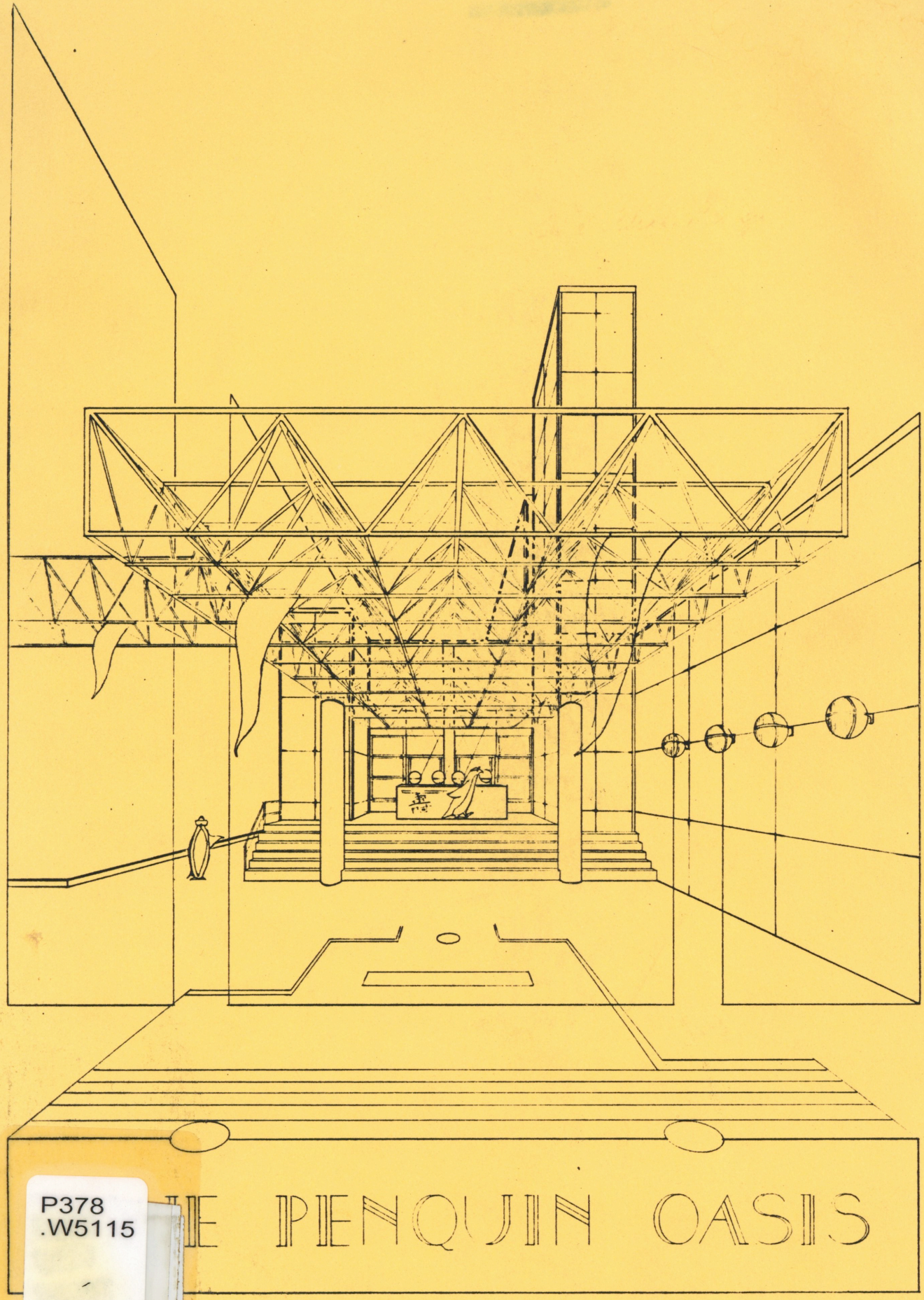

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THE BLUE PENGUIN OASIS:
A MULTI-USE RECREATIONAL FACILITY
McMurdo Bay, Antarctica

by

CHRISTIAN M. WESCHE

A professional paper submitted in partial fulfillment
of the requirements for the degree

of

BACHELOR OF ARCHITECTURE

Approved:

_____

Advisor

_____

Thesis Coordinator

_____

Director, School of Architecture

MONTANA STATE UNIVERSITY

Bozeman, Montana

June, 1987

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Signature Christine G. Weeks

Date 6/14/87

Acknowledgements

I would like to thank Robert T. Meeker, Associate Professor of Architecture, Montana State University, for his knowledgeable advice and his sometimes sarcastic remarks which helped to ease the tension of completing this project.

A special thanks to the Dolittle Club for making this past five years at most "interesting." -- Dave Seabury, Dave Trotter, Mike Glassing, Chong Jmg Ong and Dale Scheirn.

A thank you is in order for the most important person throughout this endeavor, Marie "Sam" Hildreth, who gave me encouragement and understanding no matter what the circumstances.

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INTRODUCTION

You have just finished the last of the paperwork and have been issued your departure instructions. Anything personal you want with you for the next year is in a neat pile being loaded into the plane. The adrenaline in your stomach has you nervous but yet ecstatic about fulfilling an age-old need to go where few men have been before. To be in a relatively unknown place where many have died and man has been unable to impose his integrity on the environment even with technology. The realizatiion that you are finally going there overshadows all your feelings about leaving what and who you know for the next year.

The tent structure is only 10 by 10 with the only sounds being the blasting of an outdated furnace and the 50 mile per hour wind that is trying to blow your "home" halfway across a continent. You scrape the quarter inch thick ice from the only window in the place and peer out. From the distance that you can see, you don't know if it is dark outside or if somebody painted the window black. You recline on your favorite cot to have another shot of Jack Daniels from a bottle whose label you have memorized from reading it all the time. You gaze at the clock, it is 3 o'clock . . . in the afternoon.

The mixed feelings about being in Antarctica through the winter become obvious very fast. The summer months are filled with work, things to see and do and thus make it an adventure to be there. Throughout the year, however, there needs to be a place that is relaxing, while at the same time stimulating, and mostly just always there.

More than one thousand Americans work in and around Antarctica each year in the United States Antarctic Research Program. The largest share of these people are not scientists or researchers but support people that keep the complex at McMurdo Bay functioning all year round. Due to the ever-increasing interest in Antarctica by researchers, more people are

needed for support, which in turn, has created the need for updated facilities, not only in scientific endeavors, but also in recreational facilities. This is the basis for this thesis project, to design a multi-use recreational center in Antarctica.

THESIS STATEMENT

> "All functions on the world are those of existing things. From their functions I know they possess substance. Function exists to become effect, and substance exists to become nature and feelings. Both substance and function exist, and each depends on the other to be concrete."
>
> Wang Fu-Chin

The aim of this thesis project, on a personal level, is to explore and possibly find a median in architectural design which combines the artist's egotism and the methods of the pragmatist in solving the problem of designing a recreational facility in Antarctica.

The directness of satisfying the artist's ego is not one of disrespect to him, but rather a feeling that the artist usually works alone. There is no audience applauding for a pencil stroke or an airbrush wash. There is no laughter at an area of crosshatching, nor are there tears when the wrong combination of red and blue turn a muddy brown rather than a sombre ochre. There are no long lines of admirers, no floral bouquets, and no thunder of clapping. The artist usually has an audience of one, himself, and must perform in a virtually empty theatre. By the time others join to view the work, it is too late, the artist has moved on to another project which engulfs his mind and attention.

My first reason for pursuing this goal is one wherein, owing to no specific design methodology, I am interested in looking into different theories and this is one of the few chances left to delve into a design process in this type of academic atmosphere. Secondly, I was prompted to continue in this direction after reading Associate Professor Robert T. Meeker's paper entitled "The Psystem Paradigm: Using Game and System Theories in

Architectural Programming". This paper suggests a viable solution to the above problem in terms of programming and problem solving to accomodate everyone involved in the program. The system suggested is to outline in matrix form, all of the expectations from the environment, building usage, materials and the users. Conclusions about each of the categories begin to become evident as to their individual and combined impact on the design strategy to be used by the designer. These ideas then coagulate into a solid base from which to draw upon in the design of a building, while still leaving space for the designer to add his personal preferences to the design.

The project I am attempting this with came about because of my interest in Antarctica. The building, per se, came about through research of the area and the need for a multi-purpose recreational facility for the people working in Antarctica.

Merely from the fact that this project is set in Antarctica, it lends itself to the ethereal aspirations of the artist because there is little, if anything, to draw upon in the existing built environment. There are no historical references to ellaborate on that are indigenous to the continent, nor has any of the built environment been subjected to the need of aesthetics, until now. Aside from being a "nice" building, this one might be entrusted with the task of introducing an aesthetic vocabulary to the area that may become the norm rather than the exception.

Where the artist is more interested in exploring and expanding on ideas, the pragmatist wants to systematically solve the problem functionally and economically. Due to the severe environmental conditions surrounding this project, it seems to appropriately pledge to the pragmatist a real problem to solve.

The way in which different materials are assembled as to deter the debilitating effects of the weather conditions is a major functional issue. Another principal problem comes from the fact that all materials must be transported to the site. This raises the question as to whether a pre-fabricated or a built-on-site method should be used in conjunction with the implied modular system due to regulated lengths and sizes in materials that can be shipped.

It becomes obvious that any solution to this project must be based largely with the considerations of weather and economics in mind, without forgetting about the artist's expectations.

The definition from Bacon's Design of Cities:

> "Architecture is the articulation of space as to produce in the participator a definite space experience in relation to previous and anticipated space experiences."

seems an appropriate place to start from while designing this project, with the addition of the need for some personal input from the designer to mark it as his work.

THE PSYSTEM PARADIGM

HIERARCHICAL STRATA

	P S Y		S	T	E	M
	AGENCY		SPACE	TIME	ENERGY	MATTER
	WHO?	WHY?	WHERE?	WHEN?	HOW?	WHAT?
	PEOPLE	PURPOSES	PLACE	PRECE-DENTS	PROCESS	PRODUCTS
LEVEL 1.			Market Area			
LEVEL 2.			Neigh-borhood			
LEVEL 3.	Clients Designers Builders	Reasons for Building	Site	Schedule	Methods Means Modes	Materials
LEVEL 4.			Building			
LEVEL 5.			Rooms			
GOALS & CRITERIA						
PATTERNS						
Y	T H E P R O G R A M					

DETAILED EXPLANATION

A PROBLEM-STATING MATRIX

The program for this project is an understanding of the possible needs and very probably wanting by the users for the spaces provided. It is designed to accomodate both the physical and mental attitudes of the users during the peak capacity of the area. Some spaces are provided, however, with the minimal number of users in mind. An attempt is made to cover many different forms of recreation to be included in one program.

PROGRAM

PROGRAM

A.	Rooms		15,200 SF
	38 rooms w/average net area 400 SF each		
B.	Support		11,050 SF
	1.	Employee lounge	400
	2.	Main desk and management	550
	3.	Foyer	950
	4.	Storage	2,000
	5.	Linen storage	650
	6.	Laundry	700
	7.	Receiving loading	800
	8.	Carpentry shop	480
	9.	Plumbing, electrical, lighting shop	420
	10.	Trash compaction	450
	11.	Garden	1,000
	12.	Shop	650
	13.	Plant & soil storage/pool equipment	2,000
C.	Food/Beverage		7,400 SF
	1.	Restaurant	6,500 SF
		a. Seating 200 people	4,200
		b. Office	250
		c. Pantry	450
		d. Stewards	400
		e. Food storage	1,200
	2.	Grill	800 SF
		a. Storage	100
D.	Leisure		16,430 SF
	1.	Bowling 6 lanes (26 x 100)	4,480
	2.	Billards room - 6 tables	1,800
	3.	Bar/lounge	5,600
	4.	Indoor golf 2 (19 x 9)	350
	5.	TV room	1,800
	6.	Reading room	400

	7.	Movie theatre	2,000
E.	Health Swimming		23,020 SF
	1.	Pool	3,500
	2.	Racquetball courts 2 (46 x 23)	3,050
	3.	Mens locker room	1,900
	4.	Womens locker room	1,500
	5.	Nautilus	900
	6.	Baksetball/running court	10,000
	7.	Check-in	270
	8.	Equipment storage	700
	9.	Outdoor pool	1,200

Net Area ..... 73,100 SF

F. HVAC @ 15% of Net Area ..... 10,965 SF

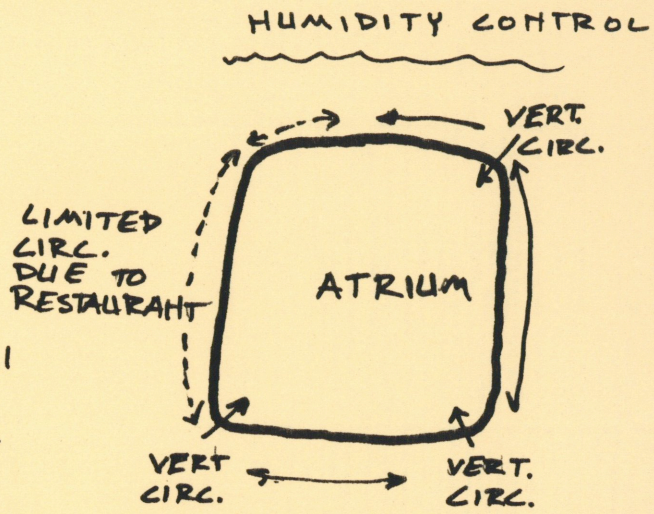
G. Structure @ 5% of Net Area ..... 3,655 SF

H. Circulatiion @ 30% of Net Area ..... 21,930 SF

Total Gross Area ..... **109,650 SF**

☐ SPACE	ATRIUM
☐ ZONING	PUBLIC
☐ SQ FOOTAGE	
☐ ADJACENCY	ACCESS TO AND FROM MOST ALL SPACES
☐ ACTIVITY	SWIMMING POOL, GARDEN HOT POOLS
☐ INDOOR OUTDOOR	Indoor Primarily 16' diam. accessable thru atrium to outside Hot pool
☐ NO. USERS	POSSIBLY EVERYONE IN BUILDING DUE TO NATURE OF CIRCULATION
☐ CHARACTER	LARGE OPEN VOLUME FULL OF PLANTS AND OPEN WATER
☐ CIRCULATION	MAJOR CIRC. AROUND AND THRU THE SPACE
☐ VIEWS	CHANGING INTERIOR VIEWS AS PARTICIPANT MOVES THRU SPACE
☐ NOTES	ATRIUM IS CENTRAL HUB OF THE BUILDING ENCOMPASSING CIRCULATION AND ACTIVITIES. SOME HUMIDITY CONTROL NEEDED DUE TO AMOUNT OF HOT WATER, HOWEVER OUTSIDE HUMIDITY ALMOST ZERO ∴ HEAT EXCHANGE MAY PROVE WORKABLE

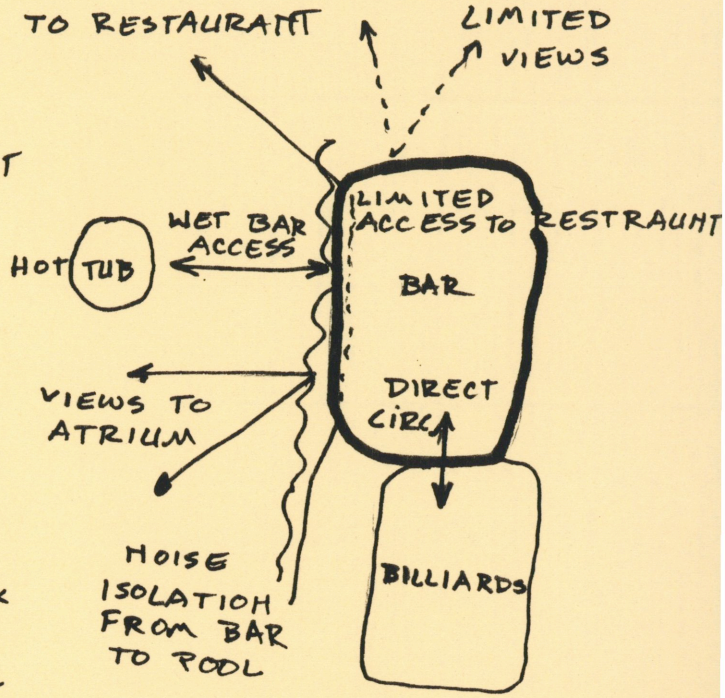
DIAGRAM



ALL SPACES ARE AROUND ATRIUM EXCEPT THE GYMNASIUM WHICH CAN BE ACCESSED FROM ATRIUM ENTRY LEVEL

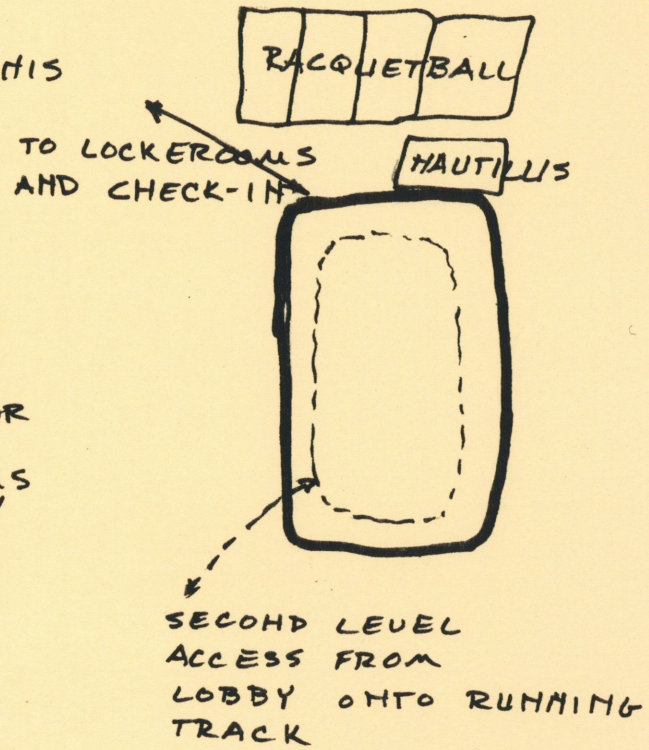
☐ SPACE	BAR
☐ ZONING	PUBLIC
☐ SQ FOOTAGE	5600 S.F. INCLUDING GAME ROOM
☐ ADJACENCY	BILLIARDS, SEMI-RESTAURANT ATRIUM
☐ ACTIVITY	DANCING, VIDEO GAMES DRINKING, RELAXING
☐ INDOOR OUTDOOR	INDOOR
☐ NO. USERS	MAX. CAPACITY 450 PEOPLE
☐ CHARACTER	LIVELY, UPLIFTING MOOD BRIGHTER COLORS NOT DARK AND SMOKEY
☐ CIRCULATION	MINOR CIRCULATION THRU BAR TO RESTRAUNT - DIRECT TO BILLIARDS
☐ VIEWS	INTO ATRIUM, LIMITED VIEW INTO BILLIARDS AND OUTSIDE
☐ NOTES	ACCESS TO WET BAR FROM ELEVATED HOT TUB BY SLIDING BAR WINDOW OUTSIDE ACTUAL BAR

