Osterbrock, Donald and Stockhausen, Ralph.**Photoelectric photometry of diffuse nebulae.**

A five-inch $f/5$ refracting telescope has been constructed at the Pine Bluff station of the Washburn Observatory for photoelectric photometry of emission nebulae. With this telescope it is possible to measure a field as large as $20'$ in diameter at a single exposure, and to compare objects in different parts of the sky rapidly. Interference filters may be used in the photometer to isolate nebular emission lines, and we have begun a program of measuring surface brightnesses with a 1P21 photocell and a filter that transmits $H\beta$ and the $[OIII]$ green lines. The calibration to energy units is provided by measurements of bright planetary nebulae previously observed by Liller and Aller, and also by measurements of stars with known spectral energy distributions. The idea of this program is that from the measured total emission of the nebula in a hydrogen line, one can find by Zanstra's method the total emission of the exciting star in the continuum beyond the Lyman limit. This measurement, together with the known visual magnitude of the star, thus provides a wide-baseline color index, and hence is a powerful check that may be applied to test the correctness of model atmospheres of early-type stars.

It is essential that the nebula be excited by the minimum number of stars, and completely absorb their ultraviolet radiation, so we have selected as an example NGC 281, excited by the O6 star HD 5005 br. The nebula is surrounded on most of its circumference by dark neutral matter, and hence is known to be a nearly complete Strömgren sphere. Our measurements of NGC 281 show that the ratio of extreme ultraviolet ($\lambda < 912\text{\AA}$) to visual radiation in HD 5005 br is somewhat below the ratios predicted by published model atmospheres for O stars, but observations of other nebulae are necessary to be sure that this is not simply an effect of incomplete absorption.

*Washburn Observatory,
Madison, Wis.*

Page, Thornton. Masses of the double galaxies.

My initial study, published in 1952 (*Ap. J.* **116**, 63) has been extended and refined to include 65 pairs of galaxies for which radial velocities are known, including 82 velocities from the Humason-Mayall list and 60 measured by the author. The mean mass of a galaxy derived from these data is inversely proportional to the Hubble constant in the velocity-distance law; if this constant is

$10^{-4} \text{ km sec}^{-1} \text{ psc}^{-1}$, the mean mass is 2.5×10^{11} suns, and the mean ratio of mass to luminosity is 18, in solar units.

The data can be divided into two groups: for 45 pairs involving elliptical or So galaxies, the mean mass is 4×10^{11} suns and mean M/L is 41; for 20 pairs involving only spiral and irregular galaxies, $\bar{M}$ is 0.3×10^{11} and mean M/L is 1.3, in solar units. Moreover, individual cases yield lower limits to M and M/L in the neighborhood of 5×10^{11} suns and 18, respectively (for NGC 5898–5903).

*Van Vleck Observatory,
Wesleyan University,
Middletown, Conn.*

Rabe, Eugene. The orbital motion of the minor planet (1362) Griqua and the mass of Jupiter.

The minor planet (1362) Griqua is of special interest not only because of its mean daily motion n which is continuously increasing from $596''$ in 1933 to $607''$ in 1977, going through the rigorous $2:1$ commensurability with respect to Jupiter's mean motion n' during the year 1943, but also because of the large eccentricity e of its orbit, which makes it possible to observe the enormously large perturbations by Jupiter in perihelion oppositions at such close geocentric distances as 1.3 a.u. When the orbital elements of the planet were derived from accurate positions in 6 oppositions during 1935–1956 (Rabe 1956), the final values of the accurate special perturbations computed on NORC as well as of the elements were obtained only by a process of successive approximations, because of the size of the perturbations by Jupiter and their dependence on the basic elements.

In Table I the two significant elements n and e

TABLE I. n AND e WITH INTERVALS OF 800 DAYS

JD	n	e	JD	n	e
27400.5	596".10	0.33975	36200.5	602".98	0.35256
28200	596.19	.34051	37000	602.84	.35314
29000	596.18	.34108	37800	603.17	.35383
29800	596.87	.34189	38600	603.92	.35454
30600	596.71	.34237	39400	603.65	.35544
31400	598.93	.34525	40200	606.00	.35766
32200	599.79	.34667	41000	606.37	.35856
33000	599.43	.34712	41800	606.28	.35907
33800	600.00	.34811	42600	606.93	.35994
34600	600.80	.34838	43400.5	607.22	0.36020
35400.5	601.41	0.35049			

have been listed with intervals of 800 days, beginning at JD 2427400.5 = 1933 Nov. 24.0 UT, and ending at JD 2443400.5 = 1977 Sep. 14.0 UT. These osculating values of n and e include the perturbations by all the major planets from Venus to Neptune, but Jupiter is almost exclu-

sively responsible for the remarkable orbital changes exhibited in Table I. From earlier long range computations for a fictitious case of such a critical Hecuba planet (Wilkins 1930) we know already that the longitude perturbations by Jupiter are of zero order and are not limited to any maximum amplitude. The purpose of this note is to point out that in the case of Griqua such rapidly increasing perturbations can be observed under most favorable conditions, and that apparently Griqua is a most suitable asteroid for the determination of Jupiter's mass.

