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THE ROTATION AND STRUCTURE OF THE GALAXY BEYOND THE SOLAR CIRCLE
I. PHOTOMETRY AND SPECTROSCOPY OF 276 STARS IN 45 HII REGIONS AND OTHER YOUNG STELLAR GROUPS TOWARD THE GALACTIC ANTICENTRE*

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Extensive photoelectric *UBV* photometry and MK spectroscopy are presented for O and B stars associated mainly with HII nebulosities in the anticentre direction of the galactic plane from $\ell = 150°$ to 250°. Our knowledge of the spiral structure in this part of the galaxy has been improved, with the hint of a distant spiral feature located ~8 kpc from the Sun, defined by at least three well observed groups of stars in HII regions at $\ell \sim 210$-220°. These are the most remote HII regions known to date in the Galaxy and suggest that spiral structure persists out to at least $R = 17$ kpc. Subsequent papers will deal with the radial velocities and their dynamical implications.

Key words: HII regions – galactic structure – *UBV* photometry – MK spectroscopy

1. INTRODUCTION

Since we do not know the rotation law of the galaxy a priori the only precise way of probing the regions beyond the solar circle is through the determination of *stellar* distances and velocities (or the velocities of non-stellar matter directly associated with the stars). In principle, the best type of stellar probes are the distant, intrinsically luminous Population I stars of the galactic disk. Not only can such objects be traced to large distances but one can be reasonably confident in assuming that they follow a nearly uniform circular rotation velocity pattern. To reach out even further, the bright objects of the galactic halo, which are relatively unobscured by interstellar extinction, appear at first to be an even more useful probe, but there always remains the difficulty in establishing the still unknown law of velocity dispersion for them. A most recent investigation of the radial velocities of distant globular clusters and other satellites of the galaxy by Hartwick and Sargent (1978) indicates that the mass of the galaxy increases beyond $R_o = 10$ kpc (the assumed solar galactocentric distance) and, out to $R \simeq 60$ kpc, is at least 2-4 times more massive than previously believed for a predominantly *radial* dispersion of the space velocities and double this again for an isotropic dispersion.

Evidence for the presence of population I stars out to relatively large galactocentric distance has recently been established: Georgelin (1975) has found HII regions and Vogt and Moffat (1975a) have detected young open clusters out to $R - R_o \simeq 5$ kpc towards the galactic anticentre. Chromey (1978) has obtained distances of several dozen likely OB stars out to $R - R_o \sim 8$-9 kpc. It should be noted that the limit of 12 kpc quoted by Chromey does not allow for the large errors often encountered with single-star parallaxes; also the nature of 15 very blue, faint stars, some of which would yield remarkably large distances for assumed Population I disk stars of over 100 kpc, still has to be established.

Radial velocities are available for a few HII regions beyond the solar circle; their analysis suggests that the Schmidt (1965) rotation model of the galaxy predicts too steep a fall-off in rotation speed, θ, compared

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to the observations (Georgelin *et al.* 1973; Vogt and Moffat 1975b). This is in complete line with recent observations of the rotation curves of other spiral galaxies (Roberts 1975; Krumm and Salpeter 1977; Rubin *et al.* 1978) which tend to be flat beyond ~10 kpc out to ~30 kpc from their centres.

In this investigation a systematic attempt is made to obtain distances mainly of hot stars associated with HII regions in the relatively neglected anticentre region from $\ell = 150°$, just beyond the direction where the dense optical Perseus arm appears to stop abruptly at $\ell \sim 140°$, to $\ell = 250°$ where the heavily obscured Vela region begins. It is also between $\ell = 150°$ and 250° that Georgelin *et al.* (1973) find the largest differences between stellar and kinematic distances to HII regions, where the kinematic distances are based on the Schmidt (1965) rotation model.

The greatest emphasis is placed on finding exciting stars of the smaller, potentially more distant HII regions for which little or no stellar photometry or spectroscopy are yet available. HII regions have the advantage that they can be easily recognized at a glance on direct photographs with a fast telescope even at very large distances, providing the interstellar extinction is not excessive. In fact we know that the extinction is relatively low towards the anticentre, especially in the directions $\ell \simeq 160° - 250°$ (c.f. FitzGerald and Moffat 1976). The ultimate goal is to extend our knowledge of the structure and rotation of the galactic disk beyond the solar circle and to improve the mass estimate of the galaxy. The next paper in this series will deal with the stellar velocities, while a third paper will present a final analysis with dynamical implications.

2. OBSERVATIONS

In the galactic longitude range 150°-250° the main source of HII regions is the well-known catalogue of Sharpless (1959). Here we find 106 regions ranging from S206 to S311, all visible on the charts of the Palomar Observatory Sky Survey (POSS). No additional catalogued regions were found among the lists of Rodgers *et al.* (1960) or of Gum (1955). However, Georgelin (1975) lists RCW 14 also in this range; note that RCW 17 is probably a planetary nebula. Neither will be considered here. On the other hand, we have added the regions RCW 19, 20 at $\ell \simeq 254°$ because they appear to be relatively distant and in any case are only just beyond the limit $\ell = 250°$.

To increase the probability of finding the most distant regions which are the most interesting ones in the present study, we restricted our choice to relatively small regions (angular diameter $\lesssim 50'$) relatively close to the galactic plane ($|b| \lesssim 8°$). However, some regions outside these limits, suspected to have large distances (cf. Georgelin 1975), were retained while several with well established distances were deleted (e.g. S236 = IC 410 which contains the open cluster NGC 1893, or S 252 = NGC 2174/2175). Our final choice was limited to 59 regions excluding RCW 19/20. These were divided into two nearly equal groups of "northern" ($\ell \leq 190°$) and "southern" ($\ell > 190°$). Of the northern group, only about half of the 28 eligible regions were studied mainly due to frequently poor observing conditions. The southern regions on the other hand are relatively complete except for S286 and S291 which are faint, extended nebulae with no obvious hot stars. Other regions omitted are the small bright nebula S270 in which no central star was seen at the telescope and S213 located adjacent to the open cluster Berkeley 11 whose earliest spectral type (B4) makes it an unlikely source of excitation (Jackson *et al.* 1979).

As an aid in locating exciting stars, the objective prism surveys of luminous stars in (a) the northern sky (NLS) of the Hamburg and Warner and Swasey Observatory (catalogues I, IV, V and VI) and (b) the southern sky (SLS) of Stephenson and Sanduleak (1971), were consulted. However, in many cases exciting stars were found to be significantly fainter than the limit of these surveys ($m_{pg} \lesssim 11$-12).

In figure 1 we show identification charts for the stars observed in or near the regions studied if no previous charts are available: 26 charts containing 33 Sharpless regions and two new miniclusters denoted "Wat 1" (Waterloo) and "Wat 2"; one chart each of RCW 20, "Wat 3" and the cluster Dolidze 24 with an adjacent reflection nebulosity and a distant, anonymous H II region. Some H II regions appear to be situated in clumps, e.g. S207, 208 or S254, 255, 256, 257, 258, or S271, 272, or S299, 300 and probably each forms a group at a common distance. All charts but one (RCW 20) are reproduced from the blue copy of the

POSS where many of the measured stars tend to be less drowned out by emission nebulosity than on the red prints. However, the outer optical boundary of H II emission, which is generally seen more strongly on the red (+Hα) charts, has often been sketched in figure 1 unless the region is otherwise obvious. For RCW 20 the visual-band Atlas of the Southern Milky Way (Wray and Westerlund 1971) was used in figure 1. The scale and orientation are indicated on each chart.

Mean *UBV* data and MK spectral types for each star observed are listed in table 1. These data were obtained from many different observing runs as indicated at the end of table 1. Calibration of the *UBV* photometry and the MK classifications was carried out in the usual way from interpolation relative to a large grid of standard stars (cf. previous publications of the present authors, e.g. Moffat *et al.* 1977). Also shown in table 1 are the interstellar reddening and the true distance moduli of stars with MK types as well as some others which appear to be O or early B stars.

3. DERIVATION OF DISTANCES

In studies of spiral structure morphology, the greatest weight is always assigned to those regions containing stars which exhibit a cluster-like sequence in the colour magnitude diagram (CMD). The brightest stars will be those responsible for the excitation of the H II nebulosity. Even for a relatively sparse sequence, such cluster moduli are generally more precise than single-star spectroscopic parallaxes. In these cases, the distance modulus was determined by zero age main sequence (ZAMS) fitting generally in the V_o–$(U-B)_o$ plane after individual reddening corrections were applied to each star. The calibrations of the ZAMS and extinction relations of Schmidt-Kaler (1965) were used. A check for consistency was then made for stars also having MK spectral types.

For regions with too small a number of stars ($\lesssim 3$) for ZAMS fitting, mean distance moduli were obtained using *BV* photometry and MK spectral types if available. The latter served as a source of intrinsic colour $(B-V)_o$ from the calibration of FitzGerald (1970) and of absolute magnitude M_v from the calibration of (i) Georgelin (1975) for spectral types $\leq$B3 and (ii) Schmidt-Kaler (1965) for $>$B3. If no MK spectral types were available, individual distance moduli were obtained from the *UBV* data alone, assuming luminosity class *V* to derive the absolute magnitudes from the photometrically derived intrinsic colours $(U-B)_o$. A comparison of the 15 regions in common with Georgelin (1975) yields the mean difference in distance modulus (present value minus that of Georgelin) $+0.1 \pm 0.1$ (m.e.) magnitude which is not significantly different from zero.

4. DESCRIPTION OF INDIVIDUAL REGIONS

Table 2 presents a summary of the main parameters for each region or group of stars observed. "eSp" refers to the earliest spectral type which gives an indication of the age and the availability of ionizing ultraviolet photons and "*n*" refers to the number of stars from which the mean distance and interstellar reddening were obtained.

S 206

In agreement with the results of Georgelin (1975) this region is probably excited by only one star whose MK type and *BV* photometry lead to a distance of 3.0 kpc.

S 207, 208

Only two stars (no. 1 in S207 at the center of this symmetric nebulosity and no. 3 in S208, obviously associated with a strong patch of nebulosity) of almost identical reddening are intrinsically blue enough to be considered as the source of excitation. Their average distance is large (7.6 kpc) and is the same whether derived from the MK types and *BV* photometry or ZAMS fitting (cf. figure 2a).

Wat 1

This is a small group of stars of similar earliest spectral type as S207/208 but with smaller distance (4.4 kpc: cf. figure 2a) and lower (constant) reddening. They appear to be associated with a very faint, small region of emission nebulosity. The fact that Wat 1 and S207/208 are so close in the sky but located at different distances may be a fortuitous superposition, although it cannot be entirely excluded thay they are physically related. If stars 9-11 with more than one reddening solution in the two-colour diagram are actually associated with the remaining stars as assumed, they must be in the stage of pre-main-sequence evolution.

S 212

This nebula contains a concentric small group (minicluster) of six early-type stars of common distance. Again, ZAMS fitting (cf. figure 2b) yields a large distance (6.0 kpc) compatible with the spectral types of two stars. Star no. 1, which is centrally located and similarly reddened, may also be associated, although its photometry (possibly contaminated by the very close star no. 2) places it 1.5 magnitudes above the fitted ZAMS. If no. 6 is a member, it would be a K-type supergiant.

S 217

Especially noteworthy here is the strong knot of nebulosity surrounding the close pair of nearly equal stars 6 E and 6 W with combined spectral type B0:V:. Their *UBV* photometry gives B2V in the mean; either of these should probably be treated with caution. A ZAMS fit (figure 2c) to five stars gives a distance modulus of much greater precision than that based on the two spectra. Interestingly, stars 11 and 14 with similar magnitudes as 6E, W are not obviously associated with strong knots of nebulosity; they may be slightly older.

S 219

Three central, early-type stars 1, 4 and 6, and possibly no. 7 appear to be associated with this slightly asymmetric H II region. The ZAMS fit (figure 2d) gives the same distance (4.2 kpc) as indicated by the spectral type of star no. 1.

S 224

This is a relatively large nebula with shell structure, which is probably excited by the B0V star, no. 1. Although the red supergiant star no. 3 is much less reddened, it has the same distance modulus as star no. 1.

S 225

Only one, off-centre, blue star (no. 4) is likely responsible for exciting this very asymmetric H II region. A small group of foreground stars (nos. 1:, 2:, 6:, 7, 8, 9:, 10) 15′ south south-east of the nebulosity, referred to as Wat 2, is too old to be associated with S 225.

S 237

Four stars, nos. 2, 4, 5 in the main part of this intense, small H II region and probably no. 1, clearly connected to a detached patch of nebulosity, appear to be associated. The ZAMS fit (figure 2e) indicates that star no. 1 may be a binary or foreground star. At only 1.8 kpc, S 237 is located at a distance from the sun similar to the adjacent regions S 231, 232 (?), 234 and 235 (Georgelin 1975). This is compatible with the interpretation that H II regions are often formed in chain-like features tightly associated with spiral arms, the arm in this case probably being an extension of the strong Perseus arm.

S 241

Located 15′ south-west of a relatively strong reflection nebulosity, only star no. 1 is well enough observed to allow a sufficiently precise determination of the distance. Two other B stars were detected: no. 4 adjacent to no. 1 has similar distance, while no. 9, off to one side, but apparently associated with a very faint wisp of nebulosity, appears to be a more distant OB star. It is located behind more dust than stars no. 1 or 4 and, based on *UBV* alone, has a distance well over 10 kpc from the sun (subject to confirmation).

S 247

The bright, centrally located, OB-star, no. 1 is clearly associated.

S 253

We present here only new spectroscopic data, *UBV* data having been published previously (referred to as Bo 1) by Moffat and Vogt (1975) who derived a distance of 4.1 kpc based on ZAMS fitting. The distance using MK spectral types with *BV* values is 4.6 kpc; our final value is a compromise between these two. Only the star NLS IV 20°40 actually lies within the asymmetric whisp of nebulosity.

S 254-258

These five regions are so close together that they probably form a group at common distance. Spectroscopic parallaxes are available for only three stars. Although stars 4 and 5 are clearly associated with their own knots of nebulosity, their photometry does not permit a precise confirmation of the distance based on the other 3 stars (cf. the CMD in figure 2f). Our distance agrees exactly with that derived independently by Pismis (1975).

S 259

Located nearly 1/2° from the previous group, the *UBV* magnitudes of the centrally located star in this small, symmetric nebula are much like those of the stars in S256 and S258. However, they are more precise and imply a photometric spectral type of B1. Assuming luminosity class V and, thus, an absolute magnitude $M_v \simeq -3.0$ leads to a conservative distance estimate of 8.3 kpc. At this large distance, the 1.′1 diameter nebula would have a true diameter of 2.7 pc compared to 3.6 pc expected for a Strömgren sphere around a B1V star with electron density $N_e \simeq 30$ cm^{-3}, the most commonly observed value in other HII regions (Münch 1968; Johnson 1968). Radio continuum observations are needed to check this.

S 267:

Only the centrally located O-star appears to be responsible for exciting this symmetric H II region.

