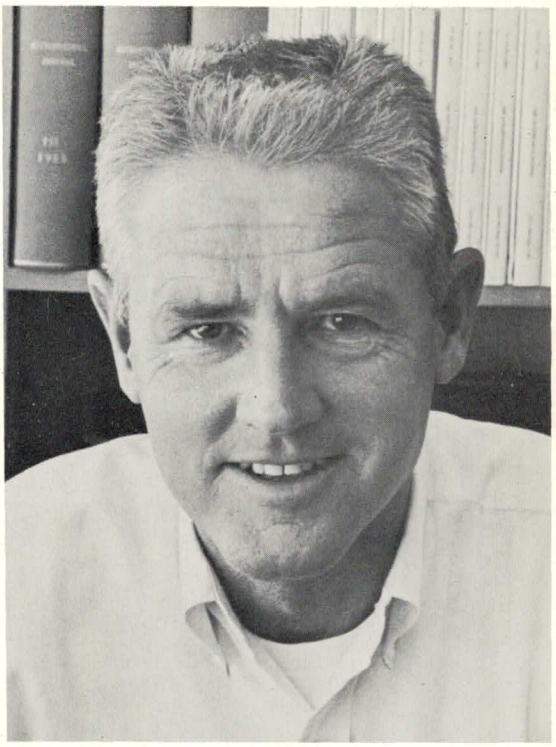
KITT PEAK NATIONAL OBSERVATORY

SCIENTIFIC STAFF:

PROFILES

April, 1975



HELMUT A. ABT

Astronomer

Dr. Helmut A. Abt *plans to complete his study of the duplicity among 134 sample solar type stars. He is continuing with the determination of the rotational velocities of virtually all (about 3000) of the BO-FO stars in the Catalog of Bright stars. About one-fifth of the spectra were obtained at CTIO. He is interested in the determination of the binary frequencies among large samples of B2-B5 IV, V stars; B2e-B5e IV, V stars, members of the Ursa Major stream; members of the Orion Nebula cluster, and runaway stars. He plans to determine the radial velocities, rotational velocities and spectral classes for about 200 visual double stars, and in collaboration with W. Morgan (Yerkes Observatory) has proposed the compilation of a new spectral atlas.*

Abt is overseeing the continuing improvement of the stellar spectrographs and plans to use the Parkinson equipment for real-time radial velocity measures at the 2.1-m coudé. About half of his time is devoted to his duties as Editor for the Astrophysical Journal.

PUBLICATIONS:

Abt, H. A. and Levy, S. G. 1971, "The Radial Velocity of 60 Serpentis", Publ. Astron. Soc. Pacific 83, *687.*

Abt, H. A. and Biggs, E. S. 1972, "The Astrophysical Journal General Index to Volumes 146-165 and to the Supplement Series Volumes 14-22", Astrophys. J. 178, *No. 3, Pt. 3.*

Abt, H. A. and Biggs, E. S. 1972, Bibliography of Stellar Radial Velocities, Kitt Peak National Observatory Publication.

Abt, H. A., Bolton, C. T. and Levy, S. G. 1972, "IC 4665, A Cluster of Binaries", Astrophys. J. 171, *259.*

Abt, H. A., Chaffee, F. H. and Suffolk, G. 1972, "Rotational Velocities of Ap Stars", Astrophys. J. 175, *779.*

Abt, H. A. and Levy, S. G. 1972, "Spectroscopic Binaries in the Open Cluster NGC 2516", *Astrophys. J.* 172, 355.

Abt, H. A., Levy, S. G. and Gandet, T. L. 1972, "Radial Velocities of Sixty-Five Early-Type Stars", *Astron. J.* 77, 138.

Abt, H. A. and Morgan, W. W. 1972, "The HR Diagram of the Open Cluster IC 2602", *Astrophys. J.* 174, L131.

Abt, H. A. and Wisniewski, W. Z. 1972, "Radial Velocity of RR Lyrae Variable-RW Ari", *I.A.U. Information Bulletin on Variable Stars No. 697.*

Morgan, W. W. and Abt, H. A. 1972, "The Spectral Classification of the F Stars of Intermediate Luminosity", *Astron. J.* 77, 35.

Abt, H. A. 1973, "Alfred Harrison Joy (1882-1973)", *Mercury* 2, 9.

Abt, H. A. 1973, "Introductory Remarks on Spectroscopic Parameters, Proceedings of I.A.U. Colloquium No. 18", *J. Roy. Astron. Soc. Canada* 67, 73.

Abt, H. A. and Levy, S. G. 1973, "Supergiant Binaries in the Hα and χ Persei Association", *Astrophys. J.* 184, 167.

Abt, H. A. and Levy, S. G. 1973, "Visual Multiples. I. ADS 7251", *Astron. J.* 78, 1093.

Abt, H. A. and Moyd, K. I. 1973, "Rotation and Shell Spectra Among A-Type Dwarfs", *Astrophys. J.* 182, 809.

Abt, H. A. and Sanders, W. L. 1973, "A Spectroscopic Study of the Open Cluster M39", *Astrophys. J.* 186, 177.

Abt, H. A. and Snowden, M. S. 1973, "The Binary Frequency for Ap Stars", *Astrophys. J. Suppl. Series No. 215*, 25, 137.

Morgan, W. W. and Abt, H. A. 1973, "On the Metallicity of the Main-Sequence Stars in M67", *Astron. J.* 78, 386.

Abt, H. A. 1974, "Catalog of Individual Radial Velocities, 12^h-24^h, Measured by Astronomers of the Mount Wilson Observatory", *Astrophys. J. Suppl.* 26, 365.

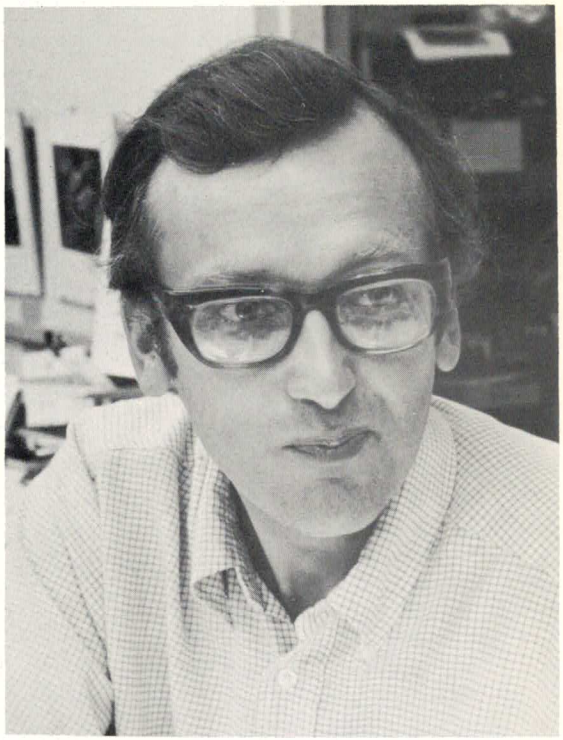
Abt, H. A. and Levy, S. G. 1974, "Reinvestigation of Certain Long-Period A-Type Binaries", *Astrophys. J.* 188, 291.

Abt, H. A. and Levy, S. G. 1974, "Period Variation of the Cepheid Zeta Geminorum", *Astrophys. J.* 188, 75.

Burke, E. W. and Abt, H. A. 1974, "The Ellipsoidal System BD+56°2190", *Publ. Astron. Soc. Pacific* 86, 677.

Joy, A. H. and Abt, H. A. 1974, "Spectral Types of M Dwarf Stars", Astrophys. J. Suppl. 28, *1.*

Abt, H. A. 1975, "Rotational Velocities of Marginal Metallic-Line Stars", Astrophys. J. 195, *405.*



MICHAEL J. S. BELTON

Astronomer

Dr. Michael J. S. Belton *plans to continue his spectroscopic studies of the outer planets, particularly Uranus and Neptune. His objectives are to obtain better abundances of CH_4 and NH_3 relative to H_2, to measure the rate of rotation and position of the rotation axis and to determine the limb darkening as a function of wavelength. He also plans to make FTS observations of Venus in an effort to understand the cloud structure on the planet. He also intends to continue his theoretical studies of the wave propagation and motions in the Venus atmosphere, of the radiative transfer in and atmospheric structure of outer planet atmospheres and clouds, and of the evolution and formation of planets.*

Belton is a member of the UVS Team for the NASA Mariner Jupiter/ Saturn Mission. His interest is centered on the possibilities of performing cruise science and of using the spacecraft as a UV observatory for stellar and interstellar projects.

Belton has the responsibilities of overseeing the solar telescope night-time operations and the 31-cm Schmidt camera. In collaboration with S. Ridgway, he is continuing plans for the development of a spectro-planetograph, an instrument planned to obtain effectively simultaneous, high resolution spectra over the disc of a planet with high spatial resolution.

He also served as Chairman of the Priorities Committee for FY 1975.

PUBLICATIONS:

Belton, M. J. S. and Hunten, D. M. 1971, "The Distribution of CO_2 on Mars: A Spectroscopic Determination of Surface Topography", Icarus 15, *204.*

Murray, B. C., Belton, M. J. S., Danielson, E. D., Davies, M. E., Kuiper, G. P., O'Leary, B. T., Suomi, V. E., and Trask, N. J. 1971, "Imaging of Mercury and Venus from a Flyby", Icarus 15, *153.*

Belton, M. J. S. and Price, M. J. 1973, "Limb Brightening on Uraus: A Prediction", Astrophys. J. 179, *965.*

Belton, M. J. S. and Spinrad, H. 1973, "H_2 Pressure-Induced Lines in the Spectra of the Major Planets", *Astrophys. J.* 185, 363.

Belton, M. J. S., Wallace, L. and Price, M. J. 1973, "Observation of the Raman Effect in the Spectrum of Uranus", *Astrophys. J. Letters* 184, L143.

Belton, M. J. S. 1974, "Planetary and Satellite Parameters", in *Geoscience Instrumentation*, ed. by E. Mercanti and E. A. Wolff. (New York: John Wiley and Sons).

Belton, M. J. S., Murray, B. C., Danielson, G. E., Davies, M. E., Gault, D., Hapke, B., O'Leary, B., Strom, R. G., Suomi, V., and Trask, N. 1974, "Mariner 10 Pictures of Mercury: First Results", *Science* 184, 459.

Broadfoot, A. L., Kumar, S., Belton, M. J. S. and McElroy, M. B. 1974, "Ultraviolet Observations of Venus from Mariner 10: Preliminary Results", *Science* 183, 1315.

Broadfoot, A. L., Kumar, S., Belton, M. J. S. and McElroy, M. B. 1974, "Mercury's Atmosphere from Mariner 10: Preliminary Results", *Science* 185, 166.

Murray, B. C., Belton, M. J. S., Danielson, G. E., Davies, M. E., Gault, D., Hapke, B., O'Leary, B., Strom, R. G., Suomi, V., Trask, N. 1974, "Mercury's Surface: Preliminary Description and Interpretation from Mariner 10 Pictures", *Science* 185, 169.

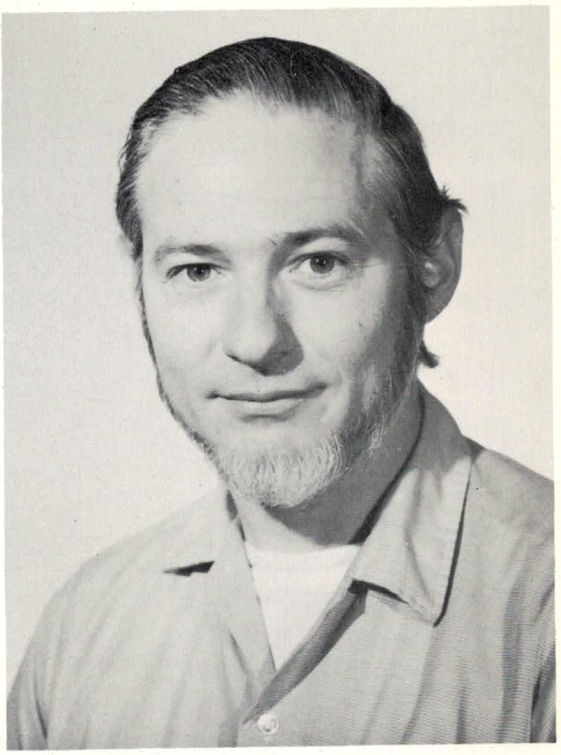
Murray, B. C., Belton, M. J. S., Danielson, G. E., Davies, M. E., Gault, D., Hapke, B., O'Leary, B., Strom, R. G., Suomi, V., and Trask, N. 1974, "Venus: Atmospheric Motion and Structure from Mariner 10 Pictures", *Science* 183, 1307.

