Colloquium No. 11 of the International Astronomical Union, "Automation in Optical Astrophysics", was held in Edinburgh, Scotland, August 12-14, and was attended by several of the KPNO staff. Dr. D. L. Crawford contributed a paper entitled, "Conservative Automation for Large Telescopes" and also presented summary remarks at the close of the meeting. Dr. A. A. Hoag presented a paper entitled, "Application of Image Dissector Photomultipliers," authored jointly with Mr. W. F. Ball and Mr. D. E. Trumbo, also of the KPNO staff. Dr. W. C. Livingston presented a paper, "The 40-Channel Magnetograph: An Example of the On-Line Computer-Controlled Observational System at the McMath Solar Telescope", and Dr. J. W. Harvey contributed a paper, "The Kitt Peak Magnetograph. III. Automation and the 40-Channel Probe."

Dr. C. R. Lynds and Dr. T. D. Kinman participated in the IAU Symposium No. 44, "External Galaxies and Quasi-Stellar Sources", held in Uppsala, Sweden, August 10-14. Lynds made two contributions to the symposium: "Radial Velocities of Galaxies Near NGC 7331", and "Absorption Line Quasi-Stellar Objects." Kinman presented a report for the proceedings entitled, "Optical Observations of BL Lac."

The XIV General Assembly of the International Astronomical Union was held August 18-27 in Brighton, England. Lynds presented to Commission 9 (Astronomical Instruments) a "Report on Image Tube Spectroscopy at Kitt Peak." Crawford was named President of Commission 25 (Stellar Photometry). Dr. A. K. Pierce presented the final results of the working group on central line intensities, and proposed the formation of two other working groups on high resolution spectroscopy and on sunspot spectroscopy; by vote of Commission 12 (Radiation and the Structure of the Solar Atmosphere) these groups were approved. Dr. M. J. S. Belton took part in Commissions 16 (The Physical Study of Planets and Satellites) and 17 (The Moon). Drs. J. W. Chamberlain, Harvey, and Livingston also attended the meetings.

Attending the IAU Symposium No. 43, "Solar Magnetic Fields", in Paris, August 31-September 4, were Livingston and Harvey, who contributed papers. Also in attendance were Drs. Pierce, D. N. Hall, and N. R. Sheeley, Jr. Sheeley presented films and narration on "Time Dependence of Magnetic, Velocity, and Intensity Fields in the Solar Atmosphere."

Dr. D. M. Hunten served as lecturer and Chairman of Session II on Atmospheric Emissions, while attending the Summer Advanced Study Institute on Aurora and Airglow, held in Kingston, Ontario, Canada, August 3-14.
Dr. M. B. McElroy attended the Space Science Board Summer Study on "Space Sciences and Applications Priorities," held July 27-August 15 at Woods Hole, Massachusetts. He served as chairman of the working group on Planetary Exploration.


PERSONNEL NOTES FROM THE SCIENTIFIC DIVISIONS

Scientists-in-Residence

Dr. Stephen E. and Mrs. Karen M. Strom returned to the State University of New York at Stony Brook, following a summer-in-residence, working with the Stellar Division of KPNO.

Dr. Peter Pesch, on sabbatical leave from the Warner and Swasey Observatory, began a year's stay at KPNO in September. Also working in the Stellar Division, Dr. Pesch will continue a number of observational programs bearing on galactic structure and photometric and kinematic properties of stars.

Consulting Astronomers

Dr. Peter Wilson, University of Sydney, Australia, spent three weeks as consulting astronomer in the Solar Division.

Dr. Ira Bowen, Hale Observatories, and Dr. Roland Shack, Optical Sciences Center, University of Arizona, spent the day of July 24 reviewing with scientific staff members and optical shop staff the current status of the 150-inch primary mirror.

Staff Changes

Dr. Michael B. McElroy, a physicist in the Planetary Sciences Division, accepted an appointment to the staff of the Division of Engineering and Applied Physics at Harvard University, leaving KPNO on September 24, 1970. Dr. John C. McConnell, who worked in association with McElroy in the field of theoretical astrophysics, accepted an appointment to the same Division at Harvard so that their joint projects could continue. He left KPNO on October 1, 1970.

Dr. Joseph W. Chamberlain resigned as Associate Director-Planetary Sciences Division on June 30, 1970, but continues in his position as Astronomer.

Mr. Robert Barnes, who resigned from his position as Chief Night Assistant in September 1965 to complete his undergraduate work at the University of Arizona, returned to KPNO on September 14 as a full-time Technical Assistant, following the award of
his B. A. degree. As a member of the Stellar Division, Barnes has begun work on the development and application of image-tube systems.

Summer Research Assistantships

Each summer a group of qualified students is selected to participate in research programs under the supervision of regular staff members of the scientific divisions. The following is a list of students, their educational institutions, and the supervising KPNO scientists.

** STELLAR DIVISION **

Reginald J. Dufour
Robert S. McMillan
Frederick J. Vrba

University of Wisconsin
Case Institute of Technology
University of Iowa

Dr. Hoag
Dr. Lockwood
Dr. Dyck

** SOLAR DIVISION **

Jay Beck
Bruce Gillespie
Charles Lada
Sou-Yang Liu
Robert Rose
Mark Semon
Paula Szkody

University of Arizona
University of Michigan
Boston University
University of Maryland
University of Arizona
Colgate University
Michigan State University

Dr. Livingston
Dr. Harvey
Dr. Sheeley
Dr. Pierce
Dr. Sheeley
Dr. Pierce
Dr. Harvey
Dr. Brault

** PLANETARY SCIENCES DIVISION **

Paul T. Giguere, Jr.
Kenneth H. Rex
Garrett S. Sylvester
Lawrence J. Tepper

University of Virginia
Rensselaer Polytechnic Institute
Princeton University
University of Illinois

Dr. Belton
Dr. Dick
Dr. Strobel
Dr. McConnell

** KITT PEAK FILM **

A full-color, narrated, documentary film, Journey into Light, portraying the Kitt Peak National Observatory facilities and activities was recently completed. The film was written and directed by Robert Anderson, of San Francisco, and produced and photographed by John H. Lutnes, head of the KPNO Photographic Laboratory. Executive Producer was James M. Miller. Kurt Cramer and Peter Ratkevich were responsible for the sound and editing, respectively.

At present, the film is available on loan for local organizations. Miller and Lutnes discussed and showed the film at the National Science Foundation at the end of August; NSF reserves the right to determine control and distribution of the film. In New York the film was shown to representatives of the McGraw-Hill
Book Company and of Time-Life Books, and in Chicago to representatives of the Encyclopaedia Britannica. Response to the film has been enthusiastic, and it is scheduled for viewing on local television channels.

**KITT PEAK WEATHER**

<table>
<thead>
<tr>
<th></th>
<th>July</th>
<th>August</th>
<th>September</th>
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<tbody>
<tr>
<td>Precipitation</td>
<td>1.59 inches</td>
<td>5.77 inches</td>
<td>8.76 inches</td>
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<tr>
<td></td>
<td>in 7 days</td>
<td>in 13 days</td>
<td>in 6 days</td>
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<tr>
<td>Temperature</td>
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<tr>
<td>Extreme High</td>
<td>90°F</td>
<td>850°F</td>
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<td>Mean High</td>
<td>82</td>
<td>77</td>
<td>71</td>
</tr>
<tr>
<td>Mean Low</td>
<td>62</td>
<td>59</td>
<td>54</td>
</tr>
</tbody>
</table>

Heavy rains on Kitt Peak during August and September provided one million gallons of storage water, the present maximum storage capacity.