DIAGRAM



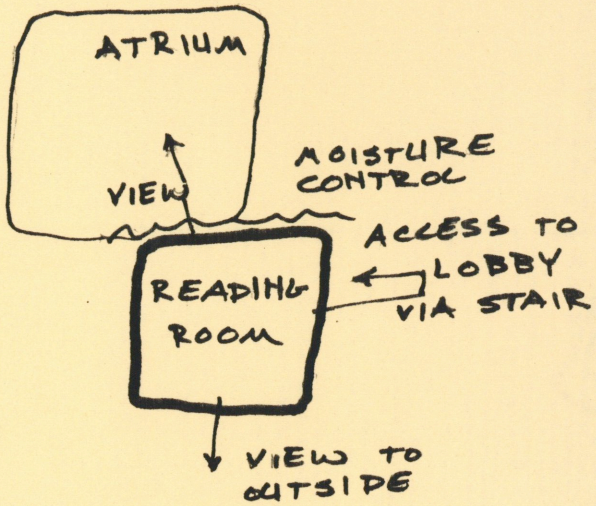
☐ SPACE	GYMNASIUM
☐ ZONING	PUBLIC
☐ SQ FOOTAGE	10,000 S.F.
☐ ADJACENCY	LOCKER ROOMS, NAUTILUS RACQUETBALL
☐ ACTIVITY	BASKETBALL, INDOOR TENNIS LARGE CONCERTS
☐ INDOOR OUTDOOR	INDOOR
☐ NO. USERS	
☐ CHARACTER	LARGE OPEN CLEARSPAN W/ ABILITY TO CHANGE FOR OTHER INDOOR SPORTS
☐ CIRCULATION	DIRECT FROM LOCKEROOMS ACCESS FROM MAIN LOBBY
☐ VIEWS	
☐ NOTES	RUNNING TRACK ON SECOND LEVEL USED FOR CIRCULATION DURING CONCERT OR STAGE USE MUST BE VERSITILE AND EASY TO KEEP CLEAN

DIAGRAM



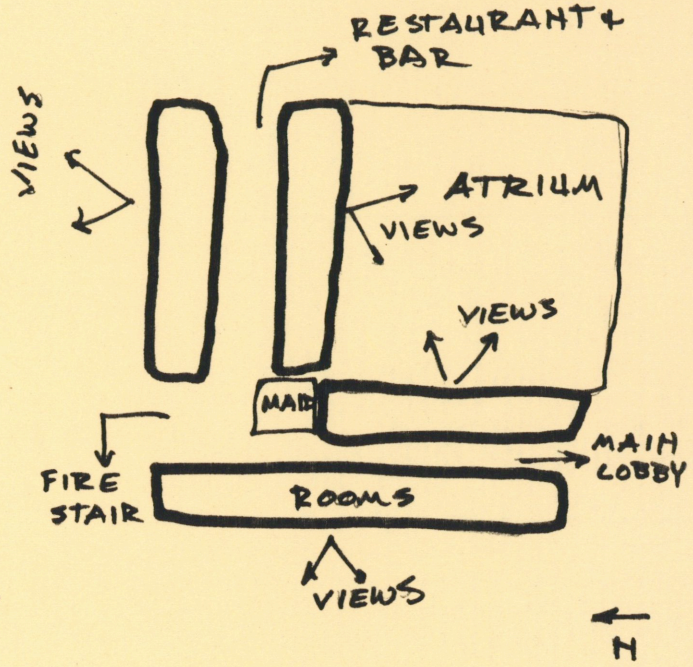
☐ SPACE	READING ROOM
☐ ZONING	SEMI - PRIVATE
☐ SQ FOOTAGE	400 S.F.
☐ ADJACENCY	FAIRLY ISOLATED FROM MAIN SPACES HOWEVER ACCESS FROM MAIN LOBBY
☐ ACTIVITY	LEISURE READING
☐ INDOOR OUTDOOR	INDOOR
☐ NO. USERS	15-20 PEOPLE
☐ CHARACTER	QUIET DAMPENING FROM ATRIUM, FULL BODIED FURNITURE (OVERSTUFFED) WELL LIGHT
☐ CIRCULATION	LIMITED CIRCULATION DUE TO BOOK STORAGE
☐ VIEWS	VIEW TO ATRIUM FROM RAILING, VIEW TO OUTSIDE LIMITED
☐ NOTES	READING ROOM SEPERATE SPACE FROM OTHERS ON FORTH FLOOR. MOISTURE CONTROL NEEDED FOR BOOK COLLECTION. BOOKS AND MAGAZINES DONATED BY PEOPLE AT THE COMPLEX, THEREBY KEEPING A REVOLVING COLLECTION SEMI-PRIVATE DUE TO LOCATION ABOVE MOST OTHER SPACES

DIAGRAM



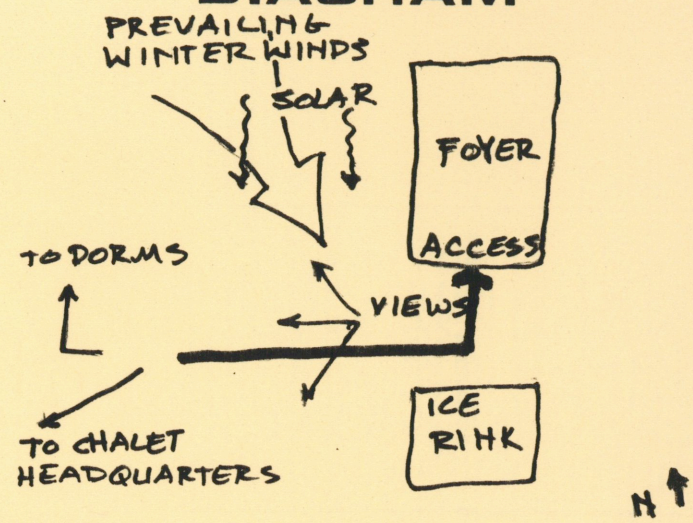
☐ SPACE	ROOMS
☐ ZONING	PRIVATE
☐ SQ FOOTAGE	400 SF. each 20 x 20' due to column spacing
☐ ADJACENCY	ACCESS TO BAR & RESTAURANT SEMI PRIVATE LOUNGE AND LOBBY
☐ ACTIVITY	READING, GETTING AWAY FROM CLOSE QUATERS W/ EVERYONE ELSE
☐ INDOOR OUTDOOR	INDOOR
☐ NO. USERS	TWO DOUBLE BEDS PROVIDED
☐ CHARACTER	SPACIOUS COMPARED TO DORMS OR TENTS, COMFORTABLE BUT NOT LUXURIOUS
☐ CIRCULATION	DOUBLE LOADED CORRIDOR, W/ FIRE ACCESS WITHIN 75
☐ VIEWS	HALF ROOMS VIEW INTO ATRIUM / OTHE VIEW TO OCEAN
☐ NOTES	VIEW LIMITED ON EXTERIOR ROOMS DUE TO LOW AMOUNT OF GLASS FOR HEAT LOSS PURPOSES - 20 S.F. GLAZING 19 ROOMS PER FLOOR x 2 FLOORS : TOTAL 38 ROOMS AVAILABLE

DIAGRAM



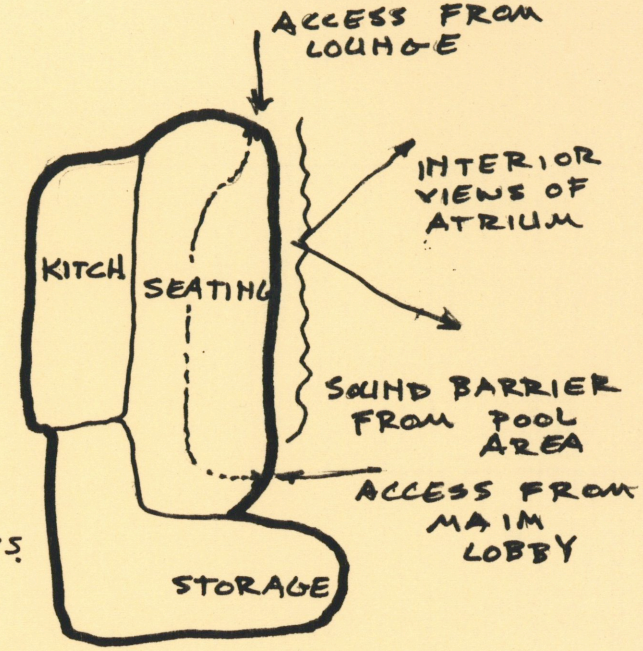
☐ SPACE	ENTRY
☐ ZONING	PUBLIC
☐ SQ FOOTAGE	
☐ ADJACENCY	FOYER, ICE SKATING RINK
☐ ACTIVITY	
☐ INDOOR OUTDOOR	OUTDOOR
☐ NO. USERS	
☐ CHARACTER	GIVES PERSON APPROACHING A SENSE OF THE INTERIOR OF THE BUILDING DUE TO UTILITARIAN NATURE OF FOYER
☐ CIRCULATION	
☐ VIEWS	TO OCEAN AND TO MAIN ROAD
☐ NOTES	WITHIN 200' OF LAGISTICS BUILDING AND 250' FROM MAJOR DORMATORIES MUST BE WELL LIGHT FOR PEDESTRIANS IN THE WINTER DUE TO EXTENDED DARKNESS USE OF LIGHTS TO DEMOTE MOVEMENT TOWARDS THE ENTRY BY USING WARM COLORED LIGHTS AS COMPARED TO BRIGHT COLD LIGHTS

DIAGRAM



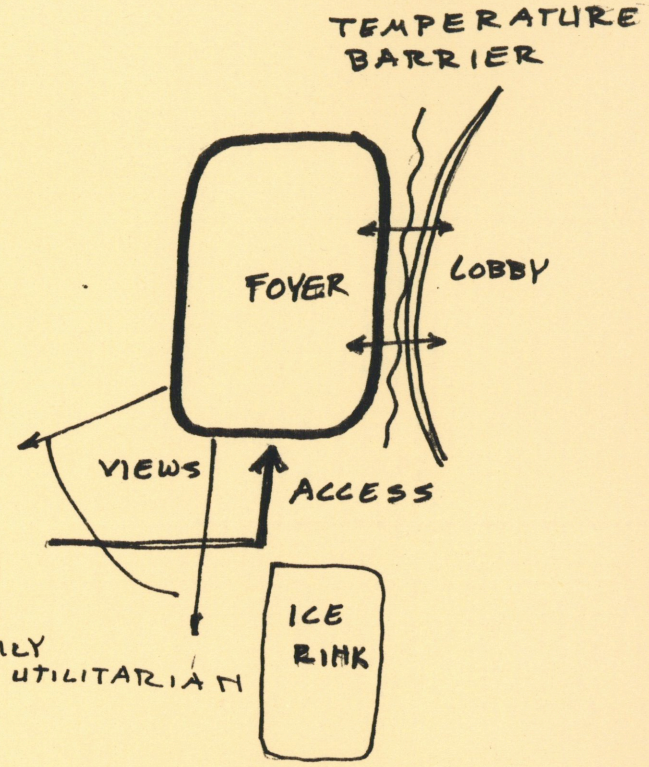
☐ SPACE	RESTAURANT
☐ ZONING	PUBLIC - CLOSED ACCESS (CONTROLLED)
☐ SQ FOOTAGE	6500 S.F.
☐ ADJACENCY	LOUNGE W/ CONTROLLED ACCESS TO RESTAURANT
☐ ACTIVITY	DINING, SOCIALIZING, FRATERNIZING
☐ INDOOR OUTDOOR	INDOOR
☐ NO. USERS	CAPACITY MAX. 200 PEOPS. WINTER - DOUBTFUL FULL EVER - COULD BE PARTIALLY CLOSED
☐ CHARACTER	WARM, RELAXING, SEMI-INDIVIDUAL DINING V.S. MESS HALL
☐ CIRCULATION	ACCESS FROM MAIN FLOOR LOBBY OR FROM LOUNGE
☐ VIEWS	FEW VIEWS TO OCEAN AND OUTSIDE. INTERNAL FOCUS TO ATRIUM SPACE
☐ NOTES	RESTAURANT REQUIRES OVERSIZED STORAGE OF BOTH DRY AND FRESH GOODS DUE TO INFREQUENCY OF SUPPLY SHIPMENTS SOUND BARRIER NEEDED FROM POOL NOISE

DIAGRAM



☐ SPACE	FOYER
☐ ZONING	PUBLIC SEMI-CLOSED
☐ SQ FOOTAGE	950 S.F.
☐ ADJACENCY	DIRECT CONNECTION TO LOBBY
☐ ACTIVITY	TAKING OFF HEAVY CLOTHING FOR STORAGE WHILE AT THE FACILITY
☐ INDOOR OUTDOOR	
☐ NO. USERS	WINTER - MAX. 100 SUMMER - 300
☐ CHARACTER	WARM COLORS W SOME INDICATION TO INTERIOR OF REST OF BUILDING, PRIMARILY UTILITARIAN
☐ CIRCULATION	OPEN CENTRAL CIRCULATION W/ LOCKERS ON SIDES
☐ VIEWS	LOOKING DIRECTLY TO ICE SKATING POND AND TO ENTRY PROCESSION
☐ NOTES	TEMPERATURE SHOULD NOT BE THE SAME AS INTERIOR OF BUILDING DUE TO EXTREME TEMP CHAGE. SUGGESTED TEMPERATURE OF 62° SUMMER USERS HAVE LESS HEAVIER CLOTHING THUS INCREASING CAPACITY

DIAGRAM



CLIMATE

Climate:

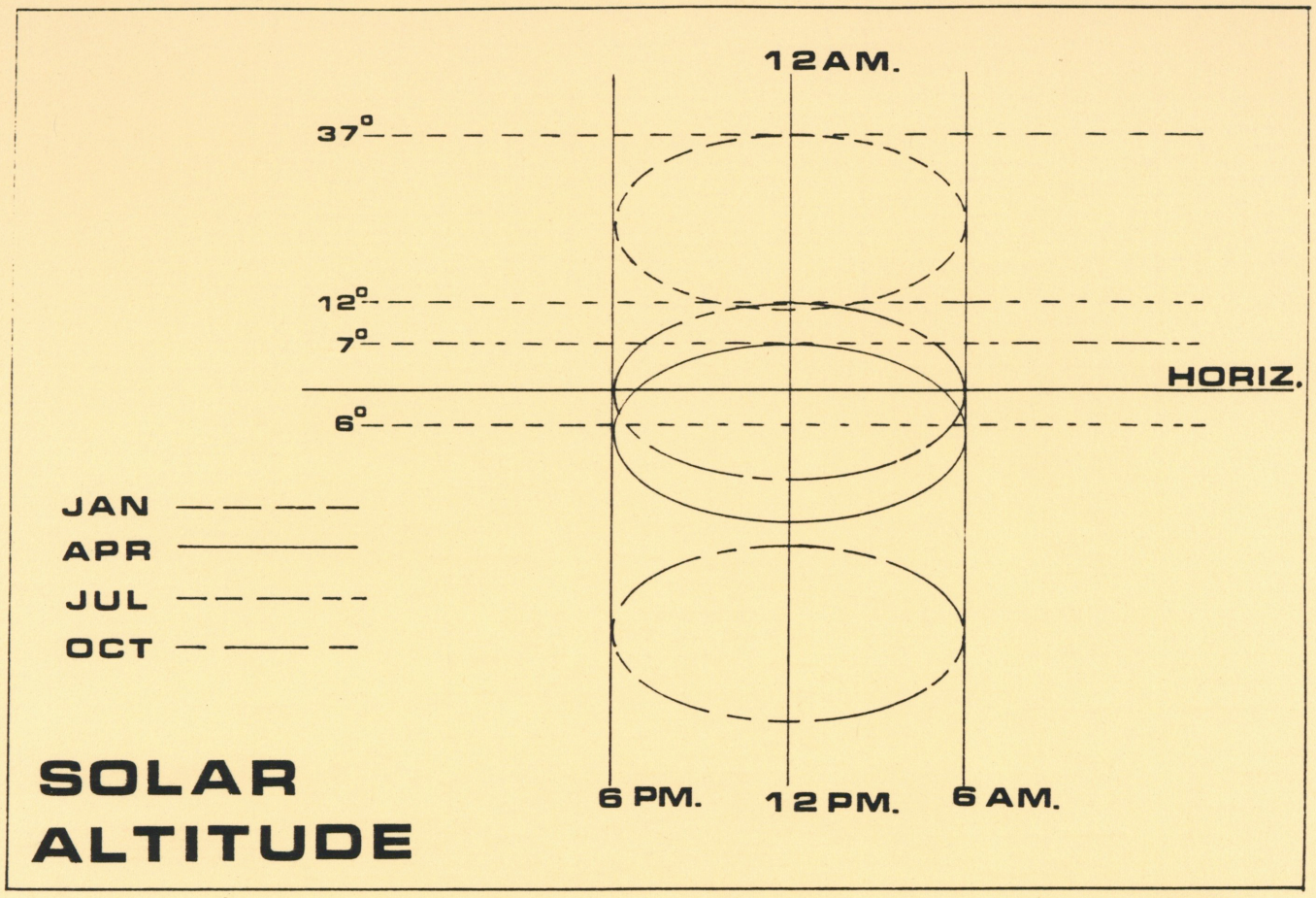
Even though the continent contains some of the most severe weather conditions in the world, there are a few havens from the worst of the onslaught. McMurdo Bay enjoys the luxury of being on the coast and is just far enough from the pole to receive a toned-down version of the harsh climate. Granted, it's not the "banana belt", but temperatures do reach 45 F when the sun hits its zenith of 37 above the horizon in January. The fact that is is located at 77 30' north latitude is enough to guarantee at least some sunlight for all but three months out of the year.

