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THE DISTRIBUTION OF EXTRA-GALACTIC NEBULAE[1]

By EDWIN HUBBLE

ABSTRACT

The *object* of the investigation is to determine the distribution of extra-galactic nebulae to a faint uniform limiting magnitude. The *material* consists of counts of about 44,000 nebulae on 1283 plates with the 100-inch and 60-inch reflectors, distributed over the three-quarters of the sky north of $-30°$ Dec. The counts are reduced to the standard conditions of excellent one-hour exposures at the zenith on Eastman 40 plates with the 100-inch reflector.

In general no nebulae are found along the Milky Way. The *zone of avoidance*, representing local obscuration, is irregular and follows the general pattern of the known obscuring clouds. It is bordered by partial obscuration, which fades away into the regions of *normal distribution* where the frequency-curve of log N_m closely approximates a Gaussian error-curve.

Systematic *variations in longitude* are appreciable only in the lower latitudes, where obscuration appears to be conspicuously greater in the direction of the galactic center than in the opposite direction. There is a definite variation with *latitude*, which from the poles to about $\beta=15°$ is represented by the *cosecant formula*

$$\log N_m = C - 0.15 \operatorname{cosec} \beta ,$$

indicating a total obscuration of 0.5 mag. from pole to pole with *no appreciable difference* between the two hemispheres.

With allowance for the effect of the red shift, the rate of increase of log N with exposure time suggests *uniform distribution in depth*.

The standard conditions represent a *threshold of identification* for nebulae at about 20.0 pg m. Corrected for red shift, the *number of nebulae* per square degree to magnitude m is

$$\log N_m = 0.6m - 9.12 ,$$

which leads to values for the *density of matter in space* of log $\rho = -16.4$ to -16.8 in nebulae per cubic parsec, or -29.8 to -29.9 gr/cc, depending upon the value adopted for the mean absolute magnitude of nebulae.

PART I. RELATIVE DISTRIBUTION OF NEBULAE OVER THE SKY

The empirical approach to the problem of the structure of the physical universe consists in extrapolating the observed characteristics of the sample available for inspection. If the sample is fair and the characteristics are well determined, the method may be significant. Investigations have recently emerged from the stellar system and now range through a large volume of space whose inhabitants, the nebulae, are of the same general order as the stellar system itself. There are as yet no indications of a super-system of nebulae analogous to the system of stars. Hence, for the first time, the region now

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observable with existing telescopes may possibly be a fair sample of the universe as a whole. This circumstance enhances the interest in, and possibly the value of, the determination of general characteristics.

The first reliable information concerning extra-galactic regions came from stars involved in the nearer nebulae, which provided rough methods of estimating distances—clues which have been rapidly exploited during the last decade until now we have a hasty sketch of some of the general features of the observable region as a unit. The next step was to follow the reconnaissance with a survey—to repeat carefully the explorations with an eye to accuracy and completeness. The program, with its emphasis on methods, will be a tedious series of successive approximations, but the procedure is necessary, since extrapolations beyond the frontiers will be significant only in proportion to the accuracy with which the trend of correlations has been established out to the frontier itself.

The present discussion is a contribution to the program in the form of an investigation of nebular distribution as observed with the large reflectors at Mount Wilson. The purpose is to delimit more closely the influence of local galactic obscuration and to sketch out the general background of normal distribution against which irregularities, local or systematic, may be further investigated. Few of the results are wholly new, but they are formulated more precisely than has hitherto been possible, in keeping with the character of the investigation as a second approximation toward the end in view.

Unless otherwise stated, the term "nebula" is used throughout the discussion to designate the extra-galactic nebulae alone. Latitude and longitude refer to galactic co-ordinates and are designated by β and λ, respectively.[2]

RECENT CONTRIBUTIONS TO THE SUBJECT

The first modern note in discussions of nebular distribution is found in an article by Hinks[3] published in 1911, urging the desira-

[2] The galactic co-ordinates are referred to the pole at R.A. = 12^h40^m; Dec. $+28°$ (1900). The conversions from equatorial co-ordinates were made or checked with the aid of the tables by John Ohlsson (*Annals of the Observatory at Lund*, No. 3, 1932).

[3] A. R. Hinks, *Monthly Notices of the Royal Astronomical Society*, **71**, 588, 1911. The earlier literature on the subject is briefly summarized by Hinks.

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bility of investigating the nebulae recorded on the Franklin-Adams plates. The gaseous nebulae, both planetary and diffuse, are recognized as galactic in the sense that they concentrate along the Milky Way. The complementary group, "the so-called white nebulae of which the large and better known examples are spirals," are called extra-galactic because

in general they avoid the actual Milky Way zone. But they do it without imposing upon themselves symmetry in either galactic latitude or galactic longitude, and these results suggest that it will be prudent in the future to discuss spiral nebula distribution more on its own merits, and less with an eye to the galactic poles.

The data from the Franklin-Adams plates compiled by Hardcastle[4] and Fath's[5] study of plates of Selected Areas with the 60-inch reflector at Mount Wilson, both published in 1914, tended to confirm Hinks's conclusions. Curtis'[6] discussion of nebulae on the Crossley plates at Mount Hamilton contributed

the valuable indication that the density of small nebulae persists to at least 60° from the galactic poles, with only a comparatively small diminution of the frequency of distribution which obtains about the two galactic poles.

This conclusion was confirmed and developed as far as the data permitted in Seares's[7] very thorough analysis of Fath's counts, published in 1925. In addition, Seares found suggestions of a complicated distribution in longitude with a band of high frequency apparently crossing the northern hemisphere in longitudes 50°–220°.

Wirtz,[8] in 1923–1924, discussed nebular distribution as indicated by the NGC, by the counts of Fath and of Curtis, and by his own extensive measures of surface brightness. He found no conspicuous dependence of surface brightness on latitude, but some indications of such a dependence on nebular density, in addition to the familiar concentration near the north pole. He concluded that distribution purely according to latitude is only a rough approximation. Well-defined centers of clustering are conspicuous, one of which is near the

4 *Monthly Notices of the Royal Astronomical Society*, **74**, 699, 1914.

5 *Astronomical Journal*, **28**, 75, 1914.

6 *Publications of the Lick Observatory*, **13**, 11, 1918.

7 *Mt. Wilson Contr.*, No. 297; *Astrophysical Journal*, **62**, 168, 1925.

8 *Astronomische Nachrichten*, **222**, 33, 1924; **223**, 123, 1924; also *Meddelanden från Lunds Astron. Observatorium*, Ser. II, No. 29, 1923.

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north pole. The fainter the nebulae, however, the less pronounced the concentration toward the pole and the more defined the tendency toward uniform distribution over the sphere.

Reynolds,[9] in 1923, discussed the distribution of the brighter nebulae and called attention, among other items, to apparent anomalies in the distribution in longitude. For instance, the large spirals and the globular star clusters tend to be mutually exclusive, congregating in opposite hemispheres whose poles are near the galactic plane. Moreover, he stated, "there is very definite evidence of a band, fairly widespread in the Ursa Major region, stretching past the pole beyond Virgo, the average size becoming smaller as the band passes beyond the pole."

The band is in the general region of that later suggested by Seares and represents the phenomenon described much earlier as the Milky Way of the nebulae.

Provisional results from the present survey were summarized[10] in 1931. Although the quantitative results have been revised in the present more detailed analysis, the general outlines of the picture remain unchanged and need not be restated.