S 269:

The central star no. 2 and to a lesser degree star no. 5 are probably the source of excitation of this small, bright nebula. However, the magnitudes of no. 5 may have been contaminated by the close star no. 4. Star no. 2 is significantly more reddened than no. 1 in agreement with the presence of a patch of obscuration (by dust) seen on the chart in figure 1, which passes directly in front of this star.

S 271, 272:

This is a close pair of nebulae, each containing one OB star at a common distance.

Dolidze 24:

This is actually an open cluster (cf. Alter *et al.* 1970) in which we have measured three stars so far along with four stars (each associated with its own local nebulosity) in a reflection nebula 43′ to the east, and a faint OB star (no. 4) associated with an anonymous, small, faint (H II?) nebulosity 18′ to the south-east, As indicated in figure 2g, stars 2 and 3 in Dol. 24 with $\bar{E}_{B-V} = 0.75 \pm 0.02$ (s.d.) and stars 5-8 with $\bar{E}_{B-V} = 0.65 \pm 0.25$ (s.d.) may be at common distance, while the more strongly reddened ($E_{B-V} = 1.16$) star no. 4 may be very distant (8.7 kpc from the sun) like the other neighbouring H II regions S 283, S 285.

S 283

In the CMD (figure 2h) stars 2, 7, 8 and 10 form a sequence parallel to the ZAMS while stars 3, 4 and 6, all close to star 2, form a possible pre main-sequence. Star no. 2 ($E_{B-V} = 1.00$) is more reddened than the rest with $\bar{E}_{B-V} = 0.83 \pm 0.03$ (s.d.). Star no. 1 is probably a foreground object. ZAMS fitting yields the largest distance of any region in the present study (9.1 kpc).

S 284

As with S 253, we present here only spectroscopic data, *UBV* data being available from Moffat and Vogt (1975) who refer to it as Dolidze 25. From three stars with reliable spectral types, we obtain a mean distance modulus of 13.6, completely in accord with that found previously by ZAMS fitting (13.7).

Bo 2

Again as with S 253, spectroscopic data for three stars yield a distance modulus of 13.0±0.3 compared to 13.7±0.3 from ZAMS fitting (Moffat and Vogt 1975). We adopt a mean of 13.4±0.3.

S 285

Stars 1-5, located at the centre of the stronger side of this dumbbell shaped nebulosity confirm the large distance and moderate reddening found for star no. 6 in the weaker section of the dumbbell by Georgelin (1975). However, since stars 2-5 are very crowded and relatively faint, their photometry produces too much dispersion in the CMD to yield a sufficiently accurate modulus. Therefore, we base our estimate on the mean of the spectroscopic parallaxes of stars 1 and 6 whose *UBV* values and spectral types are nearly identical. With its large distance of 6.9 kpc, S 285 deserves more attention with a larger telescope under conditions of favourable seeing.

S 287

Star no. 5 is probably the main source of excitation, accompanied by the fainter star no. 1 which is surrounded by its own knot of nebulosity. Both stars are probably at the same distance. Stars 11 N and 11 S, located in a faint, extended nebula about 20′ north-west of S 287 near the (probably relatively old) open cluster NGC 2311 appear to be slightly closer to the sun than S 287.

S 288

Only star no. 1 at the centre of this bright, small nebula is the obvious source of excitation. Its distance, based on *UBV* alone is uncertain.

S 289

This is the best case of a very distant, uniformly low reddened, well-observed minicluster of 6 O and B stars near the centre of a weak, extended H II region. These stars, along with the pair nos. 11, 12 centred on a small knot of adjacent nebulosity and the nearby luminous star no. 13, yield from ZAMS fitting in figure 2i a distance of 7.9 kpc, corresponding to a distance modulus of 14.5±0.2. Spectroscopic parallaxes of five stars, including a possibly evolved, luminous A-star give a modulus of 14.4±0.5 (m.e.). The low mean reddening ($E_{B-V}=0.48$) at this distance is compatible with the large distance of S 289 below the galactic plane (630 pc.). This is not unusual at this distance from the galactic centre where the thickness of neutral hydrogen is observed to widen out considerably compared to regions interior to the sun (cf. Burton 1976).

S 294

Only one star (no. 4 near the centre of this asymmetric H II region) is clearly hot enough to be the source of excitation. Assuming $M_v=-3.4$ for a photometric spectral type B0.5V, compatible with the *UBV* data, a tentative distance of 4.6 kpc is obtained. Star no. 7, which appears to be associated with its own patch of nebulosity, gives a compatible distance.

S 298

This is one of the nine H II ring-like nebulae known to surround galactic Wolf-Rayet stars of the Nitrogen sequence (Smith 1973). Besides the WR star HD 56925, there appears to be only one other star associated: the adjacent no. 8 whose *UBV* values suggest a photometric spectral type of B4V from which a distance is derived. We adopt a mean distance of 6.3 kpc from these two stars. Star no. 2, the nearest luminous star in the plane of the sky is probably in the foreground.

S 299, 300

These are two small H II regions separated by only 4′.6. Fitting the ZAMS in figures 2j to 9 stars (stars 3 and 4 in S 300 have ambiguous reddening solutions and were not included) we obtain a modulus of 13.2±0.3 compared to the spectroscopic modulus of 13.4±0.4. We adopt the former.

S 301:

Three OB stars lead to a spectroscopic distance of 5.8 kpc.

S 305:

This region was observed in order to check the previous photometry of Vogt and Moffat (VM 1975b). From the five stars observed, we find the mean differences (present minus VM) with mean errors: $\Delta V = -0.01 \pm 0.03$, $\Delta(B-V) = +0.07 \pm 0.01$, $\Delta(U-B) = +0.10 \pm 0.04$. The significant differences in the colours (probably due to a lack of highly reddened *UBV* standard stars) explain the difference in distance modulus: 13.1 ± 0.5 here (based on only three early-type stars) and $14.0 + 0.5$ by VM. There are no spectra to check this and we adopt a mean value of 13.6 ± 0.5.

S 306

A ZAMS fit (figure 2k) to all five observed stars yields a modulus of 13.1 ± 0.2 compared to the spectroscopic modulus of 13.1 ± 0.4 from the three stars with MK types.

S 307

Of the three observed OB stars, two have MK types giving a mean distance of 2.2 kpc. The other OB star, no. 3, is associated with its own knot of nebulosity and is not included in the determination of the distance.

S 309

In addition to previous observations (Moffat and Vogt 1975, referring to S 309 as Bo 6), three new early B-stars (nos. 2-4) were observed. Each of these is associated with a tight knot of nebulosity and by themselves yield a modulus of 13.9 ± 0.4 (figure 21) compared to 13.0 for the brighter, more evolved stars observed previously. An overall fit, allowing for evolution gives 13.7 ± 0.3.

Wat 3

This is a newly discovered, faint nebulosity surrounding at least four B stars (nos. 1, 2, 5, 6). ZAMS fitting in figure 2m yields a distance of 5.2 kpc. It should be noted that the magnitudes of star no. 2 may be affected by crowding with star no. 7, while the photometric spectral class of star no. 1 is B 2.5, slightly later than its MK type.

RCW 19, 20

Only 0°.6 apart, these two regions appear to have the same distance and similar reddening. In figure 2n their combined CMD yields a modulus of 13.0 ± 0.3 compared to a spectroscopic value of 11.9 ± 0.3 from eight OB stars. We adopt a mean of 12.4 ± 0.5.

5. CONCLUSIONS

In figure 3, we plot the projected positions of individual H II regions and other OB–star groups towards the anticentre in the range $\ell = 150°\text{-}250°$ together with a schematic representation of the rest of the Galaxy in which optical distances are available. Although the spread in distance increases with distance, even for a constant error in the distance modulus, there emerges the following picture: the Perseus spiral feature (+I) probably continues (as it does in H I; cf. Kerr, 1970) beyond $\ell = 140°$ at $d \simeq 2.2$ kpc from the sun to at least $\ell \simeq 240°$, $d \simeq 3$ kpc where the local spiral feature merges into it. The outer feature +II appears better defined than previous observations indicated, extending at least from $\ell \simeq 150°$, $d \simeq 5$ kpc to $\ell \simeq 245°$, $d \simeq 6.5$ kpc. There is evidence for a further outer feature (+III) especially around $\ell = 210\text{-}220°$ where 4 HII regions (Anon, S283, S285, S289) have a mean weighted distance of 8.2 ± 0.7 (s.d.) kpc. This remote arm is possibly joined by S259 at $\ell = 193°$, $d \simeq 8.3$ kpc and S207/208 at $\ell = 151°$, $d \simeq 7.6$ kpc. These large distances are substantiated by the independent observations of distant individual OB stars by Chromey (1978) reaching out to 8-9 kpc in the anticentre direction. It is possible that this distance may represent the outer boundary of the massive stellar component of the galactic disk.

It is interesting to note that there is often a large spread of interstellar reddening especially for stars situated in the youngest, densest H II regions. Often it is the apparently fainter stars which are reddened the most (e.g. nos. 6E, W in S217; nos. 4, 6, 7 in S219; nos. 4, 5 in S237; no. 4 in S241; no. 6 in S 247; nos. 4, 5 in

S254-258; no. 1 in S287; no. 3 in S309). These stars are often intrinsically luminous and hence their faint apparent magnitudes suggest that these stars are obscured by their own circumstellar proto-clouds which they have not yet succeeded in dispersing.

An important question is how a metallicity gradient in the disk of the galaxy will effect the distances obtained here. For the most likely extreme variation of $Z \simeq 0.02$-0.03 in the solar neighbourhood (where the "normal" ZAMS was calibrated) to $Z \simeq 0.01$ (the lowest value known for a galactic open cluster: McClure *et al.* 1974, and similar to the Large Magellanic Cloud) at ~ 8 kpc in the anticentre direction, one would expect the present distance moduli based on ZAMS fitting to be overestimated for the largest galactocentric distances by up to ~ 0.5 mag. (cf. Harris and Deupree, 1976) under two assumptions:

1. the effect of a variation of Z on the position of the ZAMS for medium to old clusters can be extrapolated to the extremely young groups observed here and
2. the systematic galactocentric gradient in Z in the disk is actually as strong as this.

Since neither of these questions has been yet adequately answered, we must postpone an attempt to correct for this. In any case, the ZAMS and the spectroscopic parallaxes appear to agree with one another. Perhaps the distant regions can be used as probes for a metallicity gradient in the outer portion of the galactic disk where star formation appears to have been relatively slow compared to the inner regions of the galaxy (cf. the overall distribution of HII regions in the galaxy: Georgelin 1975).

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Table 1 Photometric and spectroscopic data

True distance modulus usually given only for stars with MK types, otherwise UBV alone assuming luminosity (LC) V; parentheses imply probable foreground stars. Brackets around reddening value indicate photometric solution with LC V.

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
S 206										
1	11.22	1.05	-0.12	1	16	05 neb	4	9,15	1.36	12.4
2	12.28	0.87	0.41	2	13	F8 IV	3	9,15	0.34	(8.4)

Notes:

1 = NLS I 51° 13 = BD 50° 886; source 5 gives 05 V, V=11.24, B-V = 1.04, U-B= -0.08.

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
S 207										
1	13.23	0.77	-0.36	2	13	09.5 IV	4	9,15	1.07	14.4
2	13.97	0.68	0.44	2	13	A7 III	1	9	0.46	(11.3)
3	14.20	0.99	0.42	3	13					
4	13.85	0.87	0.00	4	13				(1.11)	
5	15.86	0.89	0.14	3	13				(1.08)	
6	16.56	1.14	0.47	2	13					
7	15.98	1.21	0.76	1	13					
8	13.10	1.38	1.20	1	13					
9	11.72	0.77	0.22	1	13					
S 208 (nos. 1-3) + Wat 1 (nos. 4-12)										
1	10.55	0.42	0.31	3	13,14	AOV	3	9,15	0.43	(8.2)
2	14.91	1.20	0.52	4	13,14					
3	14.02	0.78	-0.26	4	13,14,16	BOV:	1	9	1.08	14.3
4	13.52	0.63	-0.31	3	13,14,16				(0.90)	
5	10.94	0.60	-0.43	3	13,14,16	09.5V	3	15	0.90	12.1
6	12.65	0.63	-0.31	3	13,14,16	BOV	3	15	0.92	13.4
7	13.47	0.60	-0.31	3	13,14,16				(0.85)	
8	14.32	0.66	-0.11	2	14,16				(0.91	
9	15.16	0.90	0.51	1	14				(0.95)	
10	15.44	0.70	0.20	1	14				(0.81)	
11	15.62	0.83	0.43	1	14				(0.89)	
12	16.06	0.77	0.10	1	14				(0.94)	

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
S 212										
1	14.37	0.74	-0.01	3	13,14,16				(0.94)	
2	11.77	0.57	-0.44	3	13,14	05.5 neb	2	15	0.89	14.3
3	14.71	0.65	-0.11	3	13,14,16				(0.88)	
4	13.13	0.62	-0.32	3	13,14,16	BOV neb	2	15	0.91	13.9
5	15.70	0.71	0.05	1	13				(0.88)	
6	12.48	2.14	2.16	2	13,16					
7	14.80	0.66	-0.24	3	13,14,16				(0.92)	
8	13.38	0.89	0.58	1	13					
9	13.07	0.92	0.44	1	13					
10	12.65	1.19	1.25	1	13					
11	16.17	0.69	-0.03	2	13,14				(0.89)	
12	14.94	0.86	0.20	1	13					
13	13.57	1.73	1.86	1	13					
14	14.34	0.74	0.36	1	13					

Notes:

2: source 5 gives Sp. 06.5

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
S 217										
1						K5V	1	9		
2	13.19	0.67	0.12	1	13,14					
3	11.34	0.41	-0.58		5	BOV	4	9,15	0.71	12.8
4	12.45	0.62	0.01	2	13,14					
5	13.82	0.80	0.25	1	13					
6E	14.80:	0.56:	-0.10:	2	13,14 }	BO:V:n	1	9	{ 0.86:	15.8:
6W	15.02:	0.62:	-0.28:	2	13,14 }	neb			{ 0.92:	15.8:
7	14.41	0.46	0.15	1	13					
8	14.33	0.48	0.12	2	13,14					
9	11.88	0.46	0.09	2	13,14	B9V	1	15	0.53	(9.7)
10	13.38	0.67	0.18	1	13					
11	14.49	0.50	-0.22	2	13,14				(0.71)	
12	14.37	0.94	0.28	1	13					
13	15.47	0.97	0.31	1	13					
14	15.02	0.57	-0.17	2	13,14				(0.80)	
15	14.96	0.89	0.20	1	13					

Notes:

1= BD + 47° 1080
3= NLS V 47° 24; source 5 gives Sp. 09.5 V
6E, W: close pair (Sep. 5"), surrounded by small knot of strong nebulosity

Table 1 *(continued)*

S 219

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.10	0.52	-0.42		5	BOV	5	9,15	0.82	13.2
2	14.79	0.67	0.29	1	14					
3	15.63	0.66	0.30	1	14					
4	14.45	0.78	-0.11	1	14				(1.03)	
5	14.47	0.70	0.10	1	14					
6	15.97	0.83	0.19	1	14				(0.98)	
7	15.99	1.00	0.01	1	14				(1.27)	