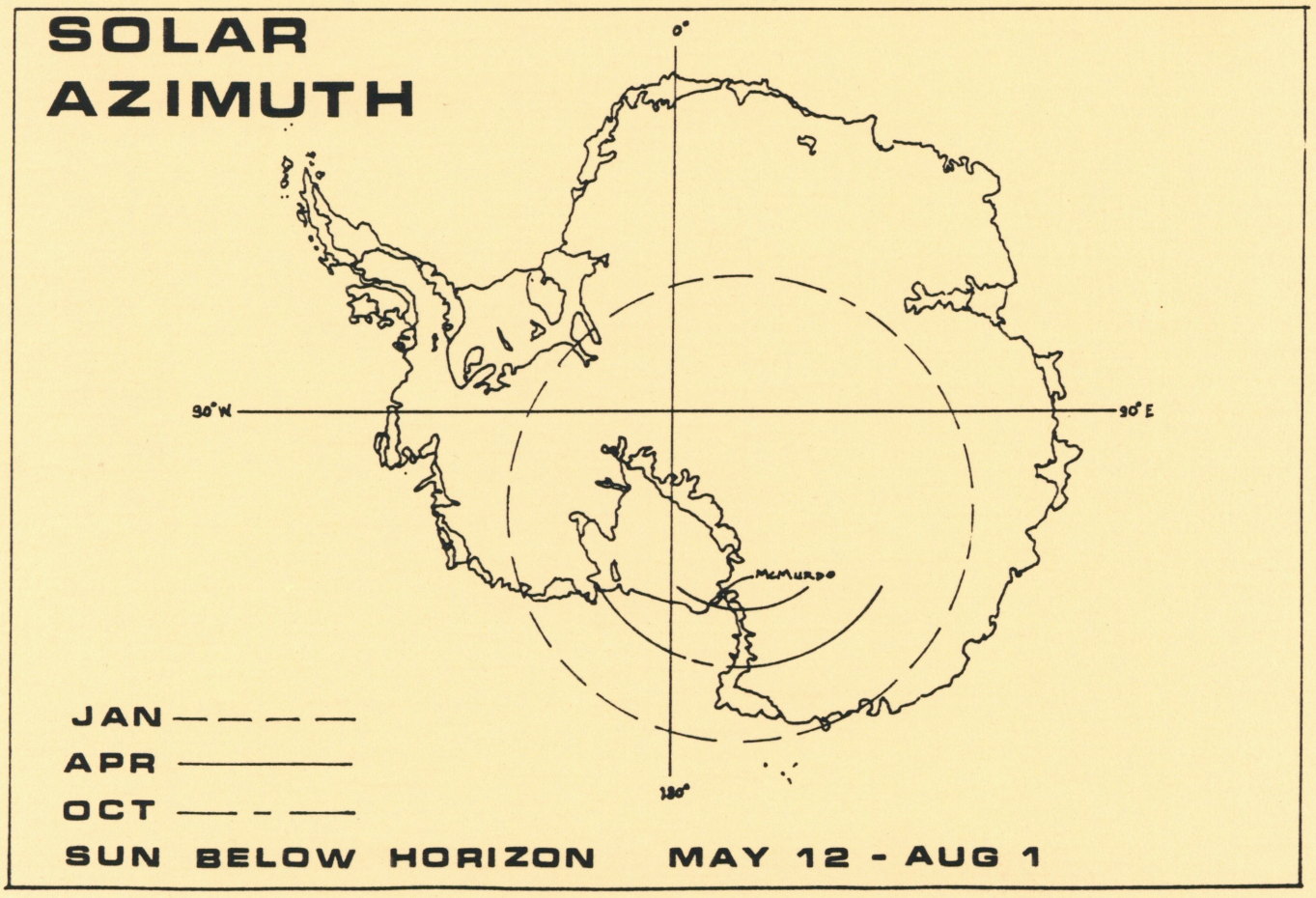
The precipitation is typical of most of the continent with less than two inches per year. Although the snow may drift as much as ten feet in a very short time in the winter, it is melted by the spring weather in October leaving barren rock exposed.

The average wind speed is 11.5 m/h is deceiving in that there are winds up to 80 m/h periodically throughout the year which raise the calm readings to this substantial average.

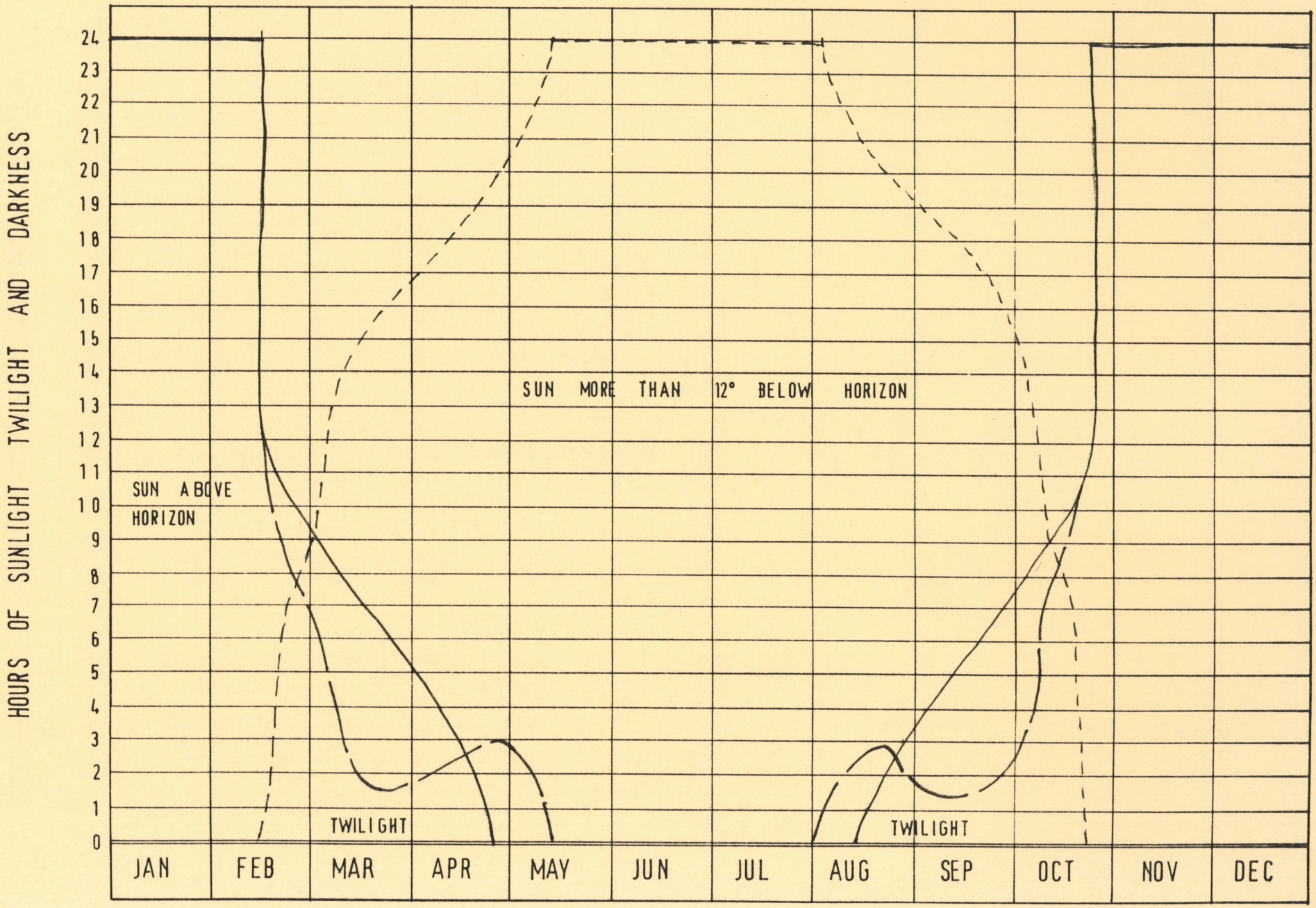
Although temperatures do go fairly high in mid-summer, they plunged down to a -56 F reading in mid-winter, keeping the average temperature at about 0 F.

The preceding data was merely an outline of the climatic conditions surrounding the area. For more specific information corresponding to specific months, see the following charts and diagrams.

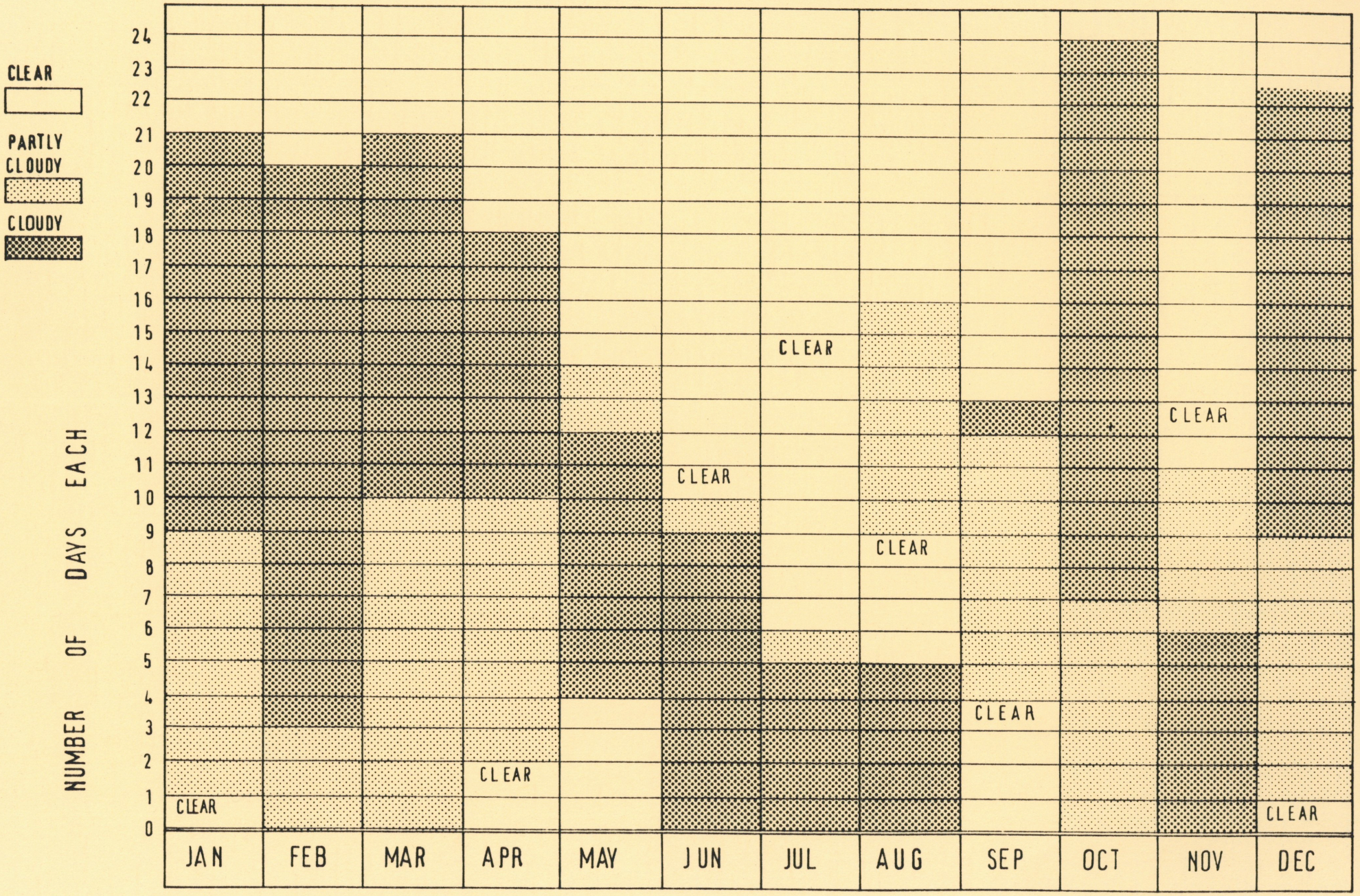

12AM.
37°
12°
7°
HORIZ.
6°
JAN
APR
JUL
OCT
SOLAR ALTITUDE
6 PM.
12 PM.
6 AM.


SOLAR AZIMUTH
0°
90°W
90°E
McMURDO
180°
JAN
APR
OCT
SUN BELOW HORIZON MAY 12 - AUG 1

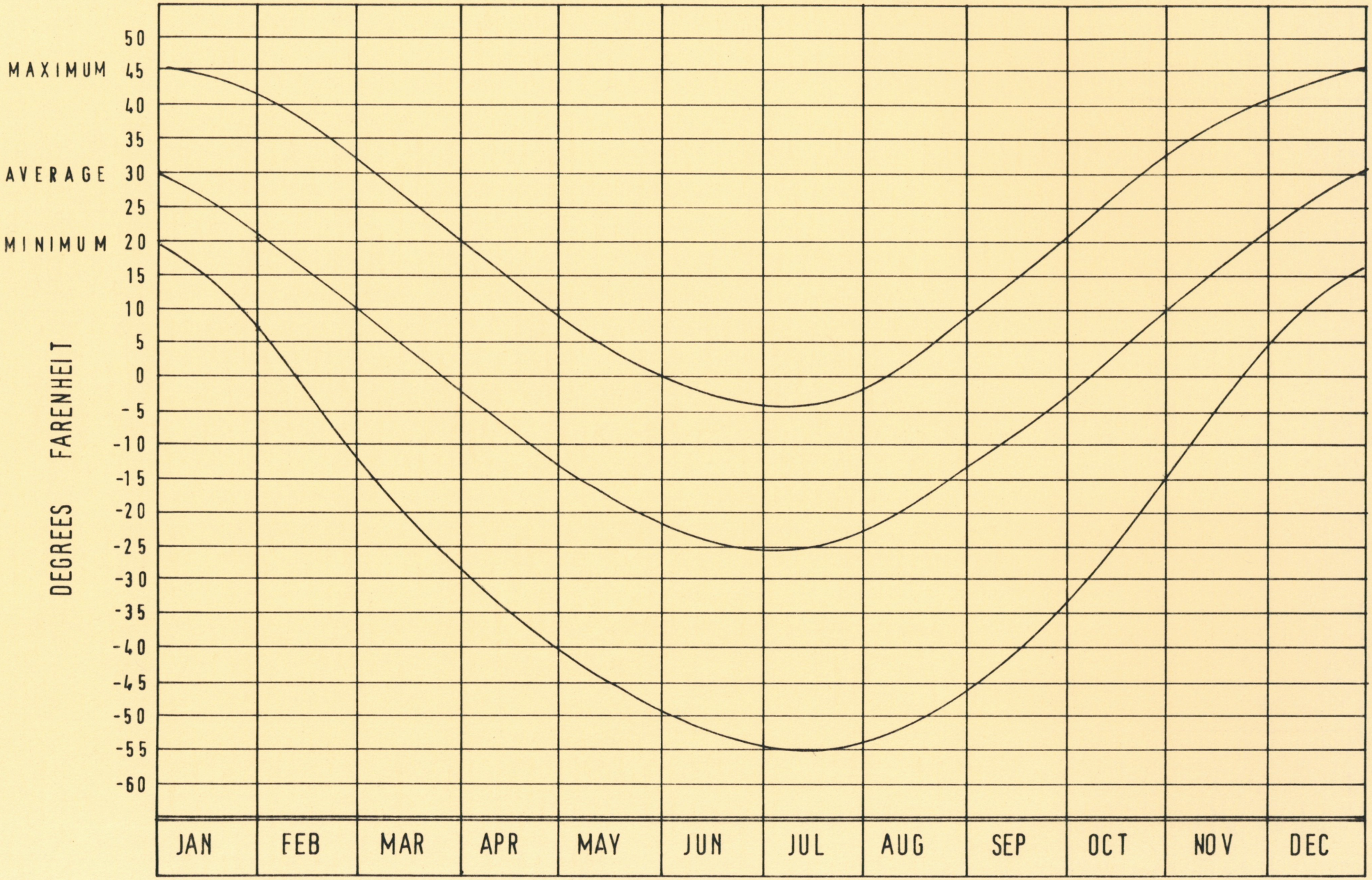
SEMIDURATION OF SUNLIGHT



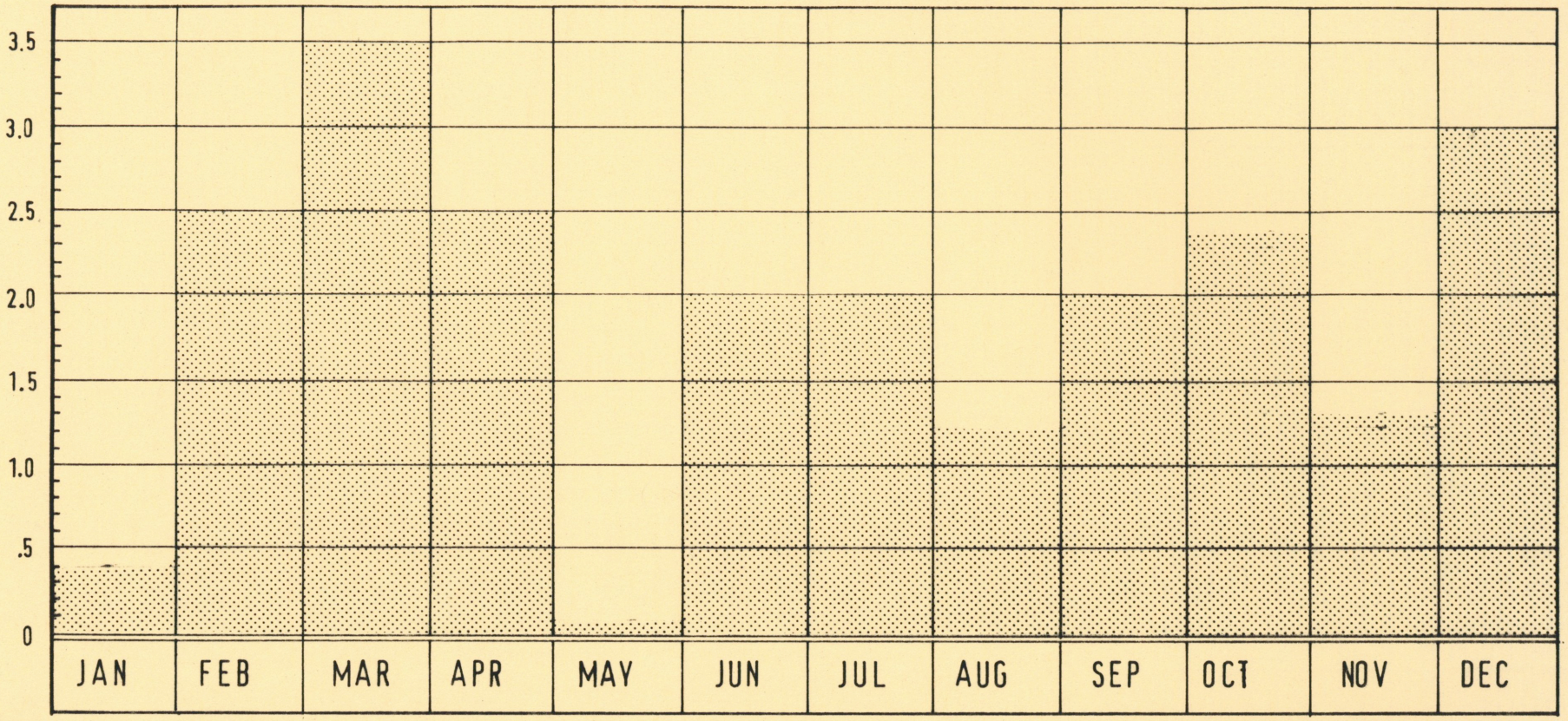
AVERAGE SKY COVER



MONTHLY TEMPERATURES



AVERAGE PRECIPITATION



WIND

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
DIRECTION FROM 0°	90°	87°	91°	76°	85°	83°	73°	62°	80°	75°	90°	70°
AVG. SPEED M/H	10.3	14.7	13.4	11.0	13.9	9.2	10.0	8.1	10.3	13.2	11.4	9.8
NO. OF DAYS VISIBILITY < 400 YDS.	0.2	0.2	0.8	0.2	0.4	2.2	1.4	0.2	2.4	2.2	3.6	0.5

166° 40′ E. LONG. 77° 30′ S. LAT.