The size of the total perturbational displacements $\Delta\alpha \cos \delta$ and $\Delta\delta$, observable in the next three perihelion oppositions 1959, 1965 and 1971, has been computed for two dates 20 days apart in each of these most favorable oppositions. These values are listed in Table II, together with

TABLE II. PERTURBATIONAL DISPLACEMENT OF GRIQUA IN COMING PERIHELION OPPOSITIONS

Date UT	ρ	r	$\Delta\alpha \cos \delta$	$\Delta\delta$	Δs
1959 Sep. 29.0	1.270	2.118	+24.89	+ 6.12	+25.63
Oct. 19.0	1.267	2.109	+24.34	+ 4.60	+24.77
1965 Oct. 27.0	1.293	2.123	+40.73	+12.83	+42.70
Nov. 16.0	1.300	2.148	+38.26	+10.51	+39.68
1971 Nov. 25.0	1.384	2.259	+57.33	+20.70	+60.96
Dec. 15.0	1.406	2.313	+51.97	+18.18	+55.06

the total displacement Δs , the geocentric distance ρ , and the heliocentric distance r . The zero epoch of these perturbations is 1935 July 31.903, corresponding to the first observation known for this planet. In 1971, or 35 years later, the observable effect of Jupiter's mass amounts to 61° .

Observers are urged to observe Griqua as extensively as possible, not only in these perihelion oppositions but in regular oppositions as well. Extended ephemerides will be published in the MPC. The author intends to utilize all suitable observations later on for a determination of the mass of Jupiter.

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Wilkins, A. 1930, *A. N.* 240, 201.

*University of Cincinnati,
Cincinnati, Ohio*

Schwartz, Sanford B. Ionization cross-section of FeXIV by electron collision and the electron coronal temperature.

A new calculation for the ionization cross-section of the $3p$ electron of FeXIV by electron collision is given, where a hydrogen-like model is used for the atom. The continuum functions are made to approach Coulomb functions at large

distances from the atom. Only the S-partial waves of the incoming particle are here included, and the resulting cross-section is more than a factor of 10 smaller than the semi-classical values previously used (e.g., Elwert, G., *Z. Naturforschung* 7a, 342, 1952) by others to deduce coronal temperature from optical spectra. The use of this new calculation for estimating coronal temperatures indicates that the electron temperature is around $2 \times 10^6 \text{K}$.

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*High Altitude Observatory,
Boulder, Colo.,*

now at Physics Dept., U. of Nevada, Reno, Nev.

Sterne, Theodore E. The effect of the rotation of a planetary atmosphere upon the orbit of a close satellite.

Drag in the stationary atmosphere of a planet causes the mean distance, a , and eccentricity, e , of a satellite to decrease secularly, but causes no secular changes in the argument ω of pericenter, the inclination i , or the longitude Ω of the node. The decreasing period, caused by the decreasing a , has been used to infer the density of the earth's atmosphere at great altitudes from the decreasing periods of artificial earth satellites. Rotational flattening of the planet leaves a , e , and i secularly unchanged but causes secular changes in Ω and ω , varying inversely as $a^{7/2}$. Combined effects of drag and flattening thus cause secular accelerations of the node and pericenter.

Wildhack, of the National Bureau of Standards, has considered the effect of atmospheric rotation upon i , and the author has more recently derived formulae for all the secular effects of general atmospheric rotation. Atmospheric rotation in the same sense as a satellite, by decreasing drag, decreases the rate of diminution of a . Neglect of this effect has led to a slight underestimation of the earth's atmospheric density. The rate of decrease of e is also diminished. The inclination is caused to decrease, at a rate dependent upon $(1 + \cos 2\omega) \sin i$ whose secular value is $\sin i$. For the artificial earth satellite 1957 $\alpha 2$, i should have decreased by about a second of arc a day. The node is caused to regress at a rate proportional to $\sin 2\omega$ and ω to increase at a rate $\cos i$ times as great. Since the planet's rotational flattening changes ω secularly, atmospheric rotation does not change Ω and ω secularly.

*Smithsonian Astrophysical Observatory
and Harvard College Observatory,
Cambridge, Mass.*