proposed by Ambartsumian for T-associations as well as O-associations. However, it is not unlikely that some of the stars, particularly those in the outer regions of the nebula, are ordinary stars that have collided with the denser clouds and filaments that compose this nebula, and that the interaction of these stars with the interstellar matter has affected their spectra and constancy of light. This explanation of the T Tauri stars has been proposed by Greenstein² and others and, although it does not appear applicable to all of the members of this central cluster, it may well explain at least a few of the stars in the region of the nebula where there appears to be a deficiency of non-variable stars without emission lines.

1. See *Astronomical News Letter*, No. 64 for a summary in English and for references to the original literature.
2. *Pub. A. S. P.* **62**, 156, 1950.

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Whitford, A. E. Colors of distant spiral and elliptical nebulae.

Additional two-color photoelectric measurements of elliptical nebulae in clusters have been obtained with the 100-inch telescope of the Mount Wilson Observatory. The results, which include objects with velocities up to 60,000 km/sec, confirm the color-velocity relation previously found by Stebbins and Whitford.¹ The calculated color change derived by the displacement of the energy curve of M32 accounts for only half of the observed effect. Four late-type spirals with velocities in the range 22,000 to 27,000 km/sec are found to be very blue, with observed international colors from +0.32 to +0.50; the excess found in the ellipticals seems definitely to be absent. This observation gives support to the age-effect explanation of the excess in ellipticals. If the spiral-elliptical distinction is found to be a general effect, very great difficulties are placed in the way of the Bondi-Gold-Hoyle cosmologies based on continuous creation.

A multicolor photoelectric study of the brightest elliptical nebula in the Corona Borealis cluster yields a differential energy curve relative to M32 over the range 3400Å to 8300Å. The result is definitely not that to be expected from the death of red giants, as in the first age-effect explanation suggested by Schwarzschild. The observed differences are not to be explained by addition or subtraction of any one type of star. The observed two-color excess, however, could

arise from additional radiation in the distant systems of a quality like that of a Type I Go supergiant. Preliminary results on the brightest system in the Boötes cluster, where the effect is larger and should be less affected by random intrinsic color differences, are consistent with this view.

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

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Wright, Frances W. and Fred L. Whipple. The photographic Perseid meteors.

The trails of 115 Perseid meteors on Harvard photographs have been analyzed. Observations extend over the years 1893 to 1952 in the seasonal interval July 28 to August 24, and include 23 meteors photographed simultaneously at two stations and 92 at one station only. The mean radiant of the stream moves eastward $43' \pm 2'$ per day and northward $7' \pm 2'$, through $\alpha = 45^\circ 56'$ and $\delta = 57^\circ 45'$ (corrected) at longitude of sun = 139 (Eq. 1950).^o An extended single trail deviates from the instantaneous mean radiant with an average scatter $\pm 38'$ (p. e.). Perseid activity attains its maximum on August 12 UT, with 62 per cent of the meteors appearing on the four days August 10–13 inclusive. No significant deviation in the radiant or its motion appears to exist among photographic, radar, or visual observations except that the scatter is probably greater for faint than for bright meteors; this magnitude effect amounts to $7'$ over the photographic range. The average scatter for 30 meteors before and after the four days of maximum activity increases to $48'$. The photographic meteors appear to be relatively more numerous near maximum activity than the fainter radar Perseids observed at Manchester, England.

The ratio of Perseid to sporadic meteors appears to decrease with luminosity in the photographic range. Comparing seven meteor showers studied photographically, we find that the average scatter increases linearly with the width of the spacial stream of meteors. The correlation is excellent; the scatter increases from 6.6 for a zero stream-width at a rate of 0.87 per million miles of stream-width. The fact that the Taurid and Geminid streams follow the scatter-duration relationship shown by such recognized cometary streams as the Draconids, Orionids, and Perseids, casts doubt on Hoffmeister's proposal that the Taurids and Geminids are "ecliptical currents," different in character from the cometary streams.

