

# THE VOYAGER MISSION AND THE ORIGIN OF LIFE: SELECTED REFERENCES

Compiled by

LINDA G. PLEASANT

*Department of Medical and Public Affairs, The George Washington University Medical Center,  
Washington, D.C., U.S.A.*

(Received 29 March, 1982)

This bibliography contains references arranged in alphabetical order by author under the relevant Voyager scientific investigation. The last section includes laboratory simulation/modelling studies of the Jovian atmospheres.

## General

- 1 Beatty, J. K.: 1979, 'The Far-Out Worlds of Voyager 1', *Sky and Telescope* 57, 423–427.
- 2 Beatty, J. K.: 1979, 'The Far-Out Worlds of Voyager 1. II', *Sky and Telescope* 57, 516–520.
- 3 Beatty, J. K.: 1981, 'No Small Rapture', *Science* 81 2(1), 26–31.
- 4 Beatty, J. K.: 1981, 'Rendezvous with a Ringed Giant', *Sky and Telescope* 61, 7–18.
- 5 Beatty, J. K.: 1979, 'Voyager's Encore Performance', *Sky and Telescope* 58, 206–216.
- 6 Gurnett, D. A., Shaw, R. R., Anderson, R. R., Kurth, W. S. and Sacrf, F. L.: 1979, 'Whistlers Observed by Voyager 1: Detection of Lightning on Jupiter', *Geophys. Res. Lett.* 6, 511–514.
- 7 Kohlhasse, C. E. and Penzo, P. A.: 1977, 'Voyager Mission Description', *Space Sci. Rev.* 21, 77–101.
- 8 Morrison, D. and Samz, J.: 1980, *Voyage to Jupiter*, National Aeronautics and Space Administration, Washington, D.C. (NASA SP–439)
- 9 Smith, B. A.: 1981, 'The Voyager Encounters', in *The New Solar System*, (ed. by J. K. Beatty, B. O'Leary, and A. Chaikin), Cambridge University Press, New York, pp. 105–116.
- 10 Soderblom, L. A.: 1980, 'The Galilean Moons of Jupiter', *Sci. Am.* 242(1), 88–100.
- 11 Stone, E. C.: 1981, 'How Voyager 2 Has Been Reprogrammed', *Nature* 292, 675–676.
- 12 Stone, E. C.: 1981, 'The Voyager Mission Through the Jupiter Encounters', *J. Geophys. Res.* 86, 8123–8124.
- 13 Stone, E. C. and Lane, A. L.: 1979, 'Voyager 1 Encounter with the Jovian System', *Science* 204, 945–948.
- 14 Stone, E. C. and Lane, A. L.: 1979, 'Voyager 2 Encounter with the Jovian System', *Science* 206, 925–927.
- 15 Stone, E. C. and Miner, E. D.: 1981, 'Voyager 1 Encounter with the Saturnian System', *Science* 212, 159–163.
- 16 Sutton, C.: 1979, 'Jupiter's Enigmatic Variations', *New Sci.* 82, 21–23.
- 17 Sutton, C.: 1980, 'Saturn's Secrets Revealed: A Special Report', *New Sci.* 88, 491–495.
- 18 Sutton, C.: 1979, 'Voyage to the Giant Planet', *New Sci.* 83, 217–220.
- 19 Waldrop, M. M.: 1980, 'Voyager 1 at Saturn', *Science* 210, 1107–1111.

## Imaging Science

- 20 Carr, M.H., Masursky, H., Strom, R. G. and Terrile, R. J.: 1979, 'Volcanic Features of Io', *Nature* 280, 729–733.

