apparent abundance deficiencies, though on a reduced scale, as did the metallic-line star.

Two physical processes may theoretically produce excessive second ionization of the metals with ionization potentials between 12 and 16 volts; both are connected with the disturbance of a stellar atmosphere by excessively ionized hydrogen, which I assume to enter the atmosphere from the top of the hydrogen-convective zone. The first is excess ionization by radiation in the Lyman lines (10 to 13.5 volts) and continuum (13.5 to probably 16 volts). If the metallic atoms exist in a region where hydrogen is nearly completely ionized then Lyman emission lines and continuum may produce an excessively large number of radiative second ionization. In particular, since hydrogen will probably be nearly neutral above this level, the strong Lyman absorption lines act like a "blanket" and dam up excess radiation in the lower layers. Theoretical computation of this "damming-up" shows that a neutral hydrogen layer increases the Lyman energy beneath it by a factor of three.

A more striking new possibility is that hydrogen may ionize by collision, in a process known as "charge-transfer." A quantum-mechanical resonance permits an electron to jump from an atom (say a singly-ionized metal) to an ionized hydrogen atom, if the second ionization potential of the metal is nearly the same as the ionization potential of hydrogen (13.5 volts). The energy difference is balanced by changes of kinetic energy; thus, if a metal requires 14.5 volts to ionize it, there must be a loss of 1 volt kinetic energy. Such small kinetic energies as are required are common in an F star, while quanta with 14.5 volts energy are very rare. It was found that for equal collisional-ionization and radiative-ionization cross-sections, there are about 10,000 as many collisions with protons as with quanta. From some laboratory and theoretical work it seems probable that if the quantum-mechanical resonance is close, the collisional cross-sections are actually larger than the radiative cross-sections. Unfortunately, laboratory data are available mainly for processes like collisional-excitation, or for charge-transfer between neutral and singly-ionized particles; no quantitative predictions can now be made. Applying this process qualitatively to the metallic-line star, however, we can expect the collisional-ionization cross-section to decrease rapidly on either side of 13.5 volts; all elements with second (or first) ionization potentials near 13.5 volts should be excessively ionized. This exactly describes the observed apparent abundance deficiencies—all cluster between 12 and 16 volts in both the metallic-line star and the supergiants. We can thus ascribe the excess ionization energy in these stellar atmospheres to the outward flow of some hotter ionized material from the stellar interior. If this proves correct, at least one striking case of apparent abundance differences between the stars can be removed from our list of stellar abnormalities.

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Gratton, Livio. The radial velocity of λ Andromedae from the *Ca* II emission lines.

The spectroscopic binary λ Andromedae (mag. = 4.0, Sp. = G8 III–IV) was found to have very strong and rather sharp emission lines of *Ca* II.[1,2] The radial velocity from these emission lines and from the absorption lines was measured on 5 Merate and 30 McDonald spectrograms. The velocities from the absorption lines agree well with Luyten's orbital elements,[3] but those from the emission lines show deviations which in some cases are several times larger than the probable error of the measurements. No simple relation can be found between the observed deviations and phase; when the deviations are large the lines usually appear sharp.

If it is supposed that the emission lines originate in the two bulges of the tidally distorted star, as was suggested by Hiltner[4] in the case of some eclipsing binaries of late spectral type, the observed deviations may be explained by irregular variations of the intensity ratio of the lines from the two bulges. In this case the spectral observations are consistent with a radius of the same order as the radius of the orbit.

λ Andromedae is a subgiant of visual absolute magnitude 1.9; its mass is then 1.8 ⊙, from the mass-luminosity relation. From the orbital elements, assuming the radius of the orbit and that of the star to be equal, one finds 0.15 as the ratio of the masses of the smaller and of the larger star; the distance of the companion is about 32×10^6 km. The computed tidal distortion is very small and the variation of the gravity from the poles to the bulges is only 1.3 per cent. This variation, however, should be large enough to cause macroscopic currents of

appreciable amount. It is probable that the emission lines originate at the bulges because of the deviation from normal equilibrium due to these currents.