Notes:

1= NLS V 47° 22

S 224

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.09	0.28	-0.64		5	BOV	3	9,15	0.58	11.9
2	9.37	0.68	0.22	1	14	GOIII	1	9	0.04	8.2
3	7.93	1.71	1.81	1	14	M2Ib:	1	9	0.06	12.5

Notes:

1= NLS V 42° 31 = BD + 42° 1286; source 5 gives Sp. BO.5V

S 225 (nos. 1-4, 11, 12) + **Wat 2** (nos. 5-10)

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	8.16	0.10	0.08	1	14					
2	9.41	0.00	-0.42	1	14				(0.16)	
3	10.30	0.28	0.12	1	14					
4	10.74	0.41	-0.58		5	09V	4	9,15	0.72	12.8
5	10.96	0.35	0.14	1	14					
6	11.56	0.25	0.07	1	14					
7	10.26	0.15	-0.07	1	14				(0.23)	
8	9.15	0.06	-0.25	1	14				(0.18)	
9	8.81	1.03	0.77	1	14					
10	9.65	0.06	-0.03	1	14				(0.10)	
11	11.14	1.14	0.90	1	14					
12	10.22	0.44	0.07	1	14					

Notes:

4= NLS V 40° 46; source 5 gives Sp. 09V

S 237

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	11.13	0.30	-0.41	1	13				(0.49)	
2	11.49	0.41	-0.57	1	13				(0.71)	
3										
4	14.11	0.70	-0.24	1	13				(0.93)	
5	13.99	0.52	-0.19	1	13				(0.69)	

Notes:

1= NLS V 34° 46 = BD + 34° 1074
2= NLS V 34° 47

S 241

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.95	0.31	-0.61	2	5	09V	3	15	0.62	13.4
2	12.74	0.69	0.20	1	14					
3	15.36	1.12	0.54	1	14					
4	14.97	0.86	-0.12	1	14				(1.11)	
5	15.73	0.94	0.38	1	14					
6	15.93	0.90	0.21	1	14					
7	15.72	0.70	0.40	1	14					
8										
9	16.39	1.16	-0.03	1	14				(1.47)	
10	14.46	1.31	0.91	1	14					
11	14.83	0.32	-0.03	1	14					
12	17.16	0.73	0.70:	1	14					

Notes:

1= NLSV 30° 31; close pair (Sep. 2"): 1 S is A7V, 1 N is 09V
source 5 gives Sp. 09V

S 247

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	11.07	0.62	-0.45		5	BO III	2	15	0.92	12.7
2	11.01	1.02	0.97	2	10	KO III	3	15	0.01	(9.8)
3	13.46	0.81	0.11	1	10					
4	14.18	0.62	0.16	1	10					
5	15.83	1.86	0.7 :	1	10					
6	12.86	0.59	0.20	2	10					
7	12.13	1.43	1.41	2	10					
8	12.30	1.24	1.00	2	10					
9	14.35	0.72	0.27	1	10					
10	14.24	0.64	0.19	1	10					

Notes:

1= NLS V 21° 27 ; source 5 gives Sp. BO III

SLS	Sp	n	Source	E_{B-V}	V_o-M_V
S 253					
44	07 III:	3	6,9	0.45	12.7
45	B1.5V	2	9	0.49	13.7
46	06	3	6,9	0.56	13.3
47	08 III	3	6,9	0.52	14.2
48	B2V	1	9	0.55	13.1
50	A3IV	1	9	0.27	(8.9)
51	B1V ne	3	6,9	0.61	12.8
53	B1V	3	6,9	0.54	13.3
54	B2V	1	9	0.52	13.1
*	OBe		5	(0.56)	13.1

Notes:

* = NLS IV 20° 40; assume Sp. B1.5 V from UBV

S 254 (no 1), **255** (no. 3), **256** (no. 5), **257** (nos. 2,6,7,8), **258** (no. 4)

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	9.79	0.34	-0.59	4	5,7	09.5V	2	5	0.64	11.7
2	10.74	0.57	-0.38	4	5,7	BOV	2	9	0.87	11.7
3	11.66	0.88	-0.21	4	5,6,7	BO III neb	2	9	1.18	12.5
4	15.28	1.22	0.40:	4	6,7,10				(1.41:)	
5	14.37	1.15	-0.03:	4	7,10				(1.47:)	
6	13.84	0.58	0.12	1	7					
7	12.99	0.44	0.33	1	7					
8	14.01	0.74	0.13	1	7					

Notes:

1= SLS 17 = BD + 18° 1123
2= SLS 18 = BD + 18° 1124
3= SLS 19

S 259

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	15.43	0.95	-0.01	2	8				(1.22)	

S 267

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.11	0.24	-0.38	1	7	B3V:	1	11	0.44	(10.4)
2	11.77	0.76	-0.31	3	7,10	09V	2	11,15	1.07	12.7
3	12.13	0.43	0.91	1	7					

S 269

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	14.28	0.65	0.17	2	7					
2	13.82	1.07	-0.06	4	7,10	BO.5V	2	9	1.35	12.9
3	14.96	0.74	0.33	2	7					
4	14.60	0.67	0.21	2	7					
5	15.36	0.80	-0.31	2	7				(1.11)	

S 271, **272**

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.19	0.68	-0.37	2	7	09V	5	9,15	0.99	13.4
2	11.78	0.50	-0.04	2	7					
3	13.28	0.66	-0.32	2	7	B1V	2	9	0.92	13.3
4	14.67	0.65	0.35	2	7					
5	14.74	0.71	0.33	2	7					
6	14.64	0.92	0.58	2	7					

Dolidze 24

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.06	0.25	0.16	1	7					
2	13.78	0.58	-0.11	2	7					
3	13.38	0.54	-0.27	2	7					
4	13.93	0.85	-0.23	2	7					
5	10.23	0.16	-0.66	2	7					
6	13.58	0.40	-0.05	2	7					
7	13.06	0.57	-0.13	2	7					
8	14.49	0.86	0.04	2	7					

Notes:

4 is centred on possibly very distant anonymous H II region

S 283

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	13.26	0.49	0.01	3	7,16					
2	14.22	0.65	-0.40	5	7,8,10					
3	15.08	0.55	0.03	2	7					
4	14.75	0.64	-0.10	3	7,16					
5	15.11	0.96	0.78	2	7					
6	15.90	0.96	0.23	2	7					
7	13.65	0.53	-0.45	3	8,10,16					
8	12.30	0.51	-0.49	3	8,10,16	BO:V:	2	9,15	0.82	13.4
9	13.12	1.30	1.01	1	8					
10	14.16	0.53	-0.38	2	8,10					

No.	Sp	n	Source	E_{B-V}	V_o-M_V
S 284					
1	BO IV	3	11,15	0.74	13.3
9	09:	1	15	0.82	14.1
10	F2Ib	2	6,15	0.80	11.0:
12	BO III	4	2,6,15	0.66	13.3
15	B1:V:	1	11	0.92	11.7:
17	B1:	2	6,11		
Bo 2					
1	09IV	3	6,15	0.83	13.6
2	08 V	3	6,15	0.88	12.9
3	09.5 V	3	6,15	0.80	12.6

S 285

No.	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.30	0.23	-0.66	3	7	BOV	2	12	0.53	14.3
2	14.42	0.33	-0.21	2	7				(0.49)	
3	15.39	0.39	-0.03	2	7				(0.52)	
4	15.70	0.56	-0.03	2	7				(0.72)	
5	16.00	0.41	-0.24	2	7				(0.61)	
6	12.05	0.26	-0.65		5	BOV		5	0.56	14.0

Notes:

6 = NLS VI -0° 9

Table 1 *(continued)*

S 287

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	14.48	0.64	-0.20	2	7				(0.88)	14.0
2	8.85	0.40	0.04	1	7					
3	10.49	0.16	-0.36	1	7	B6:V	1	11	0.30	(10.2)
4	11.04	0.07	-0.01	1	7				(0.11)	
5	10.82	0.44	-0.53	4	7,10	09.5V	2	5	0.74	12.5
6	11.46	0.07	-0.12	1	7				(0.15)	
7	11.36	0.06	-0.26	1	7				(0.19)	
8	14.13	0.67	0.08	1	7					
9	12.91	0.65	0.07	1	7					
10	12.94	0.25	0.11	1	7					
11N	9.77	0.20	-0.57	1	10	B1 V	2	11	0.46	11.3
11S	10.53:	0.18:	-0.71:	1	10				(0.47:)	

Notes:

5 = NLS VI - 4° 19; source 5 gives Sp. 09.5V,
V= 10.75, B-V = 0.47, U-B =-0.50
9 measured with close companion ~ 1/3 as bright as main star
11 NLS VI - 4° 13, surrounded by uncatalogued H II nebula.

S 288

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.31	0.64	-0.28	2	7				(0.92)	12.4
2	14.65	0.55	0.29	2	7					

S 289

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.17	0.14	-0.74	3	7	09.5 IV	4	6,9,11	0.44	15.4
2	12.66	0.21	-0.61	2	7	B1 V	3	9,12	0.47	14.2
3	13.71	0.23	-0.56	2	7					
4	13.58	0.21	-0.60	2	7	BOV	1	9	0.51	15.6
5	14.61	0.24	-0.41	2	7					
6	15.58	0.32	-0.41	2	7					
7	13.93	0.64	0.28	1	7					
8	13.62	0.72	0.34	1	7					
9	13.31	0.35	0.51	1	7					
10	7.12	0.04	0.05	1	7					
11	14.47	0.27	-0.49	2	7					
12	13.22	0.21	-0.53	2	7					
13	11.35	0.19	-0.74	1	10	BO.5V	1	11	0.47	13.2
14	10.74	0.65	0.54	2	10	A4:Ib	1	11	0.57	13.7

Notes:

1 = SLS 85
13 = SLS 86
14 = SLS 87
11,12 in adjacent, anon. H II nebula

S 294

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.75	0.00	-0.16	1	7					
2	13.25	0.22	0.15	1	7					
3	13.27	0.55	0.02	1	7					
4	13.99	1.03	-0.03	3	7,10				(1.32)	13.3
5	14.39	0.63	0.23	1	7					
6	15.69	0.63	0.15	1	7					
7	17.01	1.06	0.39	1	14				(1.20)	
8	15.49	0.84	0.20	1	14				(0.99)	
9	13.13	0.44	0.03	1	14					
10	11.41	0.52	0.02	1	14					
11	13.72	1.03	0.86	2	14					
12	14.00	0.47	0.21	2	14					
13	13.11	0.50	0.02	1	14					
14	14.72	0.70	0.17	1	14					
15	15.60	0.68	0.17	1	14					
16	14.67	0.56	0.26	1	14					

S 298

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
0	11.40	0.28	-0.47	5	7,10	WN5		5	0.56	14.2
1	9.85	0.98	0.69	1	7					
2	10.86	0.15	-0.50	2	7	B2 IV ne	1	11	0.39	(12.7)
3	11.87	1.23	1.16	1	7					
4	10.80	0.56	0.12	1	7					
5	12.70	0.31	0.31	1	7					
6	12.94	0.33	-0.01	1	7					
7	12.16	0.57	0.08	1	7					
8	13.71	0.26	-0.35	4	7,10				(0.46)	13.8
9	8.61	1.93	1.36	1	7					
10	14.76	0.74	0.12	1	7					
11	14.41	0.75	0.24	1	7					

Notes:

0 = HD 56925 = SLS 299; distance modulus from Smith (1968) with E_{B-V}= 1.2 E_{b-v}

S 299

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.54	0.58	-0.38	2	7	BO V	2	9	0.88	13.4
2	13.57	0.66	-0.25	3	7,10				(0.92)	
3	14.59	0.62	-0.22	3	7,10				(0.87)	

Notes:

1= SLS 465

S 300

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	11.50	0.44	-0.52	2	7	BO V	4	9,11,12	0.74	12.8
2	14.59	0.57	-0.09	2	7				(0.75)	
3	14.86	0.54	0.02	2	7				(0.68)	
4	15.37	0.46	0.06	2	7				(0.56)	
5	15.68	0.48	-0.07	2	7				(0.63)	
6	11.28	0.76	-0.36	2	10	BO.5Ib	3	9,12	0.98	14.1:

Notes:

1= SLS 478
6= SLS 480, 4' south of S 300

S 301

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.85	0.44	-0.56	2	7	07	3	9,11,12	0.76	13.5
2	11.48	0.29	0.16	1	7					
3	11.56	0.18	-0.70	2	7	B1 III	2	11	0.44	14.4
4	12.05	0.42	0.19	1	7					
5	11.88	0.17	0.08	1	7					
6	12.11	0.21	-0.54	2	7	B 1 V	1	12	0.47	13.6
7	12.67	0.33	0.19	1	7					

Notes:

1= SLS 207
3= SLS 208
6= SLS 212

S 305

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
2	12.77	0.90	-0.20	2	10				(1.21)	13.3
4	12.92	1.10	0.01	2	10				(1.39)	12.2
10	14.37	0.84	-0.11	2	10				(1.11)	13.9
11	14.88	0.88	0.39	2	10					
12	12.68	0.76	0.32	2	10					

Notes:
No. 12 is 1'.8 south of no. 6.