- 21 Clancy, R. T. and Danielson, G. E.: 1981, 'High Resolution Albedo Measurements on Io from Voyager 1', *J. Geophys. Res.* **86**, 8627–8634.
- 22 Collins, S. A.: 1981, 'Spatial Color Variations in the Volcanic Plume at Loki, on Io', *J. Geophys. Res.* **86**, 8621–8626.
- 23 Cook, A. F. and Duxbury, T. C.: 1981, 'A Fireball in Jupiter's Atmosphere', *J. Geophys. Res.* **86**, 8815–8817.
- 24 Cook, A. F., Duxbury, T. C. and Hunt, G. E.: 1979, 'First Results on Jovian Lightning', *Nature* **280**, 794.
- 25 Cook, A. F., Duxbury, T. C. and Hunt, G. E.: 1979, 'A Lower Limit on the Top of Jupiter's Haze Layer', *Nature* **280**, 780–793.
- 26 Cook, A. F., Jones, A. V. and Shemansky, D. E.: 1981, 'Visible Aurora in Jupiter's Atmosphere', *J. Geophys. Res.* **86**, 8793–8796.
- 27 Cook, A. F., Shoemaker, E. M. and Smith, B. A.: 1979, 'Dynamics of Volcanic Plumes on Io', *Nature* **280**, 743–746.
- 28 Danielson, G. E., Kupferman, P. N., Johnson, T. V. and Soderblom, L. A.: 1981, 'Radiometric Performance of the Voyager Cameras', *J. Geophys. Res.* **86**, 8683–8689.
- 29 Hunt, G. E., Conrath, B. J. and Pirraglia, J. A.: 1981, 'Visible and Infrared Observations of Jovian Plumes During the Voyager Encounter', *J. Geophys. Res.* **86**, 8777–8781.
- 30 Hunt, G. E. and Muller, J.-P.: 1979, 'Voyager Observations of Small-Scale Waves in the Equatorial Region of the Jovian Atmosphere', *Nature* **280**, 778–780.
- 31 Ingersoll, A. P., Beebe, R. F., Collins, S. A., Hunt, G. E., Mitchell, J. L., Muller, P., Smith, B. A. and Terrile, R. J.: 1979, 'Zonal Velocity and Texture in the Jovian Atmosphere Inferred from Voyager Images', *Nature* **280**, 773–775.
- 32 Ingersoll, A. P., Beebe, R. F., Mitchell, J. L., Garneau, G. W., Yagi, G. M. and Müller J.-P.: 1981, 'Interaction of Eddies and Mean Zonal Flow on Jupiter as Inferred from Voyager 1 and 2 Images', *J. Geophys. Res.* **86**, 8733–8743.
- 33 Johnson, T. V., Cook, A. F., II, Sagan, C. and Soderblom, L. A.: 1979, 'Volcanic Resurfacing Rates and Implications for Volatiles on Io', *Nature* **280**, 746–750.
- 34 Masursky, H., Schaber, G. G., Soderblom, L. A. and Strom, R. G.: 1979, 'Preliminary Geological Mapping of Io', *Nature* **280**, 725–729.
- 35 McCauley, J. F., Smith, B. A. and Soderblom, L. A.: 1979, 'Erosional Scarps on Io', *Nature* **280**, 736–738.
- 36 Mitchell, J. L., Terrile, R. J., Smith, B. A., Muller, J.-P., Ingersoll, A. P., Hunt, G. E., Collins, S. A. and Beebe, R. F.: 1979, 'Jovian Cloud Structure and Velocity Fields', *Nature* **280**, 776–778.
- 37 Morabito, L. A., Synnott, S. P., Kupferman, P. N. and Collins, S. A.: 1979, 'Discovery of Currently Active Extraterrestrial Volcanism', *Science* **204**, 972.
- 38 Morrison, D., Pieri, D., Veverka, J. and Johnson, T. V.: 1979, 'Photometric Evidence on Long-Term Stability of Albedo and Colour Markings on Io', *Nature* **280**, 753–755.
- 39 Owen, T. and Terrile, R. J.: 1981, 'Colors on Jupiter', *J. Geophys. Res.* **86**, 8797–8814.
- 40 Sagan, C.: 1979, 'Sulphur Flows on Io', *Nature* **280**, 750–753.
- 41 Smith, B. A., Briggs, G. A., Danielson, G. E., Cook, A. F., II, Davies M. E., Hunt, G. E., Masursky, H., Soderblom, L. A., Owen, T. C., Sagan, C. and Suomi, V. E.: 1977, 'Voyager Imaging Experiment', *Space Sci. Rev.* **21**, 103–127.
- 42 Smith, B. A., Shoemaker, E. M., Kieffer, S. W. and Cook, A. E., II: 1979, 'The Role of SO<sub>2</sub> in Volcanism on Io', *Nature* **280**, 738–743.
43. Smith, B. A., Soderblom, L., Batson, R., Bridges, P., Inge, J., Masursky, H., Shoemaker, E., Beebe, R., Boyce, J., Briggs, G., Bunker, A., Collins, S. A., Hansen, C. J., Johnson, T. V., Mitchell, J. L., Terrile, R. J., Cook, A. F., II, Cuzzi, J., Pollack, J. B., Danielson, G. E., Ingersoll, A. P., Davies, M. E., Hunt, G. E., Morrison, D., Owen, T., Sagan, C., Veverka, J., Strom, R. and Suomi, V. E.: 1982, 'A New Look at the Saturn System: The Voyager 2 Images', *Science* **215**, 504–537.
44. Smith, B. A., Soderblom, L., Beebe, R., Boyce, J., Briggs, G., Bunker, A., Collins, S. A., Hansen, C. J., Johnson, T. V., Mitchell, J. L., Terrile, R. J., Carr, M., Cook, A. F., II, Cuzzi, J., Pollack, J. B., Danielson, G. E., Ingersoll, A., Davies, M. E., Hunt, G. E., Masursky, H., Shoemaker, E., Morrison, D., Owen, T., Sagan, C., Veverka, J., Strom, R. and Suomi, V. E.: 1981, 'Encounter with Saturn: Voyager 1 Imaging Science Results', *Science* **212**, 163–191.
45. Smith, B. A., Soderblom, L. A., Beebe, R., Boyce, J., Briggs, G., Carr, M., Collins, S. A., Cook,

- A. F., II, Danielson, G. E., Davies, M. E., Hunt, G. E., Ingersoll, A., Johnson, T. V., Masursky, H., McCauley, J., Morrison, D., Owen, T., Sagan, C., Shoemaker, E. M., Strom, R., Suomi, V. E. and Veverka, J.: 1979, 'The Galilean Satellites and Jupiter: Voyager 2 Imaging Science Results', *Science* **206**, 927–950.
- 46 Smith, B. A., Soderblom, L. A., Johnson, T. V., Ingersoll, A. P., Collins, S. A., Shoemaker, E. M., Hunt, G. E., Masursky, H., Carr, M. H., Davies, M. E., Cook, A. F., II, Boyce, J., Danielson, G. E., Owen, T., Sagan, C., Beebe, R. F., Veverka, J., Strom, R. G., McCauley, J. F., Morrison, D., Briggs, G. A. and Suomi, V. E.: 1979, 'The Jupiter System Through the Eyes of Voyager 1', *Science* **204**, 951–957, 960–972.
- 47 Soderblom, L., Johnson, T., Morrison, D., Danielson, E., Smith, B., Veverka, J., Cook, A., Sagan, C., Kupferman, P., Pieri, D., Mosher, J., Avis, C., Gradie, J. and Clancy, T.: 1980, 'Spectrophotometry of Io: Preliminary Voyager 1 Results', *Geophys. Res. Lett.* **7**, 963–966.
- 48 Squyres, S. W. and Veverka, J.: 1981, 'Voyager Photometry of Surface Features on Ganymede and Callisto', *Icarus* **46**, 137–155.
- 49 Stromovsky, L. A., Suomi, V. E., Pollack, J. B., Krauss, R. J., Limaye, S. S., Owen, T., Revercomb, H. E. and Sagan, C.: 1981, 'Implications of Titan's North-South Brightness Asymmetry', *Nature* **292**, 698–702.
- 50 Strom, R. G., Schneider, N. M., Terrile, R. J., Cook, A. F. and Hansen, C.: 1981, 'Volcanic Eruptions on Io', *J. Geophys. Res.* **86**, 8593–8620.
- 51 Strom, R. G., Terrile, R. J., Masursky, H. and Hansen C.: 1979, 'Volcanic Eruption Plumes on Io', *Nature* **280**, 733–736.
- 52 Strom, R. G., Woronow, A. and Gurnis, M.: 1981, 'Crater Populations on Ganymede and Callisto', *J. Geophys. Res.* **86**, 8659–8674.
- 53 Terrile, R. J. and Beebe, R. F.: 1979, 'Summary of Historical Data: Interpretation of the Pioneer and Voyager Cloud Configurations in a Time-Dependent Framework', *Science* **204**, 948–951.
- 54 Stone, E. C. and Miner, E. D.: 1982, 'Voyager 2 Encounter with the Saturnian System', *Science* **215**, 499–504.
- 55 Veverka, J., Thomas, P., Davies, M. and Morrison, D.: 1981, 'Amalthea: Voyager Imaging Results', *J. Geophys. Res.* **86**, 8675–8682.