PHYSICAL DESCRIPTION

Physical Description

Antarctica:

Antarctica, the continent lying about the South Pole, has an area of 5.4 million square miles - making it larger than the United States and Mexico combined. An ice sheet reaching 15,670 feet (nearly three miles) in thickness covers all but about two percent of this frozen continent.

The ice slowly accumulated over a period of some 13 million years. Ironically, the interior of Antarctica is one of the world's major deserts, with the precipitation (if it were melted) averaging one to two inches of water a year.

Antarctica is the coldest continent. The world's record low temperature of -128.6 F was recorded there. The mean annual temperature of the interior is -70 F. Along the Antarctic Peninsula, temperatures as high as 59 F have ben recorded.

The coasts of Anarctica are the windiest places in the world; gusts have been recorded at nearly 200 miles an hour.

Some 200 million years ago Antarctica was joined to South America, Africa, India, Australia, and New Zealand in the single large continent Gondwana. There was no ice sheet, the climate was warm, and trees and large animals flourished. Today, only geological formations, coal beds, and fossils remain as clues to Antarctica's temperate past.

Surrounding Antarctica are the southern parts of the Pacific, the Atlantic, and the Indian Oceans. Sea ice to ten feet thick forms outward from the coast. In summer the ice occupies less than two million square miles. But in winter it is a wide belt, impenetrable even by icebreakers, whose area of eight million square miles exceeds that of the continent itself.

Life has a tenuous hold on Antarctica. The ice-covered interior supports no life at all. Bacteria and yeasts have been recorded on exposed rocks 183 miles from the South Pole. Lichens and mosses occur in a few ice-free areas, particularly near the coast, and two flowering plants grow along the Antarctic Peninsula. Native land animals are limited to 76 species of insects, most of which occur nowhere else but Antarctica.

The cold ocean waters are rich in nutrients and produce an immense amount of phytoplankton, which supports large populations of krill, fishes, birds, seals, and other animals. In summer, birds (particularly penguins) and seals come ashore to establish rookeries and breed, but they get their food from the sea.

Ross Island:

Ross Island is one of the most fascinating places in Antarctica. The island is of volcanic origin and is situated at a latitude of almost 78 South. It is roughly triangular in shape and some forty-five miles wide and an equal distance long. It contains the continent's largest and most active volcano, Mt. Erebus. Being 12,450 feet high, the volcano is readily seem from McMurdo Bay which is at sea level.

On the western side of the island at Cape Royd's, harbors a group of Adelie penguins in the world's southernmost penguin rookery. At Cape Evans, several miles south of Cape Royd's, is the world's southernmost skua rookery and on the eastern side, on the ice shelf just off Cape Crozier, is the world's southernmost Emperor penguin rookery. Ross Island thus became one of the most important places in the Antarctic to see and study penguins.

McMurdo Bay:

The southern end of the island contains the world's southernmost land that is accessible by ship, McMurdo station, which is also the largest and most populous station. The station is also the prime logistic base for inland stations and is the center of the nation's scientific research in Antarctica.

McMurdo is built on bare volcanic rock which is the furthest south solid ground that is accessible by ship. Although it sports landing strips on floating sea ice and on shelf ice, has its own bay and a helicopter pad, it did not come into existance overnight. In 1955 the base was established for the continent-wide scientific activities of the International Geophysical Year of 1957-58. At that time the base consisted of ten one-man tents and thirty two-man tents. Today there are approximately 85 buildings in the area; however, most of them are for either storage or support facilities.

People visiting McMurdo are very fortunate to be intimately exposed to a profound sense of the Antarctic past and to the influence of heroic times and men. This was the first place men actually stepped foot on the continent in 1841. In this respect, it surpasses any other place on the continent.

SITE SELECTION

Site Selection:

The placement of this building came about through site analysis studies distinguishing this site from others due to proximity to roads, paths and the help of the existing complex. During the summer months there are few problems moving around and through the complex except during occassional ground blizzards, however, the darkness of winter combined with the snow makes going from one building to the next frequently life threatening. The Oasis site is located 100 feet from the main logistics building/mess hall and 200 feet from the general housing dormitories. This puts it within the 250 foot radius that is the average visibility distance during the winter.

The main road through the complex, from the boat loading to the New Zealand complex 20 miles away, runs directly behind the Oasis making it accessable from outlying points in the complex. To the west of the Oasis is the logistics building which combined with the main road, already forms a kind of central space which is only seen in plan except for the post office hut which sits at the intersection of the space.

By placing the Oasis on this site a more comprehensible center is formed in the complex area which is at present, an ambiguous center in that it only has presence due to the post office.

The decision on the site selection was not only a planning response but also a climatic response. With the prevailing winter winds out of the west , and usually only 8 to 10 feet off the ground, the logistics building acts as a wind break for the Oasis. This makes travel between the logistics and housing buildings easier all year round with the recreational building blocking out the prevailing easterly winds in the summer.

The solar consideration for placement of this building had little relevance in the matter. The sun at this latitude has almost a circular pattern moving through the summer sky, illuminating almost every angle around a building. The sun's altitude being only 37 degrees maximum above the horizon leaves little opportunity to take advantage of a direct solar gain except on a north facade, and then only 3 months out of the year.

The site was selected from these basic criteria, thereby making it a prominant building in the complex aside from its large structural stature.

DESIGN CONSIDERATIONS

User Identification:

The people who are in Antarctica are there because they want to be. There are no prison work camps or isolation from society because of politcal affiliations as in Siberia. These people are scientists, Naval personnel or just adventurous individuals who are seeking something of themselves in the desoluteness of Antarctica.

The main populace is made up of individuals in their late twenties thru mid-thirties. These people are there for support of the scientific endeavors and the functioning of the whole complex in general. It requires approximately four people to maintain one scientist in his work, whether they work directly under him or on the running of the complex. These people have to be diversified in their skills to maintain a smooth operation of the facilities. Many times one person will be required to be able to assist in labs and then work on machinery of some sort.

The people here sign on for a year which means spending 4 months in total darkness with little to do but sleep and drink. Everyone must go through extensive testing before embarking upon their stay, which includes a physical and psychological evaluation to determine what your odds are of lasting out the year without becoming an alcoholic or going mad from isolation. This testing eliminates many people that one would imagine being there, such as the criminals looking for a haven or people who just despise the human race in general.

For many years the population was exclusively male, however, there is at present a 75 to 25 ratio of men to women. The predicted ratio will reach a 60 to 40 ratio with the increased interest in Antarctica and the monitary incentives now being established.

These people are hard working, adventurous and maybe, by some people's standards, a bit tinged. In any case, they are there and need a place to relax and keep their sanity intact. This project was designed with these people in mind, with the thought that it is just the kind of break they deserve during their stay in Antarctica.

Management:

The recreational facility will be managed and funded by the National Science Foundation. The NSF is an independed Federal agency that was established in 1950 after the many contributions it made to the field of science and technology during World War II. The personnel would be working directly for the NSF rather than out the research based foundations at McMurdo.

The oversight and maintenance of the building would be from persons who are working there already except for possibly the top supervisory position which could be filled by someone willing to stay on for a 5 to 7 year stay rather than the typical 1 year. The people staying here could make extra money or it could be written into their usual duties that are established before they leave for Antarctica.

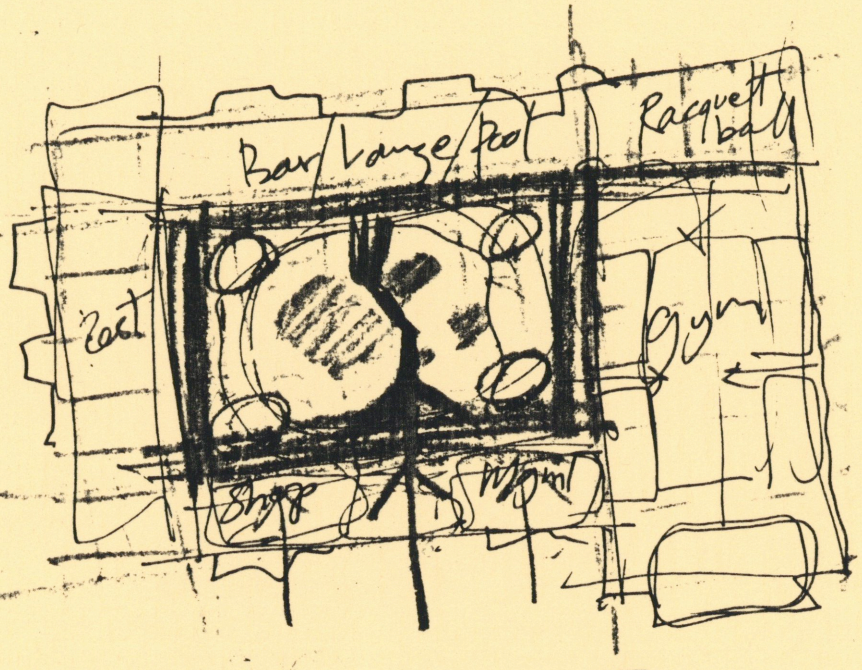
The supplies for the facility would be maintained much as they are now - with a stockpiling during the summer months and then an air drop during the winter. The added cost could be balanced by charging minimal fees for the use of the facility or a barter system for time working.

Parti:

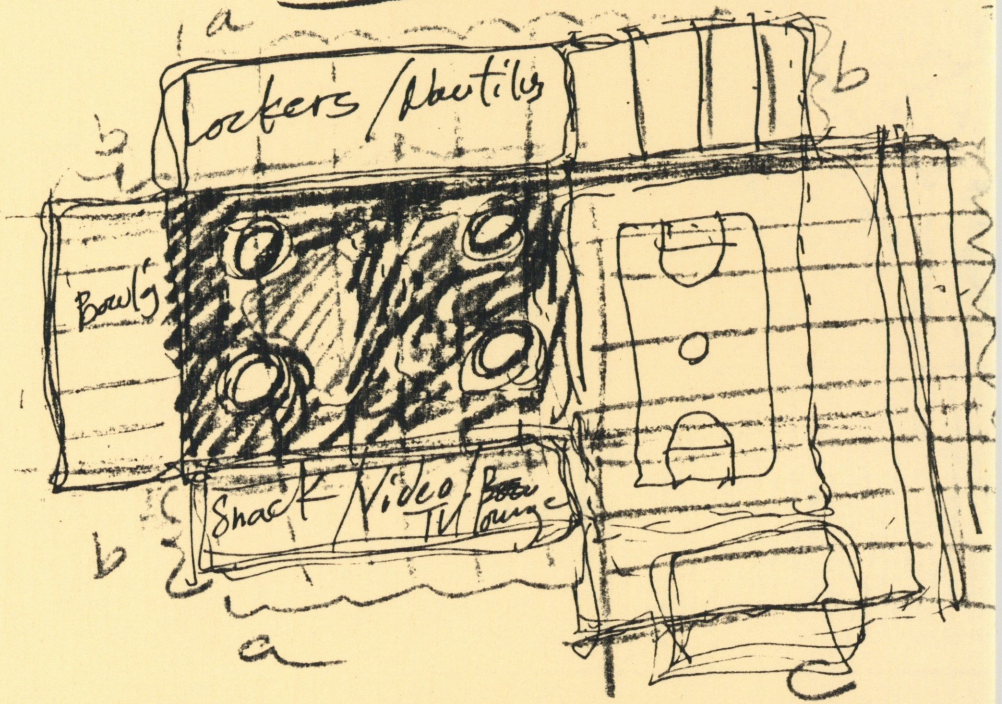
The need for a large open space became a major goal to accomplish in this building through the already discussed research. This, in turn, became a major focus for the parti development. With this as the only criteria, an infinite number of solutions arise without constraints. My interest in this project was not only one of designing for plan and elevation sake, but to include a structural system that was feasible on this site rather than a suggestable solution. At this point, a building that addressed the climatic issues also seemed appropriate, which implied a building "pile" rather than a stretched meandering building.

The solution to these issues then became a matter of making it "work". In the sense of circulation, massing, and a particular character to the spaces included in the program. The parti is straight forward and not unique, however, it was versitile enough to allow for the personal design of the spaces as they related to function and character that was bestowed upon them.

stories



UPPER FLOOR



LOWER FLOOR

40 120 120

280 ft 300

36

37.5

stairs
ramps

1) spatial definition
2) vert. & horiz circ.
3) vert. & horiz struct.
4) envelope/fenestration

1/8"

Atrium:

The idea of being closed up in a small area for a lengthy time has already been put forth, however, a solution was not suggested. The feeling of entrapment becomes a major problem when dealing with a 68 day period of darkness that leaves a person nothing to do or see outside of his immediate location. There is nothing to do outside in the winter in Antarctica and even less to see. The need for a large open space becomes a vital design element in this type of recreational facility. Being able to look across a 150' space that is well lighted will help in keeping down the depression felt during the winter.

Studies by George Brainard of Jefferson Medical College in Philadelphia show that there is a direct correlation between winter depression and the amount of light and open space a person has. By limiting the volume around a person and depriving them of sunlight the pineal gland at the base of the brain secrets melatanin, a sleep inducing hormone which seems to depress both mood and mental agility. To help diminish this hormonal production, a feeling of outdoors and the use of blue-green tinted light cut melatonin the most.

This study, combined with the isolated atmosphere, led the atrium into a forefront consideration in designing this facility.

PRECEDENTS:

The precedent studies which most influenced this project are on the following pages. The first being the Waves at Blackburn, which upon opening set new design standards in this type of building program. The reason it is included here is because of the overall ambience it projects which this project would like to carry through with.

The second is the Sainsbury Centre for the Visual Arts, by Foster Associates. This building became of importance due to the fact that it used a different panel construction to modularize the total project.

The third study exist here because of the space frame construction, which can clearspan the needed distances in this project The building is the Vancouver Government Complex.

The Waves at Blackburn, which opened in August, is perhaps architecturally, the most exciting of the new generation of 'leisure lagoons' offering the very latest in leisure water features and activities.

Unlike most leisure centres, which are for suburban sites or on the edge of town, The Waves is right in the centre of town, *4, 5*, and the architects have produced a building of rare architectural quality and civic dignity. The product of an enlightened client and caring, responsible architects, the building promotes a higher quality of architecture for this type of building. It is a move away from the low cost, often blind boxes, filled with exciting features but cheap materials, which dominated the previous generation of leisure pools and many of the recent 'round the corner' facilities.

Progressive patronage

The Borough of Blackburn has always been a progressive authority, pioneering, in the 1960s, one of the first central area redevelopments where architecture and civic design mattered. Its brief for The Waves called for a building of excellent standard of appearance and construction which would make a positive contribution to the townscape—a building to promote Blackburn.

Before establishing the initial brief and appointing the architects, the council carried out an extensive survey at home and abroad so that its officers became fully attuned to the latest in leisure thinking.

After this thorough investigation it was no surprise that the council appointed in 1983, the architects Faulkner-Brown Hendy Watkinson Stonor—a practice with solid experience in leisure buildings (AJ 13.3.85 p73). Faulkner Browns, as the practice is now known, designed the first leisure pool in the UK at Bletchley in 1974 and has since completed seven more, with nine currently under construction and a further seven on the boards. Add to this its involvement with traditional sports facilities over a period of almost 25 years and you have a practice whose experience and expertise in this field is almost second to none. It is also distinguished by its continuing search for innovation, and by its belief that quality in leisure buildings not only pays, but is essential.

Finishes, furniture and fittings

The standard of finishes is of a higher specification than normally found in local authority controlled leisure pools. This will undoubtedly assist in keeping maintenance costs low. Finishes include special non-slip mosaic tiling, high impact coloured glass changing cubicles, shot blasted fairfaced blockwork and special aluminium plank ceilings. Difficulties have been experienced with some of the glazed floor tiling as users have slipped in hurrying from one area to another. Carpet runners have had to be strategically placed to overcome this problem.

Furniture and fittings have been carefully selected and planned to complement and enhance the overall interior design. Here again the specification is much higher than normal; for example, reception counters and café tables and counters, are all made from solid laminate. The interior has benefited from the architects' involvement in this aspect, a factor not always recognised by clients.

Structure

A structural steel frame was chosen so that the roof could be erected at the earliest possible opportunity. This allowed all other building operations, including the formation of the complicated free form pool and reinforced concrete slab, to continue without interruption, thus keeping the building programme to a minimum.

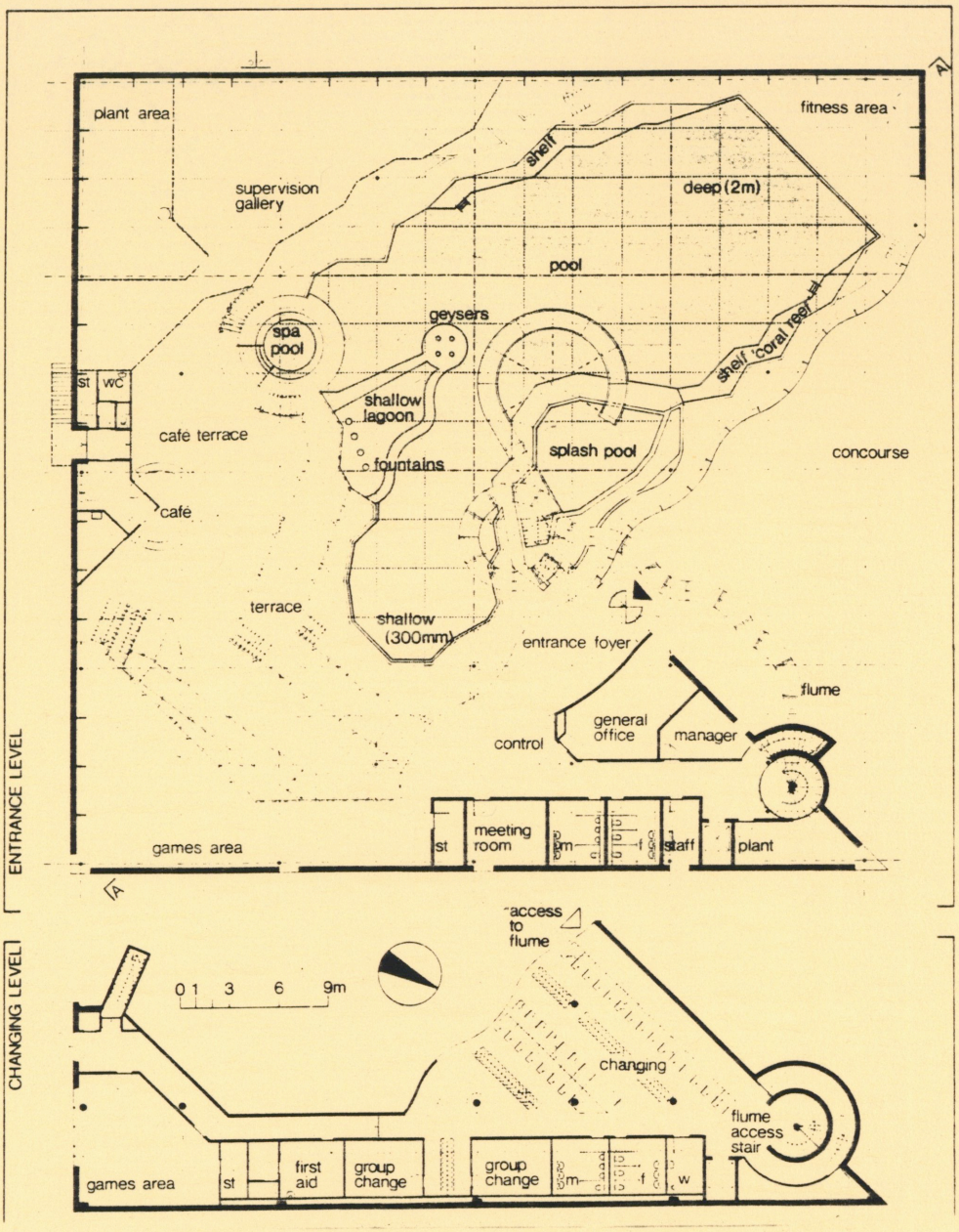
The frame is made from high yield steel, to reduce bulk, and has been designed deliberately as an exposed element. It is now generally recognised that modern paint specifications are well able to withstand the rigours of a corrosive swimming pool environment and that exposing the structure is better than hiding it behind ceilings—where any corrosion that occurred would not necessarily be seen. The saving in the cost of ceilings and pressurised voids, along with the elimination of difficulties often experienced with their construction, makes it hardly suprising that the majority of leisure pools now have such an arrangement.