S 306

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	11.14	0.64	-0.42	2	7	09.5III	1	12	0.94	13.0
2	8.97	0.53	-0.53	2	7	BOIb	2	6,12	0.77	12.5
3	13.30	0.62	-0.32	1	7					
4	11.30	0.64	-0.44	2	7	05	2	11,12	0.96	13.7
5	11.37	0.73	-0.32	2	7					

Notes:
1= SLS 467; source 5 gives 09 (V)
2= SLS 477
4= SLS 458
5= SLS 473

S 307

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.40	0.65	-0.45	2	7	09V	1	11	0.96	11.7
2	11.62	0.74	-0.26	2	7	B3 III	1	11	0.94	11.7
3	12.47	0.79	-0.32	2	7					
4	13.42	0.83	0.27	2	7					
5	11.75	0.48	0.19	1	7					

Notes:

1 = BD - 18° 1920 = SLS 561
2 = SLS 566

S 309

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.10	0.44	0.09	1	7					
2	12.90	0.71	-0.32	2	7				(1.01)	
3	14.16	0.60	-0.38	3	7,10				(0.87)	
4	13.90	0.87	-0.18	3	7,10				(1.15)	
SLS 499						09V	1	11	0.81	

Wat 3

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	12.87	0.16	-0.50	2	7	B1 III:	1	6	0.42	15.7
2	13.48	0.24	-0.22	2	7				(0.38)	
3	12.85	0.21	+0.14	1	7					
4	14.62	0.29	0.15	2	7					
5	15.00	0.21	-0.17	2	7					
6	14.67	0.16	-0.28	2	7					
7	14.85:	1.11:	0.48:	2	7					

RCW 19

SLS

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1020	9.18	0.43	-0.60	2	7	BO III	2	6,12	0.73	11.4
1022	8.79	0.31	-0.69	2	7	07	3	6,12	0.63	11.9
1026	9.48	0.42	-0.61	2	7	09.5 III	2	6,12	0.72	12.1
1027	11.33	0.56	-0.49	2	7	BO:	1	6	0.86	12.3
1029	10.44	0.64	-0.38	2	7	07n	1	6	0.96	12.5

Notes:

1020 = DM - 35° 4384
1022 = HD 69464
1026 = DM - 35° 4412

RCW 20

No	V	B-V	U-B	n	Source	Sp	n	Source	E_{B-V}	V_o-M_V
1	10.19	0.27	-0.71	2	7	BOV	1	12	0.58	12.0
2	10.68	0.41	0.19	1	7					
3	11.15	1.21	1.36	1	7					
4	11.70	0.20	0.22	1	7					
5	11.86	0.35	0.12	1	7					
6	10.52	0.43	-0.57	1	7	BO IV	2	6,12	0.73	12.5
7	9.17	0.28	-0.72	2	7	B1 V	1	12	0.56	10.4

Notes:

6= SLS 1040
7= SLS 1041; source 5 gives BO III

Sources:

2 Cass. spectrograph (73 Å/mm) 1.5 m telescope ESO (AFJM, 1973).
5 Georgelin (1975).
6 Las Campanas 0.6 m telescope (photometer or Garrison spectrograph) (MPF, 1975).
7 Bochum photometer 0.6 m telescope, La Silla (AFJM, 1975).
8 Yale 1.0 m telescope, Cerro Tololo (MPF, 1975).
9 Kitt Peak 2.1 m spectrograph (MPF, 1975).
10 Las Campanas 1.0 m photometry (PDJ, 1976).
11 Las Campanas 0.6 m spectroscopy (PDJ, 1976).
12 Yale 1.0 m image tube spectrograph, Cerro Tololo (MPF, 1976).
13 Kitt Peak 0.9 m photometer (PDJ, 1977).
14 Kitt Peak 2.1 m photometer (PDJ, 1977).
15 Kitt Peak 2.1 m spectrograph (PDJ, 1977).
16 Kitt Peak 0.9 photometer (PDJ, 1978).

Table 2 Summary list

Name	ℓ	b	cSp	V_o-M_V	d(kpc)	E_{B-V}±s.d.	n	method
S206= NGC 1491	150°6	-0°9	O5	12.4	3.0	1.36	1	MK
S207	151.2	+2.1	O9.5	14.4±.1	7.6	1.08±.01	2	MK, (ZAMS)
S208	151.3	+2.0						
Wat 1	151.4	+1.9	O9.5	13.2±.2	4.4	0.90±.03	6	ZAMS
S212= NGC 1624	155.4	+2.5	O6	13.9±.2	6.0	0.90±.02	6	ZAMS
S217	159.2	+3.3	B0	13.6±.3	5.2	0.8±.1	5	ZAMS
S219	159.3	+2.6	B0	13.1±.3	4.2	1.0±.2	3+	ZAMS, (MK)
S224	166.2	+4.4	B0	11.9	2.4	0.58	1	MK
S225	168.1	+3.1	O9	12.8	3.7	0.72	1	MK
Wat 2	168.4	+3.0	B8	8.8±.2	0.57	0.17±.05	4+	ZAMS
S237=NGC 1931	173.8	+0.3	B0	11.3±.3	1.8	0.7±.2	4	ZAMS
S241	180.9	+4.1	O9	13.4	4.7	0.9±.3	1+	MK
S247	188.9	+0.8	B0	12.7	3.5	0.9 (+)	1+	MK
S253=Bo 1	192.4	+3.2	O6	13.2±.2	4.4	0.53±.05	9	MK, ZAMS
S254								
S255								
S256 =IC 2162	192.6	-0.1	O9.5	12.0±.3	2.5	1.1±.4	3+	MK, (ZAMS)
S257								
S258								
S259	192.9	0.0	B1:	14.6	8.3	1.22	1	UBV
S267	196.2	-1.2	O9	12.7	3.5	1.07	1	MK
S269	196.4	-1.7	B0.5	12.9	3.8	1.35	1	MK
S271	197.8	-2.3	O9	13.4±.1	4.8	0.96±.05	2	MK
S272	197.8	-2.3						
Dol 24	210.7	-0.8	B1	11.9±.3	2.4	0.7±.2	6	ZAMS
Anon HII	211.0	-0.9	O9.5:	14.7:	8.7	1.16	1	UBV
S283	210.8	-2.5	B0	14.8±.3	9.1	0.86±.08	5	ZAMS
S284=Dol 25	211.9	-1.3	O9	13.6±.3	5.2	0.74±.08	3	MK=ZAMS
Bo 2	212.3	-0.4	O8	13.4±.3	4.8	0.84±.04	3	MK≃ZAMS
S285	213.9	-0.6	B0	14.2±.2	6.9	0.55±.02	2	MK
S287	218.1	-0.4	O9.5	12.5	3.2	0.74	1	MK
S288	218.7	+1.8	B1	12.4	3.0	0.92	1	UBV
S289	218.8	-4.6	O9.5	14.5±.2	7.9	0.48±.03	9	ZAMS
S294	224.2	+1.2	B0.5:	13.3	4.6	1.32	1	UBV
S298= NGC 2359	227.8	-0.1	WN5	14.0±.2	6.3	0.51±.07	2	Sp, UBV
S299	231.0	+1.5	B0	13.2±.3	4.4	0.8±.1	9-	ZAMS
S300	231.1	+1.5						
S301	231.5	-4.4	O7	13.8±.3	5.8	0.6±.2	3	MK
S305	233.7	-0.3	O9.5	13.6±0.5	5.2	1.2±.1	3	UBV
S306=RCW 10	234.3	-0.4	O5	13.1±0.2	4.2	0.9±.1	5	ZAMS, (MK)
S307=RCW 12	234.6	+0.7	O9	11.7	2.2	0.95±.01	2+	MK
S309=Bo 6	234.8	-0.2	O9	13.7±.3	5.5	0.8±.2	8	ZAMS
Wat 3	242.5	+1.4	B2:	13.6±.2	5.2	0.34±.04	4	ZAMS
RCW 19	253.8	-0.3	O7	12.4±.5	3.0	0.7±.1	8	ZAMS
RCW 20= NGC 2579	254.4	-0.1						

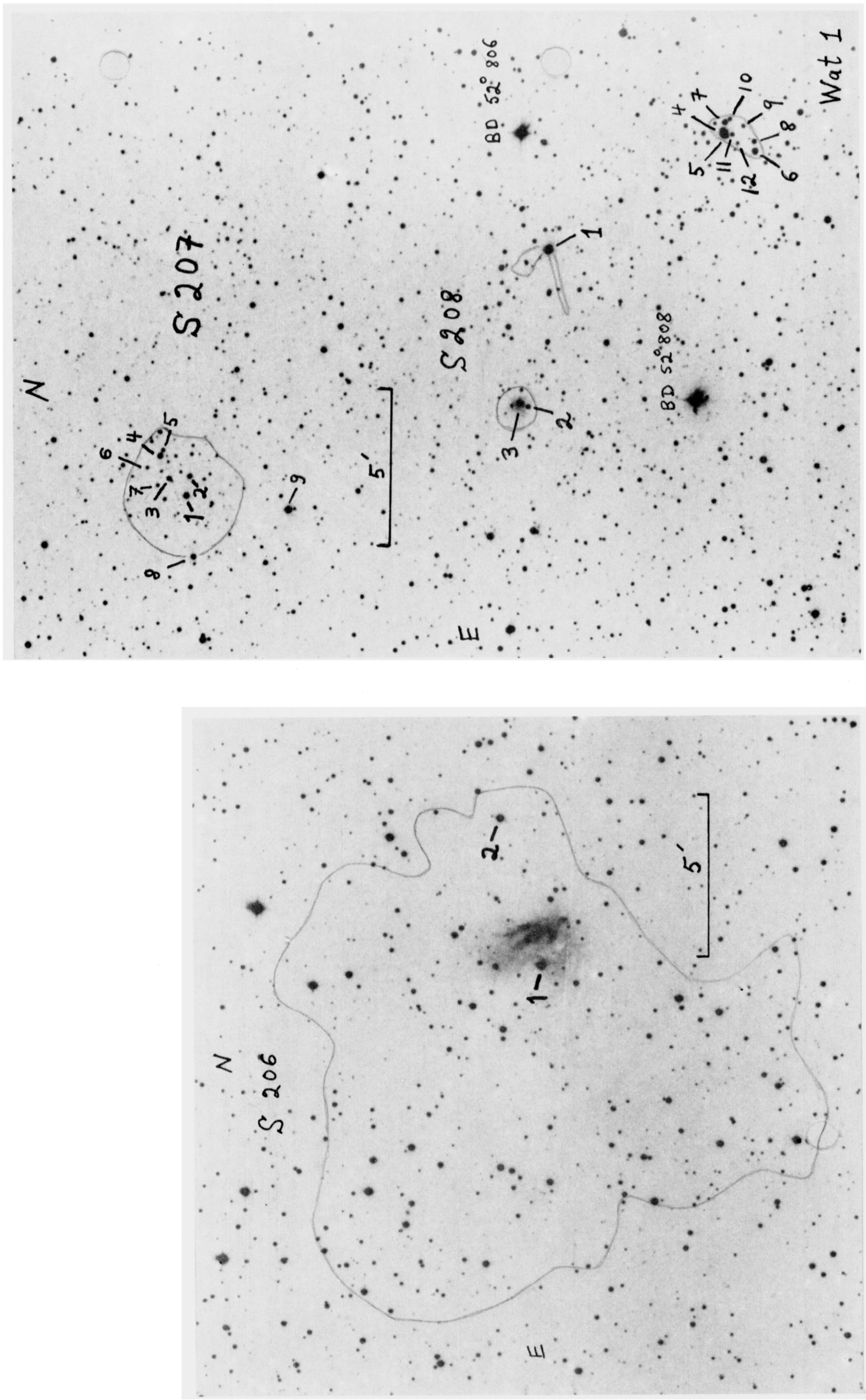


Figure 1 Identification charts in order of Table 2. All are from the POSS blue prints except RCW 20.

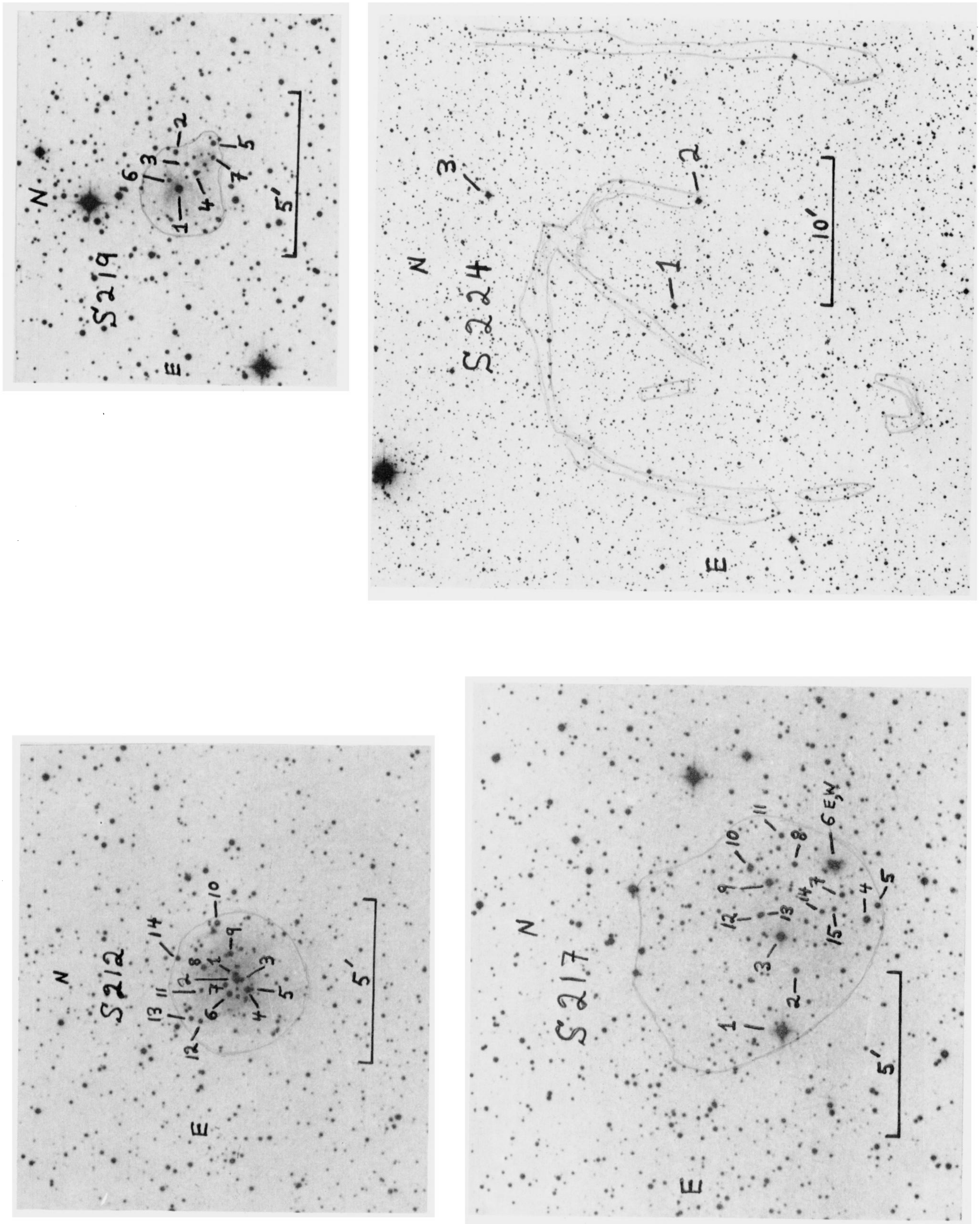
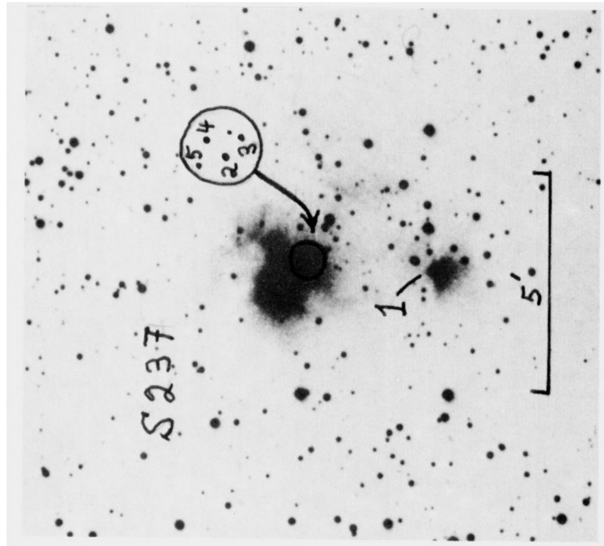
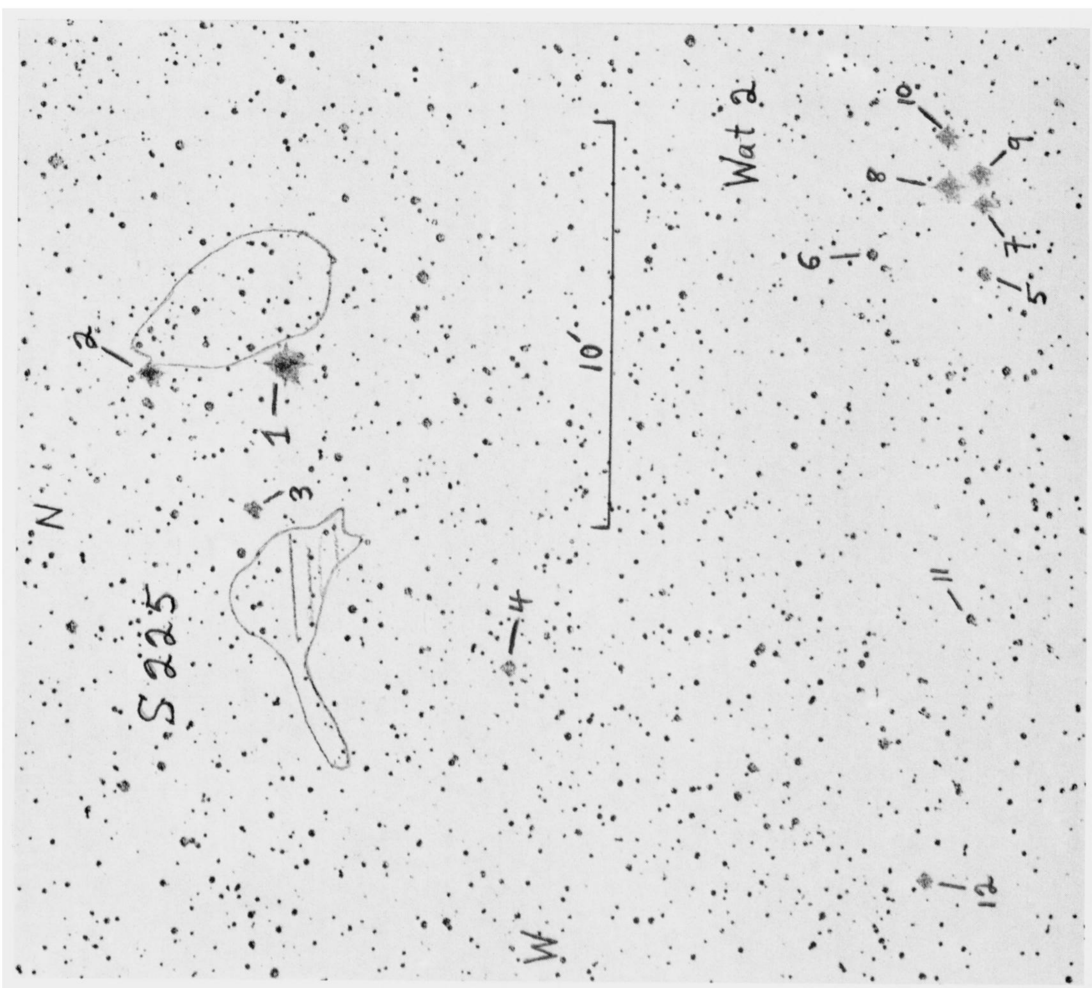