### Infrared Radiometry and Spectroscopy

- 56 Butterworth, P. S., Caldwell, J., Moore, V., Owen, T., Rivolo, A. R. and Lane, A. L.: 1980, 'An Upper Limit to the Global SO<sub>2</sub> Abundance on Io', *Nature* **285**, 308–309.
- 57 Conrath, B. J., Flasar, F. M., Pirraglia, J. A., Gierasch, P. J. and Hunt, G. E.: 1981, 'Thermal Structure and Dynamics of the Jovian Atmosphere. 2. Visible Cloud Features', *J. Geophys. Res.* **86**, 8769–8775.
- 58 Flasar, F. M., Conrath, B. J., Pirraglia, J. A., Clark, P. C., French, R. G. and Gierasch, P. J.: 1981, 'Thermal Structure and Dynamics of the Jovian Atmosphere. I. The Great Red Spot', *J. Geophys. Res.* **86**, 8759–8767.
- 59 Flasar, F. M., Samuelson, R. E. and Conrath, B. J.: 1981, 'Titan's Atmosphere: Temperature and Dynamics', *Nature* **292**, 693–698.
- 60 Gautier, D., Conrath, B., Flasar, M., Hanel, R., Kunde, V., Chedin, A. and Scott, N.: 1981, 'The Helium Abundance of Jupiter from Voyager', *J. Geophys. Res.* **86**, 8713–8720.
- 61 Hanel, R., Conrath, B., Flasar, M., Herath, L., Kunde, V., Lowman, P., Maguire, W., Pearl, J., Pirraglia, J., Samuelson, R., Gautier, D., Gierasch, P., Horn, L., Kumar, S. and Ponnampereuma, C.: 1979, 'Infrared Observations of the Jovian System from Voyager 2', *Science* **206**, 952–956.
- 62 Hanel, R., Conrath, B., Flasar, M., Kunde, V., Lowman, P., Maguire, W., Pearl, J., Pirraglia, J., Samuelson, R., Gautier, D., Gierasch, P., Kumar, S. and Ponnampereuma, C.: 1979, 'Infrared Observations of the Jovian System from Voyager 1', *Science* **204**, 972–976.
- 63 Hanel, R., Conrath, B., Flasar, F. M., Kunde, V., Maguire, W., Pearl, J., Pirraglia, J., Samuelson, R., Cruikshank, D., Gautier, D., Gierasch, P., Horn, L. and Ponnampereuma, C.: 1982, 'Infrared Observations of the Saturnian System from Voyager 2', *Science* **215**, 544–548.
- 64 Hanel, R., Conrath, B., Flasar, F. M., Kunde, V., Maguire, W., Pearl, J., Pirraglia, J., Samuelson, R., Herath, L., Allison, M., Cruikshank, D., Gautier, D., Gierasch, P., Horn, L., Koppany, R. and

- Ponnamperuma, C.: 1981, 'Infrared Observations of the Saturnian System from Voyager 1', *Science* 212, 192–200.
- 65 Hanel, R., Conrath, B., Gautier, D., Gierasch, P., Kumar, S., Kunde, V., Lowman, P., Maguire, W., Pearl, J., Pirraglia, J., Ponnamperuma, C. and Samuelson, R.: 1977, 'The Voyager Infrared Spectroscopy and Radiometry Investigation', *Space Sci. Rev.* 21, 129–157.
- 66 Hanel, R. A., Conrath, B. J., Herath, L. W., Kunde, V. G. and Pirraglia, J. A.: 1981, 'Albedo, Internal Heat, and Energy Balance of Jupiter: Preliminary Results of the Voyager Infrared Investigation', *J. Geophys. Res.* 86, 8705–8712.
- 67 Hanel, R., Crosby, D., Herath, L., Vanous, D., Collins, D., Creswick, H., Harris, C. and Rhodes, M.: 1980, 'Infrared Spectrometer for Voyager', *Appl. Opt.* 19, 1391–1400.
- 68 Kumar, S.: 1979, 'The Stability of an SO<sub>2</sub> Atmosphere on Io', *Nature* 280, 758–760.
- 69 Kunde, V. G., Aikin, A. C., Hanel, R. A., Jennings, D. E., Maguire, W. C. and Samuelson, R. E.: 1981, 'C<sub>4</sub>H<sub>2</sub>, HC<sub>3</sub>N and C<sub>2</sub>N<sub>2</sub> in Titan's Atmosphere', *Nature* 292, 686–688.
- 70 Maguire, W. C., Hanel, R. A., Jennings, D. E., Kunde, V. G. and Samuelson, R. E.: 1981, 'C<sub>3</sub>H<sub>2</sub> and C<sub>3</sub>H<sub>4</sub> in Titan's Atmosphere', *Nature* 292, 683–686.
- 71 Marten, A., Rouan, D., Baluteau, J. P., Gautier, D., Conrath, B. J., Hanel, R. A., Kunde, V., Samuelson, R., Chedin, A. and Scott, N.: 1981, 'Study of the Ammonia Ice Cloud Layer in the Equatorial Region of Jupiter from the Infrared Interferometric Experiment on Voyager', *Icarus* 46, 233–248.
- 72 Pearl, J., Hanel, R., Kunde, V., Maguire, W., Fox, K., Gupta, S., Ponnamperuma, C. and Raulin, F.: 1979, 'Identification of Gaseous SO<sub>2</sub> and New Upper Limits for Other Gases on Io', *Nature* 280, 755–758.
- 74 Pirraglia, J. A., Conrath, B. J., Allison, M. D. and Gierasch, P. J.: 1981, 'Thermal Structure and Dynamics of Saturn and Jupiter', *Nature* 292, 677–679.
- 74 Samuelson, R. E., Hanel, R. A., Kunde, V. G. and Maguire, W. C.: 1981, 'Mean Molecular Weight and Hydrogen Abundance of Titan's Atmosphere', *Nature* 292, 688–693.

