between a mean orbit M and the orbits of member meteors N has a mean value of 0.09, and more than 90% of the values are ≤ 0.20 . It seems reasonable to adopt $D(A, B)$ as a criterion for the identification of members of a stream. We have found all pairs of orbits for which $D \leq 0.20$ within a random set of 360 meteors photographed with the Baker Super-Schmidt cameras. Thirteen percent of the set had previously been known to belong to "major" streams, i.e., those streams of high hourly rate. Forty percent more of the meteors were now found to be associated into 32 minor streams, of which only 6 had previously been recognized among photographic meteors. A control experiment, seeking associations among random artificial meteors, shows that 80% or more of the minor streams found are genuine. The internal dispersion of the minor streams approximated twice the dispersion in major streams. The groups form a new class of streams. They have very broad radiant areas and protracted showers at very low hourly rates. We may recognize these groups as streams which have undergone more dynamical aging processes than the major streams, but which have not wholly dispersed into sporadic orbits.

A New Spectrum of CH_2 in the Region 6000–9000 Å. G. HERZBERG, *National Research Council, Ottawa, Canada*.—A year ago a spectrum was found [G. Herzberg and J. Shoosmith, *Nature* **183**, 1801 (1959)] near 1400 Å which on the basis of its fine structure could be definitely assigned to CH_2 . More recently, under conditions very similar to those used for obtaining the 1400 Å group (flash photolysis of CH_2N_2 at partial pressures of about 0.02 mm in the presence of a large excess of inert gas), a new spectrum was found in the region 6000–9000 Å which consists of a large number of absorption bands with wide and somewhat complicated fine structure. The spectrum is similar in appearance to the α bands of NH_2 . A preliminary analysis suggests strongly that the lower state is the expected lowest singlet state 1A_1 of bent CH_2 , while the lower state of the 1400 Å group is the $^3\Sigma^-$ state of linear CH_2 . The existence of two kinds of CH_2 , a bent and a linear form corresponding to the lowest singlet and triplet state, respectively, is in accordance with what might be expected from theory. From the slight difference in the conditions of production of the two absorption spectra of CH_2 it appears likely that the $^3\Sigma^-$ state is the lowest. Because of the low excitation energy of the first singlet state above the triplet ground state it is likely that the red bands will turn out to be of some astrophysical interest. They might be expected to be observable in emission in the spectra of comets, and in absorption in the spectra of the outer planets and of low temperature carbon stars. In order to assist in possible identifications, a table of the strongest lines of the new CH_2 bands will be presented.

An Accurate Position Determination for a Strong Component of Cygnus X. R. W. HOBBS (introduced by FRANK D. DRAKE) *Case Institute of Technology*.—Results of a study made at the National Radio Astronomy Observatory, Green Bank, West Virginia, show that a strong radio source in Cygnus X coincides in position with a nebula apparently associated with the F8 Ib star γ Cygni. Observations were made with the 85-ft parabolic antenna which has a beamwidth of 7 minutes of arc at the wavelength used, 3.75 cm. Observations consisted of right ascension and declination drifts across the position of γ Cygni. Position calibrations of the antenna were made using the position of Cygnus A as a standard; temperature calibrations were made using a 1°K source in the receiver. The Naval Research Laboratory absolute flux measurement of Cassiopeia A was used to determine antenna aperture efficiency. The right ascension and declination drifts were reduced, and Gaussian curves fitted to the results by least squares. These gave the position of maximum antenna temperature at right ascension $20^h 33^m \pm 1^s$ and declination $40^\circ 2.9' \pm 1.0'$ (1950.0). The probable errors are those of the position standard, Cygnus A. The position of the maximum is 1.1 minutes east and 3 minutes

south of γ Cygni, very near a nebula apparently associated with the star.

The Critical Inclination Case of the Motion of an Artificial Satellite. GEN-ICHIRO HORI, *Yale University Observatory*.—The ordinary procedure in developing the perturbations in the motion of an artificial satellite by a method of canonical transformations is to develop the determining function in powers of the small parameter that is a factor of the second harmonic in the earth's potential. If the inclination is close to the critical inclination, $I_c = \cos^{-1}[1/(5)^{1/2}]$ a small divisor arises which may make the developments illusory. It is shown that this difficulty may be avoided by developing the determining function in powers of the square root of the small parameter. The solutions in the vicinity of the critical inclination may be divided into three types: the libration case, the transition case, and the nonlibration case, depending on the proximity of the inclination to its critical value. The fourth harmonic of the earth's potential is included in the solution because it turns out to be equally important as the second harmonic in this aspect of artificial satellite motion. In a preliminary study of the problem, results valid as far as the square root of the small parameter have been obtained; parts of higher order have been omitted. The solutions are expressed with the aid of elliptic integrals in all cases; in the transition case the elliptic integrals degenerate to elementary functions.

Individual Characteristics of Meteor Families. LUIGI G. JACCHIA, *Smithsonian Astrophysical Observatory*.—An analysis has been made of the heights of appearance of 392 Super-Schmidt meteors. The light curve of all meteors was accurately determined and reduced to a standard meteor distance of 100 km. To eliminate instrumental and transparency effects, the "height of appearance" of a meteor was defined as the height at which its absolute photographic magnitude reached $+2.5$ on the ascending branch of the light curve. When this quantity, $H_{2.5}$, is plotted against the apparent meteor velocity, two effects emerge: (a) Meteors which reach greater maximum brightness appear at greater heights (about 1.5 km higher for each magnitude); (b) Meteors with long-period orbits appear at systematically greater heights than meteors of the Jupiter family; the difference is about 3 km. The first effect is predicted by classical meteor theory. The second effect can be connected with the individual characteristics of shower meteors previously found by the author.

The Basic Escape Rate of Stars from Clusters. IVAN KING, *University of Illinois Observatory*.—In the escape of stars from an isolated cluster the basic mechanism is the relaxation of a velocity distribution as a result of stellar encounters. All estimates of the rate of escape of stars therefore contain a multiplicative factor that expresses this relaxation rate. Short of solving the entire problem of the dynamics of an isolated cluster, the best method of estimating this basic escape rate is to solve an idealized problem that represents the relaxation process without any further dynamical complications. This idealized problem is to find a velocity distribution in which encounters maintain a steady state, subject to a cutoff at the escape velocity. As stars disappear at the cutoff, the total number of stars decreases while the shape of the velocity distribution remains unchanged. The problem has been solved previously under the assumption that the stars under consideration encounter another group of stars having a Gaussian velocity distribution. The present paper removes this restriction and treats the case of a group of stars encountering each other, so that the unknown velocity distribution in the Fokker-Planck equation appears not only in the usual derivatives but also in the encounter integrals. The usual separation-of-variables technique can be used, but a scale change in the velocities must be included, in order to conserve total energy as high-speed stars disappear across the cutoff. The resulting solution gives an escape rate about 50% higher than that recently found by Spitzer and Härm. The escape rate depends somewhat on the