Figure 1 (*continued*)





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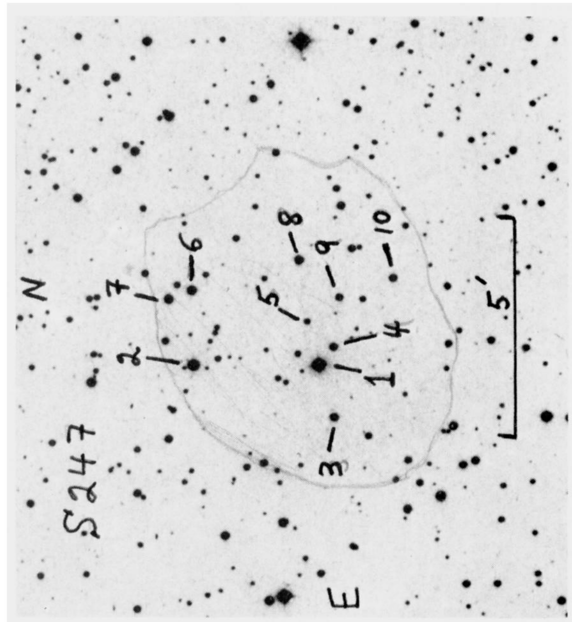

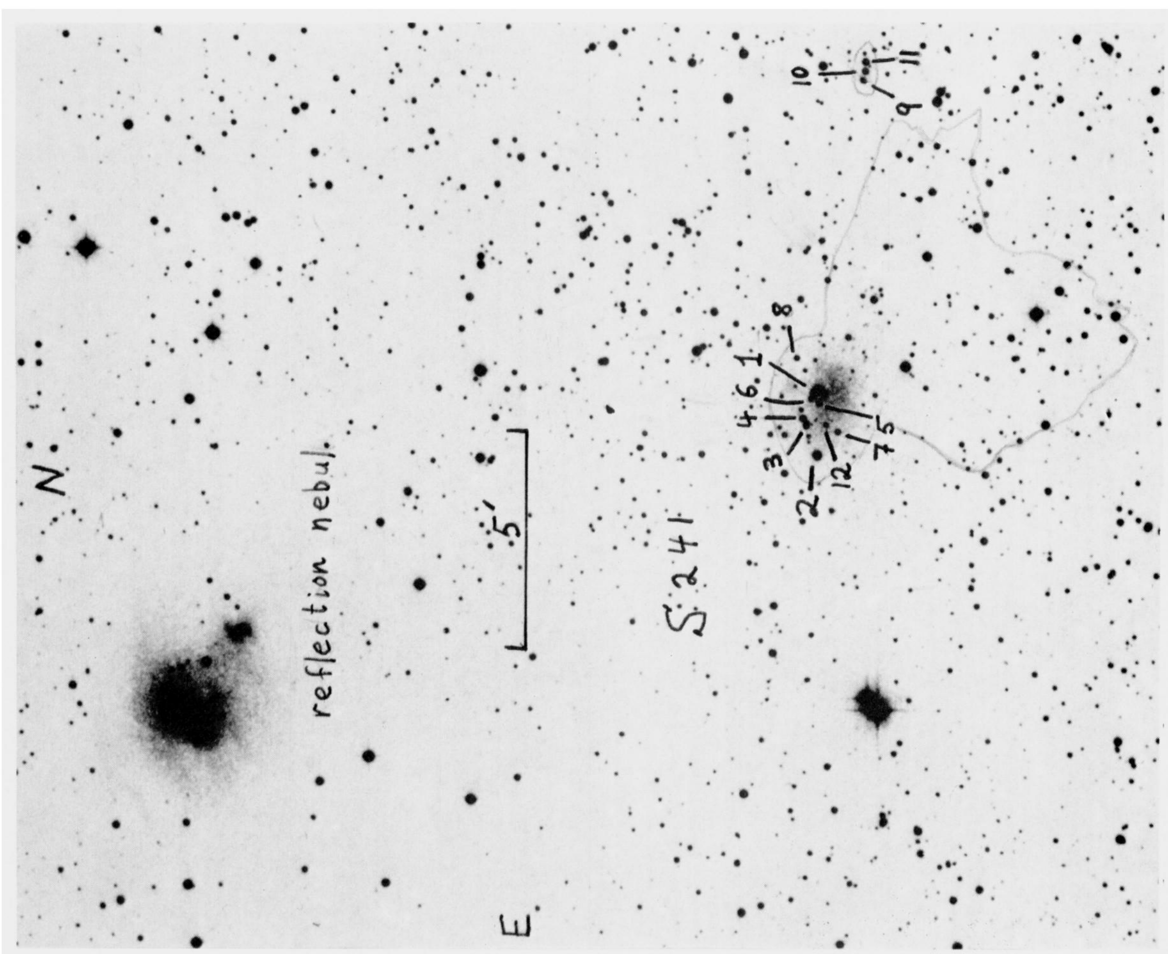

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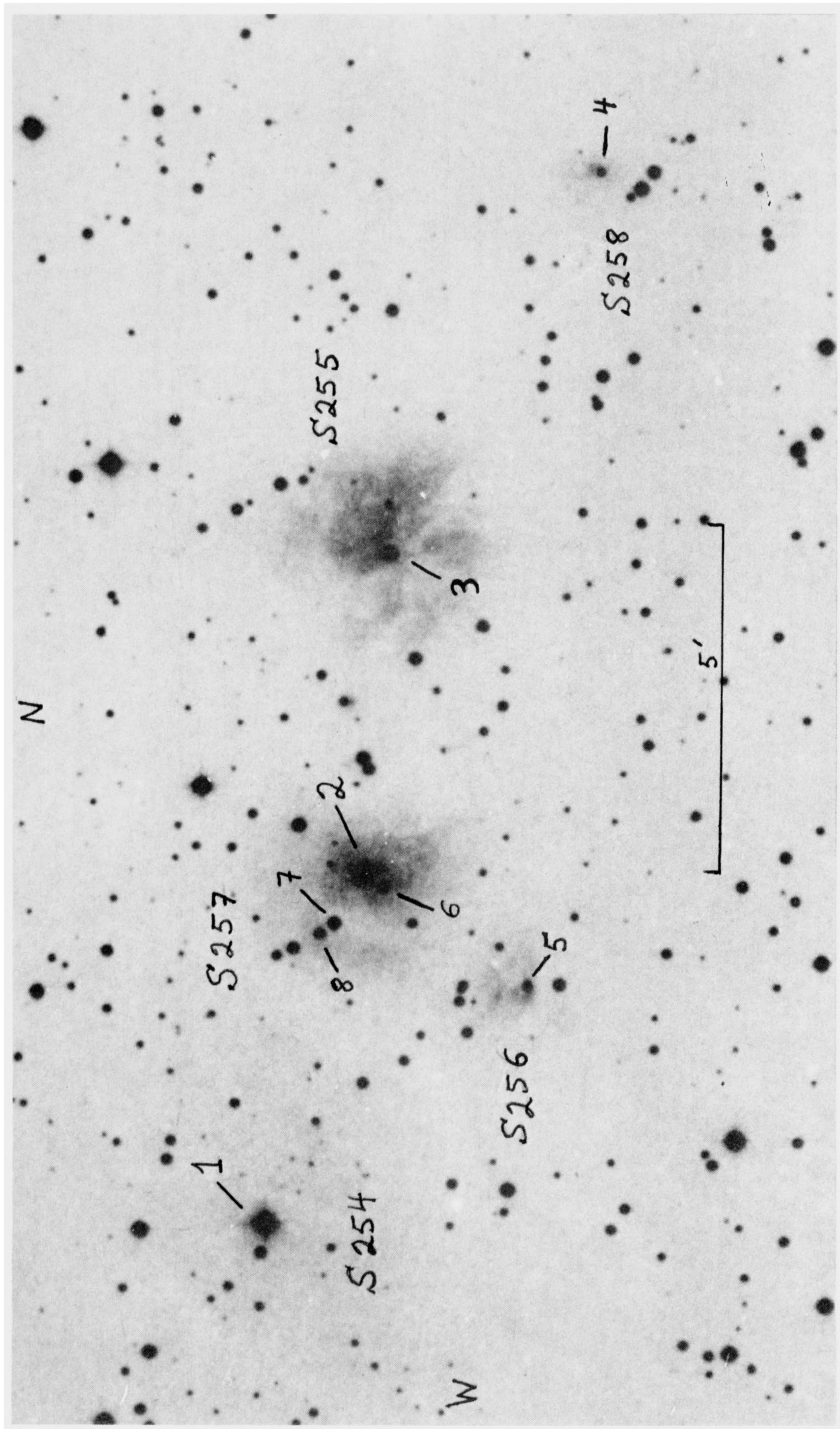

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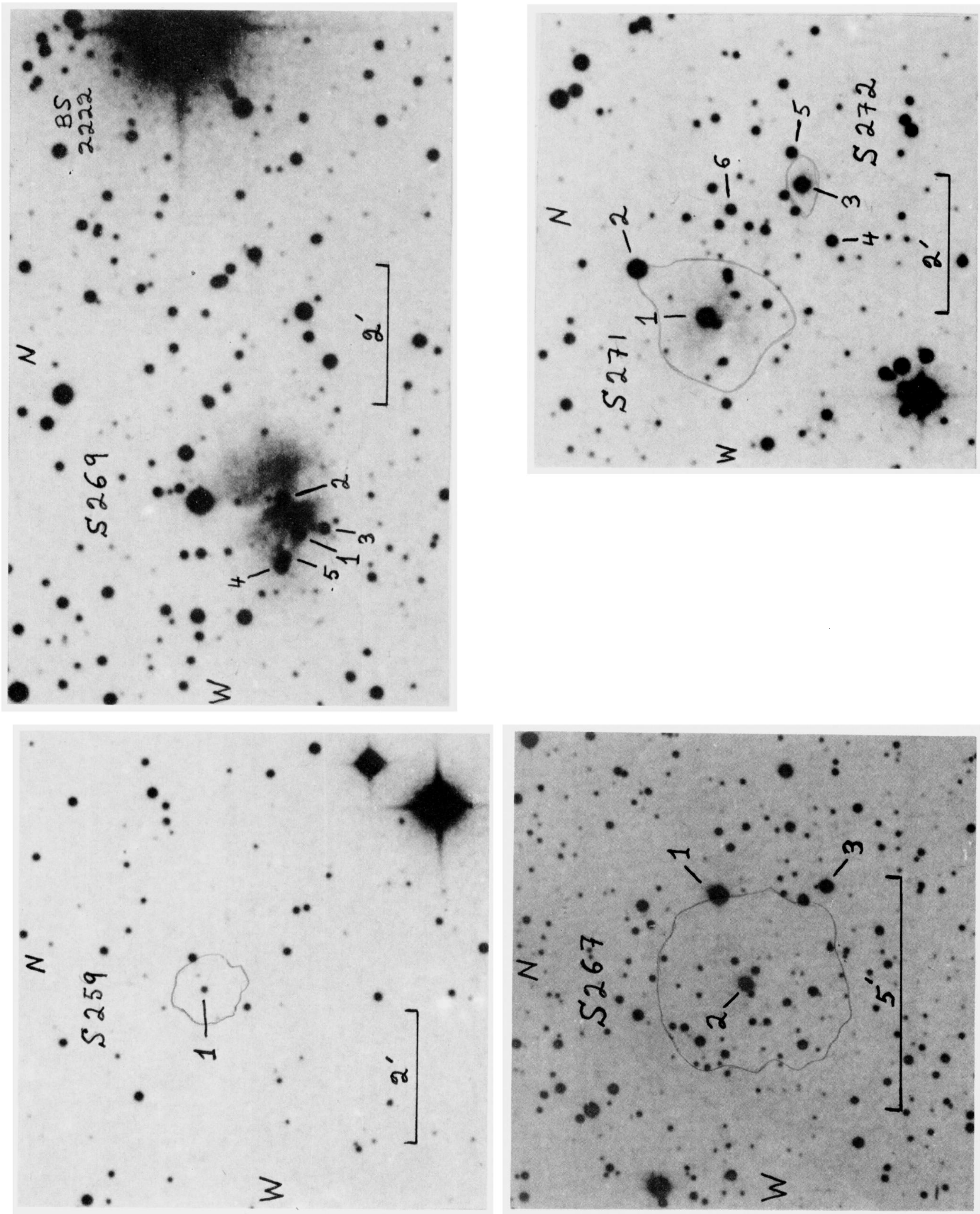