### Photopolarimetry

- 75 Hord, C. W., West, R. A., Simmons, K. E., Coffeen, D. L., Sato, M., Lane, A. L. and Bergstralh, J. T.: 1979, 'Photometric Observations of Jupiter at 2400 Angstroms', *Science* 206, 956–959.
- 76 Lane, A. L., Hord, C. W., West, R. A., Esposito, L. W., Coffeen, D. L., Sato, M., Simmons, K. E., Pomphrey, R. B. and Morris, R. B.: 1982, 'Photopolarimetry from Voyager 2: Preliminary Results on Saturn, Titan, and the Rings', *Science* 215, 537–543.
- 77 Lillie, C. F., Hord, C. W., Pang, K., Coffeen, D. L. and Hansen, J. E.: 1977, 'The Voyager Mission Photopolarimeter Experiment', *Space Sci. Rev.* 21, 159–181.
- 78 Pang, K., Hord, C. W., West, R. A., Simmons, K. E., Coffeen, D. L., Bergstralh, J. T. and Lane, A. L.: 1979, 'Voyager 1 Photopolarimeter Experiment and the Phase Curve and Surface Microstructure of Ganymede', *Nature* 280, 804–806.
- 79 West, R. A.: 1981, 'Sunlight Absorption by Aerosols in Jupiter's Upper Atmosphere', *Geophys. Res. Lett.* 8, 847–849.
- 80 West, R. A., Hord, C. W., Simmons, K. E., Coffeen, D. L., Sato, M. and Lane, A. L.: 1981, 'Near-Ultraviolet Scattering Properties of Jupiter', *J. Geophys. Res.* 86, 8783–8792.

### Radio Science

- 81 Eshleman, V. R., Tyler, G. L., Anderson, J. D., Fjeldbo, G., Levy, G. S., Wood, G. E. and Croft, T. A.: 1977, 'Radio Science Investigations with Voyager', *Space Sci. Rev.* 21, 207–232.
- 82 Eshleman, V. R., Tyler, G. L., Wood, G. E., Lindal, G. F., Anderson, J. D., Levy, G. S. and Croft, T. A.: 1979, 'Radio Science with Voyager at Jupiter: Initial Voyager 2 Results and a Voyager 1 Measure of the Io Torus', *Science* 206, 959–962.
- 83 Eshleman, V. R., Tyler, G. L., Wood, G. E., Lindal, G. F., Anderson, J. D., Levy, G. S. and Croft, T. A.: 1979, 'Radio Science with Voyager 1 at Jupiter: Preliminary Profiles of the Atmosphere and Ionosphere', *Science* 204, 976–978.
- 84 Lindal, G. F., Wood, G. E., Levy, G. S., Anderson, J. D., Sweetnam, D. N., Hotz, H. B., Buckles, B. J., Holmes, D. P., Doms, P. E., Eshleman, V. R., Tyler, G. L. and Croft, T. A.: 1981, Atmo-

sphere of Jupiter: An Analysis of the Voyager Radio Occultation Measurements', *J. Geophys. Res.* 86, 8721–8727.

- 85 Martin, J. M., Tyler, G. L., Eshleman, V. R., Wood, G. E. and Lindal, G. F.: 1981, 'A Search for the Radio Occultation Flash at Jupiter', *J. Geophys. Res.* 86, 8729–8732.
- 86 Tyler, G. L., Eshleman, V. R., Anderson, J. D., Levy, G. S., Lindal, G. F., Wood, G. E. and Croft, T. A.: 1981, 'Radio Science Investigations of the Saturn System with Voyager 1: Preliminary Results', *Science* 212, 201–206.
- 87 Tyler, G. L., Marouf, E. A. and Wood, G. E.: 1981, 'Radio Occultation of Jupiter's Ring: Bounds on Optical Depth and Particle Size and a Comparison with Infrared and Optical Results', *J. Geophys. Res.* 86, 8699–8703.

