Computation of Planetary Theories. LLOYD H. CARPENTER (introduced by Robert C. Cameron), *Goddard Space Flight Center*.—Theories of the motion of planets in the form of trigonometric series with numerical coefficients and arguments which are linear functions of the time are being obtained using an IBM 7094 program. The developments are done in rectangular coordinates (Musen, P., and Carpenter, L., "On the General Planetary Perturbations in Rectangular Coordinates," *J. Geophys. Res.* **68**, 2727, 1963). The first-order coefficients obtained using this method are equivalent, term by term with those corresponding to the method of P. A. Hansen as used by G. W. Hill in his theory of Jupiter and Saturn (*Astron. Papers Am. Ephemeris*, **IV**, 1890) and by G. M. Clemence in his theory of Mars (*Astron. Papers Am. Ephemeris*, **XI**, Part II, 1949 and **XVI**, Part II, 1961). All of the first-order parts of Hill's theory of Jupiter and Saturn and Clemence's theory of Mars have been duplicated as a test of the program. These comparisons demonstrate that the accuracy attained by the program is comparable to that of the most accurate theories previously computed. The computer time required for each case depends on the number of special values used in double harmonic analysis and the number of coefficients computed in the expansions. An average time for first-order perturbations due to Jupiter is one minute. A sound basis has been established for computing higher-order effects.

Atmospheres of the Metallic-Line Stars in the Hyades. PETER S. CONTI (introduced by George Wallerstein), *University of California, Berkeley* (present address: California Institute of Technology).—A spectrophotometric study of five metallic-line stars in the Hyades star cluster is undertaken to determine the abundances of elements with respect to a normal star of the cluster, 45 Tauri. The equivalent widths of over 400 lines in the wavelength range $\lambda\lambda$ 3900–6800 Å are used. Effective temperatures are derived from photoelectric six-color observations. Model atmospheres with these temperatures, and gravities derived from a mass luminosity relation are constructed by using a scaled solar $T(\tau)$ and extensive opacity tables. The exact state of ionization of each ion is determined from the model atmosphere and a weak line approximation is used to determine the predicted shift in a curve of growth. Abundances are derived by a comparison between this and the observed line strengths.

Several types of model atmospheres are investigated: normal dwarfs; those of effective gravity decreasing outwards through the atmosphere; those of a higher boundary temperature than a scaled

solar $T(\tau)$; and those of 80% helium abundance. It is concluded that none of these models or likely combinations thereof can lead to an explanation of the well-known observed deficiencies of calcium in metallic-line stars in terms of atmospheric structure. Models with a slightly lower effective gravity in the atmosphere than that obtained from a mass-luminosity relation fit somewhat better the observed neutral-ionized line strengths. It is possible that iron is overabundant by a factor of 2 or 3 in the hotter metallic-line stars. The elements lighter than iron are generally underabundant with respect to iron and heavier elements are overabundant.

Stability of the Triangular Points in the General Three-Body Problem. J. M. A. DANBY, *Yale University Observatory*.—It is well known that a possible solution to the problem of three bodies is one in which the three bodies lie at the apices of a rotating equilateral triangle. If the mass of one of the bodies is negligible, and the relative orbit of the other masses is a circle, then it is known that the negligible mass is in stable equilibrium at the triangular point, provided μ , the ratio of the lighter mass to the total mass, is less than 0.038. . . . Here "stability" is interpreted in the restricted sense that only infinitesimal displacements are considered. If now the two finite masses have as relative orbit an ellipse, of eccentricity e , it is possible to find a boundary in the μ - e plane within which the triangular point is stable. This boundary cuts the μ axis at the value given above, and also for $\mu=0.0285$ . . . , where one of the periods of the displaced motion is twice the period of the relative orbit of the massive bodies. In this case the onset of instability must be due to resonance. It is also found that stable points exist for $\mu>0.038$ . . . .

When all three bodies have finite masses, the condition for the stability of the relative configuration in the circular case is

$$(m_2m_3+m_3m_1+m_1m_2)/(m_1+m_2+m_3)^2 < 1/27,$$

where m_1 , m_2 , and m_3 are the masses. If the unit of mass is defined to be the sum of the masses of the bodies, then the boundary separating the regions of stability and instability in the m_2 - m_3 plane is

$$f(m_2, m_3) \equiv m_2 + m_3 - m_2^2 - m_3^2 - m_2m_3 = 1/27.$$

It has been established now that in the elliptic case all such boundaries are of the form

$$f(m_2, m_3) = \text{const.}$$

Ages of Old Clusters. P. R. DEMARQUE AND R. B. LARSON, *David Dunlap Observatory*.—The ages of old star clusters are determined from theo-