Seven steel V beams, varying in length up to 44 m, span the pool hall diagonally. At the main window wall a curved truss acts as the other diagonal of the building plan, framing the ends of the V beams and mirroring the curved glazing, *17*. On two of the perimeter walls, vertical lattice trusses stiffen the blockwork walls, and these are connected to the roof perimeter truss by a sliding coupling. At the fourth wall, facing the main street, a series of independent flying steel buttresses prop the blockwork and express the stepped motif of the glazing, *18, 23*.

The roof is highly insulated, (with a U-value of $0 \cdot 3 W/m^2 °C$) modelled on Scandinavian lines, and is finished externally in a silver powder-coated metal. The structural aluminium deck exposed internally is perforated to provide acoustic absorption. The exclusion of secondary steel purlins gives a clear and uncluttered soffit. Hermetically sealed triangular rooflights run at right angles to the main trusses.

Services

Heating to the building is provided by perimeter coils and zoned air-handling units served by two modular gas boilers. The ventilation plant and trunking is accepted by the designers as an important visual element and left exposed. High insulation values and a heat pump satisfy energy conservation needs, allowing for heat recovery and recirculation (see p45). The heat pump also controls humidity levels. Ventilation rates are adjustable in the pool hall to suit occupancy levels, thereby affecting further savings.



The energy demands to maintain pool water temperature of 29°C, air temperature of 30°C and a relative humidity of 50 per cent are considerable. Add to this the need for larger than normal quantities of fresh air and a substantial hot water supply for showers and it is clear that great care needs to be taken in the design of the building and its mechanical and engineering services if energy costs are to be kept at a reasonable level.

The following passive measures have been built into the fabric and the engineering of the scheme:

- a compact building form with only 15 per cent overall glazing in the roof and side walls. Glazing has been distributed strategically to allow for good daylighting (rooflight and clerestory) and a panoramic view in and out of the building (the serpentine wall)
- ozone treatment to the pool water reduces the amount of chlorine needed for sterilisation. This enables more air to be recirculated and reduces substantially the corrosive quality of the swimming pool air
- two separate air handling plants provide options for the control of the spectator area at a different temperature from the pool hall and thus produce economies in running the plant overnight.

The most cost effective piece of equipment adopted for heat reclaim is the heat pump. Primarily it dehumidifies the extracted air and provides either heat to the pool air or pool water system as required. This system, geared to run around coils, fully modulating fresh air dampers and reduced air volume on night set-back conditions, offers a most cost effective solution.

Exact consumption figures are not yet available for the pool; however, preliminary monitoring would indicate that energy savings in the range of 25 to 30 per cent over more conventional design solutions will be possible. If one compares this building with some of the earlier pools of the 1950s and 1960s, then energy saving of 50 to 60 per cent is not unbelievable.

For further information on heat pumps for pools, see AJ 24.3.82.

The metal-skin technology of Foster Associates

In his speech accepting the Royal Gold Medal in 1983, Norman Foster told the RIBA that his design owes much to *pragmatism* and *intuition*—two words well-chosen to encapsulate the creative force behind his work. Intuition most certainly inspires that part of the work that imparts an uplifted sense of balance, volume, light, and space to the architecture. Intuition also plays no less a role in the technological approach to building that is one of the hallmarks of his work. Norman Foster and his associates have a *feel* for the right use of materials, a feel that is made to work within the pragmatic boundaries of current building.

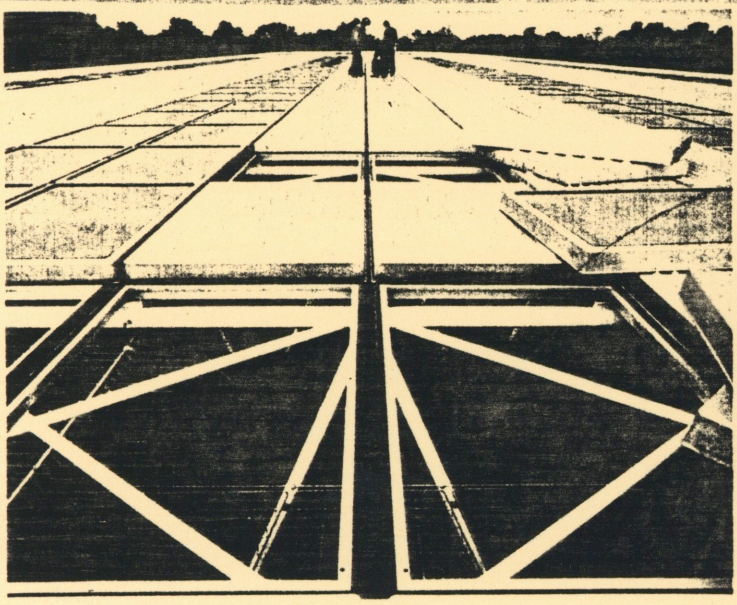
Foster Associates' involvement with material technology is fundamental to its practice, making the firm somewhat atypical among architectural firms. Because the buildings are assemblages of well-understood, clearly articulated construction pieces, to design better, the firm has cultivated a thorough grasp of mechanized production—a command of the industrial process and materials has served it well. Whether the need is for an insulated metal panel, an interior window shade, or an office table, when no existing architectural component fulfills an established design criterion, the architects are able to invent, or at least innovate, one with relative ease. As Foster has said, "Much of our work centers around a deep concern with how a building is made, with craftsmanship and tender loving care." Design collaboration between the architect and industry is one way in which that concern is realized.

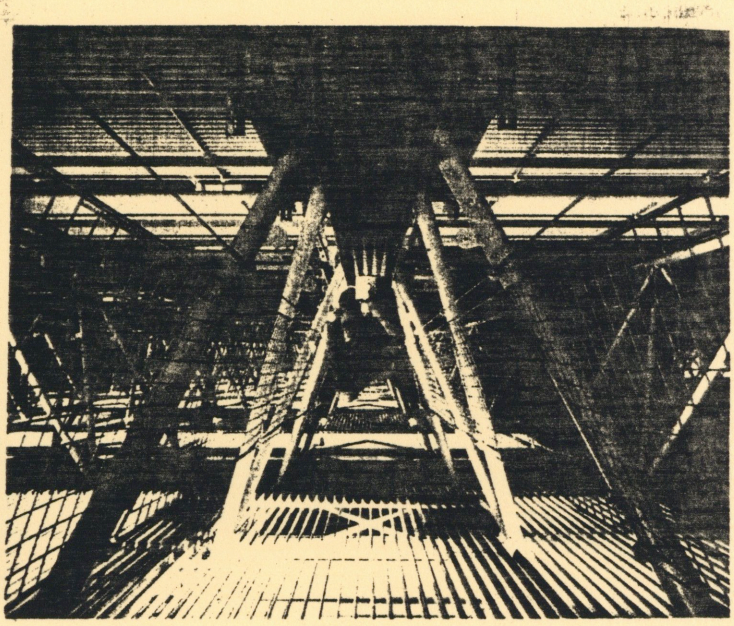
Three projects in England by Foster Associates follow—the much publicized Sainsbury Centre for the Visual Arts, the Renault Parts Distribution Centre, and IBM's Technical Park at Greenford—offering a closer look at how their metal panel systems were conceived and executed. As with most buildings, long-range performance and construction economics were key factors in the design formula. Economics dictated the extent to which the architects could be directly involved with product design from within industry. These three projects show a range of involvement—from specifying stock items, to product design per se.

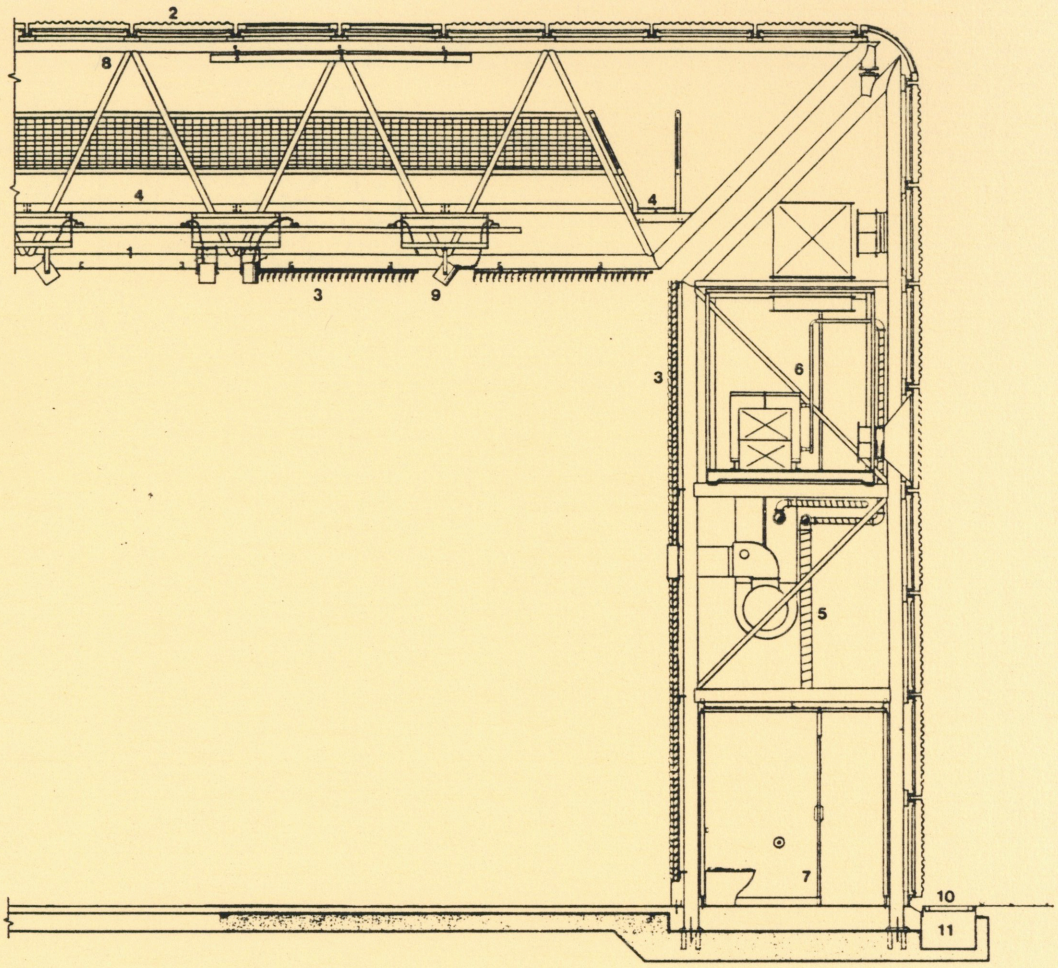
At the IBM installation (facing page, lower right) a standard, flat-ribbed sheathing was used for the planar expanse of the wall. The architects paid attention to the modular character of the sheets, placement of bolted attachments, and surface color, but otherwise had no hand in the product. (The ribbed corners at IBM are another matter, see pages 136-137.) The panel system devised for the Renault Centre (lower left) is a unique assembly, but is comprised of standard components. The perforated mullions, neoprene gaskets, and metal panels sandwiching rigid insulation were assembled on site. The one nonstandard member in the cladding system is the exterior sheet met The tooled ribs were profiled especially for the project by the architec for the sake of the surface esthetic.

Work on the Sainsbury Centre (top) entailed significant involvemen in product design. The metal-panel system's development had much t do with concerns for the building's stringent interior requirements. First, the space was to be top-lit. Second, the building was to be capat of maintaining a controlled air quality without relying on elaborate mechanization. The roof represented a major concern too, as it would no less visible on the site than the walls and, therefore, should be attractive. And of course, it shouldn't leak—no roof should, but any leakage directly above priceless artifacts could result in irreparable damage. Since leaks most often occur at penetrations, the architects designed out all penetrations with a series of modular panels set into continuous grid of gasketing that rises from grade across the roof, an back down to grade. (Using such panels for the roof is, quite possibly, one-of-a-kind application.) Too, there was a desire for interchangeabili that led to the design of its noninterlocking panel in metal or glass. Th ingenious web of neoprene gasketry that visually functions as a shadow joint ties the system together in bas relief. Finally, there was no metal product on the architectural market that could smoothly turn the face of a thin metal sheet to make the deep reveal determined by the requisite thickness of insulation. Although the firm often turns to the automotive and aviation industries when backed into a technologic corner, the solution to this metal panel came from the sector of the aluminum industry that works with super-plastic alloys for the manufacture of complex machine parts and (of all things) fireplace screens.

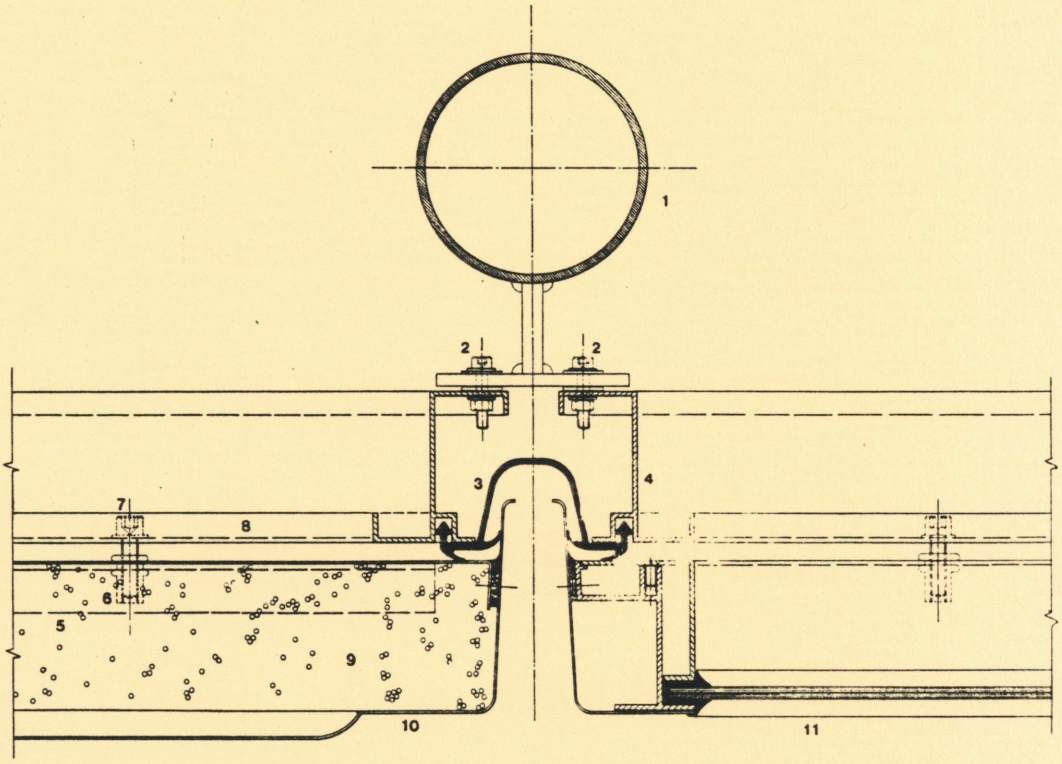
In the end, the cladding system at the Sainsbury Centre generated innovations in gasketry, panel fabrication, and attachment. Credit for these innovations and those in other projects owes much to the teamwork among varied manufacturers, contractors, engineers, and architects, all willing to experiment with well-defined practical ends as a goal. Results are as dazzling as they are pragmatic; and they stand a compelling testimony to the ongoing strength of the modern movemer with its concern for pushing at the progressive boundaries of appropriate craftsmanship and engineering. Although a building will never be a work of architecture solely on the basis of its technology, th projects of Foster Associates serve as reminders that without continuously evolving technique, there can be no contemporary architecture at all. *Darl Rastorfer*







1. *Tubular-steel structure, clear span 33 m*
2. *Interchangeable vacuum-formed aluminum panels, glazed, solid and louvered*
3. *Turnable aluminum louvers*
4. *Access walkway*
5. *Air distribution zone*
6. *Plant*
7. *All services: plant, darkrooms, toilets, stores*
8. *Solar-controlled aluminum louvers*
9. *Combined artificial and natural top light*
10. *Cast-aluminum grill*
11. *Gutter*



Tubular steel frame
Stainless-steel nuts and bolts
Rib of neoprene ladder gasket
Enameled extruded aluminum subframe
Aluminum channel stiffener
Nut-and-bolt fixing
Stainless-steel screws
Aluminum inner skin
Insulation core
Aluminum outer skin
Laminated glass

VANCOUVER'S GOVERNMENT COMPLEX, DESIGNED BY ARTHUR ERICKSON ARCHITECTS

A NEW URBAN CENTER FOR HARRISBURG, PENNSYLVANIA

THE BALTIMORE-WASHINGTON INTERNATIONAL AIRPORT

BUILDING TYPES STUDY: EMBASSIES AND CONSULATES ABROAD

FULL CONTENTS ON PAGES 10 AND 11 SEMI-ANNUAL INDEX ON PAGES 157-160

ARCHITECTURAL RECORD

DECEMBER 1980 12 A McGRAW-HILL PUBLICATION $5.50 PER COPY

The building systems for this project include structure, glazing and climatic considerations. The water used for cooking, showers, and drinking comes from a desalination plant at the complex. Electricity and waste removal is also readily available at the site via above ground piping systems. The water for the pools will be supplied by natural hot springs that are in the area which have a low sulphur content and a temperature reading of approximately 175 degrees Fahrenheit.

Antarctica is owned by no one nation and thereby each nation establishes its' own codes when dealing with construction. The McMurdo Bay area is occupied by the U.S. and, therefore, uses the current UBC manual as a guideline in cooperation with any standards set by the National Science Foundation.