**PUBLIC VISITORS**


**INSTRUMENTATION AND RESEARCH PROGRAMS**

**Stellar Division**

Early in September, Dr. H. A. Abt accepted a 14.6 x 12.2-inch grating replicated by Bausch & Lomb from a master ruled by G. R. Harrison at the Massachusetts Institute of Technology. The coudé spectrograph at the 84-inch telescope is being modified so that a collimator 13 inches in diameter can be used in place of the 9-inch collimator that now illuminates 8 x 10-inch gratings. The larger collimator will permit use of a wider slit for the same resolution at the camera foci, thus increasing the speed of the spectrograph. Because the fastest camera (F/1.5) will not accept the larger beam, the spectrograph is being modified so that both beam diameters and grating systems will be usable.

A new Cer-Vit optical system was installed in the No.1 36-inch telescope on July 13. This telescope is still used with two secondaries, either as an F/7.5 Ritchey-Chrétien or as an F/13.5 Cassegrain system. The primary supports were revised (see Technical Report No. 15) at the time this new, heavier primary mirror was installed. Subsequently, the optical system of the No.2 36-inch telescope was replaced with the No.1 telescope's former Duran 50 primary and a new matched F/13.5 secondary mirror. The image quality of the No.2 telescope has been markedly improved as a result.
The improved optical system for the 50-inch telescope should be installed this fall. The replacements, a lightweight, Cer-Vit primary mirror and a new secondary mirror, have been received from the Perkin-Elmer Corporation and new cells and support systems are to be delivered soon by the Boller & Chivens Company. Design of a digitally-controlled torque motor drive system for the 50-inch reflector has been completed; however, because of scheduling problems in the shop, it may be some time before these improved drives can be installed. The Dyck-Lockwood infrared photometer for the 50-inch telescope is being assembled and operational tests are scheduled.

D. E. Trumbo has programmed the Honeywell 416 "TELCOM 1" computer system for control, data acquisition, and processing in the operation of Dr. Dyck's polarimeter. As described in the July-August 1969 Bi-Monthly Report, polarimetric data are accumulated for 100 intervals of analyzer rotation. After data for a preset number of analyzer rotations have been accumulated, the observational results are displayed on the storage oscilloscope of the TELCOM 1 command rack (Fig. 1). The sky-corrected pulse count as a function of analyzer position, smooth fit of the data, amount of polarization, position angle, and the rms deviation from the fitted curve are available for inspection by the observer a few milliseconds after the observing cycle is completed. The raw, observational data are stored on magnetic tape for later machine processing. Having the reduced results of observations available almost instantaneously is a tremendous tactical aid to the observer.

Preliminary tests of the "Harvard" scanner were carried out by I. J. Danziger, N. Hazen, G. Nystrom, S. Diamond, and G. Papa at the No. 1 and No. 2 36-inch telescopes early in July; the instrument was then returned to the Solar Satellite Project at Harvard University for completion. Both the KPNO and CTIO instruments will be delivered to Tucson Headquarters in October. Telescope tests and applications are scheduled for mid-October and early November. Present plans call for integration of one of these instruments with the TELCOM 1 computer system prior to the November observing schedule.

The Kron electronographic tube project, under the direction of Dr. T. D. Kinman and Mr. W. J. Henson, has progressed in three major areas: 1) near-completion of the "clean room" for Kitt Peak mountain operations; 2) redevelopment of handling, pumping, and loading fixtures by Henson; and 3) Tucson laboratory space modifications, handled by the Operations Department. It is anticipated that relatively routine applications of the electronographic tubes at the telescope may be possible by the beginning of 1971. One of the two Kron tubes in the Division was used with the Schroeder spectrometer on the No. 2 36-inch telescope in July, marking the first use of the system without the direct aid of Dr. Kron's group. The other Kron tube was refurbished and supplied with a new photocathode by Kron and Henson at Flagstaff in July.

Dr. D. L. Crawford, with Mr. J. R. Jones and Mr. M. F. Martin, arranged a critical inspection tour of the nearly completed 150-
Fig. 1—On-line display of Dyck's polarimeter observations: NGC1068, U-filter, 26 September 1970. The dots are the observed points corrected for sky foreground, and the dashed line is the computed cos20 fit. Polarization and variance from the fit are given as ratios, e.g., Pol = 5.3%. The position angle result is displayed according to a convention that cannot yet be read directly in 0.
inch telescope building on September 21 for the staff members of the Stellar Division. The purpose of the tour was not only to acquaint potential users with facilities in the building, but also to provide an opportunity for constructive criticism of arrangement details.

Several research projects that warrant special mention because of participation by Summer Research Assistants, are as follows:

Reginald J. Dufour, who came from Louisiana State University, Baton Rouge, and is now a graduate student at the University of Wisconsin, worked with Dr. Hoag on alignment and testing of the recently developed, computer-controlled image dissector spectrum scanner. As one project, he monitored the equivalent width of Hβ in the spectrum of the magnetic star HR 9080. In another study, he attempted to determine the minimum number of spectral resolution elements required to obtain indices similar to the $m_1$ and $c_1$ indices of the Stromgren-Crawford 4-color photometric system. Mr. Dufour also tested a new ITT image dissector having an S-25 photocathode. This tube can be used over the spectral range $\lambda\lambda$3200-8700Å, and it has a background count of less than 10 per minute when used at a temperature of approximately -10°C. Mr. Dufour also obtained spectra of 27 possible members of the cluster Roslund-5. He has measured radial velocities from these spectrograms, and will collaborate with Dr. Charles Perry and Dr. Paul Lee, of Louisiana State University, in publishing a generalized study of this open cluster.

Robert S. McMillan has returned to the Case Institute of Technology after spending the summer working with Dr. G. W. Lockwood on the identification of very red, high-galactic latitude entries in the Two-Micron Sky Survey by Neugebauer and Leighton. A blink machine and glass copies of the National Geographic Society-Palomar Observatory Sky Survey were used for this purpose. Observations of objects so identified were begun, with the equipment Dr. Lockwood developed for use with the 36- and 50-inch telescopes. Mr. McMillan also worked with Dr. Lockwood in continuing multicolor infrared observations of Mira variables, and in testing a filter system designed to allow determination of Paschen-Delta equivalent widths in the spectra of a number of Keenan standards and Mira variables.

Mr. Frederick J. Vrba returned to the University of Iowa following a Summer Research Assistantship with Dr. Dyck. He worked on the problem of determining absolute visual magnitudes of G, K, and M stars by measuring calcium II reversal widths on medium dispersion spectrograms obtained with the 36-inch telescope Cassegrain spectrograph. Because of poor weather conditions, spectrograms were obtained for only 34 stars from a list of 125 selected for this project; however, Mr. Vrba supplemented his material with spectrograms previously obtained by Dr. Dyck and Mark Jennings. The spectrograms have been measured and analysis is continuing to evaluate this calibration method as applied to spectrograms of moderate dispersion.
Visitor Use of Stellar Telescopes

In the following listing of visitors and their programs, the first number refers to the number of nights scheduled, the figure in parentheses notes the actual hours of observation, and the last figure indicates the telescope by aperture in inches. Students observing at Kitt Peak as Summer Research Assistants are indicated by asterisks.