Wallace, L., Prather, M. and Belton, M. J. S. 1974, "The Thermal Structure of the Atmosphere of Jupiter", *Astrophys. J.* 193, 481.

Belton, M. J. S. and Hayes, S. H. 1975, "An Estimate of the Temperature and Abundance of CH_4 and Other Molecules in the Atmosphere of Uranus", *Icarus*, in press.

Belton, M. J. S. and Vescelus, F. E. 1975, "Why Image Uranus", *Icarus*, in press.

Strom, R. G., Murray, B. C., Belton, M. J. S., Danielson, G. E., Davies, M. E., Gault, D. E., Hapke, B., O'Leary, B., Suomi, V., and Trask, N. 1975, "Preliminary Imaging Results from Second Mercury Encounter", submitted to *Icarus*.



JAMES W. BRAULT

Physicist

Dr. James W. Brault *is continuing with his systematic study of larger regions of the solar spectrum, especially those where molecules are significant absorbers. Preliminary observations include the fast surveys at the solar center and limb, low sun spectra to determine telluric absorption, and supporting laboratory measurements. These observations are now undergoing empirical analyses -- continuum curve fitting, decomposition of the fast survey, identification and energy level analyses and model building. He plans to improve the observations of the fast survey in order to publish a KPNO Solar Atlas early in FY 1976, and also to collaborate with the OSO-I group in Boulder in the far UV extension of the solar spectrum observations.*

During FY 1976, he expects to have the 1-m Fourier Transform Spectrometer in routine operation in basic wide-range mode and to develop the heterodyning technique for short spectral range scans.

He is also the Program Director for the Computer Applications Program.

PUBLICATIONS:

Brault, J. W., Slaughter, C. D., Pierce, A. K., and Aikens, R. S. 1971, "True Central Intensities of Fraunhofer Lines", Solar Phys. 18, *366.*

Brault, J. W. and White, O. R. 1971, "The Analysis and Restoration of Astronomical Data via the Fast Fourier Transform", Astron. Astrophys. 13, *169.*

Lambert, D. L., Mallia, E. A. and Brault, J. W. 1971, "On the Abundance of Chlorine in the Sun", Solar Phys. 19, *289.*

Brault, J. W. 1972, "A High Precision Fourier Spectrometer for the Visible", Auxiliary Instrumentation for Large Telescopes, Proceedings of ESO/CERN Conference in Geneva, Switzerland, eds. S. Laustsen and A. Reiz, (ESO/CERN Publication), p. 367.

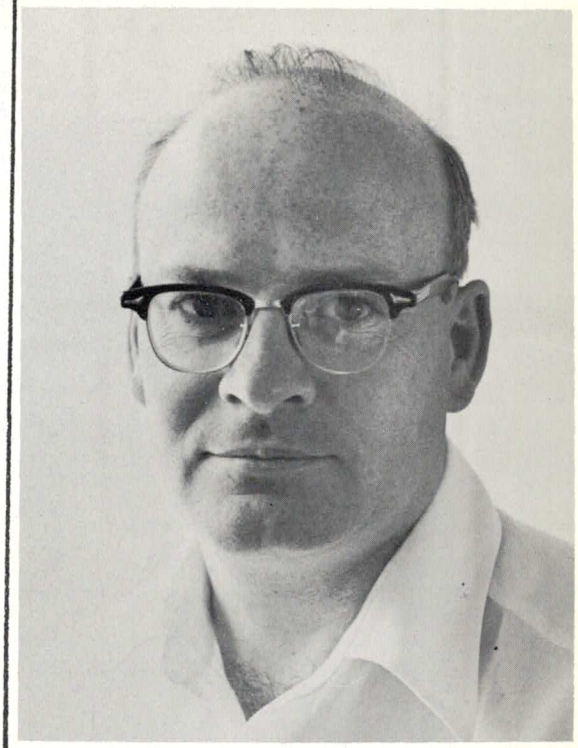
Athay, R. G., Lites, B. W., White, O. R. and Brault, J. W. 1972, "A First Order Analysis of Variations of the Limb Darkening and the Shapes for Solar Fraunhofer Lines", Solar Phys. 24, *18.*

White, O. R., Altrock, R. C., Brault, J. W. and Slaughter, C. D. 1972, "Measurements of the Limb Darkening in the Forbidden MgI Line at 4571.1 Å", *Solar Phys.* 23, 18.

Lites, B. W. and Brault, J. W. 1973, "The Solar Neutral Iron Spectrum. I. Measurement of Solar Fe I Line Profiles from Center to Limb", *Solar Phys.* 30, 283.

Brault, J. W., Fender, J. S. and Hall, D. N. B. 1974, "Absorption Coefficients of Selected Atmospheric Water Lines", submitted to *J Quan. Spectroscopy and Radiative Transfer.*

Brault, J. W. and Muller, E. A. 1975, "The Solar Lithium Abundance. Part I: Observations of the Solar Lithium Feature at 6707.8 Å", submitted to *Solar Phys.*



A. LYLE BROADFOOT

Physicist

Dr. A. Lyle Broadfoot *is continuing data reduction from the Mariner 10 UV spectrometer. Four co-investigators are associated with the interpretation of the data and preparation of the theoretical models; M. Belton (KPNO), McElroy and Yung (Harvard), and Kumar (JPL). Broadfoot is Principal Investigator on the UV Spectrometer on the Mariner Jupiter/Saturn mission.*

PUBLICATIONS:

Shemansky, D. E. and Broadfoot, A. L. 1971, "Excitation of N_2 and N_2^+ Systems by Electrons. I. Absolute Transition Probabilities", J. Quant. Spectr. Radiative Transfer 11, *1385.*

Shemansky, D. E. and Broadfoot, A. L. 1971, "Excitation of N_2 and N_2^+ Systems by Electrons. II. Excitation Cross Sections and N_2 1PG Low Pressure Afterglow", J. Quant. Spectr. Radiative Transfer 11, *1401.*

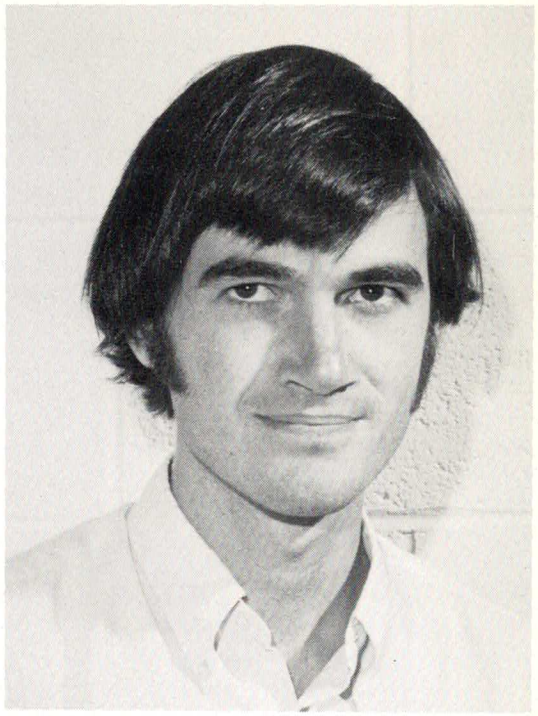
Broadfoot, A. L. 1972, "Dayglow Nitrogen Band Systems", The Radiating Atmosphere, ed. B. M. McCormac. (D. Reidel, Dordrecht), p. 34-44.

Broadfoot, A. L. 1972, "The Solar Spectrum 2100-3200 Å", Astrophys. J. 173, *681.*

Shemansky, D. E. and Broadfoot, A. L. 1973, "Comment on paper by D. C. Cartwright, S. Trajmar and W. Williams, 'Vibrational Population of the $A^3\Sigma_u^+$ and B^3II_g States of N_2 in Normal Auroras'", J. Geophys. Res. 78, *2357.*

Broadfoot, A. L., Kumar, S., Belton, M. J. S. and McElroy, M. B. 1974, "Mercury's Atmosphere from Mariner 10: Preliminary Results", Science 185, *166.*

Broadfoot, A. L., Kumar, S., Belton, M. J. S. and McElroy, M. B. 1974, "Ultraviolet Observations of Venus from Mariner 10: Preliminary Results", Science 183, *1315.*



ROGER A. CHEVALIER

Assistant Astronomer

Dr. Roger A. Chevalier *plans to continue his theoretical investigations in astrophysical gas dynamics and in the dynamics of gas and stars in galaxies. Examples of specific topics under investigation are thermal wave and heat conduction effects in supernova remnants and the determination of the hydrodynamics of shock wave propagation in a supernova explosion, galactic winds in flattened galaxies, close binary systems, star formation induced by a supernova shock, and the emission from a thermalized stellar wind.*

He serves as Chairman of the KPNO Colloquia.

PUBLICATIONS:

Chevalier, R. A. 1974, "The Evolution of Supernova Remnants. I. Spherically Symmetric Models", Astrophys. J. 188, *501.*

Chevalier, R. A. and Gardner, J. 1974, "The Evolution of Supernova Remnants. II. Models of an Explosion in a Plane-Stratified Medium", Astrophys. J. 192, *457.*

Chevalier, R. A. 1975, "The Evolution of Supernova Remnants. III. Thermal Waves", accepted for publication in Astrophys. J. June 1, 1975.

Chevalier, R. A. 1975, "The Circularization of Close Binary Orbits: Centaurus X-3", accepted for publication in Astrophys. J. July 1, 1975.

Chevalier, R. A. 1975, "The Evolution of Supernova Remnants. IV. The Supernova Ejecta", accepted for publication in Astrophys. J. Sept. 15, 1975.

Chevalier, R. A. and Gull, T. R. 1975, "The Outer Structure of the Crab Nebula", accepted for publication in Astrophys. J. Sept. 15, 1975.

Chevalier, R. A. and Theys, J. C. 1975, "Optically Thin Radiating Shock Waves and the Formation of Density Inhomogeneities", Astrophys. J. 195, *53.*

Scott, J. S. and Chevalier, R. A. 1975, "Cosmic Ray Production in the Cassiopeia, a Supernova Remnant", accepted for publication in Astrophys. J. April 1, 1975.

JUDITH G. COHEN

Assistant Astronomer

Dr. Judith G. Cohen *expects to continue her research in the interstellar medium as explored through optical interstellar lines. By using the echelle spectrograph on the 4-m telescope, she hopes to study the problem of the interstellar lines seen in the brightest blue globular cluster stars, in addition to studying the spectra of the stars for effects of stellar evolution on their surface chemical compositions. She is also studying the question of gas content and stellar populations in spiral galaxies outside the nucleus.*

She oversees some instrumental developments to improve the coudé auxiliary telescope, the efficiency and speed of the 2.1-m coudé, and the facilities for the use of image tubes at the coudé. She is also Chairman of the KPNO Summer Student Program.

PUBLICATIONS:

Cohen, J. G. 1973, "Technitium in S Sculptoris", Publ. Astron. Soc. Pacific 85, *187.*

Grasdalen, G. and Cohen, J. G. 1973, "Diffuse Nebulae at High Galactic Latitudes", Astrophys. J. 180, *L11.*

Cohen, J. G. 1974, "Interstellar Lines in Stars at High Galactic Latitudes", Astrophys. J. 194, *37.*

Cohen, J. G. 1974, "On the Reality of the High Lithium Abundances in Carbon Stars", Publ. Astron. Soc. Pacific 86, *31.*

Cohen, J. G. 1974, "Optical Interstellar Lines in Dark Clouds. II. K I and Ultraviolet Sodium Lines, Astrophys. J. 192, *379.*

Cohen, J. G. and Wallerstein, G. 1974, "On the Velocity Structure of the Interstellar Clouds near Rho Ophiuchi", Astrophys. J. 189, *259.*

Snow, T. P. and Cohen, J. 1974, "Diffuse Interstellar Band Formation in Dense Clouds", Astrophys. J. 194, 313.

Cohen, J. G. and Meloy, D. A. 1975, "The Interstellar Lines of the Feige Stars", submitted to the Astrophys. J.

