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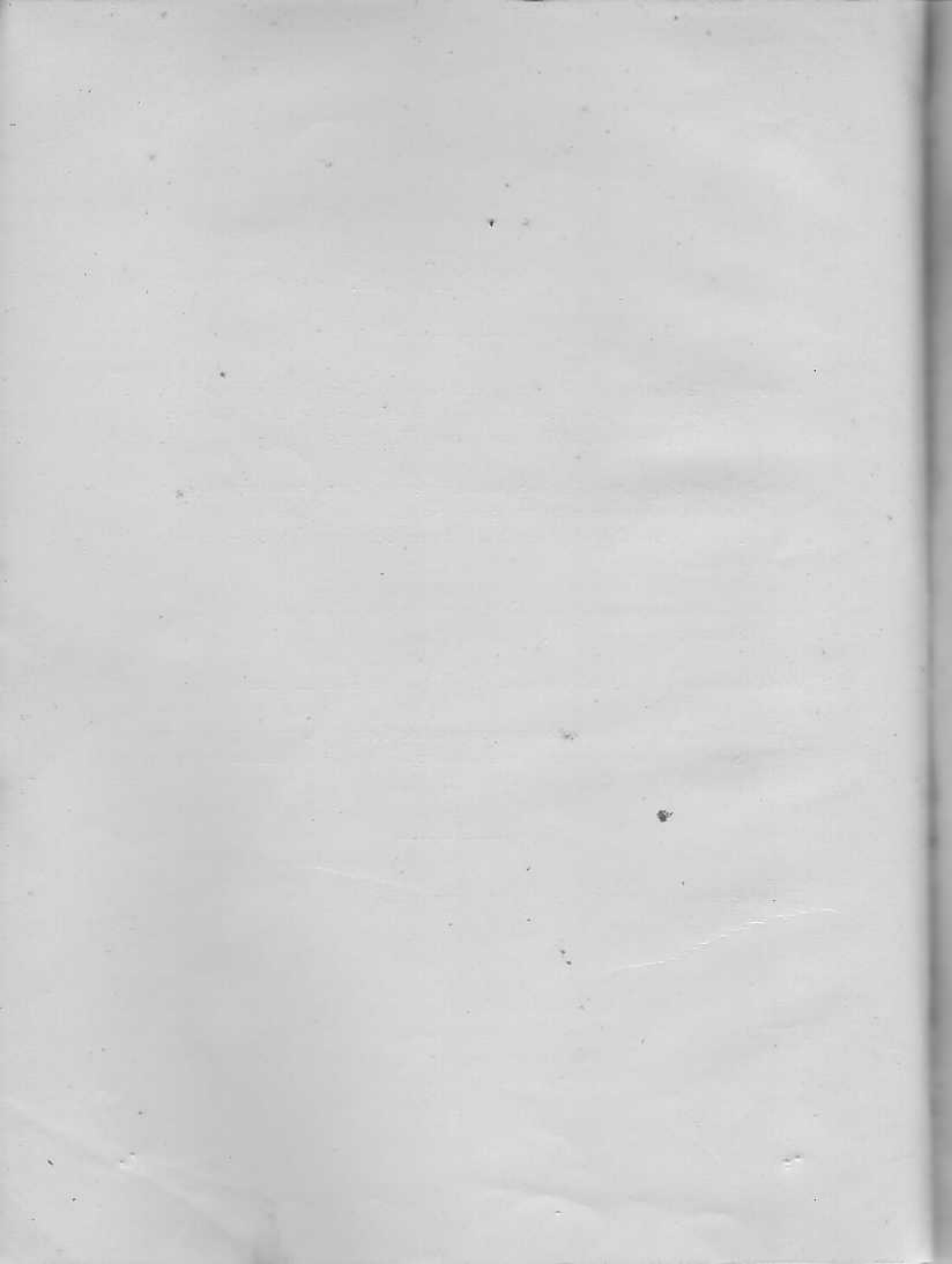
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Second Index Catalogue of Nebulae and Clusters of Stars, containing objects found in the Years 1895 to 1907, with Notes and Corrections to the New General Catalogue and to the Index Catalogue for 1888-94. By J. L. E. DREYER, Ph.D.

[Received May 4; read May 8, 1908.]

THE following catalogue is a continuation of the Index Catalogue of Nebulae found in the years 1888 to 1894, published in Vol. LI. of the *Memoirs*.

