the red shift and using Walker's magnitude corrections, a graphical solution gives $z = 5.63 \times 10^{-10}$, where the present units of the coordinate are light years and $\Delta M = -3.34$. For all of the clusters, except Virgo, the differences between the magnitudes calculated from the measured red shifts and the observed magnitudes are 0.08 mag. or less. It can be inferred that the average color index of the stars which have presumably disappeared within an E-type nebulae in Boötes during the time required for the light to reach us should be about +1.25 mag. The cosmological constant required for this hypothetical model is $\Lambda = 9.34 \times 10^{-19}$ (lt. yrs.)⁻² and the time scale indicated is 2.8×10^9 yrs.

Since the red-shift corrections depend upon the classification of the nebulae, let us assume that one-third of the extragalactic objects are composed of pure stellar population I, another third are composed of pure stellar population II, and that the remaining third are objects equally blended of the two types of stellar populations. If we adjust our constants to the nebular counts survey with 18.47 as limiting magnitude, the remaining surveys are compatible with the hypothetical model only if errors of about 0.1 mag. are assumed in the determination of the limiting magnitudes of the 20.00 mag. and the 21.03 mag. surveys.

1. *Ap. J.* **84**, 517, 1936.

2. *Ap. J.* **108**, 413, 1948.

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Page, Thornton. Hydrogen emission in extragalactic nebulae.

Spectra of fifty extragalactic nebulae, taken on red-sensitive film with the B spectrograph at the prime focus of the 82-inch telescope, show $H\alpha$ emission in 27 cases. In 24 of these 27, and in 4 others, $[O III] \lambda 3727$ also appears in emission, and in 8 other spectra both emission lines are possibly present, though underexposed. It thus appears that the two lines are highly correlated. Four of the seventeen elliptical nebulae included show both emission lines, although at systematically lower intensity relative to the continuum than in the spiral types.

Intensities accurate to about ± 25 per cent have been measured in eleven of the spectra—NGC 3077, 3310, 4038, 4039, 4486, 5954, 5953, 4485, 4490, 5426 and 5427—with the following results:

a) In the first six, the intensity of $H\alpha$ ranges from 4 to 20 times the intensity of $I_4 A$ in the background continuous spectrum; that is, $H\alpha$ is of the order of 3 per cent of the total luminosity in the observable region of the spectrum.

b) In the first five cases, where $H\beta$ and $H\gamma$ could also be measured, the Balmer decrement is somewhat steeper than that expected for recombination at an electron temperature of 10,000°K.

c) The intensity of $\lambda 3727$ is about $\frac{1}{3}$ the intensity of $H\alpha$, on the average.

d) Other forbidden lines $[Ne III] \lambda 3869$, $[O III] \lambda \lambda 4959$ and 5007, $[N II] \lambda 6584$ and $[S II] \lambda 6730$, range from zero intensity to as much as $\frac{1}{2}$ that of $H\alpha$.

e) Between $\lambda \lambda 3727$ and 6730 the continuous spectra of these nebulae can be represented roughly by gradients corresponding to color temperatures between 3800°K for NGC 4486 (E) and 5500°K for NGC 3077 (Irr.). These measurements agree fairly well with the photoelectric colors of Stebbins and Whitford¹ for other nebulae of the same class.

Four ninth-magnitude stars classified by W. W. Morgan as spectral type dF8 to dG5 were used as standards in this spectrophotometry; their gradients being assumed normal, and their temperatures being taken from Stebbins and Whitford's T_1 scale.² The films were calibrated with a tube sensitometer at $\lambda \lambda 3700$ and 6500, using exposure times equal to those for the spectra, 2 to 4 hours. The large estimated errors in the measured intensities are due mainly to irregularities in the hypersensitized film necessarily used for these long-exposure spectra. Since the galactic latitudes of all eleven nebulae are greater than 42°, the measured gradients and line intensity ratios are not affected appreciably by interstellar reddening in our galaxy. However, interstellar reddening in the nebulae themselves may well be larger; it would tend to steepen the Balmer decrement, and the associated opacity would weight the outer parts of each nebula with respect to the inner parts.

The $H\alpha$ emission may be understood as a result of fluorescence in the interstellar gas near hot stars in the nebulae. Strömgren³ has shown that such $H II$ regions are small compared to the size of our galaxy. Therefore the absorption by interstellar hydrogen of wave lengths below the ionization limit, 912 Å, is virtually complete, and