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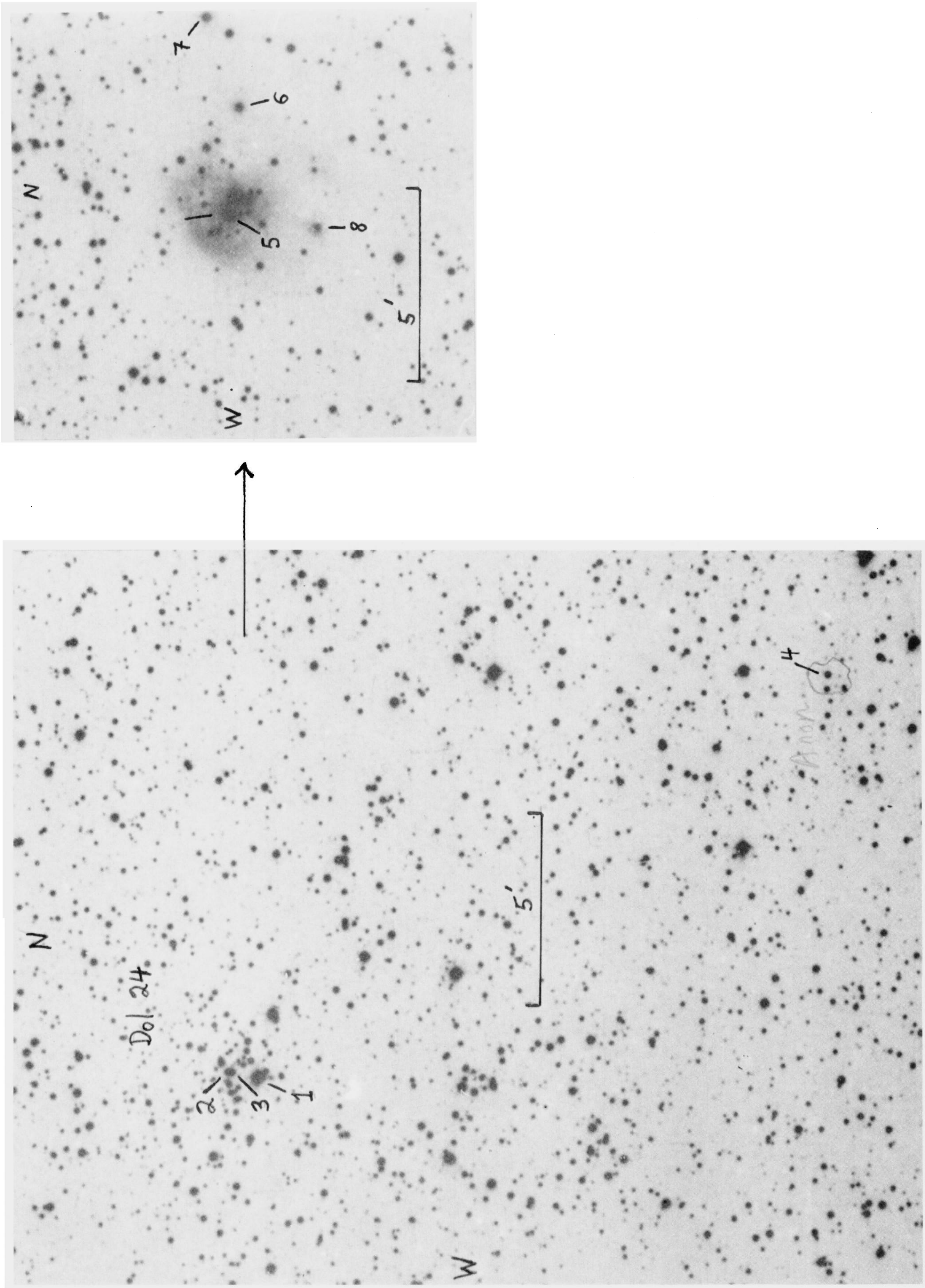

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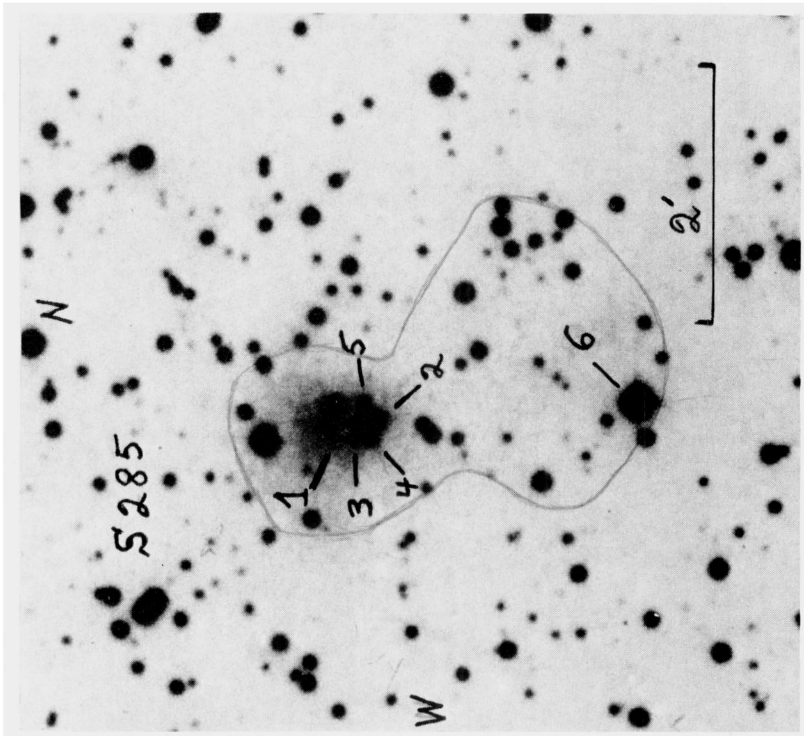

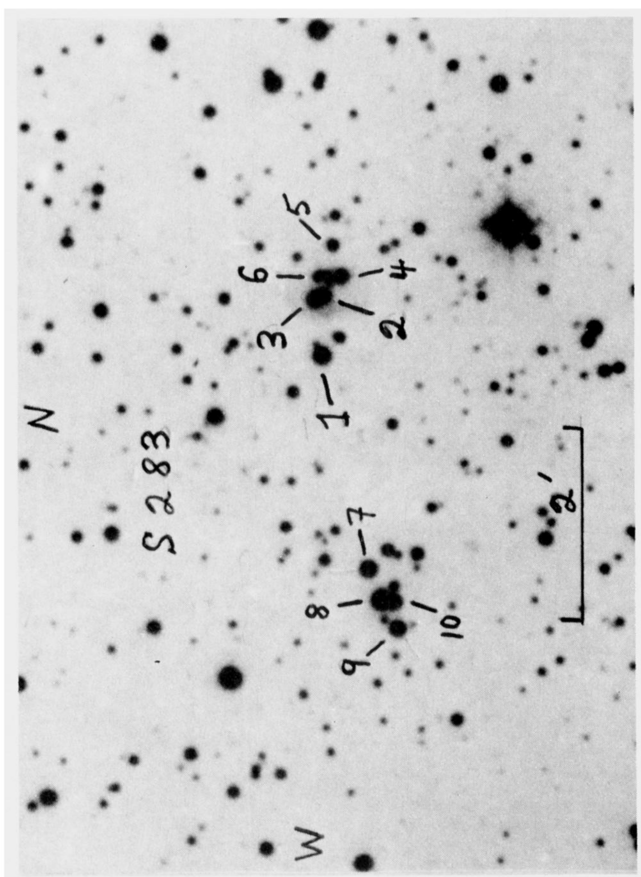

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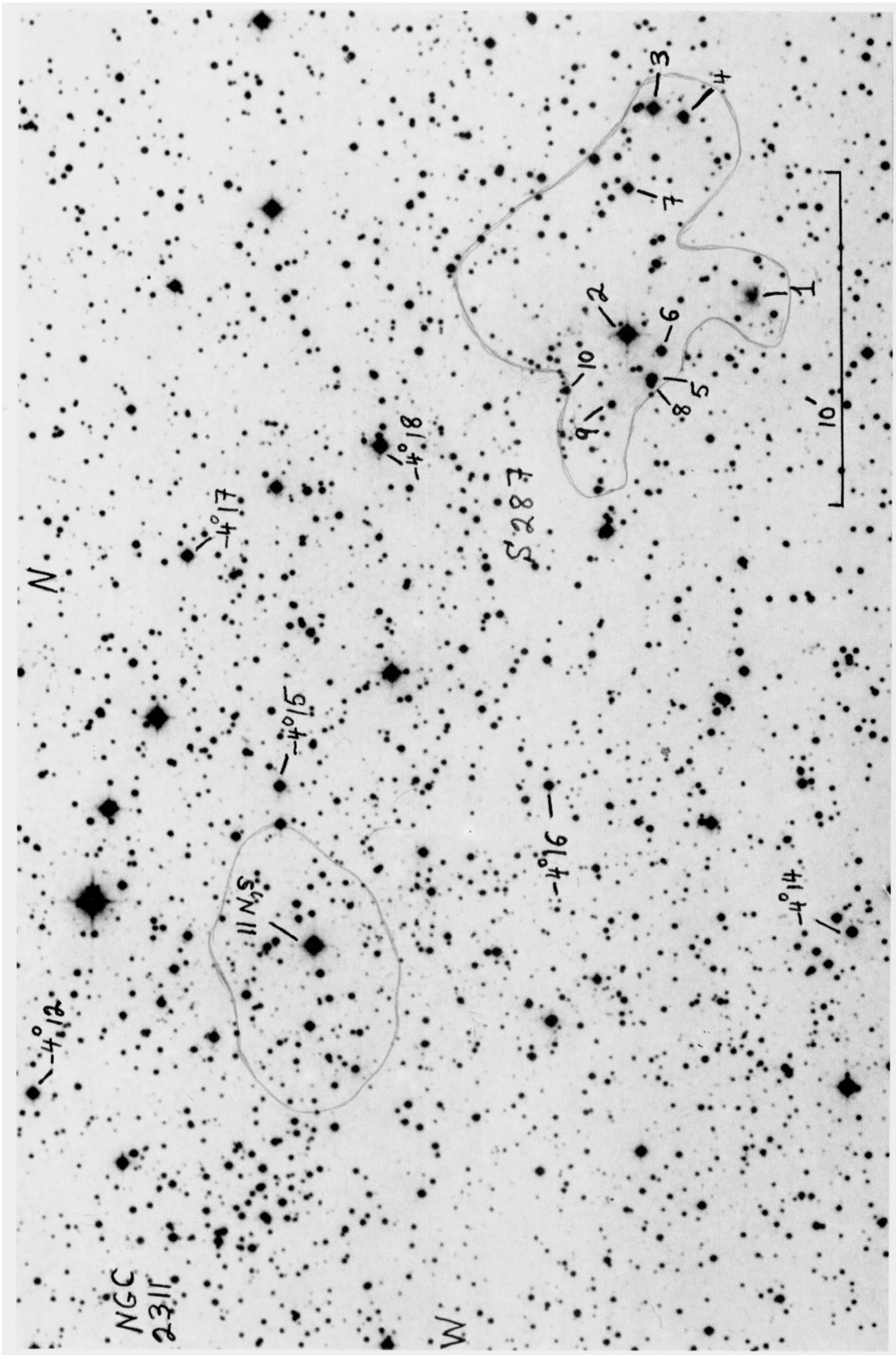

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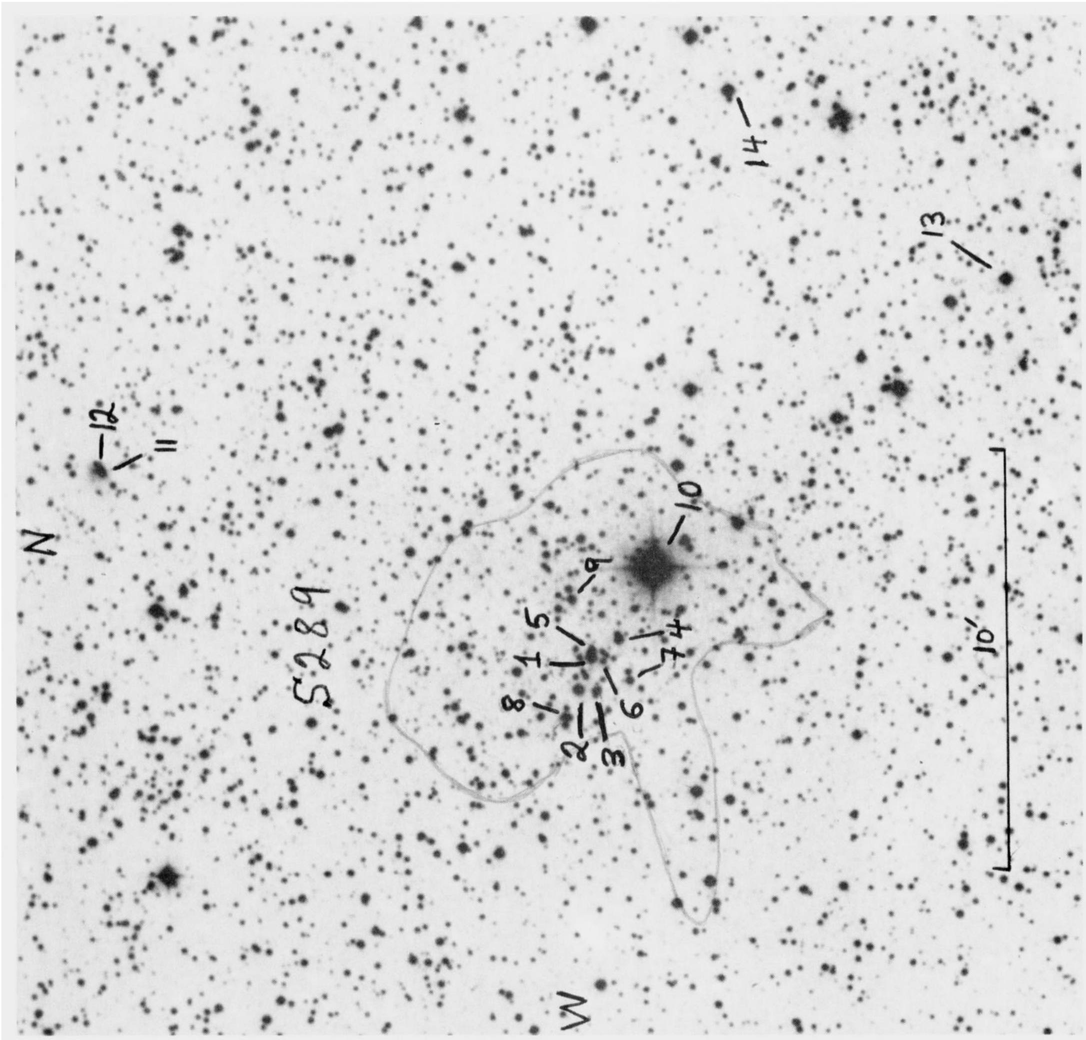