### Ultraviolet Spectroscopy

- 88 Atreya, S. K., Donahue, T. M. and Festou, M. C.: 1981, 'Jupiter: Structure and Composition of the Upper Atmosphere', *Astrophys. J.* 247, L43–L47.
- 89 Atreya, S. K., Donahue, T. M., Sandel, B. R., Broadfoot, A. L. and Smith, G. R.: 1979, 'Jovian Upper Atmospheric Temperature Measurement by the Voyager 1 UV Spectrometer', *Geophys. Res. Lett.* 6, 795–798.
- 90 Atreya, S. K., Donahue, T. M. and Waite, J. H., Jr.: 1979, 'An Interpretation of the Voyager Measurement of Jovian Electron Density Profiles', *Nature* 280, 795–796.
- 91 Atreya, S. K. and Waite, J. H., Jr.: 1981, 'Saturn Ionosphere: Theoretical Interpretation', *Nature* 292, 682–683.
- 92 Broadfoot, A. L., Belton, M. J. S., Takacs, P. Z., Sandel, B. R., Shemansky, D. E., Holberg, J. B., Ajello, J. M., Atreya, S. K., Donahue, T. M., Moos, H. W., Bertaux, J. L., Blamont, J. E., Strobel, D. F., McConnell, J. C., Dalgarno, A., Goody, R. and McElroy, M. B.: 1979, 'Extreme Ultraviolet Observations from Voyager 1 Encounter With Jupiter', *Science* 204, 979–982.
- 93 Broadfoot, A. L., Sandel, B. R., Shemansky, D. E., Atreya, S. K., Donahue, T. M., Moos, H. W., Bertaux, J. L., Blamont, J. E., Ajello, J. M., Strobel, D. F., McConnell, J. C., Dalgarno, A., Goody, R., McElroy, M. B. and Yung, Y. L.: 1981, 'Ultraviolet Spectrometer Experiment for the Voyager Mission', *Space Sci. Rev.* 21, 183–205.
- 94 Broadfoot, A. L., Sandel, B. R., Shemansky, D. E., Holberg, J. B., Smith, G. R., Strobel, D. F., McConnell, J. C., Kumar, S., Hunten, D. M., Atreya, S. K., Donahue, T. M., Moos, H. W., Bertaux, J. L., Blamont, J. E., Pomphrey, R. B. and Linick, S.: 1981, 'Extreme Ultraviolet Observations from Voyager 1 Encounter With Saturn', *Science* 212, 206–211.
- 95 Broadfoot, A. L., Sandel, B. R., Shemansky, D. E., McConnell, J. C., Smith, G. R., Holberg, J. B., Atreya, S. K., Donahue, T. M., Strobel, D. F. and Bertaux, J. L.: 1981, 'Overview of the Voyager Ultraviolet Spectrometry Results Through Jupiter Encounter', *J. Geophys. Res.* 86, 8259–8284.
- 96 Festou, M. C., Atreya, S. K., Donahue, T. M., Sandel, B. R., Shemansky, D. E. and Broadfoot, A. L.: 1981, 'Composition and Thermal Profiles of the Jovian Upper Atmosphere Determined by the Voyager Ultraviolet Stellar Occultation Experiment', *J. Geophys. Res.* 86, 5715–5725.
- 97 McConnell, J. C., Sandel, B. R. and Broadfoot, A. L.: 1980, 'Airglow from Jupiter's Nightside and Crescent: Ultraviolet Spectrometer Observations from Voyager 2', *Icarus* 43, 128–142.
- 98 McConnell, J. C., Sandel, B. R. and Broadfoot, A. L.: 1981, 'Voyager U.V. Spectrometer Observations of He 584 Å Dayglow at Jupiter', *Planet. Space Sci.* 29, 283–292.
- 99 Sandel, B. R. and Broadfoot, A. L.: 1981, 'Morphology of Saturn's Aurora', *Nature* 292, 679–682.
- 100 Sandel, B. R., Broadfoot, A. L. and Strobel, D. F.: 1980, 'Discovery of a Longitudinal Asymmetry in the H Lyman-Alpha Brightness of Jupiter', *Geophys. Res. Lett.* 7, 5–8.
- 101 Sandel, B. R., Shemansky, D. E. and Broadfoot, A. L.: 1978, 'Hydrogen L $\beta$  and L $\alpha$  Emission Lines Observed from the Interplanetary Medium by the Voyager UV Spectrometer', *Nature* 274, 666–667.
- 102 Sandel, B. R., Shemansky, D. E., Broadfoot, A. L., Bertaux, J. L., Blamont, J. E., Belton, M. J. S., Ajello, J. M., Holberg, J. B., Atreya, S. K., Donahue, T. M., Moos, H. W., Strobel, D. F., McConnell, J. C., Dalgarno, A., Goody, R., McElroy, M. B. and Takacs, P. Z.: 1979, 'Extreme Ultraviolet Observations from Voyager 2 Encounter with Jupiter', *Science* 206, 962–966.

- 103 Sandel, B. R., Shemansky, D. E., Broadfoot, A. L., Holberg, J. B., Smith, G. R., McConnell, J. C., Strobel, D. F., Atreya, S. K., Donahue, T. M., Moos, H. W., Hunten, D. M., Pomphrey, R. B. and Linick, S.: 1982, 'Extreme Ultraviolet Observations from the Voyager 2 Encounter with Saturn', *Science* 215, 548–553.
- 104 Shemansky, D. E., Sandel, B. R. and Broadfoot, A. L.: 1979, 'Voyager Observations of the Interstellar Medium in the 500– to 1700–Å Spectral Region', *J. Geophys. Res.* 84, 139–142.
- 105 Yung, Y. L. and Strobel, D. F.: 1980, 'Hydrocarbon Photochemistry and Lyman Alpha Albedo of Jupiter', *Astrophys. J.* 239, 395–402.

