shows that they all arise from lower levels with excitation potentials less than about 2.5 v. From 1955 to 1958 the position and appearance of the shortward components, attributed to an expanding shell surrounding the star, were unchanged. In 1959 the velocity of the shell relative to the star increased from 38 km/sec to 43 km/sec, while the "shell" components of the doubled lines became weaker and sharper.

The *Ca* I λ6573 emission and *Hα* emission observed by Bidelman and McKellar (1957) have continued. In addition the intercombination lines of *Fe* I, multiplets 12, 13, and 14, have been observed in emission in the red and infared. Estimates of the mass and radius of the shell have been obtained from photometry of the emission lines and the shell components of the double absorption lines. The radius of the shell is less than 4000 $R_\odot$ (about 10 times that the star) and a minimum value of the mass is 10^{26} g.

Large-scale and small-scale turbulent velocities v_e and v_s in the shell and the photosphere have been obtained using both the curve of growth and the method of S. S. Huang and O. Struve (1955, *Astrophys. J.* **121**, 84). The turbulent velocity v_s in the shell is 8 km/sec, while in the photosphere the values of v_s for *Fe* I range from 10.4 km/sec for zero-volt lines to 6 km/sec for four-volt lines. The values of v_e are higher, about 18 km/sec.

Local Magnetic Fields above Sunspots. HERMANN U. SCHMIDT, *High Altitude Observatory, University of Colorado* (introduced by R. GRANT ATHAY).—The stationary magnetic field above a sunspot group is approximately force free, as long as the magnetic energy density exceeds the gas pressure. Every force-free field configuration lying above the photospheric level and limited by field lines crossing the photosphere is uniquely determined by the field distribution in the photosphere, as in the case of a potential field. The boundary condition for potential fields in such a surface distribution,

$$\partial B_y/\partial x = \partial B_x/\partial y,$$

is abandoned for force-free fields. Visual structures in a sunspot as well as in limb prominences may be connected with the deviation of the actual force-free field from a potential field. A model, which may be typical for a force-free field configuration above a sunspot pair, is constructed.

A Small Computer for Astronomical Data Reduction. DANIEL H. SCHULTE, *Kitt Peak National Observatory* (introduced by HELMUT A. ABT).—This observatory has recently added a Royal-McBee electronic computer to its research facilities. The machine, while relatively small and inexpensive, has thus far proven adequate for the data reduction encountered in many observational astronomy programs that would otherwise not justify the use of a large computer. Brief descriptions of the reduction programs follow; they have been developed as the need for them arose and are indicative of the fields of interest prevalent at the Observatory.

The programs now receiving the most use are those for the reduction of photoelectric photometry observations; three- and four-color versions are available. At present all preparation of data for input to the machine is done by hand; the observed quantities are entered on punched paper tape by means of a normal typewriter keyboard. Once the data tape is prepared, reduction of the observations to the final *U*, *B*, *V* system (for instance) can proceed at the rate of one night's observations per hour or so. This includes least-squares solutions for extinction and transformation coefficients, from standard-star observations.

Another program has recently been devised for calculating corrections to the six elements of a spectroscopic binary orbit, using Schlesinger's least-squares method. The execution time for this program is about 30 minutes, for a set of 20 observations. It is therefore possible to start with elements which are considerably in error, since it is a simple matter to rerun the program a second or third time, until the residuals become acceptably small.

Specialized computational programs have been and will be developed in connection with the requirements of visiting astronomers using the Kitt Peak telescopes in order that the telescopes can be used for a maximum productivity.

A Spectrographic Study of Early-Type Stars near the North Galactic Pole. ARNE SLETTEBAK, *Perkins Observatory.*—A few years ago, a finding list of stars of spectral type F2 and earlier in a north galactic-pole region was prepared by Slettebak and Stock (1959, *Hamburg Obs. Publ.*, Hamburg-Bergedorf) from objective prism spectrograms taken with the Hamburg Schmidt telescope. Subsequently, slit spectrograms of 84 of these stars were taken with the Mount Wilson 60-inch and 100-inch telescopes in the spring of 1958 in order to obtain spectral types, axial rotation velocity estimates, and radial velocities. In addition, *UBV* observations of most of these stars were made by Bahner and Stock at the McDonald Observatory in the spring of 1960.

A number of subdwarfs in the spectral range B-B were found. To a limiting photographic magnitude of 11.5, however, the large majority of the stars are Population I objects. Two interesting results were obtained for the latter:

1. Metallic-line stars represent a larger percentage of early-type stars at high galactic latitudes than in the neighborhood of the sun. Considering all galactic-pole stars with K-line types between A2 and A7, 6 out