In 1932 appeared the Harvard[11] survey of nebulae brighter than the thirteenth magnitude, which covers the entire sky in a homogeneous manner. The results concerning distribution were summarized as "the avoidance of low latitudes, the strong clustering in the northern galactic hemisphere, and the general unevenness of distribution." Later, in 1933, Shapley[12] discussed the distribution of nebulae to much fainter limits on the basis of approximately 100,000 nebulae photographed with the Bruce 24-inch refractor, stating that "there is no change with latitude north of $+25°$; south of $-25°$ the mean density increases, but the obstructing streamers of dark nebulosity in latitude $-20°$ to $-40°$ are probably largely responsible for the apparent increase." He further emphasized the apparent irregularities in distribution and the greater richness in the northern hemisphere.

[9] *Monthly Notices of the Royal Astronomical Society*, **83**, 147, 1922; **84**, 76, 1923.

[10] *Publications of the Astronomical Society of the Pacific*, **43**, 282, 1931; also *Science*, **75**, 24, 1932, and *Annual Report of the Mount Wilson Observatory*, 1930, 1931, and 1932.

[11] Shapley and Ames, *Harvard Annals*, **88**, Part II, 1932.

[12] *Proceedings of the National Academy of Sciences*, **19**, 389, 1933.

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THE OBSERVATIONAL DATA FOR THE INVESTIGATION

With the broad features of nebular distribution thus outlined, it was evident that further reliable information could be expected only from large bodies of new data, reasonably complete and thoroughly homogeneous. An examination of the reflector plates available at Mount Wilson in 1926 proved them unsuitable for the particular purpose, owing to lack of uniformity in aperture, emulsion, development, exposure, distribution, etc. A special survey was therefore initiated, and current programs of direct photography were modified where possible to meet the new requirements. Extensive studies of threshold images were also undertaken, with especial attention to the comparison of plates taken with various instruments and under various exposure conditions, until now it is believed that a consistency has been attained in the treatment of nebular images which warrants a general discussion of the accumulated material.

At present about eighty thousand nebulae have been identified on Mount Wilson photographs, of which some sixty thousand are on plates in the writer's collection. Of the latter, about three-fourths[13] were observed under the standard conditions adopted for the present investigation. Both reflectors are represented indiscriminately, but, owing to differences in mounting, the 100-inch alone is generally used south of about -20° Dec., and the 60-inch alone north of about $+60^\circ$.

The standard conditions were Newtonian foci, full apertures, Eastman 40 plates—5×7 inches for the 100-inch and 4×5 inches for the 60-inch, and full development with a hydroquinone developer (X-ray). Minor variations in sky, mirrors, emulsions, and development were treated as accidental errors, but corrections were applied for atmospheric extinction, variations in definition, and exposure time. The nebular counts were first reduced to the equivalent of one-hour exposures, of excellent definition, at the zenith, with the 100-inch, and in this form were used for the investigation of relative distribution. Later the results were reduced to numbers of nebulae per square degree to a definite limiting magnitude for the purpose of

[13] The residue are about equally divided among plates of the great clusters; plates with the Ross correcting lens; plates with other apertures, emulsions, or development; and plates with the 10-inch camera.

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deriving significant quantitative values for various characteristics of the observable region.

Each plate was examined at least three times with high and low power, the last examination being a continuous review of the entire collection in the light of accumulated experience for the purpose of improving the consistency of the counts and the estimates of quality. All images not definitely stars or obvious defects were marked as nebulae. Comparisons of pairs of duplicate plates indicate that mistakes tend to balance misses; hence, for statistical purposes, the counts appear to be fairly homogeneous.[14]

It is impossible, however, to identify all nebulae recorded on a plate from the appearance of the images alone. Numbers increase rapidly with diminishing size and brightness, and, in the faintest half-magnitude, where about one-half of the total may be expected, the nebulae tend to lose themselves among the stars. The threshold of identification varies with the type; open spirals fade out, while areas are still perceptible, and compact globular nebulae merge into the star images well above the limit of the plates. This effect can be treated as statistically uniform, since it depends upon the relative frequencies of nebular types and there is no reason to assume that the relations vary systematically over the sky. But the threshold of identification also varies with the criteria upon which different observers, consciously or unconsciously, base their judgments. This irregularity represents a personal equation which may attain consider-

[14] The accuracy of the counts was tested in various ways. Several dozen duplicates were included in the collection, but most of them represent plates discarded for particular reasons (usually poor seeing) and replaced by others of better quality. Fifteen duplicates, however, were judged suitable for comparison purposes, and these pairs of independent counts, when reduced to the standard system, show an average difference without regard to sign of about 0.05 in log N. Some of the difference can be attributed to uncertainties in the reduction, especially in the corrections for quality, which exhibit a considerable range.

A more detailed investigation of these fifteen pairs (six with the 60-inch, four with the 100-inch, and five with both telescopes), together with eight two-hour exposures with the 100-inch (not included in the discussion), of fields covered by hour exposures with either telescope, indicated that among about 1020 identifications on plates included in the survey, 42 were mistakes representing defects and stars, while 56 nebulae were missed, although above the threshold of identification. A ratio of this order is assumed to hold for the entire body of data. The relative number of nebulae actually recorded, but below the threshold of identification, is discussed later.

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able proportions and must be calibrated before counts by various observers can be compared. The personal equation may also be expressed as the difference between the limiting magnitude of the nebular counts and the limiting magnitude of the star images on the plates—a quantity which varies with the observer as well as the instrumental equipment. Calibration of the present counts has been attempted in some detail, since the writer believes that the interpretation of most of the published counts is seriously restricted or even confused by the omission of this important feature.

The observational data, together with log N reduced to a homogeneous system, are listed in Tables I–IV.

Table I gives the survey data. The 765 plates, about equally divided between the two reflectors, are distributed along circles of latitude 5° apart, the galactic equator itself being omitted. From $\beta=5°$ to 60°, the longitude intervals are 10°; for $\beta=65°$ and 70°, the intervals are 20°; for $\beta=75°$ and 80°, they are 30°; for $\beta=85°$, they are 60°. With the exception of six fields,[15] the survey is complete to Dec. $=-30°$ and hence covers three-fourths of the sphere, including both galactic poles and about two-thirds of the Milky Way. The northern hemisphere is complete from the pole to and including $\beta=+40°$. The corresponding southern cap, $\beta=-40°$ to $-90°$, is about 60 per cent complete.

Uniform exposures of one hour were used for 690 plates, and half-hour exposures for 74 plates scattered along the latitude circles at $\beta=35°, 45°, 55°$, and 65°. The half-hour exposures, which are marked with an asterisk in Table I, were included primarily for use in determining the manner in which numbers of nebulae increase with exposure time. For the same reason a 45-minute exposure was included and marked with a double asterisk. The last column of the table gives the values of log N reduced to the uniform conditions of one-hour exposures of excellent quality at the zenith with the 100-inch. Log N is simply the sum of log N_1 (the number of nebulae ac-

[15] The exceptions are $\beta=+20°$, $\lambda=310°$; $-25°$, 200°; $-45°$, 190°; $-55°$, 190°; $-65°$, 190°, and 350°. The plates were rejected for various reasons and attempts to repeat them have failed. Counts on the rejected plates are considered uncertain, but they indicate no remarkable deviations from normal distribution; hence their omission is not very material.