### Laboratory Simulation/Modelling Studies

- 106 Atreya, S. K. and Donahue, T. M.: 1967, 'Model Ionospheres of Jupiter', in *Jupiter* (ed. by T. Gehrels), University of Arizona Press, Tucson, pp. 304–318.
- 107 Atreya, S. K., Donahue, T. M. and Kuhn, W. R.: 1977, 'The Distribution of Ammonia and Its Photochemical Products on Jupiter', *Icarus* 31, 348–355.
- 108 Atreya, S. K., Donahue, T. M. and Kuhn, W. R.: 1978, 'Evolution of a Nitrogen Atmosphere on Titan', *Science* 201, 611–613.
- 109 Atreya, S. K., Donahue, T. M. and McElroy, M. B.: 1974, 'Jupiter's Ionosphere: Prospects for Pioneer 10', *Science* 184, 154–156.
- 110 Axel, L.: 1972, 'Inhomogenous Models of the Atmosphere of Jupiter', *Astrophys. J.* 173, 451–468.
- 111 Bar-Nun, A.: 1975, 'Thunderstorms on Jupiter', *Icarus* 24, 86–94.
- 112 Bar-Nun, A. and Podolak, M.: 1979, 'The Photochemistry of Hydrocarbons in Titan's Atmosphere', *Icarus* 38, 115–122.
- 113 Cadle, R. D.: 1962, 'The Photochemistry of the Upper Atmosphere of Jupiter', *J. Atmos. Sci.* 19, 281–285.
- 114 Cameron, A. G. W. and Pollack, J. B.: 1976, 'On the Origin of the Solar System and of Jupiter and Its Satellites', in *Jupiter* (ed. by T. Gehrels), University of Arizona Press, Tucson, pp. 61–84.
- 115 Capone, L. A., Dubach, J., Whitten, R. C. and Prasad, S. S.: 1979, 'Cosmic Ray Ionization of the Jovian Atmosphere', *Icarus* 39, 433–449.
- 116 Capone, L. A., Prasad, S. S., Huntress, W. T., Whitten, R. C., Dubach, J. and Santhanam, K.: 1981, 'Formation of Organic Molecules on Titan', *Nature* 293, 45–46.
- 117 Cess, R. and Owen, T.: 1973, 'Effect of Noble Gases on an Atmospheric Greenhouse (Titan)', *Nature* 244, 272–273.
- 118 Chadha, M. S., Flores, J. J., Lawless, J. G. and Ponnampereuma, C.: 1971, 'Organic Synthesis in Simulated Jovian Atmosphere. II', *Icarus* 15, 39–44.
- 119 Chadha, M. S., Lawless, J. G., Flores, J. J. and Ponnampereuma, C.: 1971, 'Experiments in Jovian Atmosphere', in *Chemical Evolution and the Origin of Life* (ed. by R. Buvet and C. Ponnampereuma), North-Holland Publishing Co., Amsterdam, pp. 143–151. (Molecular Evolution I)
- 120 Chang, S., Scattergood, T., Aronowitz, S. and Flores, J.: 1979, 'Organic Chemistry on Titan', *Rev. Geophys. Space Phys.* 17, 1923–1933.
- 121 Danielson, R. E., Caldwell, J. J. and Larach, D. R.: 1973, 'An Inversion in the Atmosphere of Titan', *Icarus* 20, 437–443.
- 122 Ferris, J. P. and Benson, R.: 1980, 'Diphosphine is an Intermediate in the Photolysis of Phosphine to Phosphorus and Hydrogen', *Nature* 285, 156–157.
- 123 Ferris, J. P. and Chen, C. T.: 1975, 'Photosynthesis of Organic Compounds in the Atmosphere of Jupiter', *Nature* 258, 587–588.
- 124 Ferris, J. P. and Morimoto, J. Y.: 1981, 'Irradiation of  $\text{NH}_3$ – $\text{CH}_4$  Mixtures as a Model of Photochemical Processes in the Jovian Planets and Titan', *Icarus* 48, 118–126.
- 125 Ferris, J. P., Morimoto, J. Y. and Benson, R.: 1981, 'Photolysis of  $\text{CH}_4$ – $\text{NH}_3$  Mixtures and  $\text{PH}_3$  as Models for the Photochemical Transformations on the Primitive Earth and Jupiter', in *Origin of Life* (ed. by Y. Wolman), D. Reidel Publishing Co., Dordrecht, Holland, pp. 101–105.
- 126 Ferris, J. P., Nakagawa, C. and Chen, C. T.: 1977, 'Photochemical Synthesis of Organic Compounds on Jupiter Initiated by the Photolysis of Ammonia', in *Life Sciences and Space Research, Volume XV. Proceedings of the Open Meeting of the Working Group on Space Biology of the*

