

Bulletin No. 6 (November 1975) contains 29 abstract-length reports presented

at DVDP Seminar II which was held in Wellington, New Zealand on January 13–15, 1976. Contributing scientists from the U. S. numbered 18, from New Zealand 12, Japan 9, Australia 1, and Russia 1. The meeting was hosted by the Antarctic Research Center and Department of Geology, Victoria University. Although the second seminar was planned primarily to report on studies being made on core, preliminary results of drilling into McMurdo Sound (DVDP No. 15) were also presented to the 70 participants at the meeting.

A drilling report and summary of additional papers presented at the Wellington Seminar comprise Bulletin No. 7 (September 1976). The bulletin contains 16 contributors including 10 from the U. S., and two each from Japan, New Zealand, and Australia. This report describes the first drilling from a sea ice platform in Antarctica. A specially designed drill column permitted extraction of core in water 122 m deep. Problems with abnormal ice deformation forced an early abandonment of the site; however, the core that has been recovered is proving vital to the interpretation of McMurdo Sound history.

Bulletin No. 8 (May 1978) is a compilation of abstracts of papers given at the Tokyo Seminar (June 5–10, 1978) which was hosted by the Japan National Institute of Polar Research and supported by the Japan Society for the Promotion of Science and the U. S. National Science Foundation, Office of International Programs. Forty-seven papers were given with 17 from Japan, 4 from New Zealand, 3 Australian, and 23 from the United States.

4. DVDP Publications

The following publications list includes not only those papers which were directly supported through DVDP channels, but also peripheral studies not directly supported, which would not have been published were it not for DVDP. The list is therefore rather comprehensive and hopefully includes all materials up to DVDP Bulletin No. 8.

DVDP Publications

Publications in 1971

MCGINNIS, L. D. and JENSEN, T. E. (1971): Permafrost-hydrogeologic regimen in two ice-free valleys, Antarctica, from electrical depth sounding. *Quat. Res.*, **1** (3), 389–409.

Publications in 1972

BEHAR, J. V., ZAFONTE, L., CAMERON, R. E. and MORELLI, F. A. (1972): Hydrocarbons in air samples from antarctic dry valley drilling sites. *Antarct. J. U. S.*, **7** (4), 94–96.

CAMERON, R. E. and MORELLI, F. (1972): Antarctic microbiol ecology, dry valley drilling sites. *DVDP Bull.*, **1**, 28–29.

CAMERON, R. E., MORELLI, F. A. and RANDALL, L. P. (1972): Aerial, aquatic, and soil microbiology of Don Juan Pond, Antarctica. *Antarct. J. U. S.*, **7** (6), 254–258.

CLARK, C. C. (1972): Seismic refraction and electrical resistivity investigations in the dry valleys.

- Antarct. J. U. S., 7 (4), 91–92.
- MCGINNIS, L. D. and MONTGOMERY, G. E. (1972): Aeromagnetic reconnaissance and geologic summary of the Dry Valley region—Phase I. DVDP Bull., 1, 61–90.
- MCGINNIS, L. D., NAKAO, K. and CLARK, C. C. (1972): Geophysical identification of frozen and unfrozen ground, Antarctica. DVDP Bull., 1, 30–60.
- MCGINNIS, L. D., TORII, T. and WEBB, P. N. (1972): Dry Valley Drilling Project—Three nations are studying the subsurface in the McMurdo Sound region. Antarct. J. U. S., 7 (3), 53–56.
- MONTGOMERY, G. E. (1972): Aeromagnetic surveys of the Ross Island and Taylor Glacier quadrangles. Antarct. J. U. S., 7 (4), 90–91.
- MORELLI, F. A., CAMERON, R. E., GENSEL, D. R. and RANDALL, L. P. (1972): Monitoring of antarctic dry valley drilling sites. Antarct. J. U. S., 7 (4), 92–94.
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