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TABLE I*

SURVEY FIELDS

β	λ		Z	Q	N_1	I	log N
+90°	.....	h	39°	E	71	6	1.90
85	0°	h	29	FG	60	7	1.98
	60	h	20	E	50	2	1.71
	120	h	41	E	37	3	1.63
	180	h	34	F	80	4	2.22
	240	h	15	E	51	4	1.71
	300	h	11	E	60	10	1.78
80	0	h	11	FG	41	4	1.79
	30	s	51	G	44	5	2.00
	60	s	41	E	43	9	1.85
	90	s	42	FG	23	5	1.76
	120	s	37	F	19	1	1.76
	150	s	39	E	77	7	2.10
	180	h	23	GE	54	5	1.78
	210	s	55	G	32	7	1.90
	240	h	43	FG	44	4	1.88
	270	h	41	G	62	5	1.95
	300	h	49	G	72	5	2.05
	330	s	43	GE	76	9	2.14
75	0	h	34	E	90	10	1.99
	30	s	16	E	58	10	1.93
	60	s	7	F	22	1	1.78
	90	s	34	E	54	6	1.93
	120	s	23	E	30	7	1.65
	150	s	29	E	39	2	1.77
	180	h	8	E	97	9	1.99
	210	h	32	GE	67	2	1.90
	240	s	30	G	83	5	2.21
	270	h	35	GE	63	7	1.88
	300	h	33	E	73	12	1.90
	330	h	22	FP	27	2	1.89
70	0	s	43	G	44	5	1.96
	20	h	39	G	43	4	1.78
	40	s	28	F	31	5	1.95
	60	s	34	G	29	2	1.76
	80	h	41	G	76	7	2.04
	100	h	41	G	36	6	1.72
	120	s	26	G	51	2	1.99
	140	s	44	GE	44	6	1.91
	160	s	35	E	52	12	1.92
	180	s	20	FG	36	7	1.91
	200	s	37	E	69	3	2.04
	220	s	49	FG	33	3	1.95
	240	h	33	GE	75	8	1.95
	260	h	37	FG	43	5	1.85
	280	h	38	G	35	1	1.69
	300	h	37	FG	44	5	1.86
	320	h	29	FG	40	4	1.80
	340	h	21	G	38	5	1.71
+65	0	s*	13	E	18	5	1.82
	20	s*	19	E	12	1	1.65
	40	s*	19	E	17	3	1.80
	60	s*	23	E	12	0	1.65
	80	s*	10	F	13	1	1.95
	100	s	35	E	51	3	1.91
	120	s*	14	E	17	3	1.79
+65°	140°	s*	7°	E	14	2	1.71
	160	s*	19	GE	14	2	1.76
	180	h	32	F	37	5	1.88
	200	s	19	E	67	6	2.00
	220	s	30	E	84	12	2.11
	240	h*	28	E	26	2	1.83
	260	s	32	FG	36	4	1.93
	280	h	34	GE	48	4	1.76
	300	h*	33	F	11	2	1.75
	320	h	33	GE	86	5	2.00
	340	s*	17	E	16	1	1.77
60	0	s	21	E	58	12	1.93
	10	s	28	G	54	4	2.01
	20	s	42	G	35	5	1.86
	30	s	13	GE	39	6	1.79
	40	s	43	F	14	2	1.65
	50	s	19	G	31	5	1.76
	60	s	18	G	28	4	1.72
	70	s	37	G	25	3	1.70
	80	s	32	G	46	6	1.95
	90	s	24	GE	40	1	1.81
	100	s	42	GE	79	14	2.16
	110	s	21	GE	85	12	2.14
	120	s	30	GE	31	2	1.72
	130	h	43	FG	52	8	1.96
	140	s	30	G	31	6	1.78
	150	h	26	GE	145	23	2.22
	160	h	28	GE	37	3	1.63
	170	h	7	GE	37	9	1.61
	180	h	34	FG	50	5	1.92
	190	h	17	GE	64	8	1.86
	200	s	45	F	31	3	2.00
	210	h	29	E	120	8	2.10
	220	s	36	E	67	13	2.03
	230	h	41	E	88	7	2.00
	240	s	37	E	36	6	1.76
	250	h	40	GE	77	7	1.98
	260	h	36	GE	41	5	1.69
	270	s	42	E	77	10	2.11
	280	s	46	GE	34	2	1.81
	290	s	45	E	76	12	2.11
	300	s	33	GE	35	6	1.77
	310	h	50	G	65	7	2.01
	320	s	36	GE	53	9	1.96
	330	h	52	FG	56	7	2.04
	340	s	20	GE	74	9	2.08
	350	s	43	G	35	3	1.86
+55	0	h*	25	E	39	5	2.01
	10	s	8	GE	380	32	2.78
	20	s*	17	E	20	2	1.87
	30	s*	25	E	16	1	1.78
	40	s*	25	GE	17	3	1.85
	50	s*	23	GE	16	3	1.81
	60	s*	25	GE	22	2	1.96
	70	s*	43	E	37	6	2.19
	80	s	35	GE	57	8	2.00
	90	s*	29	F	7	1	1.71
	100	s	39	GE	58	5	2.01
	110	s*	26	E	33	5	2.10

* Symbols are: β, λ = galactic latitude and longitude; "h" = 100-inch, "s" = 60-inch, Z = zenith distance at mid-exposure, Q = quality of plate, N_1 = number of nebulae actually counted, I = number within central circle (diameter 10′ for 100-in., 13′.8 for 60-in.); corrections from Tables VI, VII, and IX, added to log N_1, give log N, N being the number of nebulae for an hour's exposure of excellent quality at the zenith with the 100-inch. All exposures are 60^m except those for which "h" or "s" are starred. A single star indicates a 30^m exposure and a double star (one field only, $\beta = +55°$, $\lambda = 130°$), a 45^m exposure.

Two fields of quality P ($\beta = +35°$, $\lambda = 300°$; $\beta = -15°$, $\lambda = 140°$) are included for which the quality factor, $\Delta Q = 0.70$, is not evaluated in the text but represents a result of low weight indicated by a dozen rejected P plates.

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TABLE I—*Continued*

β	λ		Z	Q	N_1	I	log N
+55°	120°	s*	23°	F	13	1	1.96
	130	s**	16	GE	19	3	1.66
	140	s*	14	E	15	4	1.74
	150	s*	16	G	10	4	1.67
	160	s*	16	G	14	3	1.82
	170	h	10	F	33	8	1.80
	180	s	33	GE	53	7	1.95
	190	s	25	GE	59	9	1.99
	200	h	22	G	76	8	1.99
	210	s	28	GE	44	4	1.86
	220	h	34	FP	31	4	1.98
	230	s*	34	E	27	1	2.03
	240	s*	42	F	8	0	1.80
	250	s*	40	E	32	2	2.12
	260	s*	47	GE	17	2	1.91
	270	s	41	GE	75	14	2.14
	280	s	42	GE	77	9	2.15
	290	h*	41	FG	15	0	1.82
	300	s	40	FG	35	3	1.93
	310	h*	36	G	22	2	1.88
	320	s	31	GE	75	6	2.11
	330	h*	30	GE	35	3	2.01
	340	s	28	GE	72	9	2.08
	350	h*	23	G	21	4	1.83
50	0	h	14	FG	66	8	2.00
	10	h	19	G	60	6	1.89
	20	h	31	FG	61	3	2.00
	30	s	14	G	22	1	1.60
	40	s	17	G	33	4	1.79
	50	s	35	G	38	1	1.88
	60	s	37	E	30	1	1.68
	70	s	36	G	33	2	1.82
	80	s	41	GE	22	3	1.60
	90	s	41	G	40	5	1.92
	100	s	37	G	23	2	1.66
	110	s	41	GE	32	2	1.77
	120	s	45	GE	36	3	1.83
	130	s	35	GE	58	12	2.00
	140	s	22	GE	29	2	1.67
	150	h	37	F	26	2	1.73
	160	h	23	FP	29	1	1.92
	170	h	26	F	49	7	1.99
	180	h	21	FG	53	5	1.91
	190	h	37	FP	23	4	1.85
	200	h	25	F	35	7	1.84
	210	s	35	G	84	16	2.22
	220	s	40	GE	42	4	1.87
	230	s	40	GE	41	4	1.86
	240	s	47	GE	32	3	1.79
	250	s	44	GE	28	5	1.72
	260	s	47	FG	21	1	1.74
	270	s	50	G	37	7	1.93
	280	s	43	GE	24	5	1.64
	290	h	47	F	40	4	1.96
	300	h	43	F	51	7	2.05
	310	h	40	FP	19	0	1.78
	320	h	46	F	32	5	1.87
	330	h	34	FP	22	0	1.83
	340	h	31	F	45	3	1.96
	350	h	39	FP	32	1	2.01
+45	0	h*	45	G	42	0	2.19
	10	h	15	E	65	13	1.81
	20	h	3	GE	67	10	1.87
	30	h	29	GE	72	6	1.92
	40	s	21	G	50	5	1.97
	50	s	35	GE	94	7	2.21
	60	s	48	G	39	7	1.94
	70	s	53	FG	25	5	1.86
	80	s	52	F	17	3	1.78
	90	s	41	F	20	2	1.80
	100	s*	39	E	50	5	2.31