K. Batishko, Battelle Memorial Institute: Diffuse galactic light, 7(62)16.

P. Brattlund, Stockholm Observatory, Sweden: A study of chemical abundances in late-type stars, 8(24)84.

E. Burke, R. Tate, and J. Howard, King College, Tennessee: Photometry of magnetic and spectrum variables, 2(8)36, 4(9)16.

G. Chincarini, NASA Manned Spacecraft Center, and H. Rood, Wesleyan University: Observations of compact galaxies, 7(43)84.


*R. Dufour, Louisiana State University, Low resolution scanning of stellar spectra and spectroscopic investigation of Roslund-5, 2(19)84, 2(14)36.

*R. Dufour, Louisiana State University, and D. Gilra, University of Wisconsin: Spectrophotometry of late-type stars, 1(8)84, 3(22)36.

A. Feinstein, Argentina: $H_\alpha, \beta, \gamma$ measures of Be and metallic-line stars, 3(20)16.

T. Gandet, Kansas University: Observations of three suspected late B-type binaries, 10(29)36.

*P. Giguere, University of Virginia: Photometry of Venus, 10 days (41)16; Spectroscopy of molecules in late stars, 5(32)36.

R. K. Honeycutt, Indiana University: Diffuse interstellar bands, 4(3)84.

K. Hudson, University of Arizona: uvby photometry of globular clusters, 6(29)50.

P. Lee, Louisiana State University: Spectroscopy of the helium rich star HD 184927, 8(48)84; Photometry of planetary nebulae, 6(53)16.
J. Lutz, Washington State University: UBV and H_\alpha photometry of early-type stars in the directions of selected planetary nebulae, 7(39)36.

*R. McMillan, Case Western Reserve University: Infrared photometry of red objects, 6(28)50, 6(21)36.

R. Partridge, Princeton University: A search for galaxies at very large red shifts, 6(29)50.

C. Perry, Louisiana State University: Spectroscopic observations of Roslund cluster No. 5, 4(12)36.

P. Rigterink, University of Pennsylvania: A study of the "disturbances" in close binary systems, 18(56)16.

W. Stein, R. Gehrz, and D. Strecher, University of California, San Diego: Infrared photometry and spectrophotometry of various sources, 5(21)50.

S. and K. Strom, State University of New York, Stony Brook: Post-horizontal branch star evolution, 9(23)84.

S. Tapia, University of Arizona: UBV photoelectric photometry of the flare star EV Lacertae, 7(11)16.

R. Taylor, R. Sather, and C. Vesley, University of Arizona: Photometry of asteroids, 7(2)50, 10(24)16.

G. vanBiesbroeck, University of Arizona: Micrometer measures of double stars, 4(20)84.

K. Voelcker and W. Hofmann, Germany: Photoelectric observations of extremely red stars in Cygnus, 19(110)50.

*F. Vrba, University of Iowa: K-line calibration of luminosities, 9(51)36.

N. Walborn, Yerkes Observatory: Some spectroscopic characteristics of the OB stars, 14(90)36.

G. Wallerstein, University of Washington: High dispersion spectra of long-period variables and similar stars, 4(33)84.

A. Witt, University of Toledo: Spectrophotometric studies of reflection nebulae, 3(29)84, 4(18)16.

Total visitor use of stellar telescopes:

50(250)84  49(219)50  68(355)36  59(253)16

10 days (41)16
### Summary of Telescope Use

<table>
<thead>
<tr>
<th></th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
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<tbody>
<tr>
<td>84-inch</td>
<td>25(120)</td>
<td>22(131)</td>
<td>25(212)</td>
</tr>
<tr>
<td>50-inch</td>
<td>13( 58)</td>
<td>7( 39)</td>
<td>23(166)</td>
</tr>
<tr>
<td>No. 1 36-inch</td>
<td>17(111)</td>
<td>22(119)</td>
<td>25(174)</td>
</tr>
<tr>
<td>No. 2 36-inch</td>
<td>19(102)</td>
<td>21(100)</td>
<td>19(140)</td>
</tr>
<tr>
<td>No. 3 16-inch</td>
<td>7( 31)</td>
<td>2( 19)</td>
<td>15(107)</td>
</tr>
<tr>
<td>No. 4 16-inch</td>
<td>3(  9)</td>
<td>8( 40)</td>
<td>14( 99)</td>
</tr>
<tr>
<td></td>
<td>5D( 20)</td>
<td>5D( 21)</td>
<td></td>
</tr>
</tbody>
</table>

The No. 1 and No. 2 36-inch telescopes were inoperative for 3 nights in July for installation of new and replacement optics, respectively.

### Solar Division

Progress has been made toward improving the quality of the image given by the McMath Solar Telescope. A mercury-filled bag (or tire) has been installed around the edge of the 82-inch fused silica heliostat flat, which will give an ideal edge support to this mirror and also serve as a vacuum seal. It has been proposed to evacuate partially the space behind the mirror, in order to deform mechanically the mirror to counteract the effects of solar heating on the front face. A large exhaust fan has been installed in the "adit" (the horizontal tunnel behind the 60-inch image-forming mirror) to draw air down the 500-foot long inclined light path. This experimental measure is hoped to improve the internal seeing, which has been found, on some occasions, to be a source of serious trouble.

Dr. Jack Harvey is working on a program to prepare a new atlas of the sunspot spectrum. The classical map now in use was made at Mount Wilson in the 1920's and can be greatly improved because of new developments: a larger image; better plates and films; the Babinet Compensator instead of mica 1/4 λ plates; and compensation of the polarization of the telescope. Figure 2 shows an example of the results of these improvements. What is needed is a large, stable sunspot.

During his three-week stay as consulting astronomer at KPNO, Dr. Peter Wilson, University of Sydney, Australia, worked with Mr. Charles Evans in an attempt to observe the center-to-limb variation of the contrast function of granulation at three different wavelengths. This program, which requires the very best seeing, is well underway, but it will require much more observing. A new camera system now being built will allow the three wavelengths to be observed simultaneously instead of sequentially as is done now.

Seven students worked in the Solar Division in the Summer Research Assistantship program. Jay Beck, University of Arizona, worked with Dr. Livingston and Dr. Harvey and helped in programming.
Fig. 2 - Photograph of the spectrum of a sunspot taken by Jack Harvey. The photograph taken through a Babinet Compensator shows the Fraunhofer lines split into their Zeeman components.
the KPNO computers for the display of solar magnetic field data. Bruce Gillespie, a senior at the University of Michigan, helped Dr. Sheeley to obtain spectroheliograms in a variety of spectral lines. Some of the material was taken back to Ann Arbor for further analysis with the microphotometer there. Charles Lada, Boston University, worked with Dr. Pierce on the solar wavelength program to obtain spectra and to make measurements. Sou-Yang Liu, University of Maryland, worked with Dr. Sheeley, using the spectrograph and spectroheliograph to obtain a large number of 70 mm films of the structure and time variation in the K line of Ca II. Robert Rose, University of Arizona, was also a participant in Dr. Pierce's solar wavelength program. Mark Semon, from Colgate University, was Dr. Harvey's summer assistant. He developed computer programs relating to magnetic field structures on the sun. Paula Szkody, Michigan State University, worked as computer programmer and research assistant to Dr. Brault. Her work was directed toward the analysis of the solar spectrum from observations obtained with the double pass spectrometer at Kitt Peak.