There are six binaries of spectral types G5-K0 with rather well known parallaxes, which show emission lines of *Ca* II; it is shown that for these stars there is a correlation between absolute magnitude and period. It is probable that this relation corresponds actually to a relation between density and radius of the relative orbit.

1. *Contr. Oss. Astr. Milano-Merate*, n.s. No. 17, 1944.
2. *Pub. A. A. S.* **10**, 312, 1943.
3. *Pub. Astr. Obs. Univ. Minnesota* **2**, No. 1, 1934.
4. *Ap. J.* **106**, 481, 1947.

McDonald Observatory,
Fort Davis, Tex.

Hall, John S. A photoelectric polarimeter.

A photoelectric polarimeter may be defined as a photoelectric photometer designed to measure the intensity and plane of that fraction of light from a given source that is polarized. The fundamental principle used in the device developed at Amherst is similar to that employed by Öhman.[1] The principal differences lie in the nature of the analyzer used and in the method employed to make the observations.

The analyzer in the Amherst polarimeter is a Glan Thompson prism. This prism permits measurements to be made over an extensive spectral region.

The method employed to make the observations is such that both the plane of polarization and the intensity of the polarized light are indicated on an automatic recorder once every two minutes.

Bench tests have indicated that 0.1 per cent of polarized light can be easily detected when a 1P21 is used as the photosensitive element. With a *PbS* cell this limit can be extended to one or two parts in 10,000. The same limits can be achieved when the sun is used as a source and the seeing conditions are favorable.

Tests with a 1P21 and the 18-inch Amherst refractor indicate that it would be possible to detect $\frac{1}{4}$ of one per cent of polarized light from stars of the seventh magnitude under average seeing conditions. Plans are being formulated for the observation of some eclipsing stars of special interest.

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1. *Ark. Mat. Astr. Fys.* **29B**, No. 12, 1943.

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Hamid, Salah. Prediction of theoretical radiants from very short periodic comets.

Jupiter's secular perturbations on certain comets cause a rotation of their lines of nodes in the plane of the ecliptic and a periodic motion in their inclinations while the aphelion and perihelion distances of the comets are very slightly affected. Therefore, it is possible for such comets occasionally to cross the ecliptic at the intersections with the earth's orbit and give rise to showers of meteors, provided that the comets' perihelia lie inside the earth's orbit and provided their aphelia lie inside Jupiter's orbit.

An application of Brouwer's theory of secular perturbation of Jupiter on comets, which is valid for comets of inclination less than 36°, has been made by the author. Encke's comet and Comet Grigg-Skjellerup are the only two periodic comets that satisfy the necessary criteria.

Encke's comet gives rise to known night showers, the Taurids, as shown by Whipple, while calculation indicates that it can give rise also to two daylight showers: June 12, $\alpha = 65^\circ.7$, $\delta = +26^\circ.1$ and May 19, $\alpha = 43^\circ.5$, $\delta = +13^\circ.2$. The first appears to be detected with radar by Lovell.

Comet Grigg-Skjellerup gives rise to two night showers: January 21, $\alpha = 107°$, $\delta = +9°$; February 9, $\alpha = 131°$, $\delta = +26°$; both of which seemed to be observed visually by Öpik and the American Meteoric Society. Also it produces two other daylight radiants, June 21, $\alpha = 105°$, $\delta = +15°$; May 31, $\alpha = 83^\circ.5$, $\delta = +37°$; both of which appear to be detected with radar by Clegg, Huges, and Lovell.

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Hoffleit, Dorrit. International Business Machines for spectroscopic absolute-magnitude reductions and results for 500 A5-G stars.

In resumption of the war-interrupted Harvard program for the determination of spectroscopic absolute magnitudes of bright southern stars, provisional results have now been obtained for approximately 500 A5—G2 stars, most of them 5–7 visual mag. and south of −20°. The spectra were obtained at the Harvard Southern Station with the 13-inch Boyden refractor and an ob-