New Mexico.—A method of stellar model construction is described which allows easy steps from one model to the next in the course of evolution of a stellar mass. The equations which are solved simultaneously at each time step by using the IBM 704 are the following: the radiation flux equation, an approximate convective flux equation, the electron heat conduction equation, the equation of momentum conservation, and the conservation of energy equation. The calculation is done in a Lagrangian coordinate system making the conservation of mass equation very simple. Standard energy generation expressions are used. We have calculated the equations of state and opacities as needed. These data include, among other details, the effects of radiation pressure and energy, and those of electron degeneracy. Solution of these simultaneous equations at each time step allows one to watch the one-space-dimensional relaxation of stellar mass to its equilibrium in all the nonlinear nonadiabatic detail. Some results for one solar mass are given.

H-Beta Photometry for the Association I Lacertae. D. L. CRAWFORD, *Kitt Peak National Observatory and Arthur J. Dyer Observatory, Vanderbilt University.*—The association I Lacertae has been studied recently by R. H. Hardie and C. K. Seyfert (1959, *Astrophys. J.* **129**, 601). They utilized objective prism spectra and *U*, *B*, *V* photometry to obtain an H-R diagram. The present paper may be considered an extension of that work, employing new observational data.

All stars earlier in spectral type than A0 were measured with conventional H-beta filter (Crawford, D. L., 1958, *Astrophys. J.* **128**, 185). In addition, a few stars later than A0 and lying above the observed main sequence were measured as a test for membership. Membership of some late B-type stars in the dispersed area of the association has also been tested.

A revised list of members is presented, and a new H-R diagram shown.

The Extreme Ultraviolet Spectrum of the Sun. C. R. DETWILER, J. D. PURCELL, AND R. TOUSEY, *U. S. Naval Research Laboratory.*—Spectra obtained with a normal incidence grating spectrograph on April 19, 1960 confirmed all the emission lines appearing in the March 13, 1959 spectrum and added many new lines, extending to 500 Å. The identified lines are almost all resonance and low excitation potential lines of the abundant light elements through sulfur. About 30 lines have not yet been identified. Limb effects can be seen in several lines. New lines include the resonance lines of SiXII at 499 and 520 Å.

The 1960 spectrum was obtained free from stray light by double dispersion. It reveals a solar continuum extending to 1000 Å. The intensity is en-

hanced near Lyman- α and this may be the charge transfer continuum of H_2^+ . Below 1525 Å the continuum is free of Fraunhofer lines. However, it shows H_2O absorption bands produced by water from the rocket. The Lyman continuum is also present, and shows absorption by N_2 .

Two New Applications of 21-Cm Absorption Measurements. NANNIELOU H. DIETER, *Air Force Command and Control Development Division, L. G. Hanscom Field, Bedford, Massachusetts*, AND BRUCE C. MURRAY, *Air Force Research Division, L. G. Hanscom Field, Bedford, Massachusetts.*—The annual and diurnal motions of the earth produce corresponding variations in the observed frequency of 21-cm absorption lines present in the spectra of discrete radio sources. These lines result from absorption by neutral hydrogen clouds lying between the discrete source and the observer, and at a central frequency corresponding to the relative radial velocity of the earth and the absorption cloud. Lilley and Brouwer are already instrumenting an observation of the annual frequency shift to obtain an improved value of the solar parallax. The present paper proposes two other new applications of precise frequency variation measurement.

Measurements of both annual and diurnal frequency variations can yield apparent positions of the absorbing hydrogen clouds. The apparent positions of the clouds include, however, the aberration due to the relative motion of the cloud with respect to the earth. Measurements by long-wavelength interferometry, on the other hand, yield apparent positions of the same discrete sources which include aberration caused by the relative motion of the source with respect to the earth. Consequently, comparison of Doppler-derived apparent source positions with those obtained by interferometry will give the difference in proper motion between the source and cloud.

An indirect test of the transverse Doppler effect predicted by the special theory of relativity is also proposed. This test is based upon a comparison of the measured annual frequency variation with that corresponding to the value of the astronomical unit obtained independently by improved radar-ranging techniques.

A Uniform Statistical Analysis of Jovian Decameter Radiation, 1950–1960. JAMES N. DOUGLAS, *Yale University.*—A permanent IBM-card catalogue has been initiated of all of the known Jupiter decameter radio noise storms, kindly made available by C. Shain, B. Burke, K. Franklin, R. Gallet, J. Kraus, G. Reber, A. Smith, and T. Carr, and supplemented with four years of multichannel observations at Yale. Uniform statistical analysis of this material establishes the radio (presumably also the solid-body)

rotation period of Jupiter as $9^h55^m29^s.37 \pm 0^s.16$ s.d. A provisional definition of "radio longitude" follows as $\lambda_r = \lambda_{II} + 0.2742 (t - 2433339.5000)$, with λ_r the radio longitude, λ_{II} the familiar System II longitude, and t in Julian days. Within the precision of the existing data, the period has been constant over the ten years of observation from 1950 to 1960, over the frequency range from 18 to 27 Mc, and for the three principal regions of emission whose radio longitudes are $76^\circ \pm 13$, $178^\circ \pm 7$ and $254^\circ \pm 15$. The width of the major, 178° , peak declines with frequency as noted by other observers, being 60° at 18 Mc, 47° at 20 Mc and 40° at 22.2 Mc. It is interesting to note that the two minor peaks are separated by 180° in longitude. While the three peaks are usually well defined, there is evidence that they may not be completely independent. The shape of the occurrence-frequency histogram correlates significantly with the solar elongation of earth as seen from Jupiter. Also in the combined data there appears to be a significant correlation with solar activity, delayed three or four days, in general agreement with Warwick's findings.