Visitor Use of the McMath Solar Telescope

Many of the observers listed in the previous quarterly report carried on their programs throughout the past three months: Richard Boyle, Bruce Lites, Richard Shine, and Charles Curtis. Other visiting observers at the McMath telescope were:

Mr. P. Barnhart, Otterbein College, Westerville, Ohio:
Photoelectric measurements of mean chromospheric heights above the continuum photosphere.

Dr. A. Bhatnagar, California Institute of Technology: Spectroscopic observations of the outflow of material in the neighborhood of sunspots.

Dr. R. Boese, NASA Ames Research Center: Observations of Venus and Jupiter spectra.

Dr. R. Howard, Hale Observatories: Cooperative project with J. W. Harvey in which the solar telescopes at Kitt Peak and Mount Wilson are simultaneously locked onto the same solar phenomena—the 1 sec oscillations which appear on some velocity records obtained with magnetographs.

Dr. P. Wilson, University of Sydney, Australia: Observations of solar granulation.

Planetary Sciences Division

Four students worked in the Planetary Sciences Division as participants in the Summer Research Assistantship program. Paul T. Giguere, Jr., University of Virginia, worked with supervising scientist Dr. M. J. S. Belton in a research program
involving photometry of Venus, measuring in integrated light the
total absorption of the CO₂ band at 1.05μ. Kenneth H. Rex,
Rensselaer Polytechnic Institute, working in laboratory spectro-
scopy, performed initial setups on an electron gun experiment,
tested components and subsystems, and carried out laboratory experi-
ment routines. Dr. K. A. Dick supervised him in these programs.
Garrett S. Sylvester, Princeton University, working with Dr. D. F.
Strobel, investigated polar wind in planetary ionospheres. Lawrence
J. Tepper, University of Illinois, worked under Dr. J. C. McConnell
in an investigation of the photochemistry of C₃O₂ in the Martian
atmosphere.

The following is a narrative account by Dr. A. L. Broadfoot of
plans involving the Planetary Sciences Division for the 1973 NASA
Mariner Venus/Mercury mission:

"Several members of the scientific staff of the Planetary
Sciences Division have acted in an advisory capacity to NASA in
connection with science on future spacecraft. We have now become
more directly involved, since a proposed XUV experiment has been
accepted for flight on the Mariner to Venus and Mercury in 1973.
The team of Belton, Broadfoot and McElroy submitted 'A Proposal To
Search For The Presence Of An Atmosphere On Mercury By Solar Occul-
tation In The Extreme Ultraviolet And To Identify Likely Constituents
On Mercury And Venus By Ultraviolet Airglow'. Broadfoot will act as
the principal investigator for this team.

"NASA mission planning groups have found several opportunities
to fly by two or more planets with a single spacecraft launch. The
first such opportunity occurs in late 1973. A spacecraft launched
to Venus at an appropriate time will receive an assist from the gravi-
tational pull of Venus which will put the spacecraft on an encounter
course with Mercury. The spacecraft has a further possibility; if
the Mercury flyby can be made with sufficient accuracy the space-
craft can make a second pass by Mercury 176 days later. The space-
craft orbital period about the sun is 176 days, just twice Mercury's
period of 88 days. A third flyby is also possible. The sequence
of events is illustrated in Figure 3.

"The prime objective of the mission is to detect a Mercurian
atmosphere. There is no evidence from ground-based observations
that Mercury has an atmosphere. On the other hand, we cannot
exclude the possibility of an atmosphere with a surface pressure
as large as 2 mb. The abundance of gases such as Ne and A could
be as large as this value.

"We have considered the possible types of atmospheres which
might be present on Mercury and investigated their stability versus
thermal escape or solar wind capture. We considered initially an
atmosphere with a composition similar to that of Venus and Mars at
a surface pressure of 10⁻³ mb. The exospheric temperature in this
case is calculated to be ~2000°K. At this temperature CO and O,
Fig. 3 - Ecliptic projection of the spacecraft heliocentric trajectory for the 1973 Mariner Venus/Mercury Mission.
photochemical products of CO\textsubscript{2}, escape readily; A and heavier gases are retained. Our analysis indicates that the end product of atmospheric evolution is an exospheric remnant rich in A and heavier gases, with trace amounts of CO. The temperature of the exospheric remnant is determined by collisions with the surface, and the atmosphere in this case is stable versus thermal escape, and is self regulatory; addition of gases raises the boundary temperature, increasing the escape rate and restoring the full exospheric limit ($\sim 10^{15}$ molecules cm$^{-2}$ or $\sim 10^{-7}$ mb surface pressure).

"The composition of the atmosphere will be influenced by the probable existence of cold traps on the nightside. In particular, H$_2$O and CO$_2$ will be removed efficiently. Argon and neon are unaffected unless nightside temperatures (presumably in permanently shaded craters) are less than 54°K.

"The composition of the atmosphere can be influenced also by solar wind which provides a source of gases of solar composition and can also act as a loss mechanism, picking up planetary photoions at the limb. The nature of the interaction with solar wind depends on the density of atmosphere present on the planet.

"We proposed to include two simple, low cost, body-fixed, extreme ultraviolet spectrometers in the 1973 Mariner Venus/Mercury Mission payload in order to (1) detect a Mercurian atmosphere with the greatest sensitivity, and (2) analyze the composition and structure of Mercury's atmosphere. The two, almost identical, multi-channel spectrometers, which have no moving parts, will point in separate directions. The first will observe the occultation of the sun by Mercury's atmosphere at four wavelengths between 400Å and 850Å and accomplish (1) above down to a partial pressure of A equal to 10$^{-11}$ mb; the upper limit for Ne is higher, whereas trace amounts (less than 10$^{-14}$ mb) of other gases are easily measured. The occultation experiment will also provide definitive information on (2). The second spectrometer will observe airglow at the limbs of the planet with high spatial resolution and accomplish (2) in the resonant radiation of H (1216 Å), He (584 Å), He$^+$ (304 Å), C (1657 Å), O (1304 Å), A (870 Å, 1048 Å) and Ne (744 Å).

"The airglow spectrometer will provide urgently needed data on the structure of Venus' atmosphere by observing airglow from the above molecules at Venus. It will also monitor and map the diffuse galactic and interplanetary background radiation. New near-earth observations of the Geocorona at 584 Å and 1216 Å are also proposed."
Prior to March 1970, all scientific papers published, as well as selected unpublished works, were reprinted as the numerical series, Contributions from the Kitt Peak National Observatory and Contributions from the Cerro Tololo Inter-American Observatory. This general practice has ceased; the series will continue, however, but will include only a few original papers of limited interest and an occasional reprint from an obscure journal. It is effective for KPNO with Contribution No. 550.

The following papers by staff members and visiting scientists (including graduate students) were accepted for publication between 1 July 1970 and 30 September 1970. Complete publication information is given where applicable.

Contributions from the Kitt Peak National Observatory:

#552-Lynds, Roger C.
"The Radial Velocities of Galaxies Near NGC 7331"
Int. Astron. Union Symp. No. 44: External Galaxies and Quasi-Stellar Sources

#553-Lynds, Roger C.
"The Absorption-Line QSO's"
Ibid.

Other Publications:

Abt, Helmut A. and Hudson, Katherine I.
"Rotational Velocities in Short-Period A-Type Binaries"
Astrophys. J.

Bohuski, Thomas J., Smith, Malcolm G., and Weedman, Daniel W.
"Expansions of the Planetary Nebulae NGC 6853 and IC 3568"
Astrophys. J.