β	λ		Z	Q	N_1	I	log N
+45°	110°	s*	33°	F	11	0	1.91
	120	s*	27	E	30	3	2.06
	130	s*	21	GE	27	6	2.04
	140	s*	15	FG	15	3	1.92
	150	s*	12	E	26	3	1.97
	160	s*	11	E	16	3	1.76
	170	h	27	FP	23	1	1.83
	180	s*	17	E	16	3	1.77
	190	h	27	F	30	4	1.78
	200	h*	28	GE	21	1	1.78
	210	s*	35	G	31	6	2.19
	220	s	43	E	31	5	1.71
	230	s*	44	F	7	2	1.76
	240	s*	48	G	15	2	1.93
	250	s*	49	G	11	2	1.79
	260	s*	51	FG	9	3	1.79
	270	s	51	GE	48	3	1.98
	280	s	51	GE	31	1	1.79
	290	s*	49	GE	20	5	1.99
	300	h	47	FG	26	4	1.67
	310	h	48	G	42	6	1.81
	320	h	50	FG	36	2	1.84
	330	h	42	FG	48	4	1.92
	340	h	38	GE	110	9	2.13
	350	h*	42	G	20	2	1.86
40	0	h	29	F	50	6	2.00
	10	h	40	F	44	6	1.97
	20	h	35	FG	56	3	1.97
	30	s	17	G	44	4	1.91
	40	s	13	GE	37	7	1.77
	50	s	25	GE	48	9	1.90
	60	s	30	GE	24	2	1.61
	70	s	38	FG	24	4	1.77
	80	s	41	GE	34	8	1.79
	90	s	44	FG	45	4	2.06
	100	s	42	FG	21	2	1.72
	110	s	38	E	50	7	1.91
	120	s	34	G	32	6	1.81
	130	s	26	E	77	15	2.07
	140	s	25	FP	21	5	1.95
	150	s	8	F	32	5	1.95
	160	h	31	G	107	23	2.16
	170	s	31	GE	47	6	1.90
	180	h	48	F	31	2	1.86
	190	h	50	F	24	4	1.76
	200	s	42	F	28	9	1.95
	210	s	45	G	91	15	2.29
	220	h	43	FG	95	11	2.22
	230	h	51	FP	23	4	1.91
	240	h	52	F	16	1	1.59
	250	h	54	FG	31	5	1.79
	260	h	56	FG	25	1	1.72
	270	h	57	FG	61	7	2.12
	280	h	56	FG	34	1	1.85
	290	h	54	FG	46	4	1.96
	300	h	52	FG	48	2	1.97
	310	h	48	FG	27	4	1.70
	320	h	43	FG	48	6	1.92
	330	h	37	FP	13	3	1.60
	340	h	43	FP	10	1	1.51
	350	s	34	E	37	5	1.77
+35	0	h	32	G	30	0	1.61
	10	h	16	GE	55	3	1.79
	20	h	5	GE	30	4	1.52
	30	s	18	GE	43	4	1.84
	40	s	23	FG	17	2	1.58
	50	s	27	FG	9	1	1.31
	60	s	30	F	24	2	1.81
	70	s	39	GE	33	5	1.77
	80	s	44	G	22	2	1.67
	90	s	51	GE	43	6	1.93

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TABLE I—*Continued*

β	λ		Z	Q	N_1	I	log N
+35°	100°	s	47°	GE	47	2	1.95
	110	s	43	G	35	3	1.86
	120	s	29	FG	31	4	1.85
	130	s	26	FG	45	3	2.01
	140	s	33	GE	56	7	1.98
	150	s	33	GE	82	26	2.14
	160	s*	9	GE	60	7	2.38
	170	s	39	GE	52	6	1.97
	180	s	21	E	61	11	1.96
	190	s*	28	E	18	2	1.84
	200	s	39	GE	22	3	1.59
	210	s*	41	GE	19	4	1.94
	220	h*	46	GE	21	1	1.84
	230	s	51	G	30	3	1.84
	240	h*	55	FG	17	3	1.94
	250	h*	59	F	18	3	2.11
	260	h*	62	F	7	0	1.73
	270	h*	62	F	8	1	1.78
	280	h*	62	F	31	0	2.37
	290	h*	60	FG	44	4	2.40
	300	h	56	P	6	1	1.62
	310	s	51	G	39	4	1.95
	320	s	46	G	8	0	1.24
	330	s	42	FG	16	5	1.60
	340	s	35	GE	37	3	1.81
	350	s	28	G	30	6	1.76
30	0	h	40	F	32	5	1.84
	10	h	42	F	19	1	1.62
	20	h	41	G	40	6	1.76
	30	s	21	FG	17	3	1.58
	40	s	32	G	26	2	1.70
	50	s	25	GE	40	15	1.82
	60	s	36	GE	17	1	1.47
	70	s	47	GE	15	1	1.46
	80	s	54	FG	11	3	1.50
	90	s	53	GE	17	2	1.55
	100	s	48	F	26	3	1.94
	110	s	46	G	32	3	1.85
	120	s	36	GE	48	9	1.92
	130	s	31	GE	64	11	2.04
	140	h	41	F	44	7	1.98
	150	s	14	G	35	3	1.80
	160	h	5	FG	32	4	1.69
	170	s	33	G	118	16	2.36
	180	h	30	F	33	5	1.83
	190	s	29	FG	32	4	1.87
	200	g	48	G	45	4	1.84
	210	h	43	FG	56	9	1.99
	220	h	49	G	39	7	1.78
	230	h	55	FG	24	0	1.69
	240	h	60	G	16	2	1.48
	250	h	63	F	22	2	1.83
	290	h	64	FP	38	2	2.26
	300	h	60	F	33	2	1.98
	310	h	55	FG	16	3	1.51
	320	h	50	FG	18	5	1.54
	330	h	46	F	15	1	1.54
	340	h	38	FG	18	2	1.49
	350	h	38	F	20	4	1.63
+25	0	h	27	FG	24	3	1.58
	10	h	30	FG	53	4	1.93
	20	h	35	FG	29	5	1.68
	30	h	47	G	25	2	1.58
	40	s	28	F	18	3	1.72
	50	s	38	G	27	9	1.74
	60	s	31	FG	23	5	1.73
	70	s	41	G	20	4	1.62
	80	s	49	G	22	2	1.69
	90	s	53	G	10	1	1.38
	100	s	46	FG	18	1	1.68