Since 1895 about 1400 nebulae have been detected with powerful telescopes and their places determined, nearly all by observers previously engaged in this work. But the majority of the objects in the present catalogue have been found by means of photography. Seven lists of nebulae have been issued from the astrophysical department of the Heidelberg Observatory, containing in all about 2800 objects. Most of these have been found by Professor MAX WOLF on plates taken with the 16-inch Bruce refractor at Heidelberg, while one list (No. 2) was made by Dr. SCHWASSMANN from plates taken with a 6-inch lens. The third list* contains about 1500 points of condensation in the great cloud of nebulosity situated about the northern pole of the Milky Way, near R.A. $12^{\text{h}} 53^{\text{m}}$, N.P.D. $61^{\circ} 5'$. These objects (of which 123 are identical with objects in the N.G.C. or the Index Catalogues) are arranged by Professor WOLF in separate zone-catalogues one degree of N.P.D. in breadth, from 59° to 64° , for the epoch 1875. As these zone-catalogues will be more convenient to the few photographic observers likely to study this small part of the heavens than a catalogue arranged in order of right ascension and extending from pole to pole could possibly be, these objects have not been included in the present reference catalogue. Besides, they ought more properly to be considered, not as separate nebulae, but as the more conspicuous points of condensation or "knots" in one great mass of nebulosity similar to the nebula of Orion, the great "America-nebula" in Cygnus (N.G.C. 7000 = V. 37), and others.† Should continued examination of photographic plates prove the correctness of Professor KEELER's estimate, according to

* *Publikationen des astrophysikalischen Observatoriums Königtuhl-Heidelberg*, Band I., Karlsruhe, 1902, pp. 125-176.

† For this reason I have not included any of the "knots" in the great nebula in Triangulum (Messier 33) which I measured on a plate taken by Dr. ISAAC ROBERTS, *Proc. R. Irish Acad.*, vol. xxv., sect. A., No. 2 (1904).

which there are at least about 120,000 nebulae in the whole sky,* the future great catalogue of nebulae will certainly have to be arranged in zones of one degree.

While the objects found and measured at Heidelberg are all in the northern hemisphere, Dr. DELISLE STEWART and Mr. R. H. FROST have measured a number of plates, chiefly of regions in the southern hemisphere, obtained with the 24-inch Bruce refractor at the Arequipa station of Harvard College Observatory, and containing about 1130 new nebulae.

The positions of all objects found on photographic plates are of course very reliable, and more than sufficient to identify the objects, but it is possible that in a few instances photographic defects have been mistaken for nebulae. All such objects seen on only one Harvard plate have been recorded as "susp," although in most cases they are believed to be genuine nebulae, and some marked thus were afterwards identified with known objects. In the Heidelberg lists such objects are marked with a ?. A region extending from about $12^{\text{h}} 2^{\text{m}}$ to $12^{\text{h}} 42^{\text{m}}$ and 80° to 75° is common to Dr. SCHWASSMANN'S list and the Harvard list. In this region 45 new objects are given in the former which are not in the latter, while 208 objects in the latter do not occur in the former. Thirty-six objects seen as nebulae by Dr. SCHWASSMANN are distinctly stellar on the Harvard plates, being either faint double, or triple, or single stars which have been mistaken for nebulae. In six cases nothing was found in Dr. SCHWASSMANN'S places, though there were faint stars near. Discrepancies like these are of course to be expected on account of the difference in size of the instruments used, and they are not greater than those with which telescopic observers are familiar, since extremely faint stars have occasionally been mistaken for nebulae, while very faint nebulae have been suspected in places where no nebulosity exists.

A very marked peculiarity of photographic records of nebulae is the general tendency of the observers to overestimate the brightness, even to the extent of two or three degrees of brightness. This fact must always be borne in mind by observers using even very powerful telescopes, but it did not seem feasible to allow for it in this catalogue, as the objects observed both visually and photographically are hardly yet numerous enough.

The descriptions are given with the usual abbreviations, to which only one has been added, viz. "spir" for spiral. Even among very faint nebulae photography has revealed many cases of spiral form. Of the very extensive and diffused nebulosities found by photography, I have only inserted a few fairly well-defined objects of limited size. An object like No. 27 of W. HERSCHEL'S list of regions "affected with nebulosity," filling the whole constellation of Orion, could obviously not find a place here. About these regions see ROBERTS, *Astr. Nachr.*, No. 3836, and *Monthly Notices*,

* *Monthly Notices*, vol. lx. p. 128. After the completion of KEELER'S work (not yet published) Professor PERRINE estimated the total number at 500,000; *Astrophys. Journal*, vol. xx. p. 356.

vol. lxii. p. 26; BARNARD, *Astrophys. Journal*, vol. xvii. p. 77; and M. WOLF, *Monthly Notices*, vol. lxiii. p. 303.

By special desire of the Council, the positions are given not only for 1860, the epoch of former catalogues, but also for 1900, the epoch of the photographic chart of the heavens.

In the column "Observer," a high number in brackets (*e.g.* 3520) denotes the number of the *Astronomische Nachrichten* where the object is recorded. The other references are:—

BAILEY, Catalogue of Bright Clusters and Nebulæ; *Ann. Harv. Coll. Obs.*, vol. lx. No. 8. Contains thirteen objects (clusters) not in the N.G.C., two of which (the Pleiades and the Hyades) I have not inserted.