This section deals primarily with the exterior skin of the building while considering construction materials and techniques.

BUILDING SYSTEMS

Double Wall System:

The extreme low temperatures are the dictating factor for the use of a double wall system. It is not recommended that any steel or aluminum be allowed to penetrate both an exterior wall and a wall to be used in a habitable space. The temperature change from a -40 degree Fahrenheit ouside to an interior temperature of 70 degrees Fahrenheit would cause contraction in materials and all materials, having different coefficients of expansion would pull away from each other. This at least would make the building susceptable to air penetration from the outside and, at most, a structural failure.

To isolate the structure and the exterior wall from the interior, this system is modeled after Foster's Art Center building in England, which seems to be effective towards this end with relation to an isolated panel system. However, rather than using a tubular system that allows for functional space between the structure, this building is putting forth a system of steel columns that will act as both structure and support for the aluminum panels. The columns are supported at the ground level by precast concrete pads, the method currently used for foundation support in this area. The volcanic nature of the ground requires this because it is costly and time consuming to excavate for pile footings.

The column system is designed on a 20' or 40' bay layout, according to the amount of clear span required. A larger bay may have been used except for the fact that 40' is the maximum length that anything can be shipped to the site semi-economically. The weight is of little concern leaving the length to be the dictating factor when dealing in shipping materials. Once the materials are on land there is adequate machinery to handle them throughout the construction stage.

A steel stud wall will be insulated from floor to floor, minimizing the amount of air penetration and forming a thermal break from the insulated exterior wall. This interior can then take on the finished surfaces that are required for that space.

Double Window System:

Due to the sub zero temperatures, a double glazing system is to be used throughout the building with the exception of the space frame. The outer most glazing should have a high R value due to condensation between the windows and to prevent as much heat loss as possible. The innermost glazing will consist of a glazing that is impregnated with electronic polorization capabilities, which will allow the user in a space the opportunity to adjust the amount and quality of light desire in that space. This becomes essential when dealing with the 5 months of 24 hour a day light.

Three separate zone, are integrated in each glazing panel which relate to the users desires for lighting at the sitting level, standing level or overhead zone. This panel is 5'-6' high and breaks down into three horizontal mullions 1'-8" each which relate to the above zoning. A 3'-3" panel is placed above and below the glazing panel to acquire an overall heighth of 12', which is the floor level between stories.

A separate panel that allows for placement of windows on either end, in the middle or a combination of the three is used to allow for diversity in glazing placement. This panel also allows for a small or large amount of glazing to be used depending upon the amount required in a space.

The varied sizes of panels are necessary when dealing with a set panel size in order to be diversified enough to be applied to the various functions of separate spaces. One draw back from all of this diversity is that the combinations of each become so numerous that it becomes difficult to design a layout for a large building that is comprehensive to the rest of it.

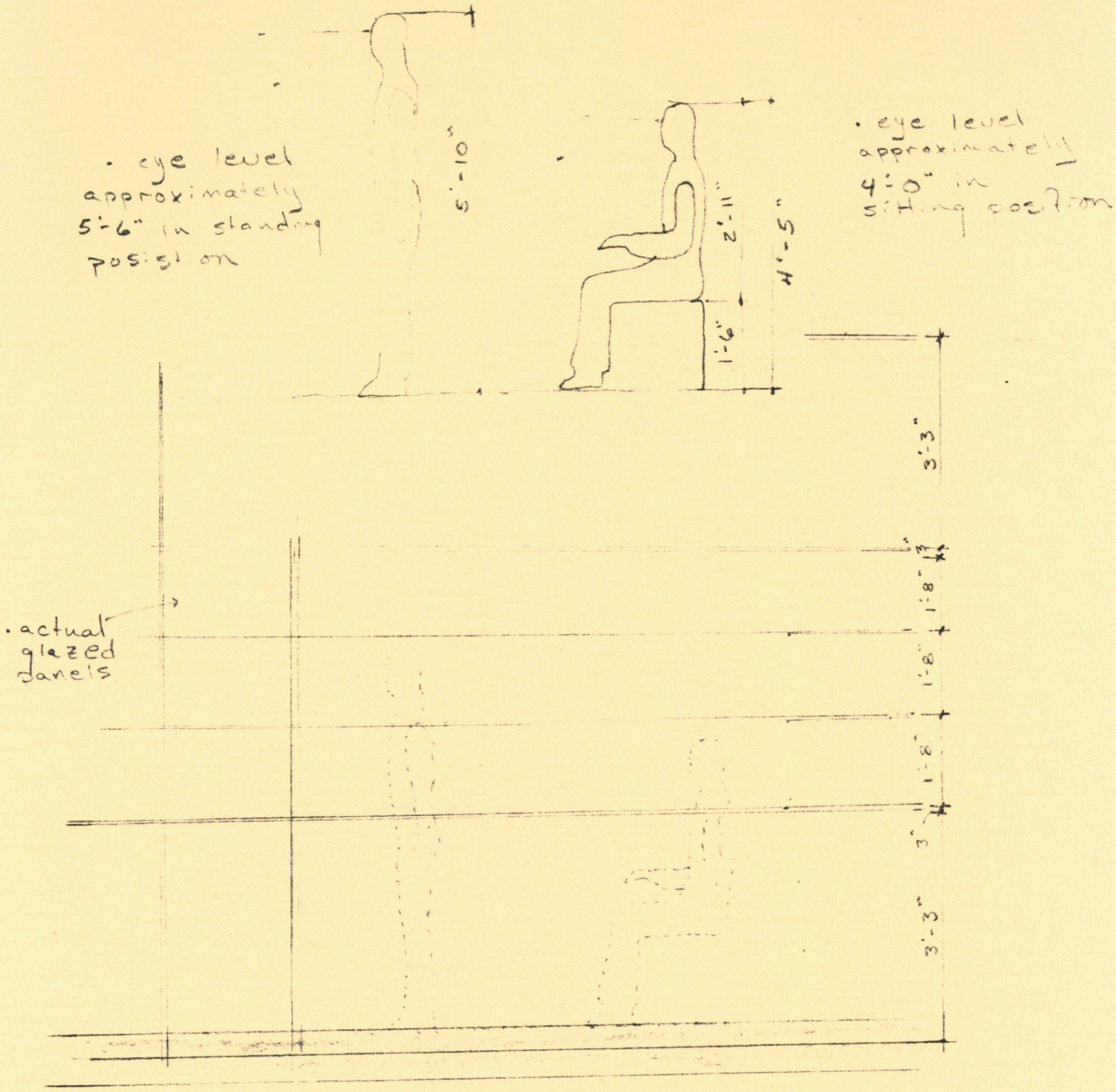
Panels:

The panels that are to be hung from the structural system on the exterior are 6' by 10' extruded aluminum with an enamel coating. This panel will also contain a preformed insulating material making the overall thickness 4 1/2" wide.

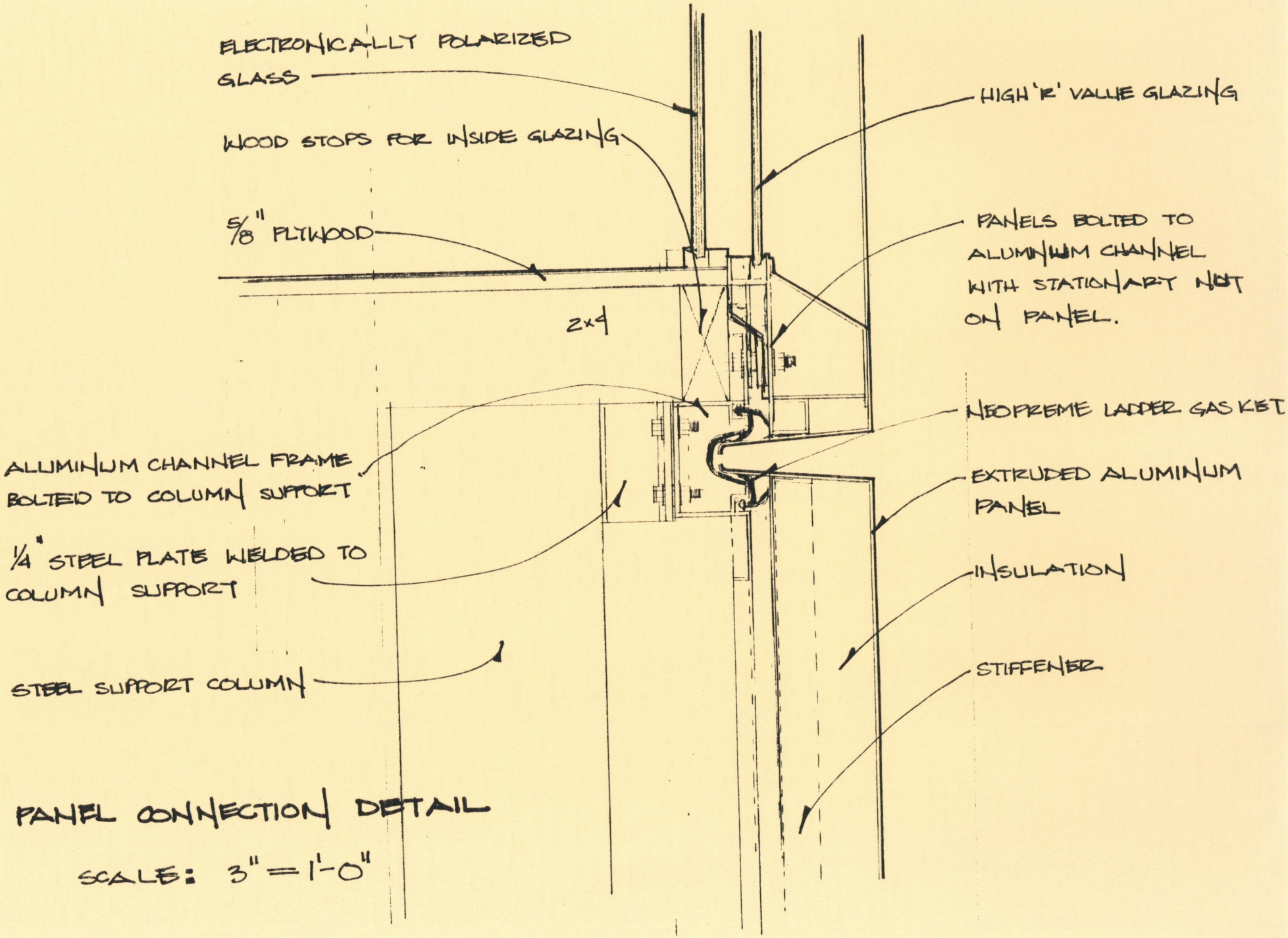
The panel's dimensions originated from both the structural layout and the decisions on the glazing units. The 6' height comes directly from the previously written about glazing panel. The fact that it filled the full 12' between floors suggested that half of that height would be appropriate for a joint line to break up the facade. A full 12' may have been used, however, to maintain a human scale with respect to the overall height and massing of the building a 6' panel becomes more appropriate. The 10' dimension comes from the fact that is spans half way between the structural columns and the minimal thickness of the panel itself would require more mass and internal support to span the full 20'.

A network of extruded aluminum channels will be the connection points for these panels to the structure. A neoprene ladder gasket is inserted along all seams to prevent air and water infiltration. The panels are bolted onto this frame from the inside with the panel having a pre-fit threaded connection.

▪ Glazing panel layout



• This illistrates the vertical breakdown of the glazing panels – the horizontal breakdown is not based on the human scale, but rather by dividing the distance between supports into 3 seperate sections so that it might coincide with the vertical layout



PANEL CONNECTION DETAIL

SCALE: 3" = 1'-0"

Comments:

Upon completion of this project I find myself firstly tired and secondly both ecstatic and depressed. It's the end of five years, sometimes too long and sometimes too short. I've learned much from the professors here and from my own accomplishments and failures, but somehow it seems like only the beginning of my education. At best, I've finally finished a goal I set for myself five years ago. At worst, I've made friends whom I "hope" not to lose track of over the years. Above architectural learning, I've found out more about people in general, whether good or bad. I've had my say on the topics that concern this project, and right now these are the only things that seem to matter.

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APPENDIX 1

Antarctic Treaty

(complete text)

[Signed 1 December 1959 at Washington, D.C., by the 12 nations listed in the preamble.]

[Entered into force 23 June 1961; the 12 signatories became the original 12 consultative nations.]

[Consultative meetings have been held since the treaty entered into force, generating 139 recommendations as of 1984.]

[As of July 1985 four additional nations (Poland, Federal Republic of Germany, India, Brazil) have achieved consultative status by acceding to the treaty and by conducting substantial scientific research in Antarctica. Another 16 nations have acceded to the Antarctic Treaty: Bulgaria, China, Cuba, Czechoslovakia, Denmark, Finland, Netherlands, Romania, German Democratic Republic, Uruguay, Peru, Italy, Papua New Guinea, Spain, Hungary, and Sweden. These nations agree to abide by the treaty and may attend consultative meetings as observers.]

[Headings (unofficial) added by National Science Foundation.]

[preamble]

The Governments of Argentina, Australia, Belgium, Chile, the French Republic, Japan, New Zealand, Norway, the Union of South Africa, The Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

Recognizing that it is in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord;

Acknowledging the substantial contributions to scientific knowledge resulting from international cooperation in scientific investigation in Antractica;

Convinced that the establishment of a firm foundation for the continuation and development of such cooperation on the basis of freedom of scientific investigation in Antarctica as applied during the International Geophysical Year accords with the interests of science and the progress of all mankind;

Convinced also that a treaty ensuring the use of Antarctica for peaceful purposes only and the continuance of international harmony in Antarctica will further the purposes and principles embodied in the Charter of the United Nations;

Have agreed as follows:

Article I
[Antarctica for peaceful purposes only]

1. Antarctica shall be used for peaceful purposes only. There shall be prohibited, inter alia, any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military maneuvers, as well as the testing of any type of weapons.

2. The present Treaty shall not prevent the use of military personnel or equipment for scientific research or for any other peaceful purposes.

Article II
[freedom of scientific investigation to continue]

Freedom of scientific investigation in Antarctica and cooperation toward that end, as applied during the International Geophysical Year, shall continue, subject to the provisions of the present Treaty.

Article III
[plans and results to be exchanged]

1. In order to promote international cooperation in scientific investigation in Antarctica, as provided for in Article II of the present Treaty, the Contracting Parties agree that, to the greatest extent feasible and practicable:

(a) information regarding plans for scientific programs in Antarctica shall be exchanged to permit maximum economy and efficiency of operations;

(b) scientific personnel shall be exchanged in Antarctica between expeditions and stations;

(c) scientific observations and results from Antarctica shall be exchanged and made freely available.

2. In implementing this Article, every encouragement shall be given to the establishment of cooperative working relations with those Specialized Agencies of the United Nations and other international organizations having a scientific or technical interest in Antarctica.

Article IV
[territorial claims]

1. Nothing contained in the present Treaty shall be interpreted as:

(a) a renunciation by any Contracting Party of previously asserted rights of or claims to territorial sovereignty in Antarctica;

(b) a renunciation or diminution by any Contracting Party of any basis of claim to territorial sovereignty in Antarctica which it may have whether as a result of its activities or those of its nationals in Antarctica, or otherwise;

(c) prejudicing the position of any Contracting Party as regards its recognition or nonrecognition of any other State's right of or claim or basis of claim to territorial sovereignty in Antarctica.

2. No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antar-

ctica. No new claim, or enlargement of an existing claim, to territorial sovereignty shall be asserted while the present Treaty is in force.

Article V
[nuclear explosions prohibited]

1. Any nuclear explosions in Antarctica and the disposal there of radioactive waste material shall be prohibited.

2. In the event of the conclusion of international agreements concerning the use of nuclear energy, including nuclear explosions and the disposal of radioactive waste material, to which all of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX are parties, the rules established under such agreements shall apply in Antarctica.

Article VI
[area covered by treaty]

The provisions of the present Treaty shall apply to the area south of 60° South latitude, including all ice shelves, but nothing in the present Treaty shall prejudice or in any way affect the rights or the exercise of the rights, of any State under international law with regard to the high seas within that area.

Article VII
[free access for observation and inspection]

1. In order to promote the objectives and ensure the observation of the provisions of the present Treaty, each Contracting Party whose representatives are entitled to participate in the meetings referred to in Article IX of the Treaty shall have the right to designate observers to carry out any inspection provided for by the present Article. Observers shall be nationals of the Contracting Parties which designate them. The names of the observers shall be communicated to every other Contracting Party having the right to designate observers, and like notice shall be given of the termination of their appointment.

2. Each observer designated in accordance with the provisions of paragraph 1 of this Article shall have complete freedom of access at any time to any or all areas of Antarctica.

3. All areas of Antarctica, including all stations, installations and equipment within those areas, and all ships and aircraft at points of discharging or embarking cargoes or personnel in Antarctica, shall be open at all times to inspection by any observers designated in accordance with parpagraph 1 of this Article.

4. Aerial observation may be carried out at any time over any or all areas of Antarctica by any of the Contracting Parties having the right to designate observers.

5. Each Contracting Party shall, at the time when the present Treaty enters into force for it, inform the other Contracting Parties, and thereafter shall give them notice in advance, of

(a) all expeditions to and within Antarctica, on the part of its ships of nationals, and all expeditions to Antarctica organized in or proceeding from its territory;

(b) all stations in Antarctica occupied by its nationals; and

(c) any military personnel or equipment intended to be introduced by it into Antarctica subject to the conditions prescribed in paragraph 2 of Article I of the present Treaty.

Article VIII
[personnel under jurisdiction of their own states]

1. In order to facilitate the exercise of their functions, under the present Treaty, and without prejudice to the respective positions of the Contracting Parties relating to jurisdiction over all other persons in Antarctica, observers designated under paragraph 1 of Article VII and scientific personnel exchange under subparagraph 1(b) of Article III of the Treaty, and members of the staffs accompanying any such persons, shall be subject only to the jurisdiction of the Contracting Party of which they are nationals in respect to all acts or omissions occurring while they are in Antarctica for the purpose of exercising their functions.

2. Without prejudice to the provisions of paragraph 1 of this Article, and pending the adoption of measures in pursuance of subparagraph 1(e) of Article IX, the Contracting Parties concerned in any case of dispute with regard to the exercise of jurisdiction in Antarctica shall immediately consult together with a view to reaching a mutually acceptable solution.

Article IX
[treaty states to meet periodically]

1. Representatives of the Contracting Parties named in the preamble to the present Treaty shall meet at the City of Canberra within two months after date of entry into force of the Treaty, and thereafter at suitable intervals and places, for the purpose of exchanging information, consulting together on matters of common interest pertaining to Antarctica, and formulating and considering, and recommending to their Governments, measures in furtherance of the principles and objectives of the Treaty including measures regarding:

(a) use of Antarctica for peaceful purposes only;

(b) facilitation of scientific research in Antarctica;

(c) facilitation of international scientific cooperation in Antarctica;

(d) facilitation of the exercise of the rights of inspection provided for in Article VII of the Treaty;

(e) questions relating to the exercise of jurisdiction in Antarctica;

(f) preservation and conservation of living resources in Antarctica.