β	λ		Z	Q	N_1	I	log N
+25°	110°	s	40°	G	29	5	1.77
	120	s	40	G	14	2	1.46
	130	s	26	G	31	7	1.74
	140	s	11	G	37	10	1.83
	150	h	27	G	52	2	1.84
	160	s	23	G	47	10	1.94
	170	s	16	GE	46	9	1.87
	180	h	30	FG	44	6	1.85
	190	h	42	FG	49	8	1.93
	200	h	46	GE	76	6	2.00
	210	h	43	FG	45	7	1.89
	220	h	56	G	45	7	1.89
	230	h	59	G	25	5	1.67
	240	h	64	F	31	5	2.00
	300	h	64	G	14	3	1.48
	310	h	59	GE	11	1	1.25
	320	h	55	G	12	0	1.31
	330	h	48	G	9	1	1.14
	340	s	42	FG	6	0	1.18
	350	s	43	G	10	1	1.32
20	0	h	25	G	14	1	1.27
	10	h	25	G	32	2	1.63
	20	s	8	GE	21	4	1.52
	30	s	31	G	27	4	1.72
	40	s	35	F	19	3	1.76
	50	s	23	GE	22	7	1.55
	60	s	29	GE	22	4	1.56
	70	s	40	GE	0	....	......
	80	s	46	G	0	....	......
	90	s	52	FG	7	2	1.30
	100	s	44	G	8	2	1.23
	110	s	38	FG	23	5	1.75
	120	s	30	G	12	4	1.37
	130	s	38	F	16	1	1.69
	140	s	27	FP	15	2	1.81
	150	h	10	GE	150	14	2.22
	160	h	22	G	49	5	1.80
	170	s	26	G	51	4	1.99
	180	s	25	G	32	3	1.79
	190	s	44	G	30	7	1.81
	200	h	44	G	36	7	1.73
	210	h	49	F	27	2	1.80
	220	h	56	F	41	3	2.03
	230	h	63	FG	24	1	1.77
	320	h	56	F	0	....	......
	330	h	50	F	0	....	......
	340	s	44	FG	0	....	......
	350	s	43	G	0	....	......
+15	0	h	29	FG	30	3	1.68
	10	h	33	FG	14	2	1.36
	20	s	19	G	18	3	1.53
	30	h	19	G	30	5	1.69
	40	s	30	FG	6	0	1.15
	50	s	44	F	18	3	1.77
	60	s	28	G	13	4	1.39
	70	s	38	F	0	....	......
	80	s	43	FG	1	0	0.40
	90	s	47	FG	0	....	......
	100	s	40	F	4	0	1.09
	110	s	33	G	9	4	1.24
	120	s	26	F	4	2	1.06
	130	s	31	FG	9	2	1.32
	140	s	19	F	10	1	1.45
	150	h	12	G	40	10	1.70
	160	h	12	G	43	5	1.73
	170	h	36	F	12	1	1.40
	180	h	27	F	30	5	1.78
	190	h	38	G	79	13	2.05
	200	h	45	G	48	3	1.86

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TABLE I—*Continued*

β	λ		Z	Q	N_1	I	log N
+15°	210°	h	53°	F	11	1	1.44
	220	h	59	F	7	1	1.30
	320	h	60	FG	0	....	......
	330	h	58	F	0	....	......
	340	h	47	F	0	....	......
	350	h	37	FG	0	....	......
10	0	h	36	F	0	....	......
	10	s	25	G	2	1	0.58
	20	h	15	G	7	1	0.95
	30	h	21	FG	1	0	0.19
	40	h	15	G	44	10	1.74
	50	s	14	G	22	4	1.60
	60	s	22	G	0	....	......
	70	s	34	FG	0	....	......
	80	s	40	FG	0	....	......
	90	s	45	G	0	....	......
	100	s	39	G	0	....	......
	110	s	38	GE	0	....	......
	120	s	26	G	0	....	......
	130	s	41	F	3	1	0.98
	140	s	25	G	7	0	1.13
	150	s	34	FG	2	0	0.68
	160	h	27	G	7	2	0.97
	170	h	27	G	10	1	1.12
	180	h	50	F	3	1	0.86
	190	h	40	FP	10	0	1.50
	200	h	47	G	25	8	1.58
	210	h	55	F	21	3	1.73
	220	h	63	FG	3	2	0.87
	320	h	65	G	0	....	......
	330	h	55	F	0	....	......
	340	h	47	G	0	....	......
	350	h	44	G	0	....	......
+ 5	0	h	36	FP	0	....	......
	10	h	24	F	4	2	0.90
	20	s	23	G	0	....	......
	30	s	18	G	1	0	0.27
	40	h	6	FG	2	0	0.48
	50	s	30	G	0	....	......
	60	s	24	FG	0	....	......
	70	s	44	F	0	....	......
	80	s	43	F	0	....	......
	90	s	37	G	0	....	......
	100	s	33	G	0	....	......
	110	s	32	G	0	....	......
	120	s	38	FG	0	....	......
	130	s	14	G	0	....	......
	140	s	16	G	0	....	......
	150	h	32	G	3	0	0.61
	160	h	38	F	0	....	......
	170	h	24	G	2	0	0.42
	180	s	32	F	2	0	0.59
	190	h	44	G	0	....	......
	200	h	49	F	0	....	......
	210	h	52	F	7	0	1.24
	330	h	63	FG	0	....	......
	340	s	50	F	0	....	......
	350	s	42	G	0	....	......
− 5	0	h	37	FG	0	....	......
	10	h	28	G	0	....	......
	20	h	19	G	0	....	......
	30	h	27	FG	0	....	......
	40	h	25	FG	0	....	......
	50	h	30	G	0	....	......
	60	s	12	G	0	....	......
	70	s	23	FG	7	1	1.20
	80	s	41	F	0	....	......

β	λ		Z	Q	N_1	I	log N
− 5°	90°	s	23°	G	0	....	......
	100	s	22	G	2	0	0.57
	110	s	24	FG	1	0	0.36
	120	s	37	G	0	....	......
	130	s	6	G	0	....	......
	140	h	27	F	0	....	......
	150	h	23	G	0	....	......
	160	h	50	FG	11	2	1.32
	170	h	28	G	7	0	0.97
	180	h	50	FP	0	....	......
	190	h	46	GE	0	....	......
	200	h	55	F	0	....	......
	210	h	63	F	2	0	0.79
	330	h	64	G	0	....	......
	340	h	60	G	0	....	......
	350	s	46	F	0	....	......
10	0	h	39	F	0	....	......
	10	s	35	G	0	....	......
	20	h	25	G	9	1	1.07
	30	h	14	G	4	0	0.70
	40	s	31	G	2	0	0.59
	50	h	45	FG	11	0	1.29
	60	s	21	G	7	1	1.12
	70	s	26	G	12	4	1.36
	80	s	28	G	23	4	1.64
	90	s	25	FG	0	....	......
	100	s	20	G	9	1	1.22
	110	s	37	G	17	5	1.53
	120	h	50	FG	6	1	1.06
	130	h	38	F	0	....	......
	140	h	45	F	0	....	......
	150	h	23	F	7	1	1.14
	160	h	26	G	0	....	......
	170	h	33	G	0	....	......
	180	s	41	G	0	....	......
	190	h	48	FG	0	....	......
	200	h	57	FP	4	1	1.20
	210	h	65	FP	4	0	1.29
	340	s	56	FG	0	....	......
	350	s	46	G	0	....	......
15	0	h	47	FP	16	1	1.73
	10	h	39	F	22	3	1.67
	20	h	38	F	10	1	1.33
	30	s	26	G	10	1	1.28
	40	s	17	G	9	1	1.22
	50	s	38	F	4	1	1.09
	60	h	32	G	39	3	1.72
	70	s	35	GE	12	0	1.32
	80	s	18	G	22	3	1.61
	90	h	48	F	22	1	1.71
	100	s	19	FG	13	1	1.46
	110	h	45	FG	74	11	2.12
	120	h	40	FP	5	0	1.20
	130	h	31	G	11	1	1.17
	140	h	14	P	3	0	1.18
	150	h	18	F	0	....	......
	160	h	29	G	21	4	1.44
	170	h	43	G	23	2	1.52
	180	h	44	G	3	1	0.65
	190	h	50	FP	14	0	1.70
	200	h	62	FG	44	4	2.02
	340	h	59	F	0	....	......
	350	s	52	F	1	0	0.55
−20	0	h	43	G	16	1	1.36
	10	h	38	G	20	1	1.45
	20	h	50	FG	14	0	1.43
	30	s	39	FG	13	2	1.50