BARNARD, *Monthly Notices*, vol. lv. p. 453; *Astr. Journal*, No. 422; *Astr. Nachr.*, Nos. 3301, 3315, 4112, 4136, 4239; *Astrophys. Journal*, vol. xiv. p. 157, vol. xxv. p. 224, p. 281. Also many MS. communications.

B. with a number refers to BIGOURDAN'S third and fourth lists, *Comptes Rendus*, vol. cxxiii. p. 1243, vol. cxxiv. pp. 65 and 133 (Nos. 245 to 356), and vol. cxxxii. pp. 1094 and 1465, vol. cxxxiii. pp. 26 and 206 (Nos. 357 to 455). The fourth list includes a copious list of corrections to the places of objects in the N.G.C., most of which are given at the end of the present catalogue.

BURNHAM, *Publ. of the Yerkes Observatory*, vol. i. p. 296 (40-inch refractor).

D. S. See STEWART.

ESPIN, *Monthly Notices*, vol. lxvii. p. 360; *A.N.*, No. 3633.

FINLAY, *Monthly Notices*, vol. lviii. p. 329. Found with the 6-inch and 7-inch refractors of the Cape Observatory.

FLEMING, *Ann. Harv. Coll. Obs.*, vol. lx. p. 150 (planetary nebulæ discovered by their spectra).

F = FROST, Nos. 786–1238, *Ann. Harv. Coll. Obs.*, vol. lx. pp. 179–192: nebulæ found by photography, see above.

Ho. = HOWE, three lists of new nebulæ found and micrometrically measured with the 20-inch refractor at Denver, Colorado,

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|------|--------------------------|-------------|---------|
| I. | <i>Monthly Notices</i> , | vol. lviii. | p. 523. |
| II. | „ „ „ | lx. | „ 129. |
| III. | „ „ „ | lx. | „ 611. |

At the end of list II. and also in vol. lviii. pp. 515–522 and vol. lxi. pp. 29–51 Professor HOWE gives a great number of valuable notes on old nebulæ, containing accurate positions of many of which only rough places had previously been given by their discoverers. These corrections are inserted in the Notes at the end of this catalogue.

INNES, *Monthly Notices*, vol. lviii. p. 329, vol. lix. p. 339, vol. lxii. p. 468. Found with the 7-inch refractor at the Cape Observatory.

J. with a number refers to M. JAVELLE's third list of micrometrically measured places of new nebulae found with the 30-inch refractor of the Nice Observatory (*Annales*, T. xi.).

KEELER, *Monthly Notices*, vol. lix. p. 537. Seven small nebulae found on photographs of M. 51 with the Crossley reflector.

KOBOLD, *Vierteljahrsschrift der Astr. Ges.*, xxxiii. p. 153. Nebulae found with the 18-inch refractor at Strassburg.

LUNT, *Monthly Notices*, vol. lxii. p. 468. Found with the 18-inch refractor at the Cape Observatory.

PICKERING. A few objects mentioned in vol. xxvi. of the *Annals of H. C. Obs.*, p. 207 sq.

ROBERTS, *Monthly Notices*, vol. lxiii. p. 302, and *A.N.*, No. 3429. Found by photography.

Sn = SCHWASSMANN, *Publ. des astrophys. Observatoriums Königstuhl-Heidelberg*, vol. i. p. 89. Found and measured on a plate taken by Professor MAX WOLF with a 6-inch lens.

STEWART (D. S., Nos. 109-785). Found on Arequipa plates (see above). *Ann. Harv. Coll. Obs.*, vol. lx. pp. 156-172.

Sw. = SWIFT. This veteran observer continued for some years at Echo Mountain, Los Angeles, California, his search for new nebulae. Eight separate lists were combined into one list (XI.) in *Astr. Nachr.*, No. 3517, which I have followed (a few discrepancies are noted in the column "Description"); list XII. in *Monthly Notices*, lix. p. 568. When any of these objects has been observed by some later observer, I have adopted the position given by him, as Mr. SWIFT's places are not as good as those formerly found by him with the same 16-inch refractor at Rochester, N.Y. Observers should remember that Mr. SWIFT used a very large field, so that some of his remarks about neighbouring stars may refer to stars a good way off.

W. = MAX WOLF (see above). His second list is referred to as Sn. The other references (to *Publ. des astroph. Obs.*) are

I.	vol. i.	p. 12.
IV.	" ii.	" 57.
V.	" ii.	" 77.
VI.	" ii.	" 89.
VII.	" iii.	" 77.

I have to express my thanks to Professor BARNARD for many valuable communications, and to Professor E. C. PICKERING for the loan of a card catalogue of references to new nebulae (exclusive of the Harvard and Heidelberg objects), which supplied a useful check on the completeness of my own notes.