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Solar Radio Burst Measurements on 0.43-, 3.15- and 9.4-Cm Wavelengths. S. EDELSON AND C. GRANT, *Radio Astronomy Branch, U. S. Naval Research Laboratory, Washington 25, D. C.*—Analyses of a series of solar outbursts observed on 0.43-, 3.15- and 9.4-cm wavelengths between November 30, and December 3, 1959 at the U. S. Naval Research Laboratory, strongly suggests that the projected positions of all the radio sources were located in $H\alpha$ flares occurring in the McMath plage region 5476. The active areas most closely associated with the radio sources were determined by correlating the $H\alpha$ light curves with the radio flux curves.

The average solar flux levels at the times just preceding each of the disturbances were $(6800 \pm 600) 10^{-22}$, $(248 \pm 12) 10^{-22}$ and $(234 \pm 8) 10^{-22}$ $\text{w m}^{-2} (\text{c/s})^{-1}$ on 0.43, 3.15, and 9.4 cm, respectively. The maximum total solar flux at the times of the disturbances ranged from $>14\,000 \times 10^{-22}$ to 6300×10^{-22} on 0.43 cm, $>850 \times 10^{-22}$ to 420×10^{-22} on 3.15 cm, and $>1630 \times 10^{-22}$ to 280×10^{-22} $\text{w m}^{-2} (\text{c/s})^{-1}$ on 9.4 cm.

A comparison of the average solar flux levels with the spectrum of the quiet sun extrapolated to 0.43 centimeters shows that there was no detectable increase in the thermal emission at 0.43 cm. Solar flux calculations at 0.43 cm, based on measurements made between April 29 and June 1, 1960, yielded a value of $(6820 \pm 600) 10^{-22}$ $\text{w m}^{-2} (\text{c/s})^{-1}$. In order to detect a slowly varying component, at 0.43 cm, which may be considerably less than the uncertainty

of $\pm 600 \times 10^{-22}$ $\text{w m}^{-2} (\text{c/s})^{-1}$, systematic observations over a longer period may be necessary.

Brightness temperatures of the radio-burst sources were deduced from the measured flux increase at each wavelength, and the assumed source size. Diameters of the radio sources of about $\frac{1}{4}$ minute of arc were inferred from the discrete $H\alpha$ correlating regions, and calculated on the assumption that they were radial projections above the optical area and were at heights of 20 000 km at 0.43 cm, 30 000 km at 3.15 cm, and 37 000 km at 9.4 cm. The 3.15-cm height was interpolated using the measured time differences between the peak flux at each of the wavelengths observed in the December 1 event. The following brightness temperatures thus deduced: 3.5×10^7 to 1.8×10^8 at 0.43 cm, 6.0×10^8 to 1.8×10^9 at 3.15 cm, and 4.3×10^9 to 3.1×10^{10} °K at 9.4 cm, suggest that this enhanced radiation is probably arising from nonthermal emission.

On the Reduction of Photographic Star Positions and Proper Motions. HEINRICH K. EICHORN, *Van Vleck Observatory, Wesleyan University.*—It is shown that a considerable increase in systematic accuracy can be obtained in photographic position work by eliminating the systematic errors which result between the positions of the same stars as obtained from overlapping plates with different centers.

Technically, a strict least-squares solution for this problem will necessitate the solution of a system where the number of unknown coordinates is equal to the total number of stars plus the number of stars times plate constants. This method lends itself particularly well to the reduction of photographic star catalogues.

A rigorous solution of this system can be easily and practically obtained by iterations which will always converge. Theoretical investigations show that the accuracy to be expected from a solution of that kind can be predicted under the assumption of a smooth distribution of stars. The application of this principle (the practical application of which requires an electronic computer) to parallax work not only increases the accuracy of the parallaxes thus obtained, but also yields accurate positions and motion of the comparison stars, which are very often urgently needed for the determination of mass ratios if observation series from different instruments are to be combined in one solution.

Polarization Measurements from the 2 October 1959 Eclipse. WILLIAM E. FELLING AND MICHAEL WITUNSKI, *McDonnell Aircraft Corporation, Research Department, St. Louis, Missouri.*—During the total solar eclipse of 2 October 1959, a joint McDonnell Aircraft Corporation-USAF Air Research