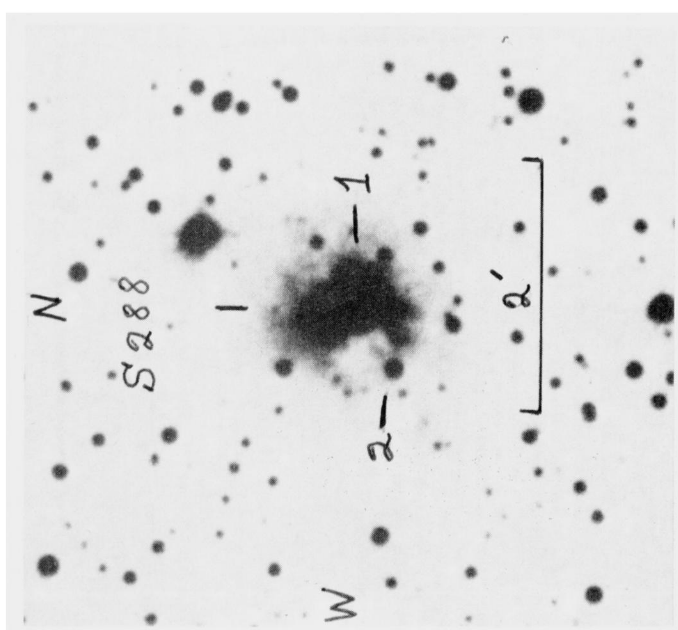

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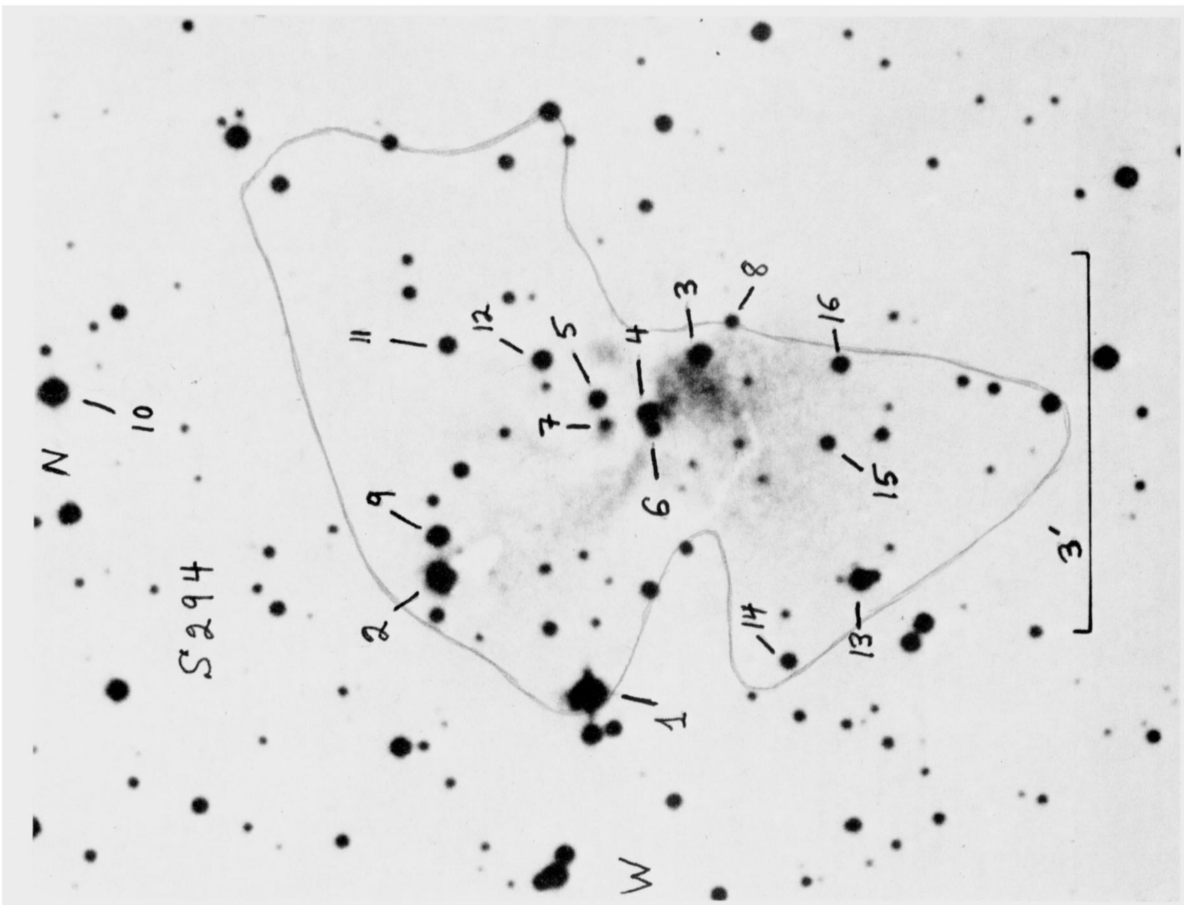

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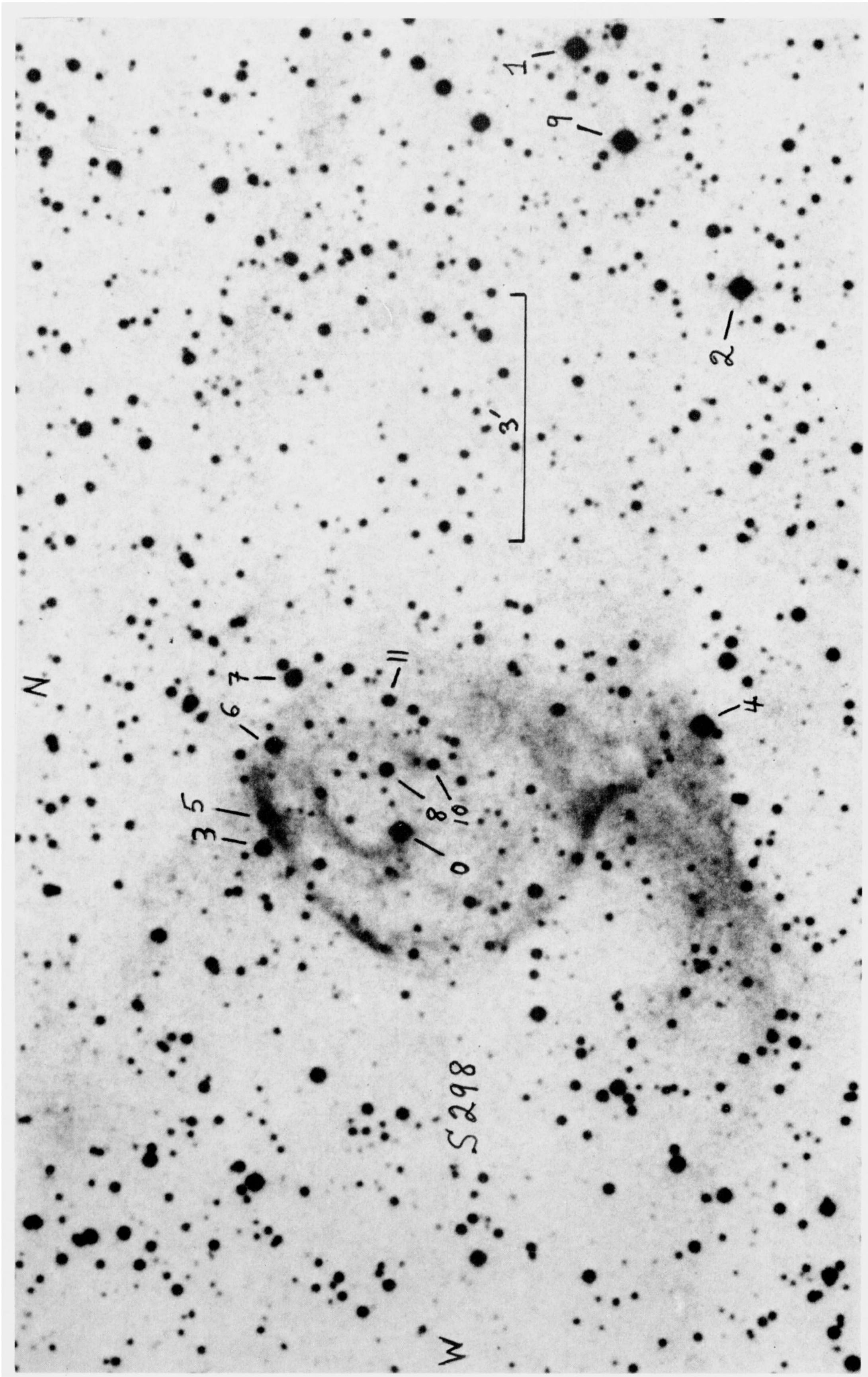

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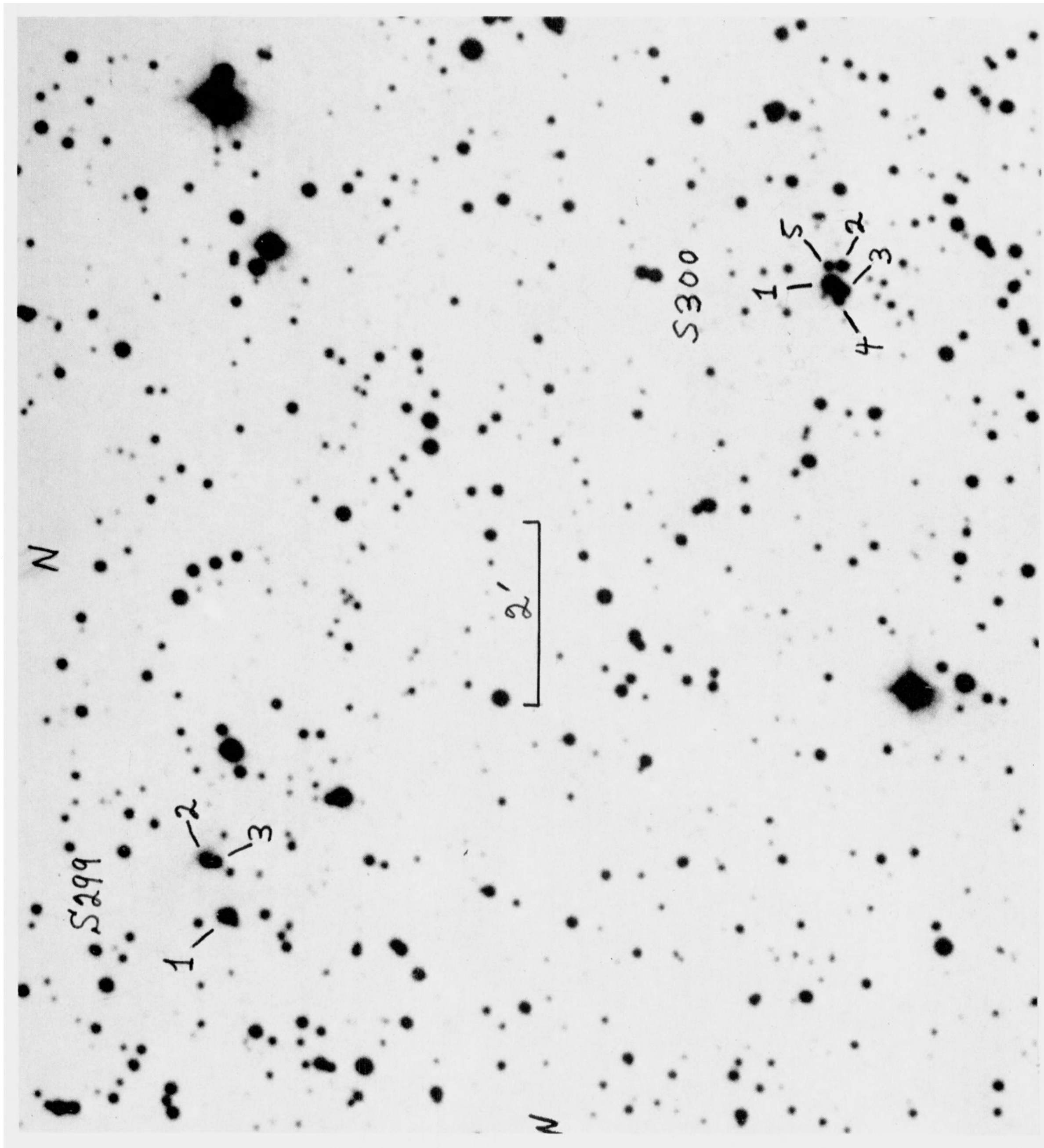

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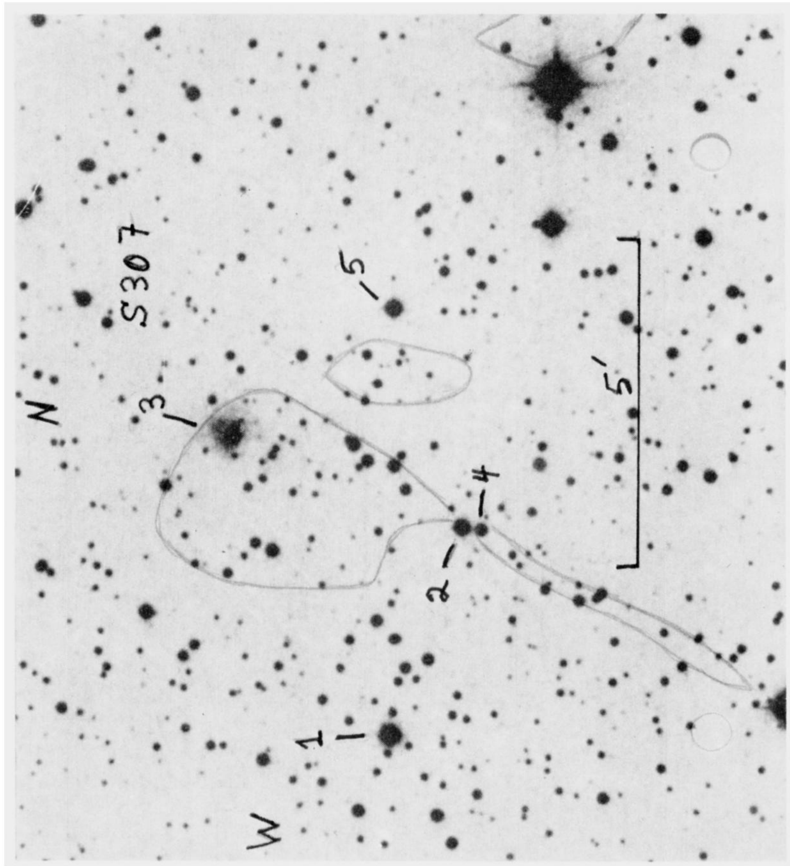