2. Each Contracting Party which has become a party to the present Treaty by accession under Article XIII shall be entitled to appoint representatives to participate in the meetings referred to in paragraph 1 of the present Article, dur-

ing such time as the Contracting Party demonstrates its interest in Antarctica by conducting substantial scientific research activity there, such as the establishment of a scientific station or the dispatch of a scientific expedition.

3. Reports from the observers referred to in Article VII of the present Treaty shall be transmitted to the representatives of the Contracting Parties participating in the meetings referred to in paragraph 1 of the present Article.

4. The measures referred to in paragraph 1 of this Article shall become effective when approved by all the Contracting Parties whose representatives were entitled to participate in the meetings held to consider those measures.

5. Any or all of the rights established in the present Treaty may be exercised as from the date of entry into force of the Treaty whether or not any measures facilitating the exercise of such rights have been proposed, considered or approved as provided in this Article.

Article X
[discourages activities contrary to treaty]

Each of the Contracting Parties undertakes to exert appropriate efforts, consistent with the Charter of the United Nations, to the end that none engages in any activity in Antarctica contrary to the principles or purposes of the present Treaty.

Article XI
[settlement of disputes]

1. If any dispute arises between two or more of the Contracting Parties concerning the interpretation or application of the present Treaty, those Contracting Parties shall consult among themselves with a view to having the dispute resolved by negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement or other peaceful means of their own choice.

2. Any dispute of this character not so resolved shall, with the consent, in each case, of all parties to the dispute, be referred to the International Court of Justice for settlement; but failure to reach agreement on reference to the International Court shall not absolve parties to the dispute from the responsibility of continuing to seek to resolve it by any of the various peaceful means referred to in paragraph 1 of this Article.

Article XII
[review of treaty possible after 30 years]

1. (a) The present Treaty may be modified or amended at any time by unanimous agreement of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX. Any such modification or amendment shall enter into force when the depositary Government has received notice from all such Contracting Parties that they have ratified it.

(b) Such modification or amendment shall thereafter enter into force as to any other Contracting Party when notice of ratification by it has been received by the depositary Government. Any such Contracting Party from which no notice of ratification is received within a period of two years from the date of entry into force of the modification or amendment in accordance with the provisions of subparagraph 1(a) of this Article shall be deemed to have withdrawn from the present Treaty on the date of the expiration of such period.

2. (a) If after the expiration of thirty years from the date of entry into force of the present Treaty, any of the Contracting Parties whose representatives are entitled to particpate in the meetings provided for under Article IX so requests by a communication addressed to the depositary Government, a Conference of all the Contracting Parties shall be held as soon as practicable to review the operation of the Treaty.

(b) Any modification or amendment to the present Treaty which is approved at such a Conference by a majority of the Contracting Parties there represented, including a majority of those whose representatives are entitled to participate in the meetings provided for under Article IX shall be communicated by the depositary Government to all the Contracting Parties immediately after the termination of the Conference and shall enter into force in accordance with the provisions of paragraph 1 of the present Article.

(c) If any such modification or amendment has not entered into force in accordance with the provisions of subparagraph 1(a) of this Article within a period of two years after the date of its communication to all the Contracting Parties, any Contracting Party may at any time after the expiration of that period give notice to the depositary Government of its withdrawal from its present Treaty and such withdrawal shall take effect two years after the receipt of the notice by the depositary Government.

Article XIII
[ratification and accession]

1. The present Treaty shall be subject to ratification by the signatory States. It shall be open for accession by any State which is a Member of the United Nations, or by any other State which may be invited to accede to the Treaty with the consent of all the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX of the Treaty.

2. Ratification of or accession to the present Treaty shall be effected by each State in accordance with its constitutional process.

3. Instruments of ratification and instruments of accession shall be deposited with the Government of the United States of America, hereby designated as the depositary Government.

4. The depositary Government shall inform all signatory and acceding States of the date of each deposit of an instrument of ratification accession, and the date of entry into force of the Treaty and of any modification or amendment thereto.

5. Upon the deposit of instruments of ratification by all the signatory States, the present Treaty shall enter into force for those States and for States which have deposited instruments of accession. Thereafter the Treaty shall enter into force for any acceding State upon the deposit of its instrument of accession.

6. The present Treaty shall be registered by the depositary Government pursuant to Article 102 of the Charter of the United Nations.

Article XIV
[United States is repository]

The present Treaty, done in the English, French, Russian, and Spanish languages, each version being equally authentic, shall be deposited in the archives of the Government of the United States of America, which shall transmit duly certified copies thereof to the Governments of the signatory and acceding States.

In witness whereof, the undersigned Plenipotentiaries, duly authorized, have signed the present Treaty.

Done at Washington this first day of December, one thousand nine hundered and fifty-nine.

For Argentina:
Adolfo Scilingo
F. Bello

For Australia:
Howard Beale

For Belgium:
Obert de Thieusies

For Chile:
Marcial Mora M
E. Gajardo V
Julio Escudero

For the French Republic:
Pierre Charpentier

For Japan:
Koichiro Asakai
T. Shimoda

For New Zealand:
G.D.L. White

For Norway:
Paul Koht

For the Union of South Africa:
Wentzel C. du Plessis

For the Union of Soviet Socialist Republics:
V. Kuznetsov (Romanization)

For the United Kingdom of Great Britain and Northern Ireland:
Harold Caccia

For the United States of America:
Herman Phleger
Paul C. Daniels

ANNEX TO APPENDIX 2

United States Antarctic Program
directive no. 84-1

SUBJECT: Antarctic Conservation Act, Pollution Control

1. *Purpose*: The purpose of this directive is to implement sections 6(b)(6) and 6(b)(7) of the Antarctic Conservation Act.

2. *Background*: The Director of the National Science Foundation has determined that those provisions of the Antarctic Conservation Act (Sections 6(b)(6) and 6(b)(7)) concerned with pollution control shall be implemented by an administrative directive in lieu of formal regulations.

Antarctic Treaty Recommendation VIII-11, "Man's Impact on the Antarctic Environment," recommends that governments comply the greatest extent feasible with a *Code of Conduct for Antarctic Expeditions and Station Activities*. The Director, Division of Polar Programs, has determined that U.S. Antarctic Program participants will comply with an amended version of the *Code of Conduct*.

3. *Policy*: The Director, Division of Polar Programs, hereby directs all participants in the U.S. Antarctic Research Program to comply to the greatest extent feasible, with the attached *Code of Conduct*.

4. *Cancellation*: This Directive is effective until cancelled.

Code of conduct for antarctic expeditions and station activities

Waste disposal

The following are recommended procedures:

(a) *Solid waste*

(i) *Non-combustible, including chemicals (except batteries)*

These materials may be disposed of at sea either in deep water or, if this is not possible, at specified sites in shallow water.

(ii) *Batteries* should be removed from the Antarctic Treaty area

(iii) *Combustibles*

Wood, wood products and paper should be incinerated, the ash being disposed of at sea.

Lubricating oils may be burnt except those containing harmful additives which should be removed from the Antarctic Treaty area.

Carcasses and materials associated with imported experimental animals should be incinerated.

Plastics and rubber products should be removed from the Antarctic Treaty area, where feasible.

(iv) The disposal of solid waste including ash shall be permitted in a landfill. Plastics and rubber products may be disposed of in a landfill.

(b) *Liquid Waste*

(i) Human waste, garbage, and laundry effluents should, where possible, be macerated and be flushed into the sea.

(ii) Large quantities of photographic liquids should be treated for the recovery of silver and the residue should be flushed into the sea.

(c) The above procedures are recommended for coastal stations. Field sites supported from coastal stations should, where feasible, use the facilities of their supporting station. Inland stations should concentrate all waste in deep pits. Disposal in a landfill is permitted.

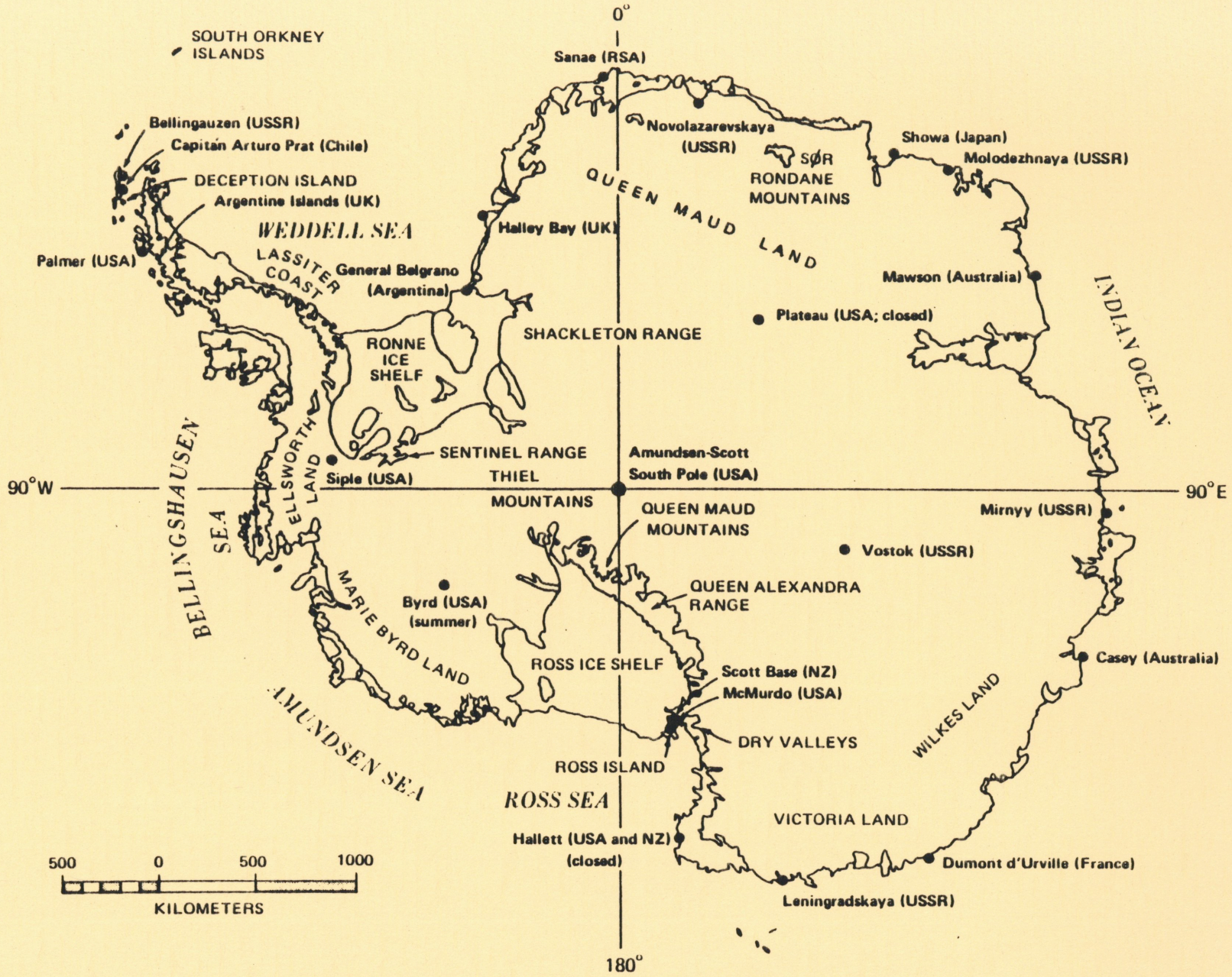
(d) Waste containing radio-isotopes should be removed from the Antarctic Treaty Area.

(e) Every effort should be made to reduce the plastic packaging of products imported into the Antarctic Treaty Area, except where there is no feasible alternative.

(f) If possible the use of leaded fuels or fuels containing ethylene bromide and ethylene chloride should be avoided.

(g) When incinerators are used it is desirable to monitor the effluents.

Edward P. Todd
Director
Division of Polar Programs



ANTARCTICA: selected stations and physical features.

MARIE BYRD LAND
KING EDWARD VII LD
SCOTT LD
ANTAR
ROSS
ROSS
ICE
SHELF ICE
(British)
SEA
Range
VICTOR
CONTI
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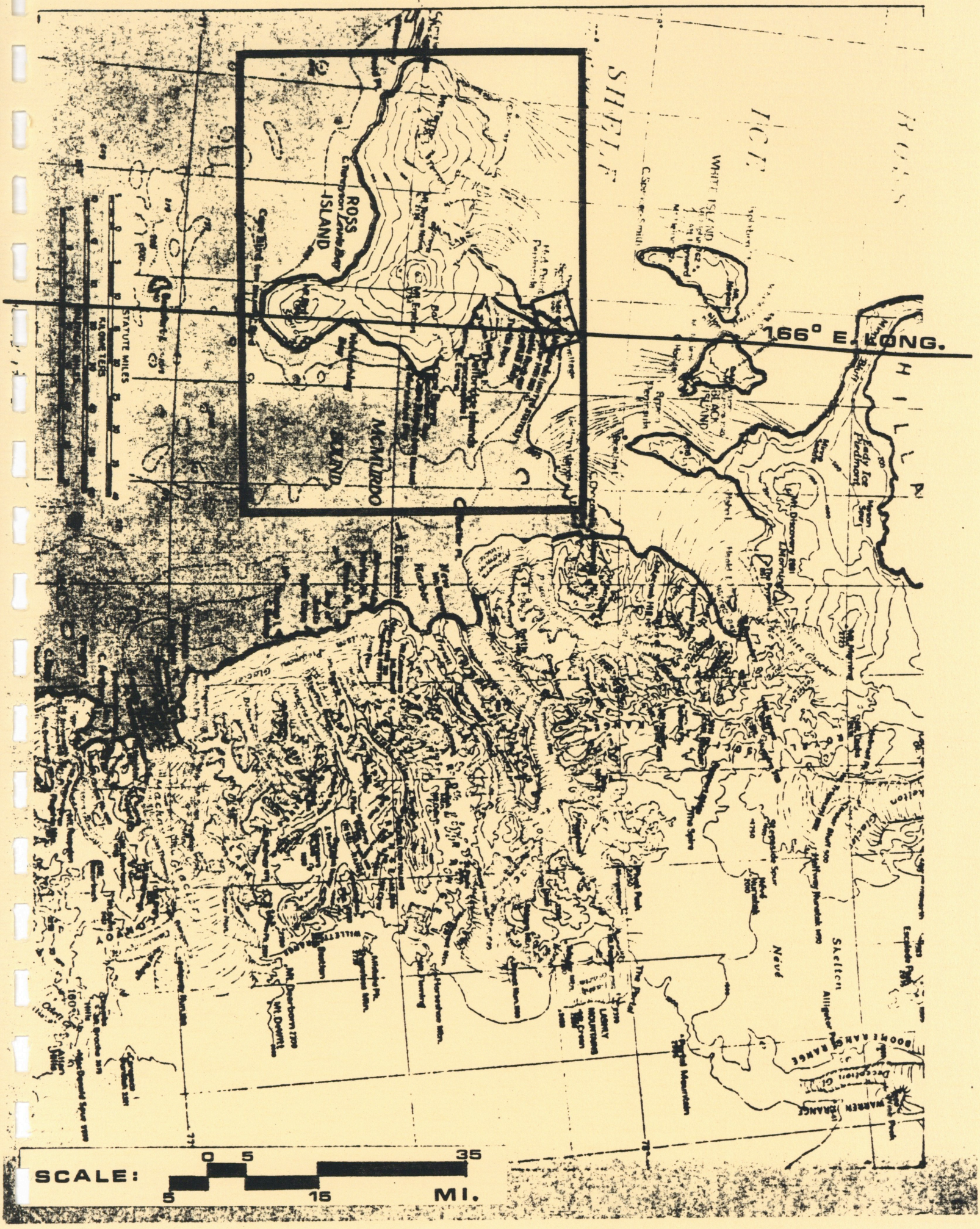
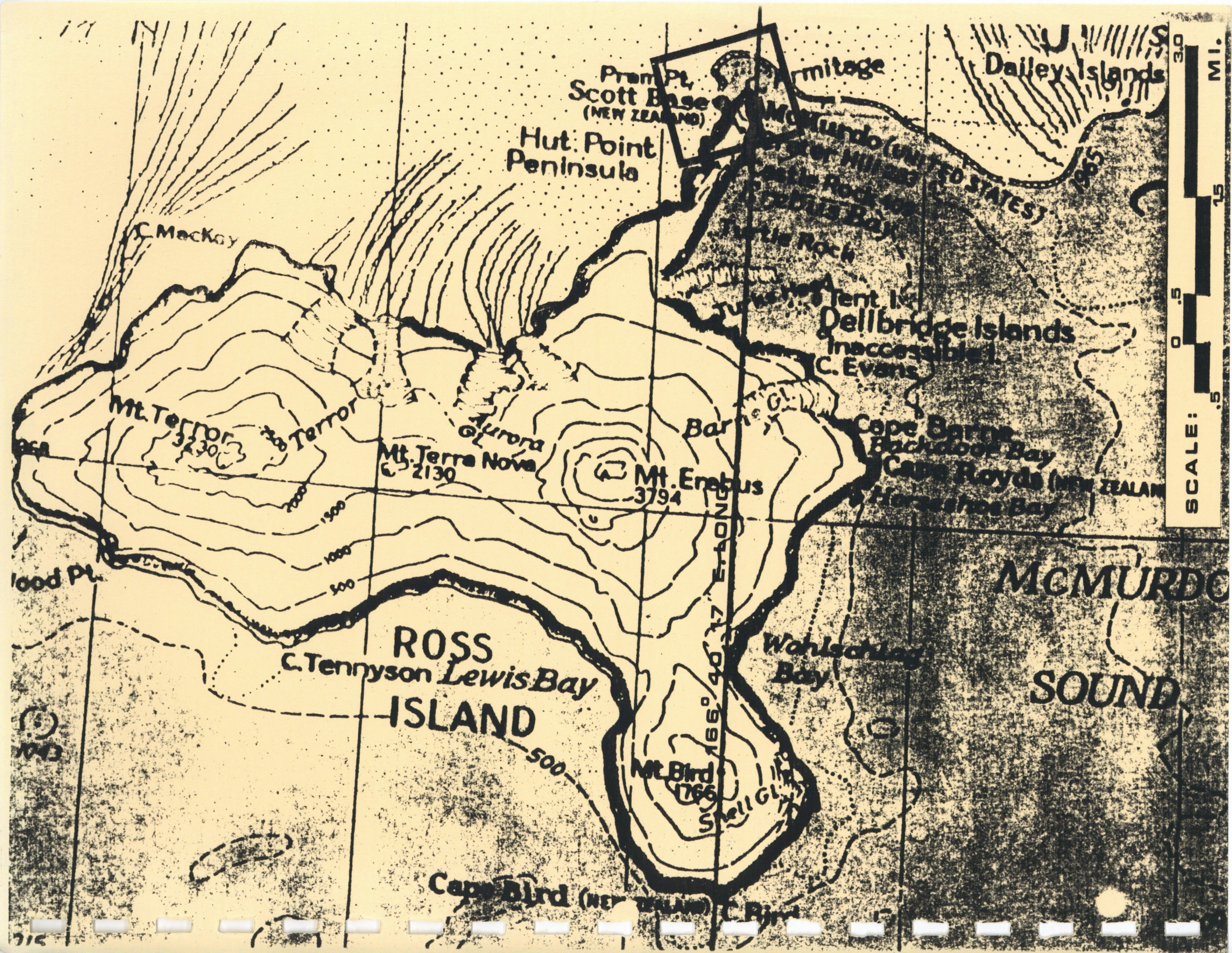
90
120
150


ROSS ISLAND
McMURDO SOUND
166° E. LONG.
STATUTE MILES
KILOMETERS
SCALE:
0 5 35
5 15 MI.