DAVID L. CRAWFORD

Astronomer

Dr. David L. Crawford *is completing his general program of obtaining photometric observations, primarily in the uvby and Hβ systems and of calibrating these systems in terms of intrinsic color, absolute magnitude and chemical composition. He now plans to emphasize the kinematics of bright stars and the determination of cxc z galactic absorption. He expects to apply the techniques of faint multi-color photometry to galactic absorption, both in our galaxy and in nearby other ones.*

PUBLICATIONS:

Crawford, D. L., Barnes, J. V. and Golson, J. C. 1971, "Four-Color and Hβ Photometry for Bright B-Type Stars in the Southern Hemisphere", Astron. J. 76, *621.*

Crawford, D. L., Barnes, J. V. and Golson, J. C. 1971, "Four-Color, Hβ and UBV Photometry for Bright B-Type Stars in the Northern Hemisphere", ibid. 76, *1058.*

Crawford, D. L., Barnes, J. V., Hill, G. and Perry, C. L. 1971, "Four-Color and Hβ Photometry for Open Clusters VII: NGC 6231 and the I Sco Association", ibid. 76, *1048.*

Crawford, D. L., Golson, J. C. and Landolt, A. U. 1971, "A UBV Equatorial-Extinction Star Network", Publ. Astron. Soc. Pacific 83, *652.*

Crawford, D. L. and Barnes, J. V. 1972, "Four-Color and Hβ Photometry for Open Clusters: VIII. IC 4665", Astron. J. 77, *862.*

Crawford, D. L., Barnes, J. V., Gibson, J., Golson, J. C., Perry, C. L. and Crawford, M. L. 1972, "Four-Color and Hβ Photometry for the Brighter Ao-Type Stars", Astron. Astrophys. Suppl. Ser. 5, *109.*

Crawford, D. L. 1973, "Absolute Magnitude Determinations from Hydrogen-line Photometry", Problems of Calibration of Absolute Magnitudes and Temperatures of Stars, IAU Symposium No. 54, ed. B. Hauck and B. E. Westerlund, (Dordrecht-Reidel), p. 93.

Crawford, D. L. 1973, "Photometric Classification of B-Type Stars", *Spectral Classification and Multicolour Photometry, IAU Symposium No. 50*, eds. C. Fehrenbach and B. E. Westerlund (Dordrecht-Reidel), p. 186.

Crawford, D. L., Barnes, J. V., Golson, J. C., and Hube, D. P. 1973, "Four-color and Hβ Photometry for the Bright B8 and B9 Type Stars North of Declination -10°", *Astron. J.* 78, 738.

Crawford, D. L., Barnes, J. V. and Warren, W. 1974, "Four-Color and Hβ Photometry for Open Clusters. IX. NGC 6871", *Astron. J.* 79, 603.

Crawford, D. L., Barnes, J. V. 1974, "Four-Color and Hβ Photometry for Open Clusters. X. The α Persei Cluster", *Astron. J.* 79, 687.

Tapia, S., Johnson, H. L. and Crawford, D. L. 1973, "Results of the Absolute Calibration of the *u*, *v*, *b*, *y* System of Filters", *Problems of Calibration of Absolute Magnitudes and Temperatures of Stars, IAU Symposium No. 54*, eds. B. Hauck and B. E. Westerlund, (Dordrecht-Reidel), p. 163.

Hill, G., Crawford, D. L. and Barnes, J. V. 1974, "Some New Spectroscopic Binary Orbits in NGC 6231 and Sco OB1", submitted to the *Astron. J.*

Crawford, D. L. 1975, "Empirical Calibrations of the uvby, β Systems. I. The F-Type Stars", submitted to the *Astron. J.*

Crawford, D. L. 1975, "Four-Color and Hβ Photometry of O-Type Stars", submitted to the *Publ. Astron. Soc. Pacific.*

Crawford, D. L. and Barnes, J. V. 1975, "The Interstellar Reddening in Front of Globular Clusters", submitted to the *Publ. Astron. Soc. Pacific.*

Crawford, D. L., Barnes, J. V., and Perry, C. L. 1975, "Emission-Line Effects in Hα, Hβ, Hγ, and uvby Photometry for B-Type Stars", submitted to the *Publ. Astron. Soc. Pacific.*

Crawford, D. L. and Snowden, M. S. 1975, "The Interstellar Reddening of the Globular Cluster 47 Tucanae", submitted to the *Publ. Astron. Soc. Pacific.*

INGEMAR FURENLID
Support Scientist

Dr. Ingemar Furenlid *supports the staff and visitors in recording and reducing photographic observations and in quantitative analysis of data. He is studying the properties of B stars as a function of rotational velocity, and is investigating the aspects of quantitative photographic photometry. In collaboration with R. Kurucz (Smithsonian Astrophysical Observatory), he is studying the microturbulence in stars of different effective temperatures and gravities, and in collaboration with W. Sanders (New Mexico State University), is establishing the optimum location of filters to separate B-type supergiants for main-sequence B-stars.*

PUBLICATIONS:

Lynds, B. T., Furenlid, I. and Rubin, J. 1973, "Observations of the Bar of NGC 4314", Astrophys. J. 182, *659.*

Lynds, B. T. and Furenlid, I. 1973, "Differential Colors of NGC 7625", Astrophys. J. 186, *445.*

FRED C. GILLETT

Astronomer

Dr. Fred C. Gillett *is continuing his infrared observations of select objects in the solar system, in the galaxy and outside the galaxy. He is studying the temperature structure in the atmospheres of the major planets, and determining the IR spectra of planetary satellites and asteroids. He is observing the IR spectra of heavily attenuated objects such as IR sources associated with H_2O/OH masers and compact H II regions, and is also measuring the polarization of such sources at wavelengths beyond 3 μ, the 10 μ absorption extinction being determined in hot stars and H II regions.*

Gillett is continuing his studies of M82, NGC 253 and NGC 1068 and other galaxies including spectra, mapping in spectra features, and time variations.

He serves as Program Director for the Infrared Program.

PUBLICATIONS:

Gillett, F. C. and Westphal, J. A. 1973, "Observations of 7.9 Micron Limb Brightening on Jupiter", Astrophys. J. 179, *L153.*

Gillett, F. C., Forrest, W. J. and Merrill, K. M. 1973, "8-13 Micron Observations of Titan", Astrophys. J. 184, *L93.*

Gillett, F. C., Forrest, W. J. and Merrill, K. M. 1973, "8-13 Micron Spectra of NGC 7027, BD+30°3639 and NGC 6572", Astrophys. J. 183, *87.*

Dyck, H. M., Capps, R. W., Forrest, W. J., and Gillett, F. C. 1973, "Discovery of Large 10μ Linear Polarization of the Becklin-Neugebauer Source in the Orion Nebulae", Astrophys. J. 183, *L99.*

Gillett, F. C. and Forrest, W. J. 1974, "The 7.5-13.5 Micron Spectrum of Saturn", Astrophys. J. 187, *L37.*

Stein, W. A., Gillett, F. C. and Merrill, K. M. 1974, "Observations of the Infrared Radiation from the Nuclei of NGC 1068 and NGC 4151", Astrophys. J. 187, *213.*

Gillett, F. C. and Orton, G. S. 1975, "Center to Limb Observations of Saturn in the Thermal Infrared", Astrophys. J. 195, *L47.*

Gillett, F. C., Forrest, W. J., Merrill, K. M., Capps, R. W., and Soifer, B. T. 1975, "The 8-13 μ *Spectra of Compact H II Regions", submitted to Astrophys. J.*

Gillett, F. C., Kleinmann, D. E., Wright, E. L. and Capps, R. W. 1975, "8-13 Micron Observations of M82 and NGC 253", submitted to Astrophys. J.

Gillett, F. C. and Merrill, K. M. 1975, "7.5-13.5 Micron Spectra of Ceres and Vesta", submitted to Icarus.

JEAN W. GOAD

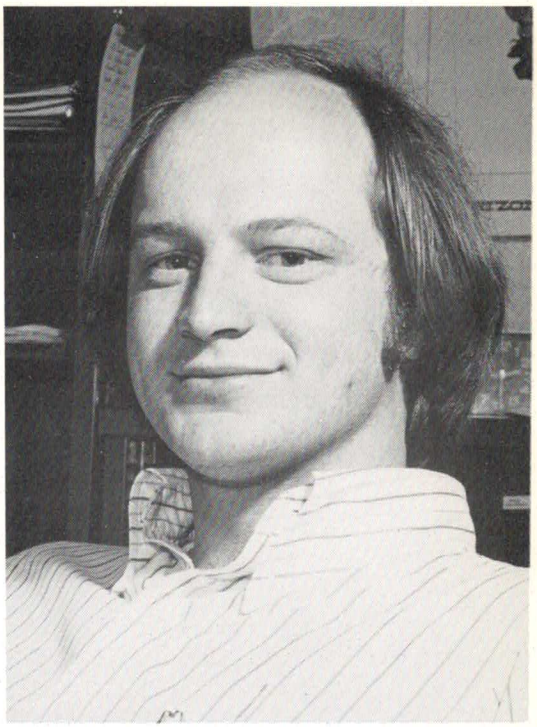
Research Associate

Dr. Jean W. Goad *plans to continue her studies of galaxies. A continuing project is the determination of the kinematics of Type I irregular galaxies and of the inner parts of M51. In collaboration with C. R. Lynds, she will be studying the kinematics, line intensity ratios and possibly stellar populations of several ring galaxies, and in collaboration with L. Goad she plans to study SO galaxies.*

She devotes half of her time to administrative tasks including the preparation of the KPNO Facilities Manual, work with the Public Information Office, and the Director's Office.

PUBLICATIONS:

Goad, J. W. 1974, "Kinematic Phenomena in the Nuclear Region of M81", Astrophys. J. 192, *311.*



LARRY E. GOAD

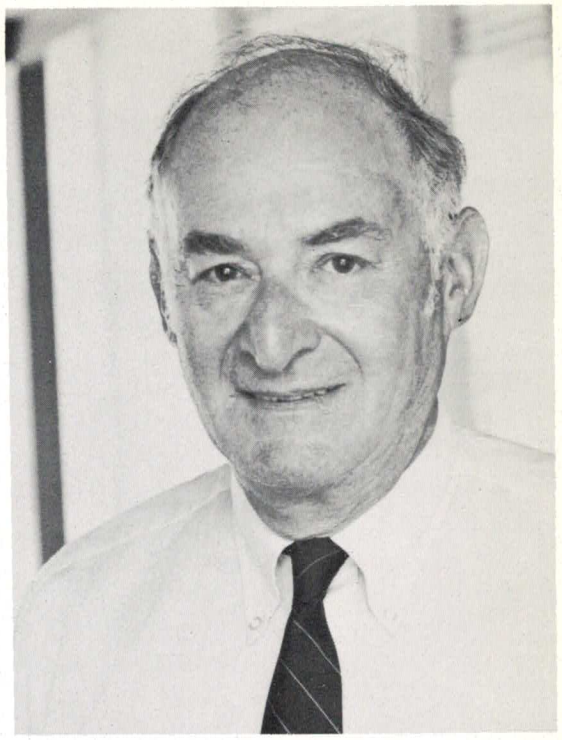
Research Associate
Post-Doc

Dr. Larry E. Goad *is continuing his studies on the nature of turbulent motions in planetary nebulae. In collaboration with J. Goad he plans to study the ionized gas in E and SO galaxies in an attempt to determine whether SO galaxies are more closely related to the ellipticals than to the spirals.*

PUBLICATIONS:

Gull, T. R., Goad, L. E., Chiu, H. Y., Maran, S. P., and Hobbs, R. W. 1973, "An Emission-Line Object Found in the Orion Nebula", Publ. Astron. Soc. Pacific 85, *526.*

Goad, L. E. 1975, "Inhomogeneities in Gaseous Nebulae", in preparation.



LEO GOLDBERG

Director

Dr. Leo Goldberg *is continuing his high-resolution spectroscopic studies of α Orionis in a program designed to define the kinematics and structure of the photosphere and shell of this star.*

PUBLICATIONS:

Goldberg, L. 1971, "The Interpretation of XUV Solar Radiation", in Highlights of Astronomy, Proceedings of Joint Discussion of IAU General Assembly, ed. C. de Jager (Dordrecht: D. Reidel Publ. Co.), p. 476.

Goldberg, L. 1971, "Summary", Physics of the Solar Corona, ed. Dr. Macris, (D. Reidel, Dordrecht), p. 333.

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Goldberg, L. 1972, "Introductory Report. Infrared and Microwave Emission from Nebulae in the Galaxy", Memoires Societe Royale des Sciences de Liege, 6e serie, tome III, p. 315-322.

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Goldberg, L. 1974, "Research with Solar Satellites", Astrophys. J. 191, 1.

Goldberg, L. 1975, "High Resolution Profiles of Sodium and Potassium Lines in Alpha Orionis", accepted for publication in Astrophys. J. July 15, 1975.