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TABLE I—*Continued*

β	λ		Z	Q	N_1	I	log N
−20°	40°	h	33°	GE	13	1	1.18
	50	h	6	FG	12	1	1.26
	60	h	31	GE	12	0	1.15
	70	h	26	F	11	2	1.34
	80	h	43	F	30	7	1.82
	90	s	16	F	14	3	1.60
	100	h	28	F	45	5	1.95
	110	h	26	FG	36	5	1.76
	120	h	25	G	37	7	1.69
	130	h	25	F	9	0	1.25
	140	h	19	FG	4	0	0.79
	150	h	23	F	1	0	0.29
	160	h	27	G	36	3	1.68
	170	s	41	G	40	5	1.92
	180	h	43	FP	14	3	1.66
	190	h	50	FG	75	17	2.16
	200	h	61	G	41	6	1.90
	340	h	60	G	6	2	1.06
	350	s	53	GE	9	1	1.26
25	0	s	46	GE	18	0	1.54
	10	s	42	GE	20	2	1.56
	20	s	43	GE	20	1	1.56
	30	s	46	GE	44	6	1.92
	40	s	21	FG	12	3	1.43
	50	s	45	E	33	5	1.75
	60	s	38	G	17	8	1.54
	70	s	27	GE	41	3	1.83
	80	s	32	GE	22	2	1.57
	90	s	36	GE	62	5	2.03
	100	s	29	E	56	14	1.93
	110	h	27	F	25	4	1.72
	120	h	20	GE	51	10	1.76
	130	s	50	F	20	3	1.84
	140	s	32	FG	6	1	1.15
	150	h	26	FP	0	....	......
	160	h	41	FG	12	2	1.32
	170	h	46	FP	20	1	1.83
	180	h	46	FG	32	2	1.77
	190	h	50	FG	42	7	1.90
	340	h	63	G	13	4	1.42
	350	s	55	E	12	3	1.37
30	0	s	48	GE	25	1	1.69
	10	s	42	GE	25	4	1.66
	20	s	43	E	16	1	1.42
	30	s	37	E	28	2	1.65
	40	s	38	GE	28	2	1.70
	50	s	20	GE	17	4	1.44
	60	s	10	E	25	2	1.56
	70	s	31	GE	31	6	1.72
	80	s	14	G	66	5	2.08
	90	s	24	G	48	8	1.96
	100	s	15	E	89	11	2.11
	110	s	22	G	53	6	1.99
	120	s	30	GE	55	19	1.97
	130	s	39	FG	24	5	1.77
	140	s	51	F	34	5	2.07
	150	h	34	F	21	3	1.64
	160	s	38	G	28	6	1.76
	170	h	41	FP	16	3	1.71
	180	h	51	FG	29	2	1.74
	190	h	56	F	37	2	1.99
	200	h	64	GE	41	2	1.88
	340	h	64	G	13	4	1.44
	350	h	57	FP	12	0	1.68
−35	0	h	53	FG	21	3	1.62
	10	s	50	FG	25	2	1.84
	20	h	47	F	22	4	1.70
−35°	30°	h	43°	GE	27	2	1.53
	40	s	25	F	12	0	1.54
	50	s	41	G	27	5	1.75
	60	s	27	GE	42	4	1.84
	70	h	34	GE	125	11	2.18
	80	h	34	GE	52	6	1.80
	90	s	14	GE	33	3	1.72
	100	h	45	E	69	5	1.91
	110	h	39	GE	29	1	1.55
	120	h	33	E	48	4	1.71
	130	h	50	G	40	1	1.80
	140	s	39	GE	2	0	0.55
	150	h	50	GE	17	3	1.37
	160	h	52	GE	39	2	1.74
	170	h	45	F	21	3	1.67
	180	s	49	G	16	2	1.55
	190	h	58	FP	18	4	1.87
	350	h	57	FG	27	2	1.76
40	0	s	52	GE	42	11	1.93
	10	s	45	G	29	5	1.79
	20	s	38	E	64	13	2.02
	30	s	32	GE	35	8	1.77
	40	s	29	E	48	8	1.86
	50	s	22	GE	42	8	1.83
	60	s	23	E	47	3	1.84
	70	s	17	G	55	6	2.01
	80	s	20	E	61	5	1.96
	90	s	15	FG	27	4	1.77
	100	s	22	E	75	14	2.05
	110	s	18	G	35	6	1.81
	120	s	27	E	45	5	1.83
	130	s	26	GE	66	5	2.04
	140	h	27	FG	6	0	0.98
	150	h	57	G	24	2	1.63
	160	h	52	G	25	2	1.61
	170	h	46	GE	70	9	1.97
	180	h	54	G	27	3	1.65
	190	h	59	G	51	5	1.98
	350	h	59	F	20	1	1.75
45	0	h	54	GE	56	6	1.91
	10	h*	47	G	14	1	1.73
	20	h*	41	GE	50	5	2.20
	30	h*	35	GE	16	1	1.68
	40	h*	32	E	15	2	1.61
	50	h*	35	E	23	2	1.80
	60	h*	30	E	34	8	1.96
	70	h*	21	E	52	5	2.13
	80	h	45	G	46	7	1.83
	90	h	36	E	56	3	1.79
	100	h	43	E	74	9	1.93
	110	h	33	GE	54	5	1.80
	120	h	42	G	30	3	1.64
	130	h	35	E	67	7	1.87
	140	h	37	G	21	1	1.46
	150	h	49	E	61	9	1.88
	160	h	44	F	67	5	2.18
	170	s	48	E	45	6	1.90
	180	h	53	F	36	5	1.96
	350	h	60	GE	45	6	1.87
−50	0	h	56	GE	77	9	2.07
	10	h	51	FG	43	4	1.91
	20	s	43	F	35	4	2.04
	30	h	39	FG	39	4	1.82
	40	s	40	F	28	4	1.94
	50	h	33	F	49	7	2.00
	60	s	40	F	28	6	1.94
	70	h	43	F	61	5	2.13