Pram Pt.
Scott Base
(NEW ZEALAND)
Hut Point
Peninsula
Hermitage
Dailey Islands
McMurdo (UNITED STATES)
Turtle Rock
Tent I.
Dellbridge Islands
Inaccessible I.
C. Evans
C. MacKay
Mt. Terror
3230
Terror
Aurora
Gl.
Mt. Terra Nova
2130
Bar
Gl.
Cape Barne
Backdoor Bay
Cape Royds (NEW ZEALAND)
Horseshoe Bay
Mt. Erebus
3794
EREBUS
Wood Pt.
MCMURDO
SOUND
ROSS
ISLAND
C. Tennyson
Lewis Bay
Wohlschlag
Bay
Mt. Bird
1766
Snell Gl.
Cape Bird (NEW ZEALAND)
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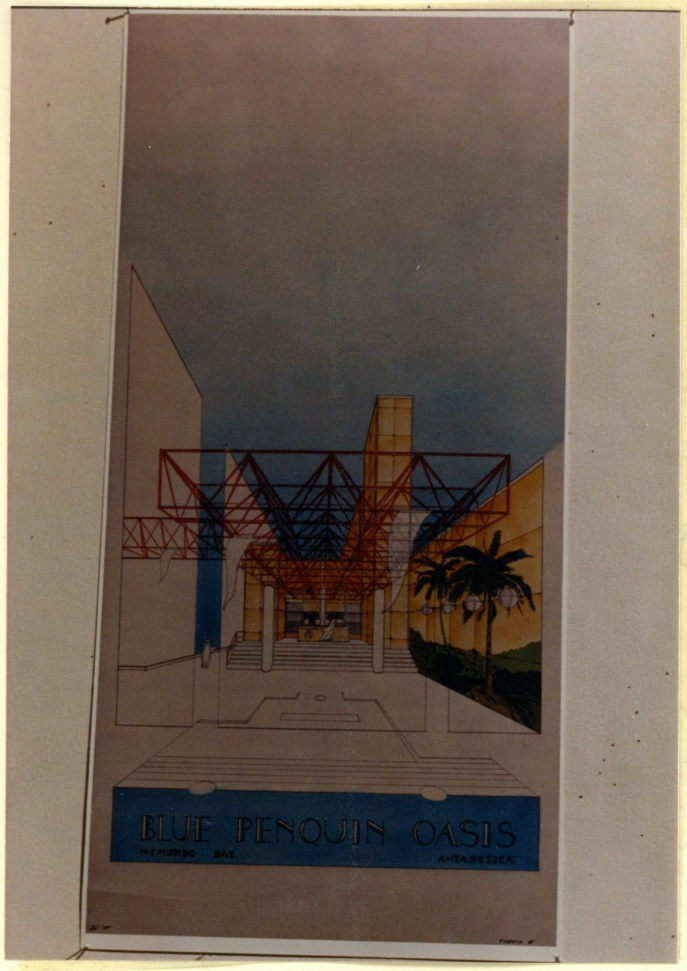
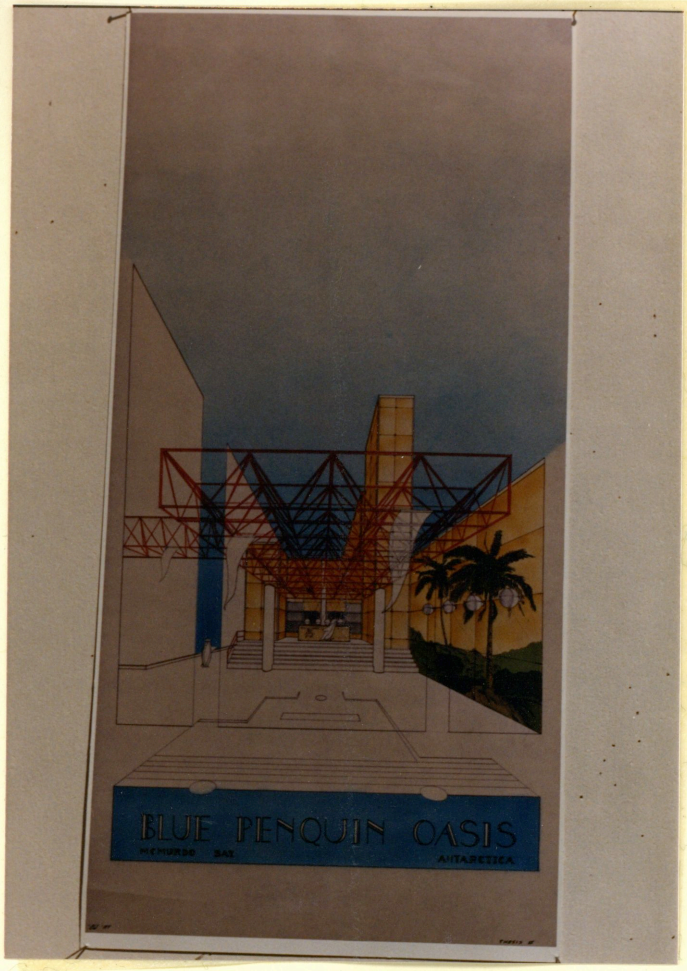

BLUE PENQUIN OASIS
McMURDO BAY
ANTARCTICA

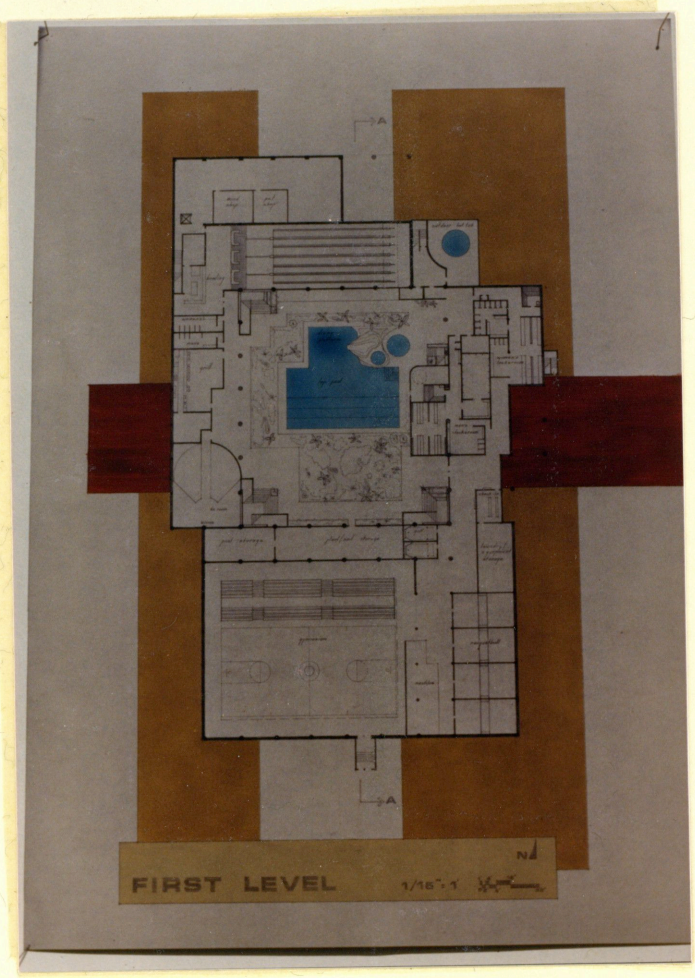
ENTRY ELEVATION
1/16"=1'

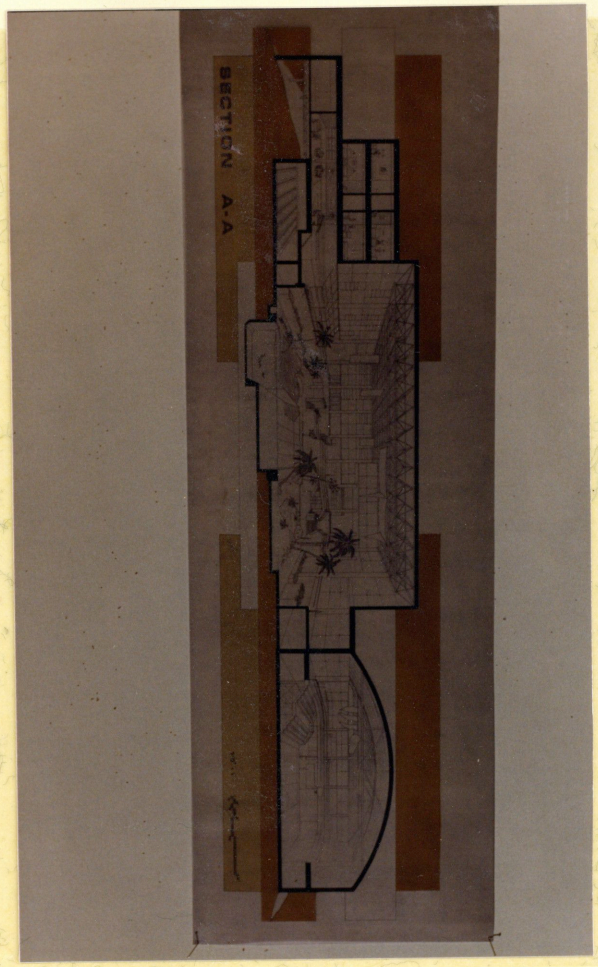
SITE PLAN
1:100
EXISTING BLDGS
RELOCATED BLDGS
REMOVED BLDGS
RECREATIONAL FACILITY

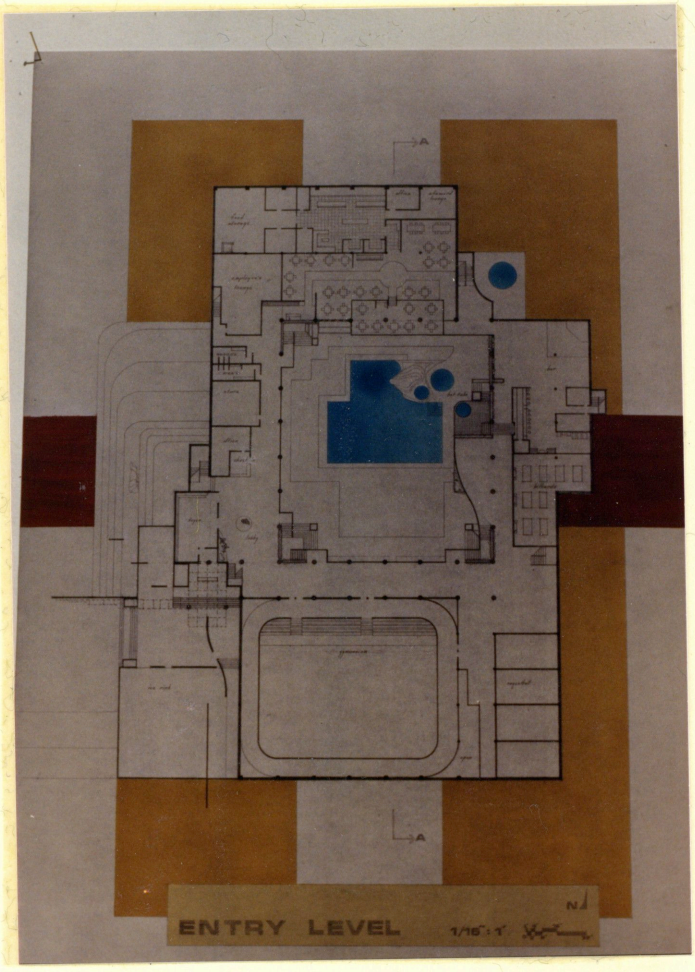

BLUE PENQUIN OASIS
McMURDO BAY
ANTARCTICA

ENTRY ELEVATION

SITE PLAN
EXISTING BLDGS.
RELOCATED BLDGS.
REMOVED BLDGS.
RECREATIONAL FACILITY


FIRST LEVEL
1/16"=1'


SECTION A-A


ENTRY LEVEL
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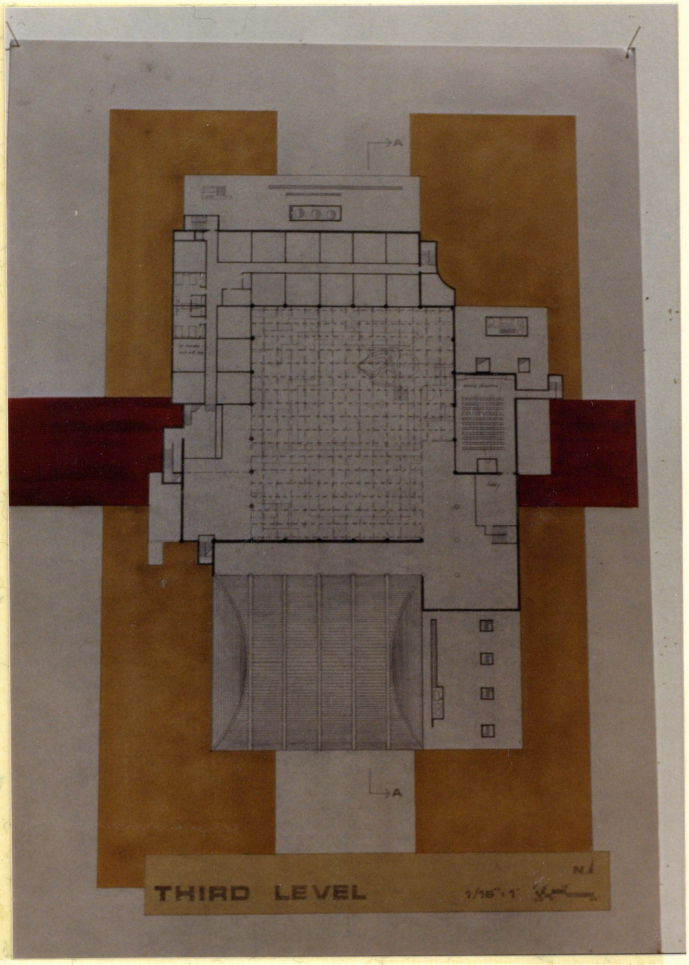
THIRD LEVEL
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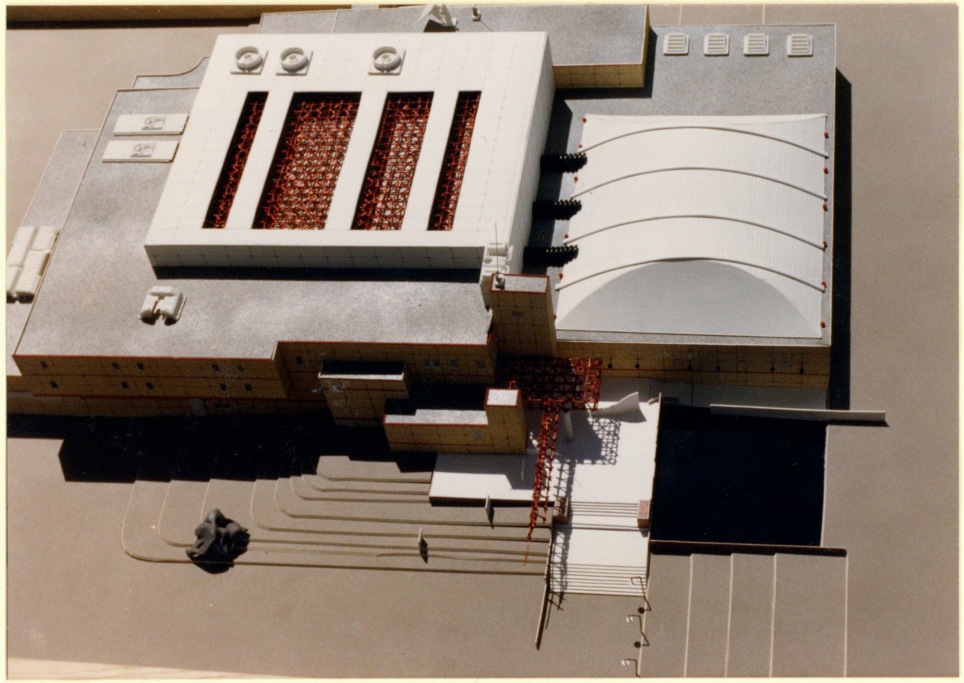

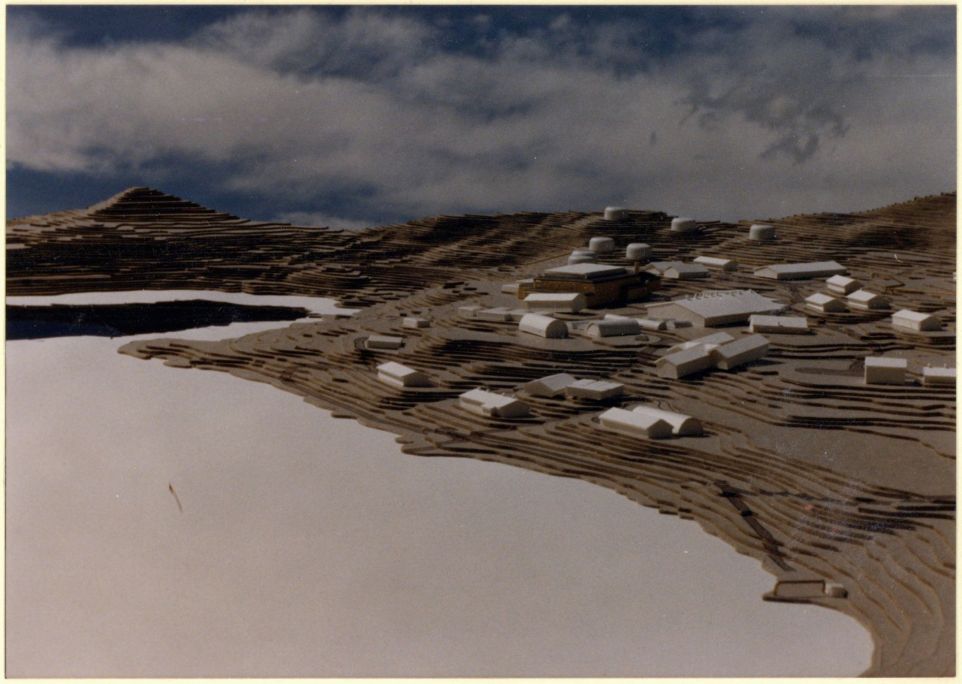

MONTANA STATE UNIVERSITY LIBRARIES
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