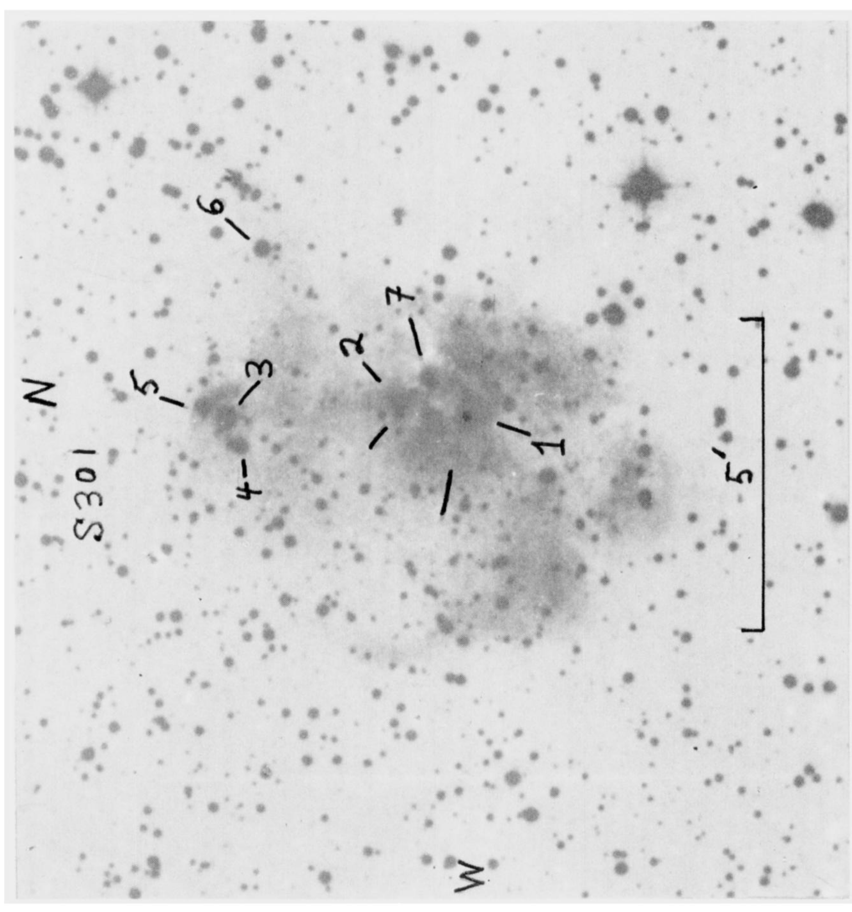

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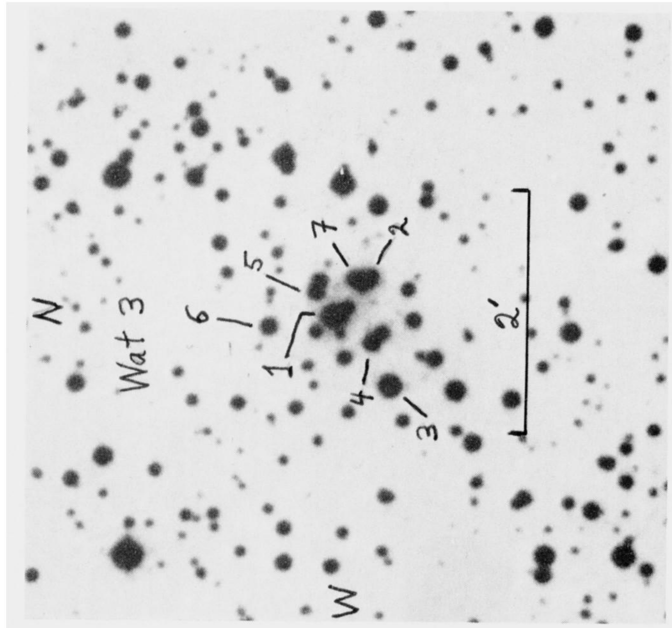

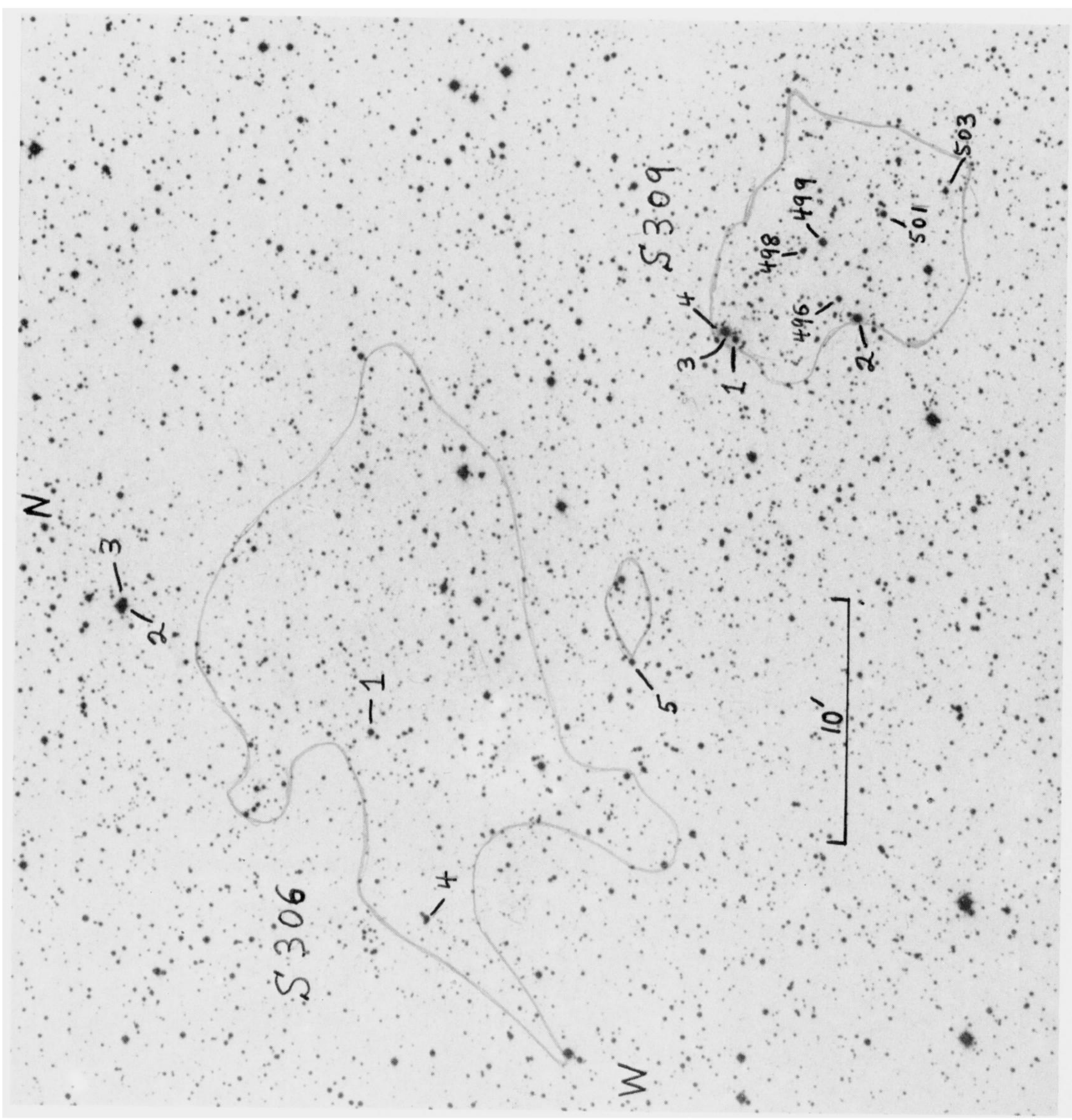

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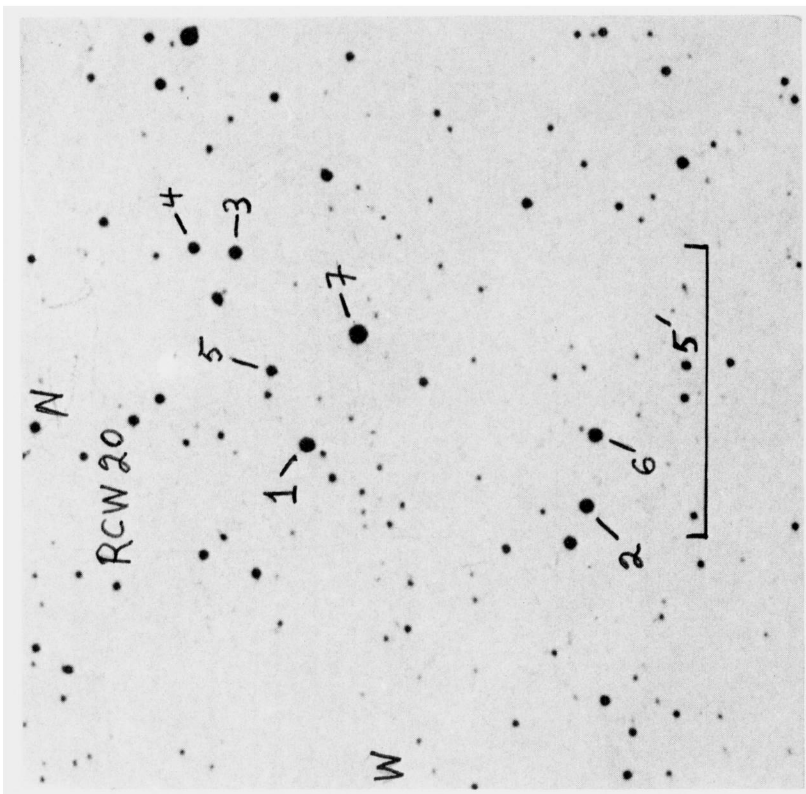

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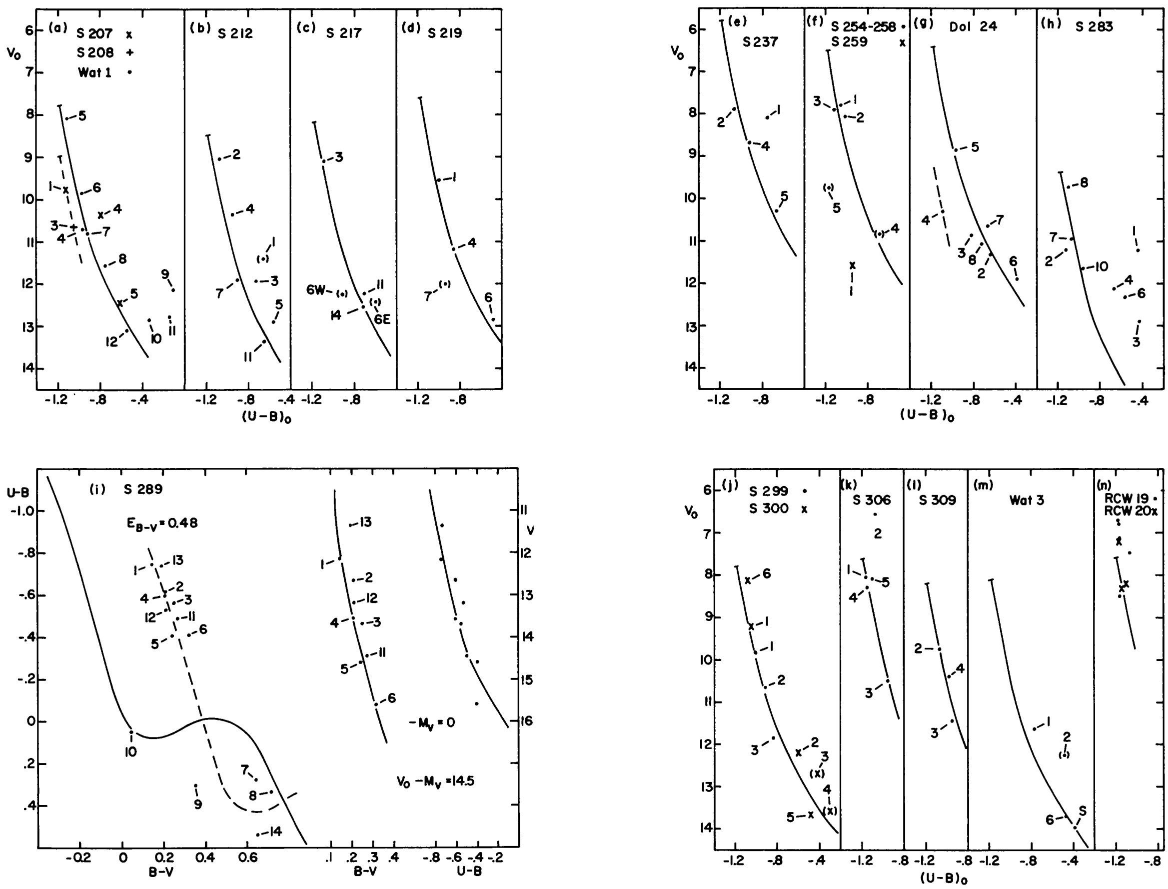

Figure 2 Colour-magnitude diagrams showing ZAMS fit in cases where it is warranted. For S 289 the two colour diagram is also displayed to illustrate the high quality observations of this important, very distant H II region.

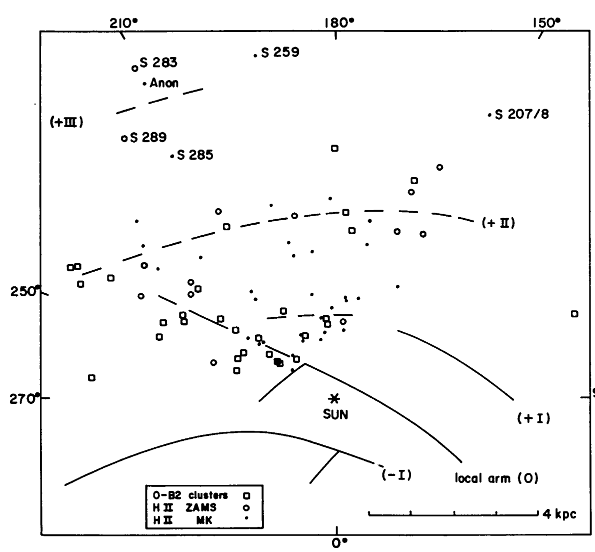

Figure 3 Positions (mainly for $150° < \ell < 250°$ and distance from the sun > 1 kpc) of individual H II regions (present work supplemented by that of Georgelin, 1975) and other OB-star groups (Vogt and Moffat, 1975a) projected on the galactic plane. Well known spiral features are sketched in with solid lines (cf. Vogt and Moffat, 1975a); probable spiral features are in broken lines.