Burke, Edward W., Jr., Roland, W. W., and Boy, W. R.
"A Photoelectric Study of Magnetic Variable Stars"

Crawford, David L. and Barnes, Jeannette V. 1970,
"Four-Color and Hβ Photometry for Open Clusters. V: NGC 752,"
Astron. J. 75, 946.

Crawford, David L. and Barnes, Jeannette V. 1970,
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RESEARCH SUPPORT DIVISION

General Services

Design has been completed for the modification of the 36-inch grinding machine to improve its effectiveness for more critical usage, including the secondaries for the 150-inch telescope.

Stellar Division

The Research Support Division has been actively involved in: 1) installation of new and replacement optics in the two 36-inch telescopes; 2) the "clean room" air filtration system for the Kron image tube laboratory; 3) design of an electronic drive system for the 50-inch telescope; and 4) plans for the installation of the new optical system for the 50-inch telescope. Each of these projects is discussed in the Instrumentation and Research section of this report.

The Division is also taking an active part in the 84-inch telescope coude feed project. Engineering design of the mirror support and mirror mounts, along with field construction of the alt-az tower and windscreen, is underway. The Optical Shop has brought the 36-inch Cer-Vit image-forming mirror to the figuring stage.
Solar Division

Several projects for this division which have involved services of the Research Support Division are:

1) A focus readout for the main lightpath, a #5 east auxiliary mirror support over the spectroheliograph, and a dual crystal instrument for the magnetograph have been installed and are operating in the McMath telescope. An optical tunnel exhaust system is complete and ready for testing. Also, a grating drive and jib crane for handling the 14x18 grating have been installed in the I-R spectrograph:

2) The Instrument Shop is in the process of building a test fixture for the electromagnetic linear motion mirror drive; and

3) An improved control rack assembly for the 82-inch heliostat mirror system was tested in the Instrument Shop, and installation in the telescope is scheduled for November 1970.

Planetary Sciences Division

One project of the Research Support Division has been the design of a 3.34 meter planetary spectrometer. The design phase is nearing completion and the main components have been procured.

The other major work done for Planetary Sciences has centered around instrumentation for rocket flight KP 3.31, launched June 15, 1970, and analysis of the data collected to evaluate the performance of the instruments.

Following a space astronomy rocket flight, the principal investigator usually poses two questions: 1) Was the instrument pointed toward the target; and 2) How well did the attitude control system keep the instrument on target. Aspect sensing devices are usually employed to provide this information.

In the case of KP 3.31 (see preliminary report in the April-May-June, 1970 Quarterly Report), three aspect sensing devices were flown: an aspect camera, a horizon scanner, and a solar sensor.

The aspect camera was to have photographed two or more identifiable stars per frame. With this information, the celestial coordinates of the camera frame center and the rocket axis could have been determined by means of spherical trigonometry. Aspect camera data have generally been self-sufficient to derive rocket pointing direction to within 1/4°. In addition to determining ex post facto the pointing direction, data from the aspect camera were intended to evaluate the performance of the horizon scanner, which was flown for the first time. Unfortunately, the aspect camera film was badly over-exposed due to scattered earth-light and no stellar images could be positively identified on any of the 41 frames. Consequently, the horizon scanner served as the prime aspect sensing device on this flight.
The horizon scanner consists of a tiny, gimballed telescope and a photo cell. These are driven by an electric motor to scan a conical (25° half angle) section of space. If the rocket is pointed correctly, the scanner encounters the sunlit horizon twice on every complete scan and from this telemetered information the zenith distance of the rocket axis and one other aspect angle may be inferred. To derive unambiguous, three-axis pointing information, it is necessary to invoke data from another source, such as the solar sensor.

The solar sensor consists of three orthogonally-mounted solar cells. On KP 3.31, this triad was positioned in such a way that the individual signals would be nearly equal with the rocket axis pointed toward the sun. Furthermore, particular care was exercised to occult all earthshine.

Apogee of KP 3.31 (185.9 km) occurred at about 230 seconds after liftoff. Based on data from the horizon scanner and from the solar sensor, the celestial coordinates of the rocket axis at this time were found to be:

\[
\begin{align*}
\text{Declination} &= 22.2° \quad (+1.7°) \\
\text{Right Ascension} &= 82.2° \quad (+1°)
\end{align*}
\]

The coordinates of the sun at this time were:

\[
\begin{align*}
\text{Declination} &= 23.314° \\
\text{Right Ascension} &= 83.602°
\end{align*}
\]

Hence, the total angular difference was about 1°7, well within the requisite 10°. Furthermore, the signals from the solar sensor were virtually constant throughout the flight, indicating insignificant drift of the attitude control system. The coordinates of the frame center of the aspect camera at apogee were:

\[
\begin{align*}
\text{Declination} &= -8° \\
\text{Right Ascension} &= 356°
\end{align*}
\]

Though there were several stars in the 45° x 45° field of view that would have been photographed if the earthshine into the camera had been more effectively suppressed, all star-like images proved to be artifacts of the photographic reproduction process. Thus, the first attempt to determine aspect information by photographing stars from a sunlit rocket was unsuccessful.

Even so, the newly developed horizon scanner saved the day and confirmed very satisfactory performance of the attitude control system. Thus, the scientific data from the solar spectrometer should prove to be unsullied as far as pointing is concerned.
The Operations Department has also been actively involved in a project of the Planetary Sciences Division. A large, vertical collimator consisting of a primary mirror, beam splitter, corrector, and instrument head is being installed by the maintenance staff in the loading pit adjacent to the Integration Lab. This instrument will be used by the Planetary Sciences Division to test instrumentation used in its rocket astronomy program.

Services for Cerro Tololo

The Research Support Division has carried on several projects for the Cerro Tololo Inter-American Observatory, including instrumentation for the 60-inch telescope. The corrector for the #3 coudé Schmidt camera has been completed and, along with its primary spherical mirror, has been shipped to Cerro Tololo. Final shop tests indicated fine resolution by this camera is limited at 4 to 6 microns over the field. The single-channel sky offset photometer has been designed and detailed. Redesign of the 2-speed secondary focus drive has been completed, and a depolarizer cell and plate have been made for attaching to the 3-channel modular photometer. Final alignment of the coudé spectrograph system was begun in August; initially, only the #2 camera will be operational.

Other developments and improvements have included the sun screens being installed around the Schmidt telescope building; completion of the road from "Lone Cactus Pass" to the summit of Cerro Morado; and erection of a prefabricated 12-unit dormitory on Cerro Tololo, to be used primarily for personnel stationed there on the 150-inch telescope project and for KPNO staff visitors. Several other construction projects in which the Research Support Division has been involved are included in the CTIO report section.

150-INCH STELLAR TELESCOPES PROJECTS

Buildings

During September, KPNO engineers and the M. M. Sundt Construction Co. have jointly occupied the 150-inch telescope building at Kitt Peak for the purpose of detailed inspections of all architectural, structural, electrical, and mechanical aspects of the building. Sundt is making corrections and completing all work. Staff astronomers at Kitt Peak have also made a detailed examination of the building and needed changes will be incorporated in the near future.
L. K. Randall, of the KPNO Engineering Department, inspected the CTIO 150-inch telescope building in September and found the ground and second floors ready for final inspection and found the general quality of workmanship throughout the building to be excellent. After correction of several minor problems, the laboratories on these floors can be occupied by the astronomers and the electronics group on Cerro Tololo. Final balancing of the heating and cooling system for the building is being done under the direction of a U. S. representative of the Johnson Controls Company.