Eleven observed velocities from double-station Perseids lead to the following mean elements (and p. e.): $1/a = +0.048 (\pm 0.016) \text{ (a.u.)}^{-1}$, $q = 0.951 (\pm 0.003) \text{ a.u.}$, $\omega = 151.2 (\pm 0.7)^\circ$, $\Omega = 138.1 (\pm 0.5)^\circ$, $i = 113.7 (\pm 0.3)^\circ$. The mean observed velocity is $60.0 (\pm 0.2) \text{ km/sec.}$ The probable error of a single velocity is $\pm 0.7 \text{ km/sec.}$, relatively great in comparison with slower meteors. The angular elements correlate roughly with date, but $1/a$ and q do not. The elements exhibit a random character, of the general nature predicted by Hamid.

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Wyatt, Stanley P., Jr. Isophotometry of elliptical galaxies.

Isophotal contours have been traced directly for several regular galaxies with the Michigan isophotometer. The plate material includes short and long exposures with the Curtis Schmidt telescope, in blue and red light, with each plate standardized in a tube sensitometer. Tracings were made at several orientations in order to minimize grain effects.

So far the following preliminary results have been obtained. The study of a number of other smooth galaxies is being continued.

1. The prototype E7 galaxy, NGC 3115, has been examined on both blue and red plates, and there is no conclusive evidence of any changes in color index throughout the system. The b/a ratios change markedly with distance from the nucleus, with a minimum value 0.29 at $a = 1.0$ and less flattened isophotes both interior and exterior to this point. These results are in general accord with those of Oort and de Vaucouleurs. Within the accuracy of the measures, a given contour has the same shape in blue and red light.

2. NGC 3377 (E5) and NGC 3379 (E0) have fairly regular elliptical contours, with no obvious changes in the b/a values.

3. Isophotes were also derived for two very regular-appearing barred spirals in the same field, NGC 3384 (SBa) and NGC 3412 (SBa). In each of these systems, the contours change from approximate circles near the center to highly elongated ellipses at low intensity levels, with a progressive twist in the position angle of the major axis.

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Zirin, Harold. Radiative opacity of stellar matter.

A detailed calculation has been made of absorption coefficients and opacities of the hot, dense gas inside a star. The basic assumption made is that the potential field surrounding a nucleus in the stellar gas is that due to the nucleus and to a uniform cloud of electrons surrounding it, up to the boundary of a neutral sphere. Outside this ion sphere the potential is zero. I have found by a variational technique the wave functions describing the motion of the electrons in this potential field, both in bound and free states. If we then assume that the electrons are distributed in energy according to the Fermi Dirac statistics, we may determine the potential field due to the electrons moving with these wave functions. The resulting potential field almost exactly duplicates the assumed potential, especially in very hot gases, therefore justifying our approximation.

We have in computing the self-consistent potential developed the exchange potential for a non-degenerate free electron gas along the theory of Dirac. This turns out to be appreciable even in hot gases.

I have determined the absorption coefficients for free-free and bound-free transitions in various elements of astrophysical interest, using the wave function of electrons in the assumed potential corresponding to a given temperature and density. With these absorption coefficients it is possible to compute the opacity of any astrophysical mixture, under a wide variety of temperatures and pressures. The opacity turns out to be much smaller than computed by Miss Harrison, because of the effect of pressure ionization. As a result of this, the radiative temperature gradient at the center of the sun must be much smaller, and the convective core much larger, than found by some other workers using Miss Harrison's tables.

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TITLES OF ADDITIONAL PAPERS PRESENTED AT THE MEETING IN AMHERST, MASS.

- Douglas, A. E. and P. M. Routly. On the spectra of CN^+ and CN molecules.
- Dyer, Edward R., Jr. The motions of dwarf M stars.
- Gjellestad, Guro. On stationary velocities and magnetic fields in rotating stars.
- Goldberg, Leo and E. A. Mulder. Carbon monoxide in the sun and in the earth's atmosphere.
- Hagen, John P. Observations of the solar eclipse of 25 Feb. 1952.
- Hamid, Salah and Fred L. Whipple. On the motions of 64 long-period comets.
- Henriksen, S. Solar photospheric gradient.
- Hosfield, Roger. Variations in the daytime scintillation of stars.