GARY L. GRASDALEN
Assistant Astronomer

Dr. Gary L. Grasdalen's *primary interest concerns the color evolution of elliptical galaxies. In order to analyze the integrated colors in terms of a mixture of populations of varying metal content, Grasdalen has determined the (V-K) colors and K magnitudes of late-type giants as a function of Z. He has found that the intrinsic dispersion in (U-K) colors for the brightest elliptical galaxies is very small and that large (V-K) color gradients exist in the largest ellipticals. He plans to measure the precise location and size of the gradient in order to determine the metal content gradients in the central region of elliptical galaxies.*

PUBLICATIONS:

Strom, K. M., Strom, S. E., Breger, M., Brooke, A. L., Yost, J., Grasdalen, G. and Carrasco, L. 1972, "Infrared and Optical Observations of a Young Stellar Group Surrounding BD+40°", Astrophys. J. 173, L65.

Strom, S. E., Strom, K. M., Yost, J., Carrasco, L. and Grasdalen, G. 1972, "The Nature of the Herbig Ae- and Be-Type Stars Associated with Nebulosity", ibid. 173, 353.

Grasdalen, G. 1973, "V1057 Cygni and Pre-Main-Sequence Evolution", Astrophys. J. 182, 781.

Grasdalen, G. and Cohen, J. G. 1973, "Diffuse Nebulae at High Galactic Latitudes", Astrophys. J. 180, L11.

Grasdalen, G., Kuhi, L. V. and Harlan, E. A. 1973, "New Emission-Line Stars in OH Clouds", Publ. Astron. Soc. Pacific 85, 193.

Grasdalen, G., Strom, S. E. and Strom, K. M. 1973, "A 2-Micron Map of the Ophiuchus Dark-Cloud Region", Astrophys. J. 184, L53.

Grasdalen, G. L. 1974, "An Infrared Study of NGC 2024", Astrophys. J. 193, 373.

Grasdalen, G. L. 1974, "Near Infrared Magnitudes and (V-K) Colors of Globular Clusters", *Astron. J.* 79, 1047.

Kinman, T. D., Grasdalen, G. L. and Rieke, G. H. 1974, "Optical and Infrared Observations of the Jet of M87", *Astrophys. J.* 194, L1.

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Grasdalen, G., Joyce, R., Knacke, R. F., Strom, S. E. and Strom, K. M. 1975, "A Photometric Study of the Chamaeleon T-Association", *Astron. J.* 80, 117.

Grasdalen, G. L. and Carrasco, L. 1975, "NGC 2175: The Cluster Age and the Nature of the Nebulosity Surrounding S 252a", submitted to the *Astron. Astrophys.*

Strom, S. E., Strom, K. M. and Grasdalen, G. L. 1975, "Young Stellar Objects and Dark Interstellar Clouds", submitted to *Ann. Rev. of Astron. Astrophys.*

Vrba, F., Strom, K. M., Strom, S. E., and Grasdalen, G. 1975, "Further Study of the Stellar Cluster Embedded in the Ophiuchus Dark Cloud Complex", submitted to the *Astrophys. J.*

THEODORE R. GULL

Assistant Astronomer

Dr. Theodore R. Gull *is continuing his studies of the structure and kinematics of emission regions of the interstellar medium. He is also overseeing the development of the echelle spectrograph.*

PUBLICATIONS:

Gull, T. R. and Harwit, M. O. 1971, "A Search for Near-Infrared Emission of Interstellar Molecular Hydrogen", Astrophys. J. 168, *15.*

Gull, T. R., Goad, L. E., Chiu, H. Y., Maran, S. P. and Hobbs, R. W. 1973, "An Emission-Line Object Found in the Orion Nebula", Publ. Astron. Soc. Pacific 85, *526.*

Chiu, H. Y., Maran, S. P., Hobbs, R. W., Harris, G. D., Gull, T. R. and Shore, S. N. 1973, "Astronomical Observations with an SEC Vidicon System", Astronomical Observations with Television-Type Sensors, eds. J. W. Glaspey and G. A. H. Walker, (Vancouver: Univ. British Columbia), p. 237.

Gull, T. R. 1974, "Electrography, Director and Image-Intensified Photography: Laboratory Comparison and Observational Application", Electrography and Astronomical Applications, Proceedings of a Conference held by McDonald Observatory, (University of Texas), p. 273.

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Gull, T. R., O'Dell, C. R. and Parker, R. A. 1974, "Water Vapor in Venus Determined by Airborne Observations of the 8200 Å Band", Icarus 21, *213.*

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Chevalier, R. A. and Gull, T. R. 1975, "The Outer Structure of the Crab Nebula", accepted for publication in the Astrophys. J. for September 15, 1975.

Smith, M. G. and Gull, T. R. 1975, "Spectroscopic Observations of the Planetary Nebula 283+25°1", submitted to the Astron. Astrophys.

DONALD N. B. HALL
Associate Astronomer

Dr. Donald N. B. Hall *plans to continue his reasearch on measurements of the solar light element abundances and isotopic ratios, and he plans to concentrate principally on eliminating the possibility of deep mixing of surface material during the life of the sun. This result would raise serious doubts about the interpretation of many meteoritic abundances as "universal" and would reinforce the hypothesis that present solar surface abundances may be used to infer element abundances in the proto-stellar material.*

In collaboration with Ridgway, he plans to use the 10-cm FTS at the 4-m coudé to obtain spectra of selected cool stars and to extend his studies of the solar atmosphere to them by analysis of their spectra.

Under the auspices of the Infrared Program, he plans to continue the investigation of the properties of selected infrared detectors and the optimization of performance by development of preamplifier techniques and by suggestion of new design goals to manufacturers.

Hall plans to continue his terrestrial atmosphere monitoring program. This is a long-term project aimed at collecting reliable data which may be used to assess quantitatively the effects such as depletion of the stratospheric ozone layer and changes in the carbon dioxide and methane abundances in the troposphere.

He is also developing the technique of spatially multiplexed infra-red imaging in the hope of reconstructing an entire image for the signal from a single IR detector. In situations where sensitivity is limited by detector noise this technique gives the same gain as an array without the disadvantages of cost and multiple electronics.

Hall is in charge of the Gratings Laboratory Program.

PUBLICATIONS:

Hall, D. N. B. and Noyes, R. W. 1972, "The Identification of the 1-0 and 2-1 Bands of HCl in the Infrared Sunspot Spectrum", Astrophys. J. 175, *L95.*

Hall, D. N. B., Noyes, R. W. and Ayres, T. R. 1972, "The Identification of $^{13}C^{16}O$ in the Infrared Sunspot Spectrum and the Determination of the Solar $^{12}C/^{13}C$ Abundance Ratio", *Astrophys. J.* 171, 615.

Giovanelli, R. G., Hall, D. N. B. and Harvey, J. W. 1972, "A Comparison Between the Helium 10830 Å and the Hydrogen Hα Chromospheres", *Solar Phys.* 22, 53.

Noyes, R. W. and Hall, D. N. B. 1972, "Thermal Oscillations in the High Solar Photosphere", *Astrophys. J.* 176, L89.

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Breckinridge, J. B. and Hall, D. N. B. 1973, "The Absorption Spectrum of Atmospheric Water Vapor in the Vicinity of the He 10830 Å Triplet", *Solar Phys.* 28, 15.

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Lena, P., Viala, Y., Mondellini, J., Hall, D. N. B., McCurnin, T. W., Soufflot, A., Darpentigny, C. and Belbeoch, J. 1974, "The Thermal Emission of the Dust Corona, During the Eclipse of June 30, 1973", *Astron. Astrophys.* 37, 75.

Hall, D. N. B., Aikens, R. S. and Joyce, R. 1975, "Johnson Noise Limited Operation of Photovoltaic InSb Detectors", *Appl. Optics* 14, 450.

Hall, D. N. B. 1975, "Spectroscopic Detection of Solar ^{3}He", accepted for publication in the *Astrophys. J.* for the April 15, 1975 issue.

Hall, D. N. B. and Engvold, O. 1975, "A Reduced Upper Limit to the Solar Boron Abundance", accepted for publication in the *Astrophys. J.* for the April 15, 1975 issue.

Brault, J. W., Fender, J. S. and Hall, D. N. B. 1975, "Absorption Coefficients of Selected Atmospheric Water Lines", submitted to the *J. Quantitative Spectroscopy & Radiative Transfer.*

JACK W. HARVEY
Astronomer

Dr. Jack W. Harvey *is continuing his research on solar magnetism, including investigations on the nature of strong field elements, the existence of intrinsically weak fields, the comparison of photospheric fields with coronal structures, the evolution of fields and their associations with solar flare activity. He is also measuring the solar velocity fields, including oscillations, variations with flares and correlations with coronal velocities. He plans to continue his production of photographic and photometric sunspot atlases and to extend the atlas into the infrared. He plans further study of chromospheric helium, and is developing a technique of interferometry to study solar features and α Orionis. During FY 1976 he plans to study the magnetic and velocity structure of the disc filaments using He I 10830 Å and in collaboration with Livingston, to make a synoptic study of solar rotation and large scale circulation.*

Harvey and Livingston plan to develop an image photometer (kinetograph) to be used for single two-dimensional image recording as well as serving as a system for determining and recording spatial variations of spectral line profile parameters including wavelength and polarization.

PUBLICATIONS:

Harvey, J. 1971, "Solar Magnetic Fields -- Small Scale", Publ. Astron. Soc. Pacific 83, 539.

Livingston, W. C. and Harvey, J. 1971, "The Kitt Peak Magnetograph. I. Principles of the Instrument", KPNO Contribution No. 558.

Livingston, W. C. and Harvey, J. 1971, "The Kitt Peak Magnetograph. IV. 40-Channel Probe and Detection of Weak Photospheric Fields", IAU Symposium No. 43, Solar Magnetic Fields, ed. R. Howard, (D. Reidel, Dordrecht), p. 51.

Harvey, J. W. 1972, "C_2 in Sunspots", Solar Phys. 24, 354.

Harvey, J. W. 1972, "Interferometry Applied to Visible Solar Features", Nature 235, 90.

Harvey, J. W. 1972, "Recent Solar Magnetograph Results", in *Solar Activity Observations and Predictions*, ed. P. S. McIntosh and M. Dryer, 51-63 (MIT Press, Cambridge, Mass.).

Harvey, J. and Howard, R. 1972, "Observations of Short Period Oscillations in Two Dimensions", *Solar Phys.* 23, 300.

Bhatnager, A., Livingston, W. C. and Harvey, J. W. 1972, "Observations of Sunspot Umbral Velocity Oscillations", *Solar Phys.* 27, 80.

Giovanelli, R. G., Hall, D. N. B. and Harvey, J. W. 1972, "A Comparison Between the Helium 10830 Å and the Hydrogen Hα Chromospheres", *Solar Phys.* 22, 53.

Harvey, J. W. 1973, "Polarization of Red System CN Lines in Sunspots", *Solar Phys.* 28, 43.

Harvey, J. W. 1973, "Fraunhofer Lines with Large Zeeman Splitting", *Solar Phys.* 28, 9.

Harvey, J. W. and Breckinridge, J. B. 1973, "Solar Speckle Interferometry", *Astrophys. J.* 182, L137.

Gillespie, B., Harvey, J., Livingston, W. and Harvey, K. 1973, "Polar Magnetic Fields and the New Solar Cycle", *Astrophys. J.* 186, L85.

Harvey, K. and Harvey, J. W. 1973, "Observations of Moving Magnetic Features Near Sunspots", *Solar Phys.* 28, 61.

Nakagawa, Y., Raadu, M. A. and Harvey, J. W. 1973, "The Topological Association of Hα Structures and Magnetic Fields", *Solar Phys.* 30, 421.

Gurman, J. B., Withbroe, G. L. and Harvey, J. W. 1974, "A Comparison of EUV Spectroheliograms and Photospheric Magnetograms", *Solar Phys.* 34, 105.

