

Contents

<i>Foreword</i>	<i>page</i> xiii
<i>Preface</i>	xix
1 Interstellar Carbon Monoxide	1
Celebrating a Toxic Gas	1
Interstellar Medium	1
Discovery of Interstellar Carbon Monoxide	2
Early Development of Interstellar Molecular Astronomy	7
2 What Now?	9
Demise of the 25 Meter Project	9
Community Action	11
The Barrett Report	12
Impact of the Barrett Report	13
University of California, Berkeley, and HCRO	14
HCRO Interferometer and BIMA	14
California Institute of Technology, and OVRO	15
OVRO Millimeter Array	15
Combined Array for Research in Millimeter-wave Astronomy	16
Submillimeter Array	18
Millimeter Arrays in Japan and Europe	18
Nobeyama Millimeter Array	19
IRAM Plateau de Bure Interferometer	20
3 The Millimeter Array	22
First Concept of a US National Array	22
A Revised Concept	25

viii Contents

Steps to the MMA Proposal	27
Technical Advisory Committee	27
Science Advisory Committee	29
Management Changes Affecting the MMA	30
Final Steps toward a Formal MMA Proposal	30
MMA Proposal	31
Proposal Review	37
Design and Development Plan	38
4 Searching for a Site	43
Millimeter Array Site Requirements	43
United States Continental Sites	45
Hawaii	49
Atacama Desert of Chile	50
Llano de Chajnantor	57
Chajnantor Site Studies	59
The Container	61
Cost Considerations	65
Site Proposal	66
Protecting and Securing the Site	67
Legal Status in Chile for AUI	71
Radio Frequency Interference	73
5 Foreign Affairs	76
Funding Hurdles	76
International Participation	77
Selling the MMA Abroad	79
Europe's Large Southern Array	80
Japan's Large Millimeter/Submillimeter Array	84
The MMA and LSA Become One Project	87
6 Organizing ALMA	92
Gaz Atacama	92
Land Concession	93
Early Joint Activities	98
Defining ALMA in the United States	98
A Revised Design and Development Plan	98
The Reference Design for the MMA	98
Further Steps in the Merger	99
Defining ALMA in Europe	101
LSA/MMA Feasibility Study	101
ESO ALMA Proposal	101
Dividing the Effort	101

ALMA Coordinating Committee	102
30 March 1999, Garching	103
29 September 1999, Tokyo	104
12 November 1999, London	104
7 April 2000, Washington DC	105
13 October 2000, Paris	106
6 April 2001, Tokyo	107
30 October 2001, Washington DC	107
19 April 2002, Venice	108
17 September 2002, Garching	108
29 October 2002, Santiago	109
Musical Chairs	110
7 Contentious Matters	113
Bilateral ALMA Agreement	113
Japan Joins ALMA	114
Site Negotiations	119
Contracting for the Antennas	120
Specifications	121
Prototype Antenna Testing	122
Prototype Destinies	124
Production Antennas	124
Local Staff Employment	133
ALMA Headquarters Location	135
8 Funding ALMA	141
Europe	141
Japan	142
North America	144
Project Reset	147
9 Construction and Inauguration	154
Groundbreaking	154
Basics	155
Roads	155
Electrical Power	156
Security	156
Safety	157
Water	158
Communications	158
High Site	159
Antenna Pads	159
Antenna Transporters	160

x Contents

Buildings	161
Operations Support Facility	161
AOS Technical Building	162
Residence Hall	162
Antenna Assembly Building	163
Joint ALMA Office	164
Antennas	165
Preliminary Acceptance In-house	165
Provisional Acceptance On-site	165
Assembly, Integration, and Verification	166
Commissioning and Science Verification	166
Vertex Antenna Assembly	166
Electronics	171
Receivers	171
Local Oscillator System	172
Intermediate Frequency System	174
Correlators	174
Software	175
Local Benefits of ALMA	176
Inauguration	178
10 Promises Fulfilled	182
ALMA Science Goals	182
Molecular Gas in Distant Galaxies	183
Protoplanetary Disks as Sites of Forming Planets	183
High Angular Resolution Imaging	187
The Breadth of ALMA Science	189
ALMA’s First Image	189
Astrochemistry	191
Distant Galaxies	193
Competition for Observing Time	194
Open Skies	194
Annual Observing Cycles	195
Proposal Preparation	196
Panel Review	196
Distributed Peer Review	197
Dual Anonymous Review	197
Steps in Remote Observing and Reduction of Data	198
Remote Observing	198
Data Reduction	199
ALMA Science Archive	200
Publication Statistics	201
Large Programs	201

Cambridge University Press & Assessment
978-1-009-27968-0 — The ALMA Telescope
Paul A. Vanden Bout, Robert L. Dickman, Adele L. Plunkett
Table of Contents
[More Information](#)

Contents xi

Very Long Baseline Interferometry	203
Future Prospects	204
Conclusion	206
<i>Appendix A: Radio Astronomy</i>	211
<i>Appendix B: Millimeter/Submillimeter Telescopes</i>	223
<i>Appendix C: Lessons Learned</i>	240
<i>Glossary</i>	246
<i>References</i>	251
<i>Index</i>	256