- 19th Plenary Meeting of COSPAR, Philadelphia, Pennsylvania, June 8–19 (ed. by R. Holmquist), Pergamon Press, New York, pp. 95–99.
- 127 Gehrels, T. (ed.): 1976, *Jupiter*, University of Arizona Press, Tucson, 1254 pp.
- 128 Greenspan, J. A. and Owen, T.: 1967, 'Jupiter's Atmosphere: Its Structure and Composition', *Science* 156, 1489–1494.
- 129 Gross, S. H. and Rasool, S. I.: 1964, 'The Upper Atmosphere of Jupiter', *Icarus* 3, 311–322.
- 130 Gupta, S., Ochiai, E. and Ponnampereuma, C.: 1981, 'Organic Synthesis in the Atmosphere of Titan', *Nature* 293, 725–727.
- 131 Hubbard, W. B.: 1973, 'The Significance of Atmospheric Measurements for Interior Models of the Major Planets', *Space Sci. Rev.* 14, 424–432.
- 132 Hubbard, W. B.: 1970, 'Structure of Jupiter: Chemical Composition, Contraction, and Rotation', *Astrophys. J.* 162, 687–697.
- 133 Hubbard, W. B.: 1969, 'Thermal Models of Jupiter and Saturn', *Astrophys. J.* 155, 333–344.
- 134 Hubbard, W. B. and Smoluchowski, R.: 1973, 'Structure of Jupiter and Saturn', *Space Sci. Rev.* 14, 599–662.
- 135 Ingersoll, A. P.: 1981, 'Jupiter and Saturn', *Sci Am.* 245 (6), 90–98.
- 136 Ingersoll, A.: 1981: 'Jupiter and Saturn', in *The New Solar System* (ed. by J. K. Beatty, B. O'Leary, and A. Chaikin), Cambridge University Press, New York, pp. 117–128.
- 137 Khare, B. N. and Sagan, C.: 1973, 'Red Clouds in Reducing Atmospheres', *Icarus* 20, 311–321.
- 138 Khare, B. N., Sagan, C., Bandurski, E. L. and Nagy, B.: 1978, 'Ultraviolet-Photoproducted Organic Solids Synthesized Under Simulated Jovian Conditions: Molecular Analysis', *Science* 199, 1199–1201.
- 139 Kuhn, W. R., Atreya, S. K. and Chang, S.: 1977, 'The Distribution of Methylamine in the Jovian Atmosphere', *Geophys. Res. Lett.* 4, 203–206.
- 140 Kumar, S.: 1980, 'A Model of the SO<sub>2</sub> Atmosphere and Ionosphere of Io', *Geophys. Res. Lett.* 7, 9–12.
- 141 Kumar, S. S.: 1977, 'On the Origin and Evolution of Jupiter and Saturn', *Astrophys. Space Sci.* 49 (2), L17–L19.
- 142 Lasker, B. M.: 1963, 'Wet Adiabatic Model Atmospheres for Jupiter', *Astrophys. J.* 138, 709–719.
- 143 Lewis, J. S.: 1969, 'Clouds of Jupiter and the Ammonia-Water and Ammonia-Hydrogen Sulfide Systems', *Icarus* 10, 365–378.
- 144 Lewis, J. S.: 1969, 'Observability of Spectroscopically Active Compounds in the Atmosphere of Jupiter', *Icarus* 10, 393–409.
- 145 Lewis, J. S. and Prinn, R. G.: 1971, 'Chemistry and Photochemistry of the Atmosphere of Jupiter', in *Theory and Experiment in Exobiology, Vol. I.* (ed. by A. W. Schwartz), Wolters-Noordhoff Publishing, Groningen, The Netherlands, pp. 123–142.
- 146 Libby, W. F.: 1974, 'Life on Jupiter?', *Origins of Life* 5, 483–486.
- 147 McElroy, M. B.: 1973, 'The Ionospheres of the Major Planets', *Space Sci. Rev.* 14, 460–473.
- 148 McNesby, J. R.: 1969, 'Photochemistry of Jupiter Above 1000 Å', *J. Atmos. Sci.* 26, 594–599.
- 149 Molton, P. M.: 1972, 'Exobiology, Jupiter and Life', *Spaceflight* 14 (6), 220–223.
- 150 Molton, P. M. and Gilbert, J. C.: 1973, 'Photochemical Reactions in the Jovian Atmosphere', *J. Brit. Interplanetary Soc.* 26 (7), 385–407.
- 151 Molton, P. and Ponnampereuma, C.: 1974, 'Organic Synthesis in Simulated Jovian Atmosphere, III', *Icarus* 21, 166–174.
- 152 Molton, P. and Ponnampereuma, C.: 1972, 'Survival of Common Terrestrial Microorganisms Under Simulated Jovian Conditions', *Nature* 238, 217–218.
- 153 Newburn, R. L., Jr. and Gulkis, S.: 1973, 'A Survey of the Outer Planets: Jupiter, Saturn, Uranus, Neptune, Pluto, and Their Satellites', *Space Sci. Rev.* 3, 179–271.
- 154 Newman, W. I. and Sagan, C.: 1978, 'Five Micron Limb-Darkening and the Structure of the Jovian Atmosphere', *Icarus* 36, 223–239.
- 155 Nicodem, D. E. and Ferris, J. P.: 1973, 'Ammonia Photolysis on Jupiter', *Icarus* 19, 495–498.
- 156 Noda, H. and Ponnampereuma, C.: 1971, 'Polymer Formation in a Simulated Jovian Atmosphere', in *Chemical Evolution and the Origin of Life* (ed. by R. Buvet and C. Ponnampereuma), North-Holland Publishing Co., Amsterdam, pp. 236–244. (Molecular Evolution I).