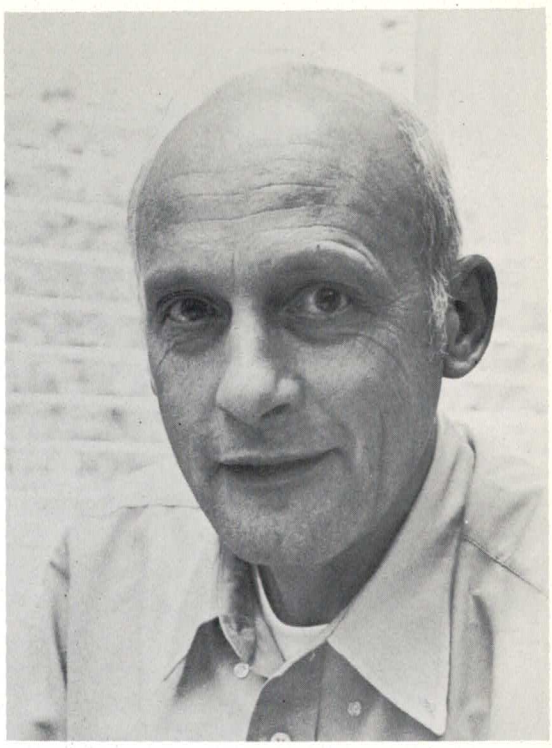
Harvey, J. W. and Schwarzschild, M. 1975, "Photoelectric Speckle Interferometry of the Solar Granulation", *Astrophys. J.* 196, 221.

Harvey, K. L., Harvey, J. W. and Martin, S. F. 1975, "Ephemeral Active Regions in 1970 and 1973", *Solar Phys.* 40, 87.

Harvey, J., Krieger, A. S., Timothy, A. F. and Vaiana, G. S. 1975, "Comparison of Skylab X-Ray and Ground-Based Helium Observations", in press in *Conference Proceedings of Skylab S054 Collaborators meeting in March, 1974, Florence, Italy.*

Harvey, J. W. 1975, "Photospheric Magnetic and Velocity Fields in Active Regions", (paper presented at a conference held in Boulder, Sept. 23-25, 1974, will be published in conference proceedings).

Boyer, R., Sotirvoski, P. and Harvey, J. S. 1975, "Table of Solar Diatomic Molecular Lines. I. Spectral Range: 6100-6600 Å", submitted to Astron. Astrophys. Suppl. Series.



ARTHUR A. HOAG

Astronomer

Dr. Arthur A. Hoag *has been developing a technique of measuring redshifts by prime focus stellar spectroscopy. He is attempting to use this method for obtaining material for the Gurin-Oke cluster at Z ≃ 0.5. He is also continuing his program of optical identification of galactic center X-ray sources. He conducts a program of sky brightness measures for calibration of wide angle camera sky monitoring.*

PUBLICATIONS:

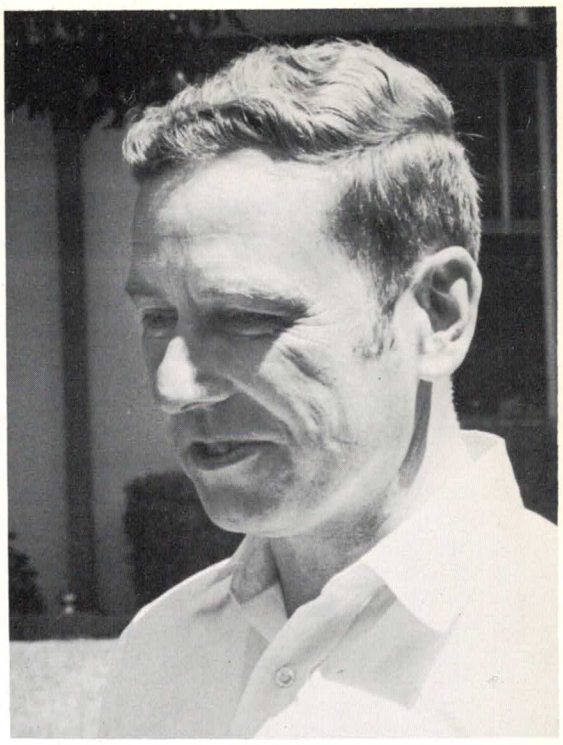
Hoag, A. A. 1972, "Instrumentation for the KPNO and CTIO 4-m Reflectors", Proc. of the ESO/CERN Conf. on Instrumentation for Large Telescopes, eds. S. Laustsen and A. Reiz, Geneva.

Hoag, A. A. 1972, "Kodak Spectroscopic Plate Type IIIa-J Applied to Low-Dispersion Stellar Spectra", Amer. Astron. Soc. Photo-Bull. No. 12, 12.

Hoag, A. A. 1972, "Observatories and City Lights", Mercury 1, 2.

Hoag, A. A., Schoening, W. E. and Coucke, M. 1973, "City Sky Glow Monitoring at Kitt Peak", Publ. Astron. Soc. Pacific 85, 503.

Hoag, A. A. 1974, "Stellar Research at the Kitt Peak National Observatory", Proc. of ESO/SRC/CERN Conf. on Research Programs for the New Large Telescopes, eds. Reiz and Laustsen, (Geneva), p. 43.



DONALD M. HUNTEN

Physicist

Dr. Donald M. Hunten's *research can be categorized into three subjects: aeronomy of planetary atmospheres; high dispersion spectroscopy of solar-system objects; and satellite and planet occultations.*

He has been developing a silicon-vidicon camera and plans to use it in the stellar program during FY 1976. He is Vice-Chairman of the Science Steering Committee for the NASA Pioneer-Venus mission and also serves on the Climatic Impact Committee.

PUBLICATIONS:

Hunten, D. M. 1971, "Airglow -- Introduction and Review", The Radiating Atmosphere, ed. B. M. McCormac, (D. Reidel, Dordrecht), p. 3.

Hunten, D. M. 1971, "Hydrogen Isotopes Around the Planet", Com. Astrophys. Space Sci. 3, 1.

Belton, M. J. S. and Hunten, D. M. 1971, "The Distribution of CO_2 on Mars: A Spectroscopic Determination of Surface Topography", Icarus 15, 204.

Hunten, D. M. 1972, "Aeronomy of CO_2 Atmospheres", Com. Astrophys. Space Sci. 4, 1.

Hunten, D. M. 1972, "Composition and Structure of Planetary Atmospheres", Space Sci. Rev. 12, 539.

Hunten, D. M. 1972, "The Atmosphere of Titan", Comments on Astrophysics and Space Physics 4, 149.

Hunten, D. M. 1972, "Re-shaping and Stabilization of Astronomical Images", Methods of Experimental Physics 11, eds. M. L. Meeks and N. P. Carleton, (Academic Press, New York).

Parkinson, T. D. and Hunten, D. M. 1972, "Martian Dust Storm: Its Depth on 25 November 1971", Science 175, 323.

Parkinson, T. D. and Hunten, D. M. 1972, "Spectroscopy and Aeronomy of O_2 on Mars", J. Atmos. Sci. 29, 1380.

Hunten, D. M. 1973, "Atmospheres of Other Planets (Conference Review)", *Physics and Chemistry of Upper Atmospheres*, ed. B. M. McCormac, (Dordrecht-Reidel), p. 373.

Hunten, D. M. 1973, "The Escape of H_2 From Titan", *J. Atmos. Sci.* 30, 726.

Hunten, D. M. 1973, "The Escape of Light Gases from Planetary Atmospheres", *J. Atmos. Sci.* 30, 1481.

Hunten, D. M. and Munch, G. 1973, "Helium Abundance on Jupiter", *Space Sci. Rev.* 14, 433.

Parkinson, T. D. and Hunten, D. M. 1973, "CO_2 Distribution on Mars", *Icarus* 18, 29.

Wallace, L. and Hunten, D. M. 1973, "The Lyman-Alpha Albedo of Jupiter", *Astrophys. J.* 182, 1013.

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Hunten, D. M. 1974, "The Atmosphere of Titan", *Icarus* 22, 111.

Hunten, D. M. 1974, "Blowoff and Escape of H2", *The Atmosphere of Titan, NASA SP-340*, ed. D. M. Hunten, (Washington, D.C. - NASA), p. 110.

Hunten, D. M. 1974, "Energetics of Thermospheric Eddy Transport", *J. Geophys. Res.* 79, 2529.

Hunten, D. M. 1974, "Reshaping and Stabilization of Astronomical Images", *Astrophysics, Part A: Optical and Infrared*, ed. N. P. Carleton, (New York: Academic Press), p. 193.

Hunten, D. M. and Strobel, D. F. 1974, "Production and Escape of Terrestrial Hydrogen", *J. Atmos. Sci.* 31, 305.

Kumar, S. and Hunten, D. M. 1974, "Venus: An Ionospheric Model with an Exospheric Temperature of 350°K", *J. Geophys. Res.* 79, 2529.

Hunten, D. M. 1975, "Residence Times of Aerosols and Gases in the Stratosphere", *Geophys. Res. Letters* 2, 26.

Hunten, D. M. 1975, "Vertical Transport in Atmospheres", in *Atmospheres of Earth and the Planets*, ed. B. M. McCormac, (Dordrecht: D. Reidel), p. 97.

Hunten, D. M. 1975, "The Atmosphere of Venus", in press in *J. Atmos. Sci.*

Hunten, D. M. 1975, "Stratospheric Pollution: How It Dissipates", submitted to *Science*.

Hunten, D. M. 1975, "Titan's Atmosphere and Surface", submitted to *Planetary Satellites, IAU Colloq.* 28.

GARTH ILLINGWORTH

Research Associate
Post-Doc

Dr. Garth Illingworth's *major research interest lies in furthering the understanding of the dynamics of stellar systems. He is obtaining observational data on rotation and velocity dispersions from spectroscopic observations and color gradients from surface photometry. He is applying these techniques to spheroidal systems (elliptical galaxies), disc systems (SO to SC galaxies) and to globular clusters.*

PUBLICATIONS:

Illingworth, G. 1974, "Dynamical Masses and Mass-to-Light Ratios for Globular Clusters", paper given at IAU Symposium No. 69, The Dynamics of Stellar Systems, held in France in August 1974.

Illingworth, G. and Illingworth, W. 1975, "The Masses of Globular Clusters. I. Surface Brightness Distributions and Star Counts", in preparation.

Illingworth, G. 1975, "The Masses of Globular Clusters. II. Velocity Dispersions and Mass-to-Light Ratios", in preparation.

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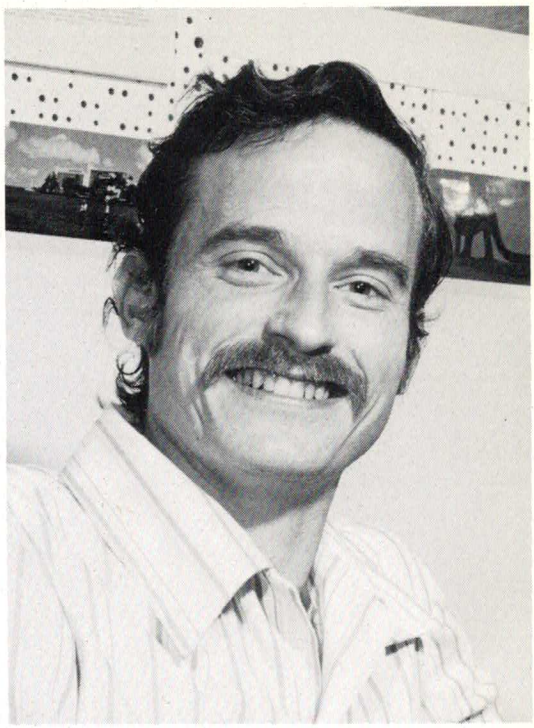

RICHARD R. JOYCE
Support Scientist

Dr. Richard R. Joyce *has been largely responsible for the development of the InSb system now in use at the 1.3-m telescope and he collaborates with staff and visitors who make use of this equipment. He is carrying out Hα surveys of several 100-μ sources associated with dark clouds. He plans to continue mapping and photometry in the dark clouds and to search for strong IR sources in Markarian's lists of galaxies with uv continua. Several extremely luminous sources have been found, including one whose luminosity approaches that of 3C 273. Also planned is monitoring of these established sources for time variations of intensity.*

PUBLICATIONS:

Joyce, R. R., Knacke, R. F. and Owen, T. 1973, "An Upper Limit on the 4.9-Micron Flux From Titan", Astrophys. J. 183, *L31.*

Grasdalen, G., Joyce, R., Knacke, R. F., Strom, S. E. and Strom, K. M. 1975, "A Photometric Study of the Chamaeleon T-Association", Astron. J. 80, *117.*