Mountings

Western Gear Corporation is completing the major parts of its manufacturing effort in Everett, Washington, and sub-assembly of telescope parts is progressing. Work has proceeded slowly this quarter, but installation of the Kitt Peak telescope is still planned for February, 1971.

The Kitt Peak telescope motor controls, logic racks, R. F. screen room and control consoles are being re-assembled and interconnected in the building by United Power & Control Co. of Seattle (sub-contractor to Western Gear). The telescope drive gears and drive gearboxes have been completed and inspected by AURA at the Western Gear Lynwood plant and will be stored until needed for telescope site assembly. Boiler & Chivens has completed the manufacture of parts for the prime focus secondary system, but it is being delayed in assembly until delivery of parts supplied by Western Gear.

The controls for the CTIO telescope are being checked out in the Tucson shop by the AURA electronics staff.

Support Equipment

Both aluminizing chambers have been received at their respective observatories. The Kitt Peak chamber is assembled and ready for testing (Fig. 4). The chamber for CTIO arrived at Cerro Tololo in July (see Dr. Blanco’s narrative in the CTIO report); the unit is being cleaned and assembly has begun.

Specifications and concept drawings for the large handling equipment needed for the Cassegrain cage, the support shell, and the No. 3 mirror assembly are complete and bid requests for manufacture will be released soon.
Fig. 4 - Aluminizing chamber for the Kitt Peak 150-inch telescope, complete except for the roughing pump. The chamber, 13 1/2 feet in diameter, 18 feet high, and weighing 30 tons, will be used to deposit a coating of aluminum on the face of the primary mirror to form the reflecting surface.
Optics

During the report quarter, the Kitt Peak primary mirror has undergone Hartmann tests and a review of progress was made in July by Drs. Bowen (Hale Observatories), Shack (University of Arizona), Hoag, and Mayall. The tests have shown steady progress in improving the figure of the mirror. Currently, local polishing is being done by the opticians, based on Foucault tests made through the null lens. The most recent Hartmann tests have shown the need for better regulation of the air pads supporting the mirror, so the actual telescope mirror support regulators are being installed in the Optical Shop for use in the test phases. The Instrument Shop is building a new, full-size Hartmann screen with a rectangular coordinate system of 440 holes for use in the final image analysis in the shop.

The 158-inch Cer-Vit mirror blank for CTIO, produced by Owens-Illinois, was received in Tucson in early August. Grinding and polishing will begin when the KPNO mirror has been completed and removed. Figure 5 shows the uncrating of the CTIO mirror for inspection in the loading yard of the Tucson Headquarters.

Instrumentation

Numerous instrumentation projects are in progress for the 150-inch telescopes. Brief descriptions follow:

1) Prime focus instrumentation: A contract is being placed with the R. L. Parker Co. for construction of two manual cameras to be completed by September 1, 1971. This action follows evaluation of bids from seven sources.

Work on the automatic guider for the prime focus has been deferred temporarily until test results from the Cassegrain guider test fixture are available.

Prime focus correctors, consisting of one fused silica doublet, one UV glass triplet, and one visual-red corrected triplet, have been ordered from the Perkin-Elmer Corporation. These units are designed to fit inside the prime focus camera.

Further work on a completely automatic camera has been deferred to allow completion of higher priority items. Automatic roll film units have been ordered from Producers Service Corporation and are currently being designed for both Cassegrain and prime focus camera plateholder positions.

2) Cassegrain instrumentation: Engineering design work on the instrument adapter-rotator is nearing completion and fabrication work will begin during the next three months. This unit will mount to the primary mirror cell and provide instrument rotation, power, a comparison light source, and two auxiliary focus positions.
Fig. 5 - Arrival at KPNO Headquarters in Tucson of the 158-inch Cer-Vit mirror blank destined for the Cerro Tololo Inter-American Observatory.
The automatic guider to be mounted just below the instrument rotator is in the final layout stage. A test fixture is being built to test feasibility of a new x-y guideway system.

Increased emphasis is being placed on the basic Cassegrain spectrograph, sponsored by Dr. Lynds, in order to complete it by the end of 1971. The image tube camera is expected to be complete during 1972; at present, the engineering design work continues.

A prototype of a simple photometer is being constructed under the guidance of Dr. Dyck and Dr. Kinman. Bids for a photographic plateholder will be solicited, probably during the next quarter, with the intent to complete this unit by October 1971.

Engineering layouts are in process for basic observer facilities, storage racks, and utility equipment in both the Cassegrain and prime focus observers' cages.

3) Coudé instrumentation: A duplicate of the Hunt- Parkinson echelle spectrometer is being built, along with the original instrument under construction for the 60-inch CTIO telescope. Because the No. 5 mirror system is not yet designed, a low priority has been given to completion of this instrument; however, the advantage of building duplicate parts is being retained.

KPNO ENGINEERING TECHNICAL REPORTS

The following three technical reports were issued during the current report period:

#27- Pearson, E. T.
"Thermo-Elastic, Infinitesimal Deflection and Stress Analysis for a Homogeneous, Isotropic Body, Part I: Introduction and Governing Relations in General Coordinates"

#28- Barr, L. D.
"Analysis of Bullgear Deflections — 150-Inch Stellar Telescope"

#30- Pearson, E. T.
"150-Inch Stellar Telescope Optical Studies, Part V: Refocusing"
AURA, Inc. - NSF Meetings

N. U. Mayall, Observatory Director, and J. M. Miller, Associate Director-Administration, met in Washington, D. C. on August 19 with representatives of the National Science Foundation to review the KPNO and CTIO FY 1972 programs and budgets. On August 30, Mr. Miller held a de-briefing session with NSF representatives in Washington, D. C. regarding his July 19-28 business trip to Chile.

Executive Committee Meeting

On September 24, the Executive Committee of AURA, Inc. convened in the lounge area of the completed 150-inch telescope building on Kitt Peak. Several matters came under consideration. Approval was given for the purchase of a modified Mark II Attitude Control System from Space General Corporation for a rocket flight scheduled for November 1970. The policy of financing visitors' scientific payloads to be flown on KPNO Aerobee rockets was discussed, and it will be further considered at the October meetings of the AURA scientific sub-committees. Purchase of on-line computers for Kitt Peak telescopes was discussed and approved, subject to NSF approval and staff justification. Approval was also given for re-arrangement of offices in the Tucson Headquarters building for consolidation of the new Research Support Division. Dr. Blanco proposed a policy for disposal of AURA, Inc. vehicles in Chile, and it was approved by the Executive Committee. The policy will now be forwarded to the National Science Foundation for their review and approval.

Western Gear Negotiations

In Everett, Washington, from July 6-10, representatives of Western Gear Corporation and AURA, Inc. met to discuss outstanding change requests under the subcontract with Western Gear for fabrication of the 150-inch telescope mountings. Representing AURA, Inc. were Messrs. Miller, Dinsmore, Graham, Hendy, Pearson, Randall, and Schlotterbeck. During the session four change requests were negotiated.
A limited number of Research Assistantships will be awarded by the Kitt Peak National Observatory for the summer of 1971 to qualified graduate and undergraduate students interested in a career in astronomy. Assistants will work closely with members of the Observatory scientific staff in such areas as astronomical spectroscopy, photometry, the design and construction of astronomical equipment, and computer programming. There are also a limited number of opportunities for theoretical work in astrophysics, solar physics, and physics of planetary atmospheres.