- 157 Opik, E. J.: 1962, 'Jupiter: Chemical Composition, Structure, and Origin of a Giant Planet', *Icarus* 1, 200–257.
- 158 Owen, T.: 1970, 'The Atmosphere of Jupiter', *Science* 167, 1675–1681.
- 159 Owen, T.: 1976, 'Chemical Abundances in the Atmospheres of the Giant Planets and Their Satellites', in *Chemical Evolution of the Giant Planets* (ed. by C. Ponnampertuma), Academic Press, New York, pp. 49–58.
- 160 Owen, T. and Mason, H. P.: 1969, 'New Studies of Jupiter's Atmosphere', *J. Atmos. Sci.* 26, 870–873.
- 161 Peebles, R. J. E.: 1964, 'The Structure and Composition of Jupiter and Saturn', *Astrophys. J.* 140, 328–347.
- 162 Podolak, M.: 1978, 'The Envelopes of Jupiter and Saturn', in *Space Research XVIII. Proceedings of the Open Meetings of the Working Groups on Physical Sciences*, Tel Aviv, Israel, June 7–18, 1977, Pergamon Press, Oxford, pp. 455–456.
- 163 Podolak, M. and Cameron, A. G. W.: 1975, 'Further Investigations of Jupiter Models', *Icarus* 25, 627–634.
- 164 Podolak, M. and Cameron, A. G. W.: 1974, 'Models of the Giant Planets', *Icarus* 22, 123–148.
- 165 Pollack, J. B.: 1973, 'Greenhouse Models of the Atmosphere of Titan', *Icarus* 19, 43–58.
- 166 Ponnampertuma, C. (ed.): 1976, *Chemical Evolution of the Giant Planets*, Academic Press, New York, 240 pp.
- 167 Ponnampertuma, C.: 1976, 'The Organic Chemistry and Biology of the Atmosphere of the Planet Jupiter', *Icarus* 29, 321–328.
- 168 Ponnampertuma, C.: 1976, 'Organic Synthesis in a Simulated Jovian Atmosphere of the Planet Jupiter', in *Chemical Evolution of the Giant Planets* (ed. by C. Ponnampertuma), Academic Press, New York, pp. 221–231.
- 169 Ponnampertuma, C. and Molton, P.: 1973, 'The Prospect of Life on Jupiter', *Space Life Sci.* 4, 32–44.
- 170 Ponnampertuma, C. and Molton, P. M.: 1973, 'Life on Jupiter', *New Sci.* 60, 692–693.
- 171 Ponnampertuma, C. and Woeller, F.: 1969, 'Organic Synthesis in a Simulated Jovian Atmosphere', *Icarus* 10, 386–392.
- 172 Prasad, S. S., Capone, L. A. and Schneck, L.: 1975, 'Photochemistry of Hydrocarbons in the Jovian Upper Atmosphere', *Geophys. Res. Lett.* 2, 164.
- 173 Prinn, R. G.: 1970, 'UV Radiative Transfer and Photolysis in Jupiter's Atmosphere', *Icarus* 13, 424–436.
- 174 Prinn, R. G. and Owen, T.: 1967, 'Chemistry and Spectroscopy of the Jovian Atmosphere', in *Jupiter* (ed. by T. Gehrels), University of Arizona Press, Tucson, pp. 319–371.
- 175 Raulin, F., Bossard, A., Toupance, G. and Ponnampertuma, C.: 1979, 'Abundance of Organic Compounds Photochemically Produced in the Atmospheres of the Outer Planets', *Icarus* 38, 358–366.
- 176 Sagan, C.: 1968, 'Simulating Extraterrestrial Environments', *Sci. J.* 4, 75–79.
- 177 Sagan, C.: 1971, 'The Solar System Beyond Mars: An Exobiological Survey', *Space Sci. Rev.* 11, 827–866.
- 178 Sagan, C. and Khare, B. N.: 1971, 'Experimental Jovian Photochemistry: Initial Results', *Astrophys. J.* 168, 563–569.
- 179 Sagan, C., Lippincott, E., Dayhoff, M. O. and Eck, R. V.: 1967, 'Organic Molecules and the Coloration of Jupiter', *Nature* 213, 273–274.
- 180 Sagan, C. and Salpeter, E. E.: 1976, 'Particles, Environments, and Possible Ecologies in the Jovian Atmosphere', *Astrophys. J.* 32, 737.
- 181 Scattergood, T., Lesser, P. and Owen, T.: 1975, 'Production of Organic Molecules in the Outer Solar System by Proton Irradiation: Laboratory Simulations', *Icarus* 24, 465–471.
- 182 Sill, G. T.: 1967, 'The Chemistry of the Jovian Clouds', in *Jupiter* (ed. by T. Gehrels), University of Arizona Press, Tucson, pp. 372–383.
- 183 Smoluchowski, R.: 1967, 'Internal Structure and Energy Emission of Jupiter', *Nature* 215, 691–695.
- 184 Smoluchowski, R.: 1976, 'Origin and Structure of Jupiter and Its Satellites', in *Jupiter* (ed. by T. Gehrels), University of Arizona Press, Tucson, pp. 3–21.



- 185 Stevenson, D. J. and Salpeter, E. E.: 1967, 'Interior Models of Jupiter', in *Jupiter* (ed. by T. Gehrels), University of Arizona Press, Tucson, pp. 85–112.
- 186 Strobel, D. F.: 1974, 'Hydrocarbon Abundances in the Jovian Atmosphere', *Astrophys. J.* **192**, L47–L49.
- 187 Strobel, D. F.: 1973, 'The Photochemistry of Hydrocarbons in the Jovian Atmosphere', *J. Atmos. Sci.* **30**, 489–498.
- 188 Strobel, D. F.: 1969, 'The Photochemistry of Methane in the Jovian Atmosphere', *J. Atmos. Sci.* **26**, 906–911.
- 189 Strobel, D. F.: 1973, 'The Photochemistry of NH<sub>3</sub> in the Jovian Atmosphere', *J. Atmos. Sci.* **30**, 1205–1209.
- 190 Trafton, L.: 1972, 'The Bulk Composition of Titan's Atmosphere', *Astrophys. J.* **175**, 295–306.
- 191 Trafton, L. M.: 1967, 'Model Atmospheres of the Major Planets', *Astrophys. J.* **147**, 765–781.
- 192 Weidenschilling, S. J. and Lewis, J. S.: 1973, 'Atmospheric and Cloud Structures of the Jovian Planets', *Icarus* **20**, 465–476.
- 193 Woeller, F. and Ponnampereuma, C.: 1969, 'Organic Synthesis in a Simulated Jovian Atmosphere', *Icarus* **10**, 386–392.
- 194 Woodman, J. H., Trafton, L. and Owen, T.: 1977, 'The Abundances of Ammonia in the Atmospheres of Jupiter, Saturn, and Titan', *Icarus* **32**, 314–320.
- 195 Young, R. S. and MacElroy, R. D.: 1976, 'Biology on the Outer Planets', in *Chemical Evolution of the Giant Planets* (ed. by C. Ponnampereuma), Academic Press, New York, pp. 199–219.

#### Acknowledgement

This work was performed under NASA contract NASW-3165.