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TABLE I—*Continued*

β	λ		Z	Q	N_1	I	log N
−50°	80°	h	34°	F	25	2	1.72
	90	h	33	FG	21	3	1.53
	100	h	37	F	26	2	1.73
	110	h	46	FP	22	1	1.87
	120	s	44	GE	65	19	2.08
	130	s	35	F	25	5	1.88
	140	s	45	FG	39	5	2.00
	150	h	42	F	51	4	2.05
	160	h	44	FP	24	3	1.90
	170	h	51	GE	57	10	1.90
	180	h	56	G	81	6	2.15
	190	h	62	G	29	3	1.76
	350	h	62	GE	45	2	1.89
55	0	h	59	GE	70	7	2.06
	10	s	51	GE	47	7	1.97
	20	h*	41	G	21	1	1.88
	30	h*	44	G	34	1	2.10
	40	h*	40	G	16	1	1.75
	50	s	34	GE	40	1	1.84
	60	s*	36	E	14	0	1.75
	70	s	42	GE	43	7	1.89
	80	s	36	FG	34	6	1.91
	90	h*	34	FG	23	2	1.98
	100	h*	28	F	14	1	1.85
	110	s	30	E	48	4	1.87
	120	s	33	E	47	7	1.86
	130	s	39	E	42	6	1.83
	140	s	42	E	54	6	1.95
	150	s	43	GE	32	7	1.77
	160	s	46	E	45	9	1.89
	170	s	52	FG	20	0	1.75
	180	h	57	FG	28	3	1.78
	350	h	63	FG	25	2	1.79
−60	0	h	59	FG	52	11	2.07
	10	h	53	G	45	5	1.87
	20	h	49	G	63	8	1.99
	30	h	45	GE	98	13	2.10
	40	h	43	E	34	8	1.59
	50	s	43	G	32	2	1.83
	60	h	41	F	30	4	1.82
	70	s	44	GE	76	11	2.15
	80	h	34	FP	23	1	1.85
	90	s	49	GE	51	9	2.00
	100	h	37	F	44	4	1.96
	110	h	44	F	46	3	2.01
	120	s	42	GE	27	4	1.69
	130	h	51	FP	25	2	1.95
	140	h	42	FP	28	2	1.96
	150	h	46	F	42	2	1.98
	160	h	50	FP	24	3	1.93
	170	h	55	G	40	3	1.83
	180	h	60	G	43	4	1.91

β	λ		Z	Q	N_1	I	log N
−60°	190°	h	64°	GE	38	8	1.85
	350	h	64	G	25	4	1.73
65	0	h	60	GE	43	3	1.85
	10	h	56	GE	43	1	1.81
	20	s	51	GE	37	5	1.87
	30	s	45	E	49	5	1.92
	40	s	51	GE	36	4	1.86
	50	s	43	GE	33	3	1.78
	60	s	40	E	58	10	1.97
	70	h	46	FG	34	4	1.79
	80	s*	39	E	21	3	1.93
	90	h*	40	FG	39	3	2.22
	100	s	39	FG	65	6	2.20
	110	h	38	G	32	2	1.66
	120	s	41	E	52	2	1.94
	130	s	45	GE	30	2	1.75
	140	s	40	E	31	5	1.70
	150	s	48	E	39	6	1.84
	160	s	52	GE	40	7	1.91
	170	h	56	E	33	4	1.66
	180	h	60	F	23	1	1.82
70	0	h	61	FG	47	4	2.04
	20	h	58	G	83	7	2.18
	40	h	48	F	26	1	1.78
	60	h	45	F	43	6	1.98
	80	h	43	G	61	7	1.95
	100	h	43	G	68	6	1.99
	120	h	45	F	43	2	1.98
	140	h	51	G	62	8	1.99
	160	h	54	FG	33	2	1.82
	180	h	60	FG	48	8	2.04
75	0	h	61	GE	32	5	1.74
	30	s	54	G	34	7	1.91
	60	s	49	GE	29	3	1.75
	90	s	48	G	23	5	1.71
	120	s	49	E	111	9	2.30
	150	h	54	F	27	2	1.83
	180	h	63	GE	64	3	2.06
80	0	h	62	F	45	3	2.13
	30	h	58	GE	61	8	1.99
	60	h	53	G	43	3	1.85
	90	h	53	G	109	7	2.26
	120	h	53	G	63	1	2.02
	150	h	58	GE	148	20	2.37
	180	h	62	FG	58	7	2.14
85	30	h	60	FG	41	8	1.97
	90	h	57	FG	35	1	1.87
	150	h	59	F	28	2	1.90
−90	.....	h	62	GE	49	2	1.93

tually counted) and ΔZ, ΔQ, and ΔE as derived from Tables VI, VII, and IX, respectively. The first entry ($\beta=+90°$), for instance, represents an hour's exposure with the 100-inch of excellent quality at $Z=39°$, on which 71 nebulae were counted. Log N_1 is 1.85, ΔZ is 0.05, ΔQ and ΔE are both zero, hence log N, the sum of these quantities, is 1.90.

Tables II*a*, *b*, and *c* give the extra-survey plates conforming to the

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standard conditions and centered on co-ordinates, stars, or small planetaries. The arrangement is similar to that in Table I, with the addition of E, the exposure time in minutes. The 27 plates with twenty-minute exposures in Table II*c* were included as bearing on the relation between log N and log E.

TABLE II*a**

100-INCH; EXTRA-SURVEY FIELDS

β	λ	E	Q	Z	N_1	I	log N	β	λ	E	Q	Z	N_1	I	log N
+85°	168°	60	GE	42°	130	6	2.21	−9°	42°	130	FG	38°	10	3	0.78
84	208	60	FG	46	64	6	2.07	9	119	60	G	10	5	1	0.80
81	231	60	FG	35	95	9	2.20	9	119	110	G	25	42	1	1.39
78	242	60	FG	23	54	5	1.92	12	78	60	FG	51	15	1	1.46
75	243	45	GE	24	43	3	1.86	14	133	100	FG	9	6	2	0.67
75	262	60	E	21	150	18	2.19	15	355	60	GE	46	9	1	1.07
74	249	60	F	21	83	5	2.21	16	10	60	G	41	27	3	1.59
74	262	60	E	23	120	13	2.09	16	158	50	G	28	12	2	1.31
74	276	60	E	28	127	27	2.12	21	90	60	FG	13	87	5	2.12
73	250	60	E	29	132	16	2.14	22	89	60	G	14	71	12	1.95
73	250	60	FG	30	68	2	2.04	22	90	60	G	6	92	13	2.06
73	288	60	E	25	138	8	2.16	25	139	50	FG	32	33	3	1.84
72	237	60	G	31	58	11	1.89	27	191	60	GE	56	65	7	1.99
72	300	60	GE	32	138	13	2.21	37	22	40	G	45	14	0	1.55
70	229	60	G	22	252	22	2.51	37	93	60	GE	37	62	9	1.87
70	253	60	G	43	71	4	2.01	40	145	60	GE	35	29	2	1.54
70	310	60	GE	28	196	30	2.35	40	155	60	G	48	36	4	1.75
67	221	60	G	27	84	4	2.04	42	104	30	E	15	42	6	2.02
66	255	60	FG	41	80	10	2.14	52	87	60	GE	28	41	1	1.67
65	323	60	GE	37	152	15	2.26	53	187	60	FG	60	48	7	2.04
63	0	150	GE	40	363	41	2.12	54	22	30	G	46	23	1	1.94
63	257	60	FG	36	100	16	2.22	56	100	30	F	28	24	2	2.08
59	259	60	G	37	101	9	2.14	60	107	40	FG	45	41	4	2.09
58	318	30	FG	18	20	2	1.89	71	37	85	G	50	123	13	2.09
56	200	60	F	23	96	10	2.27	−72	40	135	GE	51	301	36	2.15
40	325	60	GE	46	41	0	1.73								
40	335	60	E	39	44	3	1.69								
34	232	60	FG	52	45	4	1.94								
28	39	60	GE	19	93	11	2.02								
+11	191	60	FG	46	16	2	1.46								

* E = exposure time in minutes. Two fields at $\beta=+73°$, $\lambda=250°$ overlap about 10 per cent; two at $\beta=-9°$, $\lambda=119°$ overlap about 5 per cent; two, $\beta=+75°$, $\lambda=243°$ and $\beta=+28°$, $\lambda=39°$, are also included in Table II*b*.