Announcements of this program have been distributed widely among colleges and universities in the United States and sent to one institution in England; there has been an increasing number of requests for information. Applications are due February 1, 1971 and appointments will be made by March 22, 1971. Further information and application forms are available from:

The Office of the Director
Summer Research Assistantship Program
Kitt Peak National Observatory
P. O. Box 4130
Tucson, Arizona 85717
### KITT PEAK NATIONAL OBSERVATORY

**PERSONNEL SUMMARY**

**AS OF**

October 1, 1970

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**TOTAL POSITIONS FILLED**

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CERRO TOLOLO INTER-AMERICAN OBSERVATORY

Scientific Staff Activities

Dr. John Graham, Associate Astronomer-CTIO, visited the Córdoba Observatory on July 22-28 to confer with the staff there on observational programs and on possibilities of critical optical tests for the optics of the CTIO 60-inch telescope.

The following CTIO staff members attended the IAU meetings in Brighton, England, as well as various IAU-sponsored meetings elsewhere in Europe: Drs. B. Lasker, J. Hesser, M. Smith, and Senior Engineer, D. J. Ludden. The following papers were contributed by the CTIO astronomers at these meetings:


J. A. Graham, "The Field RR Lyrae Stars in the Large Magellanic Cloud" (presented by J. E. Hesser).

B. M. Lasker, "The Cerro Tololo Data Acquisition System."

M. G. Smith, "Some Recent Observations Related to the Kinematics of H II Regions."

Noted Visitors

Dr. A. N. Deutsch and Dr. D. Polojentsev, members of the Pulkovo Observatory (USSR) group working currently at Cerro Calán and Cerro Robles, Chile, visited the Cerro Tololo Inter-American Observatory on August 1-2. On September 27-28, Dr. Lukas Plaut of the Kapteyn Astronomical Laboratory, Groningen, the Netherlands, visited CTIO.

Roberto Rosellini, Italy's well-known movie director and producer, visited Cerro Tololo on August 24 and 29 at the request of the President of the Republic, for the purpose of obtaining footage for educational films to be used by the Ministry of Education.
Local Color News

On July 18, in excavation work around the new La Serena housing sites, a human skeleton was uncovered. No clue to its identity exists, but it is possible that it may have been a young soldier killed in one of the several battles that took place on the present grounds of CTIO's headquarters during a revolution in 1890. The remains were ceremoniously removed by municipal authorities.

An unusual friendship is developing on Cerro Tololo -- staff members are making the acquaintance of huge, Andean condors. These winged creatures abound in the interior regions of the Andes and are thought to be the largest non-aquatic birds in existence. Offal left on a rocky ridge near the Tololo summit has attracted three birds so far; on occasion, they have even been hand fed (not fed hands!).

Saga of the Aluminizing Tank

The following account of how the aluminizing tank for CTIO's 150-inch telescope mirror arrived in the port of Coquimbo and was transported to Cerro Tololo is given in some detail so that the reader may appreciate the complexities of the operations in Chile, and the degree of support and cooperation given by Chilean authorities. Dr. Victor M. Blanco, Director-CTIO, is the narrator.

"This very bulky piece of equipment was shipped in the Prudential-Grace steamship, 'Santa Barbara', from Boston, Massachusetts and was scheduled to arrive in the port of Coquimbo on July 7. On the day prior to the scheduled arrival, we received word that because of a strike in the port, the port authorities had decided to instruct incoming traffic to by-pass Coquimbo.

"As a result, the vacuum chamber was to be delivered to Valparaiso, about 300 miles to the south. It was absolutely impossible to bring this equipment back overland because of its bulk; thus, delivery in Valparaiso would mean subsequent shipment back to Coquimbo at an undetermined date. Unfortunately, the chamber had been exposed to a rainstorm in Boston and we knew that it could be undergoing irreparable damage from rust. Prompt delivery was essential.

"The afternoon of July 6 was spent by Mr. V. Glasinovic, CTIO's purchasing agent and importation expert, visiting various maritime authorities to find a solution to our problem. Through his efforts, the Intendente of the Province of Coquimbo issued an order to the administrator of the port to permit docking of the S.S. 'Santa Barbara'."
On Tuesday morning, however, the Port Administrator refused to permit the ship to dock, claiming that the Intendente had no authority to issue him an order. I entered into the picture at this juncture by attending with Mr. Glasinovic a strategy meeting with the shipping company's representative. It was agreed that if the ship could dock, its own cranes would unload the shipment onto AURA's own heavy duty trucks. After this meeting, I called on the Intendente and explained to him what a serious problem we had in hand. Meanwhile, the 'Santa Barbara' had reached the latitude of Coquimbo and was proceeding southward. The Intendente then managed to obtain agreement from the port authorities to ask the 'Santa Barbara' to stand by for three hours while the problem was brought up to the offices of the Presidency of Chile.

A flurry of telephone calls to Santiago by the Intendente followed, and he was promised that a telegraphic order would immediately be sent by the Minister of Transportation to the Coquimbo Port Administrator ordering him to admit the 'Santa Barbara'. Unfortunately, the expected telegram was not received by the end of the three-hour period in which the 'Santa Barbara' had stood by. Another visit to the Intendente and further calls to Santiago followed. As a result, the Minister of Transportation called the Port Administrator forthwith and the required orders were given. It was indeed a sight to see the giant freighter come into port and discharge that one single load in the late evening.

After all this activity, we were not able to remove our shipment from the dock area because of the strike. Understandably, the strikers were upset by their being by-passed in the unloading of this equipment. I had to visit the union offices and explain to them how much this meant to us and what a great favor it would be to the Observatory if they would interrupt the strike long enough for us to remove the equipment from the port. They called an extraordinary meeting of the union, and an hour later called to tell me the coast was clear.

Escorted by the police and a power company truck that could raise any low-lying electric power cables, the caravan finally left the port about 10:00 AM, July 10. Unfortunately, a nearby pedestrian overpass proved too low for our trucks to pass under. The route to be followed had been studied with care sometime previously and no difficulties had been foreseen. In the meantime, however, the Public Works Department had filled and oiled the road, raising its surface a good 20 inches at the critical location of the underpass. Fortunately, the required permits to dig up the road were promptly obtained, and the labor crew working on the CTIO headquarters building addition was diverted and put to work lowering the road level.
Three hours later the trucks went through (Fig. 6), and except for minor contretemps, such as tying up the traffic in the main street of La Serena, the load eventually reached the Tololo summit. There, our 50-ton crane lifted the aluminizing chamber parts off the trucks, through the 150-inch telescope building dome slit (Fig. 7), and lowered them to their final location in the first floor of that building.

"Later examination of the tank showed that progressive rust damage to certain critical flange surfaces was occurring because of rain water accumulated in the packing material. The cooperative efforts of many people helped to curb this damage."

Instrumentation and Research Programs

The IBM 1130 computer was delivered on September 1 and installation at La Serena headquarters was completed on September 9 (Fig. 8) under the supervision of Dr. W. E. Kunkel, Assistant Astronomer at CTIO. The computer operator is Mr. L. Pasten, a trained mathematician who has been assiduously studying about computers for some time in order to take on this new responsibility.

Much progress was made in aligning the optics of the 60-inch telescope coudé spectrograph components. This work was done by Dr. P. Osmer, Assistant Astronomer-CTIO, in collaboration with Dr. H. A. Abt of KPNO and Mr. F. Golden, a technical associate at CTIO.