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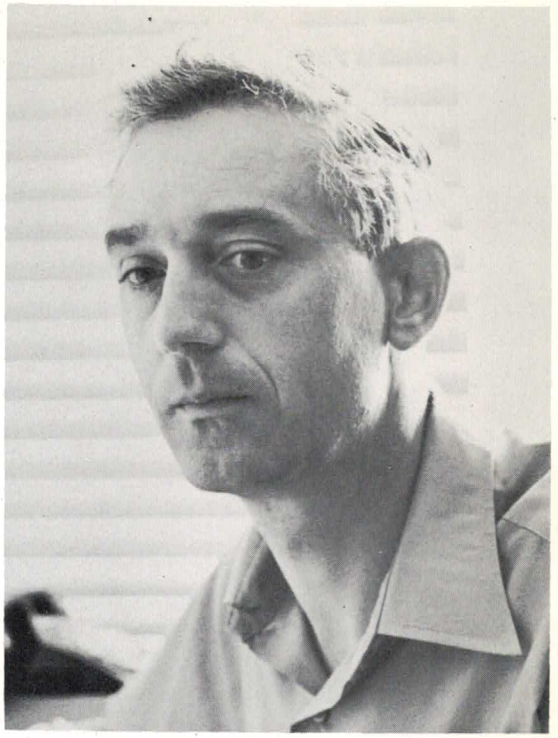

THOMAS D. KINMAN

Astronomer

Dr. Thomas D. Kinman's *interests are in two fields: (1) the variation in both flux and polarization of the non-thermal sources in quasars and related objects; and (2) the study of population II stars, largely through the study of variables. These are the oldest stars whose properties reflect most nearly the conditions under which our galaxy was formed. Kinman's work includes not only the study of variables in our own galaxy and M31, but also Population II systems (globular clusters and sculptor systems)in our own and other galaxies.*

PUBLICATIONS:

Kinman, T. D. and Conklin, E. K. 1971, "Observations of OJ 287 at Optical and Millimeter Wavelengths", Astrophys. Letters 9, *147.*

Dyck, H. M., Kinman, T. D., Lockwood, G. W. and Landolt, A. U. 1971, "Observations of the Radio Source OJ 287 in the Wavelength Range 0.36 to 3.4 Microns", Nature 234, *71.*

Kinman, T. D. 1972, "A Survey for RR Lyrae Stars at High Galactic Latitude", Quarterly J. Roy. Astron. Soc. 13, *258.*

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Carswell, R. F., Strittmatter, P. A., Williams, R. E., Kinman, T. D. and Serkowski, K. 1974, "Optical Observations of the Radio Source 0735+178", Astrophys. J. 190, *L101.*

Rieke, G. H. and Kinman, T. D. 1974, "Correlated Optical and Infrared Behavior of OJ 287 and Similar Radio Sources", Astrophys. J. 192, *L115.*

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Kinman, T. D. 1975, "Variable Quasi-Stellar Sources, with Particular Emphasis on Objects of the BL Lac Type", accepted for publication in Variables in Relation to the Evolution of Stars and Stellar Systems, IAU Symposium No. 67, ed. L. Plant.

Ulrich, M. -H., Kinman, T. D., Lynds, C. R., Rieke, G. H. and Ekers, R. D. 1975, "Non-Thermal Continuum Radiation in Three Elliptical Galaxies", accepted for publication in Astrophys. J. for June 1, 1975 issue.

ROBERT P. KIRSHNER

Research Associate
Post-Doc

Dr. Robert P. Kirshner *plans to continue his work in the physics of supernovae and of their remnants, on the extragalactic distance scale as determined by supernovae, and on the dynamics of nearby groups of galaxies. He has planned an observing program designed to obtain spectra or spectrophotometry of supernovae shortly after discovery to establish the type of supernova, to determine relative elemental abundances and to derive the physical conditions in the expanding shell.*

In collaboration with several of his colleagues, he plans to measure velocities and emission line strengths of certain supernova remnants in order to determine their distance and age. He hopes to use the definitive data established for supernovae to help complete the redshift-magnitude diagram for supernovae.

PUBLICATIONS:

Kirshner, R. P. 1974, "Spectrophotometry of the Crab Nebula", Astrophys. J. 194, *78.*

Kirshner, R. P. and Kwan, J. 1974, "Distances to Extragalactic Supernovae", Astrophys. J. 193, *27.*

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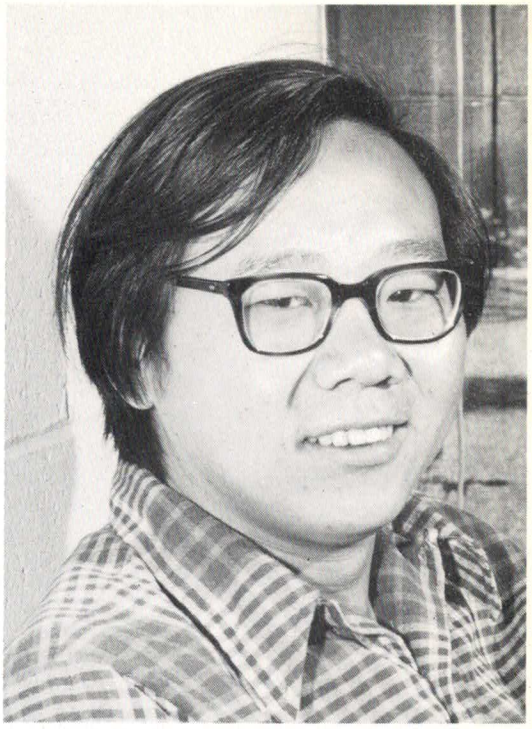
Kirshner, R. P. and Oke, J. B. 1975, "Supernova 1972e in NGC 5253", accepted for publication in Astrophys. J. 198.

Woodgate, B. E., Angel, J. R. P. and Kirshner, R. P. 1975, "Detection of the [Fe XIV] 5303 Å Coronal Line in the Supernova Remnant Vela X", accepted for publication in Astrophys. J. 198.

Kirshner, R. P. 1975, "Abundances in Supernova", accepted for publication in the Proc. of the New York Academy of Sciences.



PUI KUAN

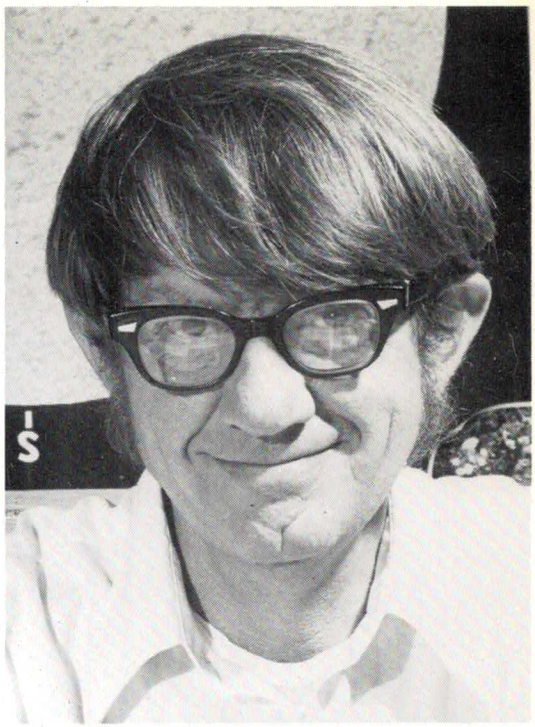
Research Associate
Post-Doc

Dr. Pui Kuan *is studying the mass loss from T Tauri, early-type and red giant stars; stellar wind and related interstellar medium interaction; and the role of radiation in astronomically relevant aerodynamic phenomena. He is using measures of the hydrogen emission lines to search for ejection mechanisms that can explain the empirically determined mass loss rate. By developing relativistic ways of constructing an extended spherical atmosphere about a supergiant star, he hopes to improve our knowledge of the absolute luminosity of these stars.*

PUBLICATIONS:

Kuan, P. 1975, "Shock Waves in Stellar Atmospheres", accepted for publication in Astrophys. J. for September 15, 1975 issue.

Kuan, P. 1975, "Emission Envelopes of T Tauri Stars", submitted to Astrophys. J.



WILLIAM C. LIVINGSTON

Astronomer

Dr. William C. Livingston *has a long-term research plan to determine the dependence of certain solar phenomena on the 11-year solar cycle. In particular, he is studying the photospheric/chromospheric rotation, the chromospheric/coronal rotation, and the coronal rotation. These rotation and circulation studies should assist in our understanding of the sun's outer convective patterns and how the energy and magnetic fields evolve. He is continuing with his high dispersion studies of prominences which will lead to evaluations of the exchange of matter between the corona or photosphere and prominence, and of the mechanisms related to coronal heating.*

In collaboration with Harvey, he has undertaken a number of experiments designed to obtain sub-arc-sec solar resolution. Such high resolution observations will allow these investigators to determine the actual field strength of magnetic elements, to resolve spectroscopic macroturbulence and to define its role in integrated line-profile formation and to define the filamentary nature of prominences.

Livingston and Harvey are collaborating with their colleagues on a number of Skylab programs.

PUBLICATIONS:

Livingston, W. C. 1971, "Solar Rotation: Direct Evidence from Prominences for a Westward Wind", Solar Phys. 19, 379.

Livingston, W. C. and Harvey, J. 1971, "The Kitt Peak Magnetograph. I. Principles of the Instrument", KPNO Contribution No. 558.

Livingston, W. C. and Harvey, J. 1971, "The Kitt Peak Magnetograph. IV. 40-Channel Probe and Detection of Weak Photospheric Fields", IAU Symposium No. 43, Solar Magnetic Fields, ed. R. Howard (D. Reidel, Dordrecht), p. 51.

Engvold, O. and Livingston, W. 1971, "High-Dispersion Spectroscopic Study of Quiescent Prominences", Solar Phys. 20, 375.

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Livingston, W. C. 1973, "Photospheric and Chromospheric Magnetograms Related to the 3B Flare of 4 August 1972", *World Data Center A For Solar-Terrestrial Physics, Report UAG-28, Part I, (U. S. Dept. of Commerce), ed. H. Coffey, p. 95.*

Livingston, W. and Ramsey, L. 1973, "Telluric Lines in the Vicinity of λ5250 and λ6562 Å", *Solar Phys.* 31, 317.

Doe, L. A. and Livingston, W. C. 1973, "Solar Magnetograph Utilizing Fiber Optics", *Proc. of Society of Photo-Optical Instrumentation Engineers* 28, 149.

Gillespie, B., Harvey, J., Livingston, W. and Harvey, K. 1973, "Polar Magnetic Fields and the New Solar Cycle", *Astrophys. J.* 186, L85.

Livingston, W. C. and Orall, F. Q. 1974, "Magnetic Pukas and the Lifetime of the Supergranulation", *Solar Phys.* 39, 301.

Livingston, W. C. and White, O. R. 1974, "Small Scale Structure in Metal Lines at the Extreme Solar Limb", *Solar Phys.* 39, 289.

Livingston, W. C. 1975, "Saturn's Rings and Perfect Seeing", *Sky and Telescope* 49, 207.

Hildner, E. and Livingston, W. C. 1975, "Evidence for Downflow Following a Coronal Transient", accepted for publication in *Solar Phys.*

BEVERLY T. LYNDS

Assistant to the Director
Astronomer

Dr. Beverly T. Lynds *is continuing her studies of the systematics of the location of dust and H II regions in spiral galaxies. She plans to investigate the physical properties and frequency of occurrence of H II regions as a function of location in spiral galaxies and to continue to develop a system whereby spiral structure is defined by parameters related to the distribution of dust (size and extent of dust lanes, fragmentation of lanes, frequency of appearances of H II regions). Once these basic spiral patterns are defined for spirals in general, she plans to tie these characteristics in with the observational data available in our own galaxy so as to attempt to define the basic pattern of the Milky Way system. She also serves as Assistant to the Director.*

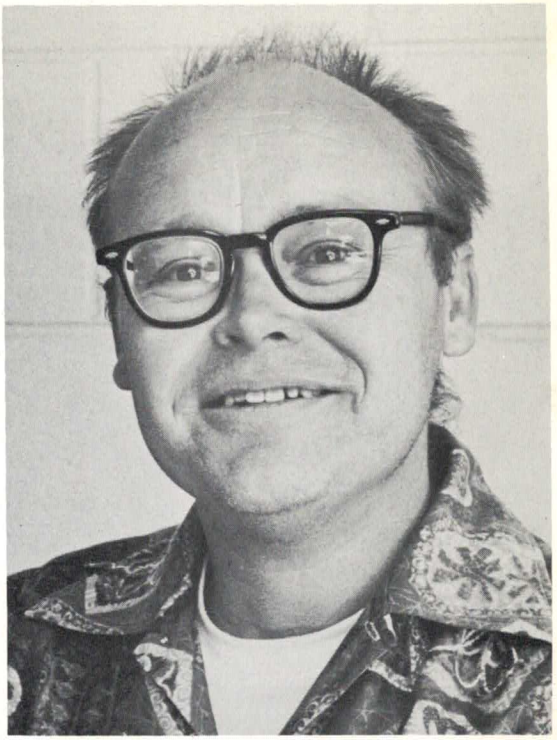
PUBLICATIONS:

Cromwell, R. H. and Lynds, B. T. 1972, "Observational Evidence of Collisional Excitation in Two Diffuse Nebulae", Astrophys. J. 171, 279.

