wavelengths of 3.2 and 9.1 cm, the radio source has a size of about 3 minutes of arc, while at 21 cm it has a size of about 4 minutes of arc. The average height above the photosphere is 19 000 km at 3.2 cm and 27 000 km at 9.1 cm. Flux density of the source associated with a sunspot area of 1000 millionths is about $25 \times 10^{-22} \text{ W m}^{-2} (\text{cps})^{-1}$ at 9.1 cm and about $20 \times 10^{-22} \text{ W m}^{-2} (\text{cps})^{-1}$ at 3.2 cm. For three sources the flux density was appreciably higher at 9.1 cm than at 3.2 cm. This cannot be explained by assuming greater optical depth for the extraordinary wave at 9.1 cm since the degree of polarization seems to be much smaller at 7.5 or 9.1 cm than at 3.2 cm. It is suggested that the increased radiation near 9 cm arises from the resonance absorption at harmonics of gyrofrequency.

Polarization Measurements of Solar Emission at a Wavelength of 9.1 cm. T. KAKINUMA and G. SWARUP, *Radio Astronomy Institute, Stanford University*.—A phase-switched interferometer has been used to measure the polarization of solar radio emission at a wavelength of 9.1 cm. The interferometer provides resolution of about 1.5 minutes of arc and the resulting high-resolution observations show that the north and south pole regions of a bipolar sunspot group give rise to right-handed and left-handed circular polarization, respectively. Contrary to the theory of Piddington, and supporting eclipse observations made in Japan, the sense of polarization remains the same irrespective of the quadrant in which the north or south pole region is located. The results of a comparison made between the 9.1-cm polarization observations made at Stanford and 3.2-cm observations made at Nagoya are also described.

The Structure and CO_2 Content of Venus' Atmosphere. LEWIS D. KAPLAN, *The Rand Corporation and Department of Meteorology, Massachusetts Institute of Technology*.—The Venus spectra of Kuiper and that of Strong and Sinton have been reinterpreted with the aid of laboratory CO_2 absorption measurements by Howard *et al.* and Kostkowski and the results of the Regulus occultation measurements. A self-consistent picture is obtained for the part of the Venus atmosphere above the "effective reflecting level" for near-infrared radiation.

This effective reflecting level is at about 400 mb, and is most likely composed of sand or dust stirred up from the surface. The emission around 10μ is from a thin cloud layer at 90 ± 50 mb, where the temperature is $230 \pm 5^\circ \text{K}$. It may be composed of ice crystals, and is presumably the visible cloud.

The fraction by volume of CO_2 is $15 \pm 7\%$.

A Uniformly Valid Asymptotic Representation for All Times of the Motion of a Satellite in the Vicinity of the Smaller Body in the Restricted Three-Body Problem. JIRAIR K. KEVORKIAN, *Aero/Astrodynamic Section, Douglas Aircraft Company*.—This analysis proceeds from the differential equations governing the restricted three-body problem. The equations are given in nondimensional variables, and contain a small parameter equal to the ratio of the masses of the planet and sun.

Certain concepts originally developed in the study of the asymptotic solutions of fluid-mechanical problems are introduced. In particular, the connection between the solution of an approximate differential equation and the corresponding exact solution is related to the limit process by which the approximate differential equation was obtained from the exact equation.

It is shown that Hill's equations can be derived by such a limit process from the restricted three-body equations. When the motion is confined to a smaller neighborhood of the planet, an analogous limit process exists, and leads to a set of simpler equations for which the intermediate orbit is Keplerian in an inertially oriented frame. These approximate differential equations are transformed to an appropriate coordinate system containing unknown uniform precessions for the node and line of apsides.

It is shown that by requiring the motion to be bounded for all time, one can uniquely define these precessional rates and obtain a uniformly valid asymptotic solution for the motion.

The results obtained for the precessions of the node and perigee agree exactly with those of the classical lunar theories (e.g., de Pontecoulant).

The solutions are only carried out for the case where the inclination of the satellite orbit with respect to the plane of the ecliptic is small. However, the proposed method can readily be generalized to the case of arbitrary inclination.

A Method for Computing Monochromatic Fluxes in Model Stellar Atmospheres. S. S. KUMAR, *Smithsonian Astrophysical Observatory*.—The usual numerical procedures for obtaining accurate monochromatic fluxes for a given model atmosphere are very lengthy. Here is presented an analytical method that is quick and that gives the following simple expression for the monochromatic flux for any frequency and at any optical depth:

$$F_\nu(\tau_\nu) = \sum_i a_i(\nu) \Phi_i, \quad (1)$$

where Φ_i are the known Φ operators of the simple functions like τ_ν^m , $E_n(\tau_\nu)$ and $e^{-d_p \tau_\nu}$. By solving a set of algebraic equations, one obtains the a_i 's. This set of algebraic equations is obtained by assuming

an analytical expression for the monochromatic source function.