Through the efforts of Mr. D. J. Ludden, senior engineer at CTIO, and F. Golden, the 60-inch aluminizing chamber has become an efficient tool. During August, all the optics of the 36-inch telescope, as well as the f/7.5 secondary and primary mirrors of the 60-inch telescope were re-aluminized.

Visiting Observers

In the following listing of observers and their programs, the first figure indicates the number of nights scheduled, the figure in parentheses is the hours of actual observing time logged, while the last figure denotes the aperture of the telescope in inches.

J. Barnes, Kitt Peak National Observatory, Tucson: Reddening of globular clusters; spectroscopy in Sco OB-1, 20(174)36.

E. Brandi, Universidad de La Plata, Argentina: Spectroscopy of variable stars, 12(92)60.

L. Cathey, Lick Observatory, Santa Cruz, California: UBV photometry of giant and subgiant stars in globular clusters, 6(13)36.
Fig. 6 - After prolonged and determined efforts, which involved some excavation work, the crucial moment arrived and the CTIO aluminizing chamber slid under the obstructing overpass in Coquimbo.
Fig. 7 - The CTIO aluminizing chamber being lowered through the dome slit of the 150-inch telescope building on Cerro Tololo.
Fig. 8 - Installation at La Serena of the new IBM 1130 computer for CTIO was completed on 9 September 1970.
C. Coutts, David Dunlap Observatory, Richmond Hill, Ontario, Canada: Variable stars in southern globular clusters, 10(107)24/36.

J. Drilling, Louisiana State University, Baton Rouge: Space distribution of stars at high galactic latitudes, 13(77)36.

R. Garrison, David Dunlap Observatory, Richmond Hill, Ontario, Canada: Spectral classification, a) of southern OB stars; b) in the Sco-Cen Association; and c) of Mira variables, 3(38)60, 5(70)36.

H. Moreno, Universidad de Chile, Santiago: Spectrophotometry of late-type stars, 11(49)36.


J. Stock, Universidad de Chile, Santiago: Spectroscopic observations of peculiar high-latitude stars, 5(28)60.

W. Stonacker, University of Arizona, Tucson: Multi-color photometry for stars brighter than 5.0 magnitude, 90(143)16.

R. Williamson, University of Florida, Gainesville: Variables BV 421 (U2 Oct) and TW Ceti, 5(7)16.

R. Wing, Ohio State University, Columbus: Infrared narrowband photometry of late-type stars, 8(45)36, 8(70)16.


Lowell Planetary Patrol Program: 86(228)24.

Michigan Program: 35(151)24/36.

Staff Observers

V. M. Blanco and E. Figueroa: Photography of galaxies, 5(38)60.

J. Graham: Galactic structure in Norma; photometry of high latitude blue stars; RR Lyrae stars in the Small Magellanic Cloud, 14(107)60, 6(37)36.

W. Kunkel: Search for optical counterparts of x-ray sources, 9(68)60.
P. Osmer: Narrow-band photometry of Magellanic Cloud supergiants, 8(59)60.

M. Smith: Radio source identification; Fabry-Perot spectroscopy of H II regions and planetary nebulae, 3(26)60, 5(36)36.

CTIO Publications

The issue of the series, Contributions from the Cerro Tololo Inter-American Observatory, has been modified in observance of the new policy established in March, 1970 and described under the KPNO Publications section of this report. The policy is effective for CTIO with Contribution No. 125.

Contributions from the Cerro Tololo Inter-American Observatory:


Other Publications:


Hesser, James E. and Lasker, Barry M.
"High Frequency Stellar Oscillations. IV. Photoelectric Monitoring of Southern White Dwarfs"
Int. Astron. Union Symp. No. 42: White Dwarfs

Kunzel, William E.
"On the Existence of an Upper Limit in the Activity of Solar Neighborhood Flare Stars"

Landolt, Arlo U.
"Time of Minimum for WY Hydrae"
Int. Astron. Union Bull. on Variable Stars No. 445
July 8, 1970

Landolt, Arlo U.
"Photoelectric Time of Minimum for AI Crucis"
Int. Astron. Union Bull. on Variable Stars No. 446
July 8, 1970

Administrative Activities

In connection with their administrative duties, the following AAO staff members traveled to CTIO during the last quarter:
Mr. J. M. Miller, July 22-28, Mr. I. G. Blevins, July 22 - August 19, Dr. N. U. Mayall, August 23-27, and Mr. L. Randall, September 21-26.

Attending the AURA Executive Committee meetings in Tucson in late September were Dr. Victor M. Blanco, Director-CTIO, and Mr. Oscar Kolbach, AURA's legal counsel in Santiago, Chile.

Construction

The technicians' dormitory at Cerro Tololo is now receiving finishing touches on the two wings completed so far, with occupancy hopefully planned for November 1970.

For the office addition to the La Serena headquarters building, all interior partitions have been erected and the roof beams laid in place.

The exterior of the 150-inch telescope building is now complete and work is progressing on the interior details.
Excavation of a cable trench was begun in August to interconnect instrumentation at the 60-inch and No. 1 16-inch telescopes with the Nova computer data control system, which is housed in the 36-inch telescope building. The section extending to the 150-inch telescope building will be installed later.

Library Acquisitions

During the report period, three shipments of library materials were received from the Kitt Peak National Observatory, with journals and publications for the La Serena headquarters and Cerro Tololo libraries, in addition to the materials received regularly by air mail. On August 26, architect Giorgio Energicici presented a preliminary study for the future library expansion, planned to accommodate 7500 to 8000 volumes, as well as to provide reading areas.

Personnel

Mr. and Mrs. L. Marmont returned to the United States on July 15 after a 12-month stay at CTIO, during which time Mr. Marmont served as Inspector on the 150-inch telescope building project, as well as on other construction efforts. His replacement, Mr. G. Ingram, arrived with his family on July 14.

Dr. Malcolm G. Smith, Assistant Astronomer-CTIO, and Miss Ana Maria Marabolf, Scientific Secretary-CTIO, were married at the Santo Domingo Chapel on August 8. The bride was given away by her parents, and the groom by Sra. Juanita Muñoz and Dr. V. M. Blanco.

Cerro Tololo Weather

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<th>Temperature</th>
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<th>September</th>
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<td>21°.1C</td>
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<tr>
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In July and August, 21.5mm of rain and 6.5cm of snow fell on Tololo. On August 10, rain amounting to 9mm fell in La Serena. These are the first appreciable traces of precipitation measured in three years. The prolonged lack of precipitation has now affected the La Junta springs, which have been under study as a possible new source of water for Cerro Morado and Cerro Tololo. Since the Los Placeres spring dried up, water for Cerro Tololo is trucked from the Elqui River.
Public Visitors

Public visitors to the Observatory numbered 307, 370, and 237 during July, August, and September, respectively.
CERRO TOLOLO INTER-AMERICAN OBSERVATORY

PERSONNEL SUMMARY
AS OF
September 30, 1970

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<th>Engineers</th>
<th>Physicists</th>
<th>Others</th>
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*Note for this report: (1) Dr. Blanco included w/Admin. Division
(2) Ludden & Golden included in Engineering.

Vacancies:
(a) Scientific = 1 Night Assistant
(b) Mechanical Engineer = Position committed to Juan Schmalz who went on payroll 10-1-70
(c) Administration = 3 (1) Accounting Clerk
(l) Inventory Clerk
(1) Computer Programmer
(d) Mountain Operations = 2 Janitors

copies:
Dr. Mayall
Dr. Blanco
Mr. Miller
Mr. Erickson

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