Tables III*a* and *b* list plates conforming to the standard conditions but centered on selected nebulae. Reduction to the homogeneous system requires elimination of the central nebulae and correction for the areas they cover, the corrected counts being designated by N_1'. For this purpose the products of the two diameters in minutes of arc, *ab*, are listed, from which, on the assumption that the images approximate ellipses, the fraction of the inner circles, I, can readily be estimated. Since very large nebulae are not included in

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the table, N_1' differs but little from N_1, and, in general, $N_1' = N_1 - 1$ within the uncertainty of the counts; but for deriving distance cor-

TABLE II*b*

60-INCH; EXTRA-SURVEY FIELDS

β	λ	E	Q	Z	N_1	I	log N	β	λ	E	Q	Z	N_1	I	log N
+87°	28°	90	G	33°	64	8	1.87	+28	39	60	GE	18°	54	9	1.94
85	13	90	G	36	124	21	2.16	23	187	60	G	30	67	2	2.12
80	163	60	E	12	85	6	2.09	15	25	60	G	5	22	6	1.60
78	172	90	G	9	100	26	2.03	+13	19	60	G	14	14	1	1.41
75	243	60	GE	21	79	11	2.11	−12	119	60	FG	47	26	1	1.83
70	161	60	G	10	49	7	1.95	13	118	60	FG	11	48	3	2.02
69	228	60	FG	26	60	5	2.14	19	19	60	G	31	9	0	1.24
67	220	60	GE	37	91	10	2.20	25	15	60	GE	42	24	4	1.64
61	209	60	G	45	45	1	1.98	25	35	60	GE	26	18	2	1.48
60	158	60	G	33	23	3	1.65	26	95	60	G	8	67	8	2.09
60	291	60	GE	49	36	11	1.85	35	145	60	E	27	13	2	1.29
58	114	100	GE	27	176	15	2.18	36	60	60	G	19	75	5	2.15
58	299	60	GE	40	39	5	1.84	49	38	60	E	51	46	7	1.92
55	224	60	GE	51	44	6	1.94	−51	101	60	FG	32	17	3	1.60
54	201	60	G	28	133	13	2.41								
44	1	60	G	51	32	8	1.87								
41	206	60	GE	35	77	20	2.13								
40	59	60	GE	37	21	3	1.56								
35	112	60	GE	39	56	10	2.00								
+30	180	45	FG	21	23	2	1.88								

TABLE II*c**

60-INCH; EXTRA-SURVEY FIELDS; 20-MINUTE EXPOSURES

β	λ	Z	Q	N_1	I	log N_2	β	λ	Z	Q	N_1	I	log N_2
+75°......	320°	32°	E	18	4	1.45	−45.....	109	33°	E	17	1	1.42
74......	315	28	GE	10	0	1.22	53.....	52	32	E	19	1	1.47
73......	313	25	E	18	2	1.44	54.....	36	42	GE	11	0	1.30
63......	323	24	GE	24	2	1.60	54.....	51	34	E	13	1	1.31
63......	325	24	E	15	1	1.36	55.....	35	45	E	13	3	1.34
62......	338	28	GE	23	5	1.58	55.....	50	37	E	26	4	1.61
62......	340	33	E	16	3	1.39	63.....	99	36	E	20	1	1.50
60......	20	31	E	10	2	1.19	63.....	118	41	E	22	3	1.56
59......	24	30	E	21	4	1.51	64.....	100	36	E	33	4	1.72
59......	28	37	E	21	6	1.52	64.....	119	41	E	18	3	1.48
58......	34	42	GE	6	1	1.04	65.....	100	38	E	34	4	1.74
58......	36	31	GE	13	0	1.34	−65.....	120	40	E	21	3	1.53
58......	40	38	GE	5	1	0.95							
53......	294	42	GE	17	0	1.49							
+51......	247	43	GE	10	0	1.26							

* N_2 = corrected number of nebulae for a 20^m exposure. To obtain log N, corresponding to the standard one-hour exposure, add $\Delta E = +0.63$.

rections or "coma factors," by which the counts are eventually reduced to uniform definition over the entire plates equal to that in the central circles, the procedure is essential.

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TABLE IIIa*

100-INCH; FIELDS CENTERED ON NEBULAE

NGC	β	λ	E	Q	Z	N_1	I	ab	N_1'	log N
4459	+87°	160°	60	GE	6°	66	5	60	71	1.89
4725	87	303	120	G	10	108	1	100	120	1.78
4008	79	169	60	FG	47	54	4	0.7	53	1.98
4293	79	230	60	G	29	72	14	27	76	2.00
			30	FP	39	12	2	27	11	1.94
4651	78	269	60	*F*	32	35	2	9	34	1.84
4192	75	240	40	E	25	77	1	100	84	2.17
4762	73	276	135	FG	29	157	21	8	156	1.92
4178	72	245	60	G	43	68	5	9.5	66	1.98
4124	71	242	60	GE	24	81	8	48	86	1.99
4535	70	261	60	F	31	53	1	100	56	2.06
4612	70	266	60	F	29	43	5	1.6	41	1.91
4532	68	262	60	FG	27	97	17	4.8	95	2.18
4215	67	250	40	G	37	40	6	0.3	39	1.96
3430	65	162	60	F	31	46	5	6.2	45	1.96
3489	63	203	60	G	26	75	8	2.1	74	1.99
5363	62	310	45	E	30	38	4	2.6	37	1.77
3412	60	202	45	F	35	20	1	2.5	19	1.77
5829	59	0	80	G	14	187	35	3.2	187	2.20
4593	57	268	60	G	39	78	5	12	78	2.04
3521	53	223	60	G	34	55	1	100	61	1.93
4742	52	272	90	F	46	38	6	....	37	1.70
5713	51	320	40	GE	47	50	8	4	49	2.04
2859	47	159	135	FG	20	146	11	19	147	1.89
2830	46	159	60	E	14	83	14	....	82	1.91
5850	46	329	110	G	45	140	15	19	142	1.97
5964	44	340	60	G	29	37	4	28	37	1.69
2712	43	144	45	FG	12	55	3	1.6	54	2.08
2693	42	135	20	F	20	10	2	0.3	9	1.87
5812	42	318	45	G	42	19	4	1	18	1.59
5990	41	337	60	G	32	35	7	1.4	34	1.66
6014	40	344	60	FG	32	47	4	0.8	46	1.87
2639	39	135	45	FG	22	28	8	0.3	27	1.79
6070	34	340	60	G	45	51	10	5.8	51	1.88
6080	34	342	60	GE	41	67	15	0.5	66	1.92
2545	28	169	60	GE	40	54	11	2.2	53	1.81
2855	27	212	45	F	50	20	1	2.3	19	1.83
6280	26	354	60	G	27	23	5	0.1	22	1.46
2642	23	198	60	F	51	13	1	13	12	1.46
6296	+23	352	60	GE	29	27	4	1	26	1.47

* N_1' is derived from N_1 by rejecting the central nebula and correcting for the area which it covers. If the product of the two diameters, ab in the ninth column, is not listed, the nebula falls outside the central circle, I, and, while the nebula is omitted in deriving N_1, the correction for the area covered is negligible. The four cases for which $ab=100$ refer to central nebulae so large that the entire central circles are omitted.

Duplicate plates are included for NGC 4293 and 524.

The two nebulae, $\beta=-47°$, $\lambda=61°$, and $\beta=-51°$, $\lambda=54°$, are uncatalogued.

Plates in the Virgo cluster with the numbers of nebulae omitted in the reductions as presumably members of the cluster are:

NGC 4293	1 neb.	NGC 4124	2 neb.
4651	1	4535	3
4192	2	4612	2
4762	3	4532	3
4178	2	4215	1

The following fields are in both Tables III*a* and III*b*:

FIELD	LOG N 60-In.	LOG N 100-In.
NGC 4762	1.87	1.92
4535	2.06	2.06
2859	2.03	1.89
4454	2.03	1.93

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