Lynds, B. T. and Furenlid, I. 1973, "Differential Colors of NGC 7625", Astrophys. J. 186, 445.

Lynds, B. T., Furenlid, I. and Rubin, J. 1973, "Observations of the Bar of NGC 4314", Astrophys. J. 182, 659.

Lynds, B. T. 1974, "An Atlas of Dust and H II Regions in Galaxies", Astrophys. J. Suppl. 28, 391.



C. ROGER LYNDS

Astronomer

Dr. C. Roger Lynds *is continuing his studies of the distribution of luminous material in the universe and the concomitant question of the nature of the actual cosmological geometry. His approach is based on performing mini-surveys of the sky at fairly high galactic latitudes. The observational data will be used to delineate the three-dimensional distribution of galaxies and quasars down to the limit of prime focus photographs. The method in general will consist of transferring distance criteria from redshift determination by means of slit spectroscopy of the brighter objects through relatively crude gredge spectroscopy measurements for fainter objects, estimates from multi-band photography for yet fainter objects and finally to distances inferred from angular dimensions and crude apparent brightness measurements for objects at the limit of 4-m prime-focus photographs.*

He is also studying the question of the existence of intergalactic clouds of pre-stellar material with special emphasis on the ring galaxies.

He has been active in the development of interferometric techniques and hopes to use this method to observe quasars and Seyfert nuclei.

Lynds serves as Program Director for the Panoramic Detector Program.

PUBLICATIONS:

Lynds, C. R. 1971, "On the Nature of the Galaxy Identified with 3C 386", Astrophys. J. 168, L87.

Lynds, C. R. 1972, "The Absorption-Line QSO's", IAU Symposium No. 44: External Galaxies and Quasi-stellar Objects, ed. D. S. Evans, (D. Reidel, Dordrecht), p. 127.

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Lynds, C. R. and Millikan, A. 1972, "On the Evidence for a Physical Connection Between Markarian 205 and NGC 4319", Astrophys. J. 176, L5.

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Lynds, C. R. and Wills, D. 1972, "A New Complete Sample of Quasistellar Radio Sources and the Determination of the Luminosity Function", Astrophys. J. 172, *531.*

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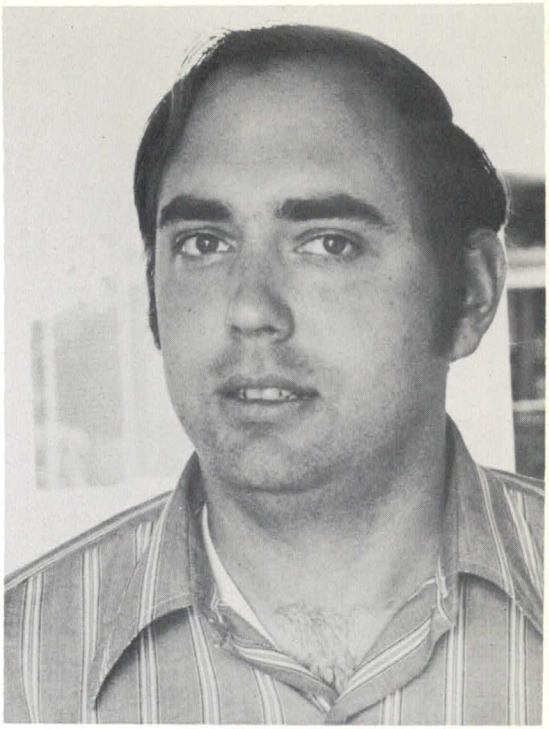
Wills, D. and Lynds, C. R. 1972, "On the Optical Identification of 3C 220.2", Astrophys. Letters 11, *189.*

Bahcall, J. N., Joss, P. C. and Lynds, C. R. 1973, "On the Temperature of the Microwave Background Radiation at a Large Redshift", Astrophys. J. 182, *L95.*

Oemler, Augustus Jr. and Lynds, C. R. 1975, "The Absorption Spectrum of 4C 25.05", accepted for publication in Astrophys. J. for August 1, 1975 issue.

Ulrich, M. -H., Kinman, T. D., Lynds, C. R., Rieke, G. H. and Ekers, R. D. 1975, "Non-Thermal Continuum Radiation in Three Elliptical Galaxies", accepted for publication in Astrophys. J. for June 1, 1975 issue.



ROBERT W. MILKEY

Assistant Astronomer

Dr. Robert W. Milkey *is working on the development of theoretical techniques for radiative transfer calculations and applications of these to the analysis of solar and stellar spectra. He is continuing studies into the influences of partial frequency redistribution on the formation of resonance lines. He is making calculations of the formation of molecular bands (CO in cool stars, for example) relaxing the assumption of LTE.*

PUBLICATIONS:

Milkey, R. W., Blocker, N. K., Chambers, W. H., Fehlau, P. E., Fuller, J. C. and Kunz, W. E. 1971, "The Time Behavior of Temperature and Emission Measure in X-Ray Flares", Solar Phys. 20, *400.*

Auer, L. H., Heasley, J. N. and Milkey, R. W. 1972, "A Computational Program for the Solution of Non-LTE Transfer Problems by the Complete Linearization Method", KPNO Contribution No. 555.

Milkey, R. W. and Harvey, K. L. 1972, "A Study of D_3 Emission in a Solar Flare by Use of Narrow-Band Filtergrams", Publ. Astron. Soc. Pacific 84, *400.*

Beebe, H. and Milkey, R. W. 1972, "The Effect of Resonance Line Transfer on Hydrogen Ionization", Astrophys. J. 172, *L111.*

Dyck, H. M. and Milkey, R. W. 1972, "Infrared Excesses in Early-Type Stars: Free-Free Emission", Publ. Astron. Soc. Pacific 84, *597.*

Livingston, W. C. and Milkey, R. W. 1972, "Solar Rotation: The Photospheric Height Gradient", Solar Phys. 25, *267.*

Milkey, R. W. and Dyck, H. M. 1973, "Low-Temperature Free-Free Emission: Infrared Excesses in Be Stars", Astrophys. J. 181, *833.*

Milkey, R. W. and Mihalas, D. 1973, "Resonance-Line Transfer with Partial Redistribution: A Preliminary Study of Lyman-α in the Solar Chromosphere", Astrophys. J. 185, *709.*

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Milkey, R. W., Heasley, J. N. and Beebe, H. A. 1973, "Helium Excitation in the Solar Chromosphere: He I in a Homogeneous Chromosphere", Astrophys. J. 186, 1043.

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Johnson, H. R., Milkey, R. W. and Ramsey, L. W. 1974, "Formation of the Luminosity Sensitive O I Multiplet at 7774 Å", Astrophys. J. 187, 147.

Milkey, R. W., Ayres, T. R. and Shine, R. A. 1975, "Resonance Line Transfer with Partial Redistribution: III. Mg II Resonance Lines in Solar-Type Stars", accepted for publication in Astrophys. J. for April 1975 issue.

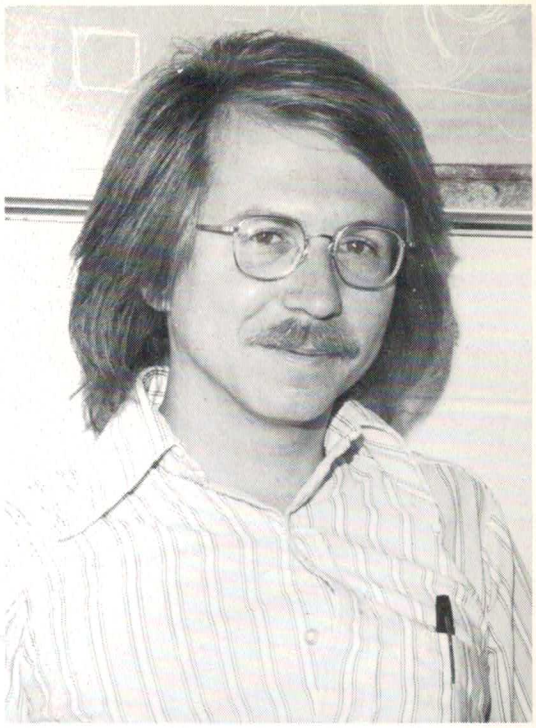
Milkey, R. W., Shine, R. A. and Mihalas, D. 1975, "Resonance Line Transfer with Partial Redistribution: IV. A Generalized Formulation for Lines with Common Upper States", accepted for publication in Astrophys. J. for August 1975 issue.

Shine, R. A., Milkey, R. W. and Mihalas, D. 1975, "Resonance Line Transfer with Partial Redistribution: V. The Solar Ca II Lines", accepted for publication in Astrophys. J. for August 1975 issue.

Shine, R. A., Milkey, R. W. and Mihalas, D. 1975, "Resonance Line Transfer with Partial Redistribution: VI. The Ca II K-Line in Solar-Type Stars", submitted to Astrophys. J.

Milkey, R. W. 1975, "Comments Concerning the Photoionization Model for Excitation of Resonance Lines of He I and He II in the Solar Chromosphere", submitted to Astrophys. J.

Becker, J. M. and Milkey, R. W. 1975, "The Line Response Function of Stellar Atmospheres and the Effective Depth of Line Formation", submitted to Solar Phys.



AUGUSTUS OEMLER, JR.

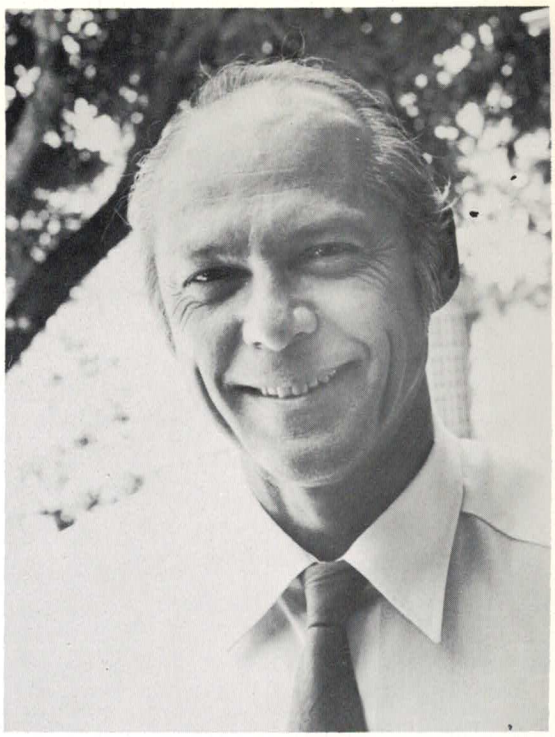
Research Associate
Post-Doc

Dr. Augustus Oemler, Jr., *in collaboration with C. R. Lynds, is studying the absorption lines in quasi-stellar objects. He is attempting to answer the questions concerning the Doppler origin of the redshifts, the possible intergalactic nature of the clouds and the consequent questions concerning acceleration mechanism and cosmological implications.*

PUBLICATIONS:

Oemler, Augustus Jr. 1974, "The Systematic Properties of Clusters of Galaxies. I. Photometry of 15 Clusters", Astrophys. J. 194, 1.

Oemler, Augustus Jr. and Lynds, C. R. 1975, "The Absorption Spectrum of 4C 25.05", accepted for publication in Astrophys. J. for August 1, 1975 issue.



A. KEITH PIERCE

Astronomer

Dr. A. Keith Pierce *plans to devote his research to obtaining accurate values of solar physical quantities such as limb darkening, solar energy distribution, solar rotation, wavelengths and line profiles. He also plans to develop a model solar atmosphere. The available ultraviolet data on limb darkening is very meager and we now have available large images of high quality, a double pass spectrometer and sensitive detectors that make it worthwhile to obtain good limb darkening curves below 4000 Å. He also plans to extend this technique to the red portion of the spectrum. When the 1 mm/Å spectrograph is finished, he plans to make intensity measurements of the chromospheric lines observed at the extreme limb. He is also interested in obtaining high dispersion stellar spectra of bright stars for comparison with the solar spectrum.*

PUBLICATIONS:

Brault, J. W., Slaughter, C. D., Pierce, A. K. and Aikens, R. S. 1971, "True Central Intensities of Fraunhofer Lines", Solar Phys. 18, 366.

Pierce, A. K. and Breckinridge, J. B. 1973, "The Kitt Peak Table of Photographic Solar Spectrum Wavelengths", Kitt Peak Contribution No. 559.