The method is very general and can simultaneously handle both scattering and pure absorption. The method was applied to a model atmosphere for which accurate monochromatic fluxes had been computed by a conventional numerical procedure. For the monochromatic source function, we tried several analytical expressions, such as

$$S_\nu = a_0 + a_1\tau_\nu + a_2E_2(\tau_\nu) + a_3E_3(\tau_\nu). \quad (2)$$

We found that, with a suitable expression for the source function, one can obtain fluxes that are quite accurate. We tried terms like $e^{-d\tau_\nu}$ and τ_ν^m in the expression for the source function, and we needed both Φ and Λ operators of these functions in this method. Therefore, we prepared extensive tables for Φ and Λ operators of $e^{-d\tau}$ and τ^m . These tables will also be of some use in deriving nongray temperature distribution by the analytical methods (such as Swihart method) in which we represent the approximate temperature distribution by an analytical expression containing terms of the type $e^{-d\tau}$ and τ^m .

Some Studies on the Occurrence of Type IV Solar Bursts of Continuum Radiation. M. R. KUNDU, *The University of Michigan*.—It is shown that type IV emission in the range of frequencies 25–580 Mc occurs in two distinct phases: (a) the first phase, usually observed at frequencies higher than about 250 Mc, appears to be an extension of the associated centimeter-wave burst which is also a broad-band continuum emission. This emission occurs earlier than the associated type II burst and can even occur independent of any type II burst. The source of this emission is situated low in the chromosphere, has no significant movement and has a small angular size, usually less than $4'$. The observed properties of this phase of continuum emission are consistent with the suggestion that it is caused low in the chromosphere by synchrotron radiation of electrons generated during the flare. (b) The second phase, usually observed at frequencies lower than about 250 Mc, is closely associated with a type II burst preceding it. The source of this continuum emission is situated high in the corona and moves with velocities of more than 1000 km/sec. It has a large angular size, usually $10'$ or larger. This second phase of type IV emission was previously explained as due to synchrotron radiation of electrons higher in the corona, when a cloud of gas with a shock front (which excites the type II burst) moving at high velocities carries a frozen-in magnetic field to the appropriate heights in the corona.

The Calculation of Velocity from an Ephemeris.

E. R. LANCASTER, *General Electric Company, Philadelphia, Pennsylvania*.—Explicit formulas are derived which give the velocity of a body in space in terms of its coordinates in an ephemeris. For n position vectors in an ephemeris, the formulas are of order $3n-1$, whereas the customary formulas are of order $n-1$. This additional increase in accuracy is achieved by including the equations of motion. Analytical error formulas are derived. The formulas make possible a great reduction in interval size of an ephemeris.

On the Accuracy of Measurements Made upon Films Photographed by Baker-Nunn Satellite Tracking Cameras.

KAROLY LASSOVSKY, *Smithsonian Astrophysical Observatory*.—The photographs taken by the Baker-Nunn cameras of the Smithsonian Astrophysical Observatory were formerly measured with Van Biesbroeck goniometers, but are now measured exclusively with Mann two-screw comparators. Instead of measuring point images, we usually have to measure oblong images, either trails or breaks (the latter produced by interruption of the exposure). We can therefore expect that the accuracy of the determination of their positions is more influenced by the personal errors than it is in conventional astrometry. Approximately 800 measurements were made on 34 images of different length, and from these the frequency distribution of settings was determined. Then the relationship between this distribution and the length of the image (trail or break) was examined, and the relationship between the "magnitude error" and the length of image was determined. Measurements were made at different angles formed by the trails and the reticle lines, and it was found that the accuracy was not affected by the angle of the setting. Position determinations have been made using reference stars at different distances. On the basis of these results we can conclude that the accuracy is neither influenced by the distortion of the emulsion nor by the optical distortion within an area of a diameter of 5 cm ($5^\circ.8$). We believe that we are justified in using the linear plate-constant method, at least within this area. From numerous double and multiple measurements the following standard errors were determined for a single position:

	μ_α	μ_δ	μ_D	n
Van Biesbroeck	$4''.0$	$3''.2$	$5''.7$	54
Mann	1.1	1.1	1.7	136.

A Remark on Observational Cosmology.

DAVID LAYZER, *Harvard College Observatory*.—Consider a spherical galaxy cluster of radius r and mean density ρ distant R from the sun. If the cluster is in a steady state and v denotes the velocity of a galaxy relative