very small angular diameter (Allen *et al.*, *Monthly Notices Roy. Astron. Soc.* **124**, 477, 1962). Thus the drop in decametric spectra appears definitely to be a function of brightness temperature, not necessarily a function of the quasi-stellar nature of the source.

On the other hand, we find that several source spectra curve upward at decameter wavelengths. The most striking example of this is 3C84, whose flux at 26.3 Mc/sec is 2.5 times higher than its extrapolated Conway, Kellerman, and Long spectrum would predict. 3C84 is identified with the Seyfert galaxy NGC 1275. Preliminary data concerning the decametric spectra of other sources are presented.

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Early Contraction Phases of Stellar Evolution.

D. EZER AND A. G. W. CAMERON, *Institute for Space Studies, Goddard Space Flight Center, NASA*.—Evolution of stars in the mass range $0.5 M_{\odot}$ – $100 M_{\odot}$ has been investigated for the stages of gravitational contraction, approach to the main sequence, and on the main sequence. Each evolutionary study is started when the star becomes stable against gravitational collapse from energy considerations. The initial composition used is $X = 0.739$ for hydrogen, $Y = 0.240$ for helium, and $Z = 0.021$ for heavy elements. The ratio of the mixing length to pressure scale height is taken as equal to 2 in the treatment of convection because this gives an approximate fit to the present properties of the sun. The effect of mass loss during the gravitational contracting phase has been neglected. In each case, there is an almost vertical path corresponding to the evolution in the fully convective gravitationally contracting phase; the path becomes shorter as the mass of the star increases. The time the star spends during this phase is only of the order of a few tens of years for $50 M_{\odot}$ and $100 M_{\odot}$. The fully convective phase is followed by a radiative phase, in which the paths are nearly horizontal for the massive stars and increase slowly in luminosity for low-mass stars. The time required for the onset of energy generation by hydrogen-burning reactions ranges from 3×10^3 to 5×10^6 yr for the mass range of $100 M_{\odot}$ to $0.5 M_{\odot}$.

Coupled Oscillations and Secular Variation in VX Hydrae. W. S. FITCH, *Steward Observatory*.—1288 yellow photoelectric observations of the intrinsic variable VX Hydrae, obtained between December 1954 and March 1959, are discussed.

The complex light variation, closely resembling that of AI Velorum, can be accurately reproduced by fitting with least-squares the observed yellow luminosity to a double harmonic expansion in time with

frequencies $(jn_0 + kn_1)$, where $j(\geq 0)$ and k are integers, and $n_0 = 4.47650$ cycles/day and $n_1 = 5.78979$ cycles/day are the frequencies of fundamental and overtone, respectively. Designating the order of a term by $m = j + |k|$, a fourth-order fit gives an excellent representation of the light variation. In each order above the first, terms representing cross-coupling ($j \neq 0$ and $k \neq 0$) generally dominate terms representing self-coupling ($j = 0$ or $k = 0$).

During the first and last observing seasons the amplitudes of both fundamental and overtone were smaller than during the three intermediate seasons, and the phase zero points also differed significantly. By themselves, these phase variations indicate a secular decrease in frequencies of both fundamental and overtone, given approximately by $\dot{n}_0/n_0 = -4 \times 10^{-6}$ yr $^{-1}$ and $\dot{n}_1/n_1 = -7 \times 10^{-6}$ yr $^{-1}$, respectively. The former would imply an expansion of the star at the rate $\dot{R}/R = +3 \times 10^{-6}$ yr $^{-1}$.

However, some periodic variation with period of the order of eight years or longer might instead be the cause of the observed changes in both amplitudes and phase zero points, and the present observations do not suffice to distinguish between these possibilities.

Evidence for a Supernova of A.D. 1006. BERNARD R. GOLDSTEIN, *Yale University*.—(See *Astron. J.* **70**, 105, 1965 for article.)

Density and Color Distribution of Light in the Earth's Shadow. JAMES E. HANSEN AND SATOSHI MATSUSHIMA, *The University of Iowa Observatory*.—A computer program has been written for an IBM 7040 to calculate the density of light for various spectral regions in the earth's shadow. By extending the analytical method developed by Link (*Ann. Geophys.* **4**, 47, 1948), the calculation is carried out by performing a double numerical integration over various detailed models of the earth's atmosphere. As sources of the attenuation of light, ozone absorption, dust extinction, and diffusion are taken into account in addition to the Rayleigh scattering and the atmospheric refraction.

Special emphasis is placed on finding an explanation for the unusually dark and apparently nonreddened shadow observed during the eclipse of 30 December 1963, in which the brightness decrease was found to be approximately a factor of 100 larger than normal (S. Matsushima and J. R. Zink, *Astron. J.* **69**, 481, 1964).

Different models of the earth's atmosphere are considered and it is shown that the dust and water vapor particles, both of which are variable in content and particle size, may account for very large changes in the total light density from eclipse to eclipse. Al-