Pierce, A. K. and Breckinridge, J. B. 1974, "Addendum -- The Kitt Peak Table of Photographic Solar Spectrum Wavelengths", Addendum to Kitt Peak Contribution No. 559.

Pierce, A. K. 1975, "The Solar Program of the Kitt Peak National Observatory", accepted for publication in Solar Phys.

STEPHEN T. RIDGWAY

Assistant Astronomer

Dr. Stephen T. Ridgway *is continuing his studies of late-type stars with special emphasis on abundance analyses from photographic and IR spectra (especially from relatively weak lines of H_2, CO, OH, CN, and H_2O), on studies of atmospheric temperature structures, on use of molecular fundamental bands for detection of shells and chromospheric effects, on the determination of radial velocities of Mira variables as functions of excitation temperature and time, and on spectral type-effective temperature calibration for stars cooler than M1 using angular diameters determined by the lunar occultation techniques. He is also interested in obtaining high resolution spectra in the 10 micron region of Jupiter and Saturn in order to study the molecular, elemental and isotopic abundances and the temperature structure.*

PUBLICATIONS:

Ridgway, S. T. 1974, "The Carbon Monoxide Band Strength and $^{12}C/^{13}C$ Ratio in K Giants", Astrophys. J. 190, *591.*

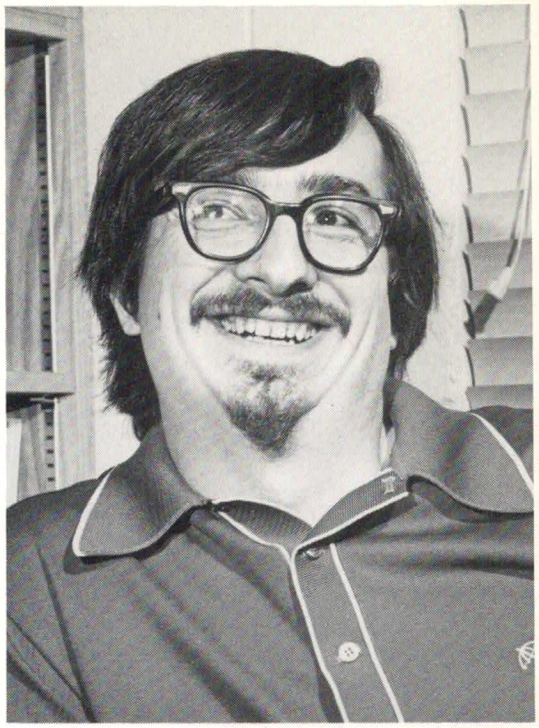
Ridgway, S. T. 1974, "Jupiter: Identification of Ethane and Acetylene", Astrophys. J. 187, *L41.*

Ridgway, S. T. 1974, "Fourier Transform Spectrophotometry and its Application to the Study of K-Giants", IAU Highlights of Astronomy, ed. G. Contopoulos, (Dordrecht: Reidel), p. 327.

Ridgway, S. T. and Capps, R. W. 1974, "A Fourier Transform Spectrophotometer for Astronomical Applications, 700 to 10000 cm^{-1}", Rev. Sci. Inst. 45, *676.*

Ridgway, S. T., Wells, D. C. and Carbon, D. F. 1974, "Diameter of μ Geminorum M3 III from Lunar Occultation", Astron. J. 79, *1079.*

Lockwood, G. W., Dyck, H. M. and Ridgway, S. T. 1975, "The Composite Spectrum and Energy Distribution of XX Ophiuchi", Astrophys. J. 195, *385.*



STEPHEN E. STROM

Astronomer

Dr. Stephen E. Strom *is continuing his studies of young stellar objects and dark interstellar clouds and beginning an investigation of the relationship between galaxy dynamics and chemical composition. His studies of selected dark cloud complexes has resulted in a deeper understanding of the earliest phases of stellar evolution and the influence of young stellar objects on the physical conditions within dark clouds. The increased sensitivity of InSb detectors has provided us with the ability to study the luminosity functions for the embedded stellar population. These embedded sources have been employed in polarimetric studies aimed at eliciting the geometry and possibly the magnitude of the magnetic fields internal to the cloud complexes. Combined with optical studies of the global magnetic field geometry in dark cloud regions, these polarization measurements can form the basis for an empirical evaluation of the role played by magnetic fields during the collapse and fragmentation of a cloud.*

He is also investigating the question of whether or not the rate of star formation depends on the characteristics of the rotation curve for disc systems. Other related questions of interest concern the nature of the composition gradients "built into" disc systems, the possible morphological evolution of disc systems and how it is influenced by rich cluster membership.

PUBLICATIONS:

Strom, S. E. 1972, "Optical and Infrared Observations of Young Stellar Objects -- An Informal Review", Publ. Astron. Soc. Pacific 84, 745.

Strom, S. E., Strom, K. M., Brooke, A. L., Bregman, J. and Yost, J. 1972, "Circumstellar Shells in the Young Cluster NGC 2264. II. Infrared and Further Optical Observations", Astrophys. J. 171, 267.

Strom, S. E., Strom, K. M., Yost, J., Carrasco, L. and Grasdalen, G. 1972, "The Nature of the Herbig Ae- and Be-Type Stars Associated with Nebulosity", Astrophys. J. 173, 353.

Strom, S. E. and Strom, K. M. 1973, "The Early Evolution of Stars -- I.", Sky and Telescope 45, 279.

Strom, S. E. and Strom, K. M. 1973, "The Early Evolution of Stars -- II.", *Sky and Telescope* 45, 359.

Carrasco, L., Strom, S. E. and Strom, K. M. 1973, "Interstellar Dust in the Rho Ophiuchi Dark Cloud", *Astrophys. J.* 182, 95.

Grasdalen, G. L., Strom, K. M. and Strom, S. E. 1973, "A 2-Micron Map of the Ophiuchus Dark-Cloud Region", *Astrophys. J.* 184, L53.

Knacke, R. F., Strom, K. M., Strom, S. E., Young, E. and Kunkel, W. 1973, "A Young Stellar Group in the Vicinity of R Coronae Austrinae", *Astrophys. J.* 179, 847.

Knacke, R. F., Strom, K. M. and Strom, S. E. 1973, "Infrared Observations of a Highly Reddened Star Near NGC 6231", *Astrophys. J.* 179, 493.

Strom, S. E., Grasdalen, G. L. and Strom, K. M. 1974, "Infrared and Optical Observations of Herbig-Haro Objects", *Astrophys. J.* 191, 111.

Strom, S. E., Strom, K. M., Grasdalen, G. L. and Capps, R. W. 1974, "Infrared Observations of H II Regions in External Galaxies", *Astrophys. J.* 193, L7.

Strom, S. E., Strom, K. M. and Carrasco, L. 1974, "A Study of the Young Cluster IC 348", *Publ. Astron. Soc. Pacific* 86, 798.

Strom, K. M., Strom, S. E. and Grasdalen, G. L. 1974, "An Infrared Source Associated with a Herbig-Haro Object", *Astrophys. J.* 187, L83.

Strom, K. M., Strom, S. E. and Kinman, T. D. 1974, "Optical Polarization of Selected Herbig-Haro Objects", *Astrophys. J.* 191, L93.

Dickinson, D. F., Kohoian, G. and Strom, S. E. 1975, "A Strong Water Maser Associated with a Herbig-Haro Object", *Astrophys. J.* 194, L93.

Grasdalen, G. L., Joyce, R., Knacke, R. R., Strom, S. E. and Strom, K. M. 1975, "A Photometric Study of the Chamaeleon T-Association", *Astron. J.* 80, 117.

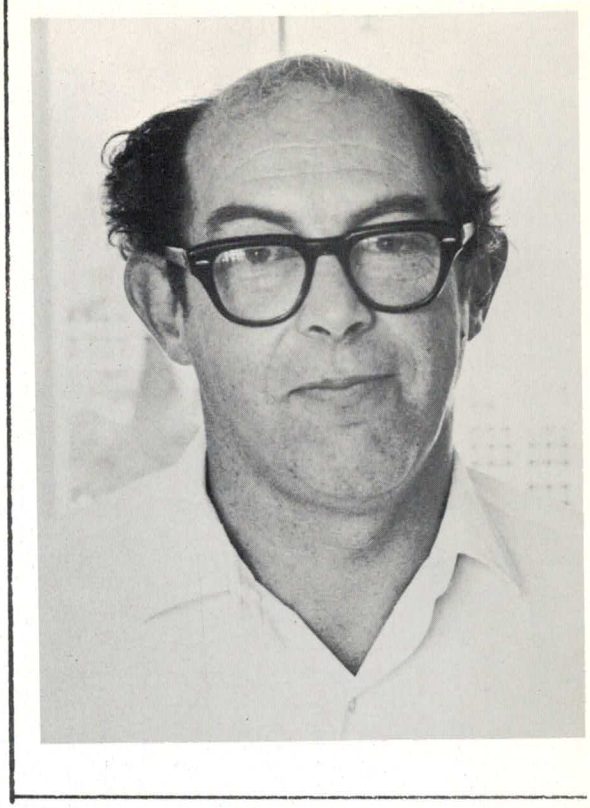
Strom, K. M., Strom, S. E., Carrasco, L. and Vrba, F. J. 1975, "M78 -- An Active Region of Star Formation in the Dark Cloud Lynds 1630", *Astrophys. J.* 196, 489.

Strom, S. E., Strom, K. M. and Grasdalen, G. L. 1975, "Young Stellar Objects and Dark Interstellar Clouds", accepted for publication in *Ann. Rev. Astron. Astrophys.* for the August 1975 issue.

Vrba, F. J., Strom, K. M., Strom, S. E. and Grasdalen, G. L. 1975, "Further Study of the Stellar Cluster Embedded in the Ophiuchus Dark Cloud Complex", accepted for publication in the *Astrophys. J.* for the April 1975 issue.

Vrba, F. J., Strom, S. E. and Strom, K. M. 1975, "Optical Polarization of a Herbig-Haro Object in Corona Austrina", accepted for publication in the *Publ. Astron. Soc. Pacific.*

Rydgren, A. E., Strom, S. E. and Strom, K. M. 1975, "The Nature of the Objects of Joy: A Study of the T Tauri Phenomenon", submitted to *Astrophys. J.*



LLOYD V. WALLACE

Astronomer

Dr. Lloyd V. Wallace's *research is primarily in the area of temperature structures of Jupiter, Saturn, Uranus and Neptune. There are several phases of these investigations including the examination of IR spectra beyond ~ 14μ to establish the thermal opacity sources, an analysis of the Pioneer 10 Jupiter radio occultation temperature profile, calculations of thermal structures including trace hydrocarbons, and adjustment of heating sources so the model spectrum of the trace hydrocarbons fits the observed spectrum in the 3-14μ region.*

PUBLICATIONS:

Wallace, L. V., Stuart, F. E., Nagel, R. H. and Larson, M. D. 1971, "A Search for Deuterium on Venus", Astrophys. J. 168, *L29.*

Wallace, L., Caldwell, J. J. and Savage, B. D. 1972, "Ultraviolet Photometry from the Orbiting Astronomical Observatory. III. Observations of Venus, Mars, Jupiter and Saturn Longward of 2000 Å", Astrophys. J. 172, *755.*

Wallace, L. and Strobel, D. F. 1972, "Diurnal Variation of Atomic Hydrogen in the Thermosphere", Planet. Space Sci. 20, *521.*

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Wallace, L. and Hunten, D. M. 1973, "The Lyman-Alpha Albedo of Jupiter", Astrophys. J. 182, *1013.*

Belton, M. J. S., Wallace, L. and Price, M. J. 1973, "Observation of the Raman Effect in the Spectrum of Uranus", Astrophys. J. 184, *L143.*

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DONNA WEISTROP

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Dr. Donna Weistrop *is conducting studies of the low velocity red dwarfs with the aim of determining the nature of these objects and their relevance to problems of galactic structure. Spectral analysis will be performed to investigate the distribution of ages and chemical abundances. She plans to establish new absolute magnitude criterion in order to obtain better space distributions. She plans to initiate an investigation of the galactic halo in order to determine its role in the structure and evolution of the galaxy.*

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DONALD C. WELLS

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Dr. Donald C. Wells *is primarily concerned with the automation of information-handling processes in astronomical research. His main effort during FY 1976 will be in the development of software for the new Interactive Picture Processing System at KPNO. He is also interested in the development of procedures for measuring metric diameters of cluster galaxies and correlating the morphological properties of clusters with the metric diameter of the individual cluster galaxies.*