

to about two kiloparsecs, and more probably it is at least fifty per cent larger. The mean angular diameter of the Sculptor system, derived from the star counts on two Bruce plates,⁵ is 75', corresponding to a linear diameter of 1.8 kiloparsecs. These linear dimensions are comparable with those of average spheroidal galaxies and with that of the main body of the Small Magellanic Cloud.

From the tabulated measures it is seen that the inner part of the Fornax cluster is distinctly elongated, NE to SW, although the faint outermost envelope is more nearly circular. The phenomenon of a corona of stars, spheroidal in shape whatever the basic form of the underlying structure, is thus indicated in projection for both of these new objects and is beginning to appear as a significant structural feature common in stellar systems. Already it has been shown that an "escape atmosphere" surrounds the Andromeda Nebula. The galactic system apparently is similarly constructed, as illustrated by the observations reported in the preceding paper of this series. Around the two Magellanic Clouds are also such extensions—envelopes in which are found scattered giant stars, star clusters and classical Cepheid variables.

¹ The objects were described in detail at the Cambridge meeting of the British Association for the Advancement of Science, August, 1938; see also *Harv. Bull.* 908 (1938) and *Nature*, 143, 715 (1938).

² Examination of the AX plates has been carried through chiefly by Miss Martha Dowse and Miss Rebecca Jones, who have had extensive experience in the study of faint galaxies.

³ This object is also noted by Baade and Hubble; they give 15.0 as a preliminary estimate of the apparent magnitude; *Pub. Astr. Soc. Pac.*, 51 (February, 1939).

⁴ *Loc. cit.*, *supra*.

⁵ *Harv. Bull.* 908 (1938).

THREE SUPERNOVAE IN THE SPIRAL NGC 3184

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In the recent discovery in the northern spiral NGC 3184 of three highly luminous variable stars, all probably of the supernova class, the observatories at Palomar, Mount Wilson and Harvard have collaborated. The three stars appeared within an interval of sixteen years, two of them indeed were at maximum in 1921—an indication that in some external systems there may be a particularly high frequency of supernovae. (The general infrequency of such outbursts has been established by Zwicky at Palomar, and verified at least qualitatively by Harvard observers.) Similarly in both NGC 4321 and NGC 6946 two supernovae have appeared, separated by in-

tervals of thirteen and twenty-two years, respectively. All three of these spirals are of class Sc and much alike in general appearance; their planes are nearly perpendicular to the line of sight, which facilitates somewhat the detection of supernovae.

The present brief account of the supernovae in NGC 3184 is made with the aid of communications from Dr. Fritz Zwicky of Palomar and Dr. E. P. Hubble of Mount Wilson.

Equatorial and galactic coördinates of the nucleus of NGC 3184 are $10^h 12^m 2, +41^{\circ} 55'$ (1900); $145^{\circ}, +57^{\circ}$, and the total photographic magnitude is 11.8.¹ From Hubble's data² the distance is found to be about four million light years.

No. 1.—The supernova $149''$ south of the nucleus and $5''$ east, reported on Harvard Announcement Card 494, had been found on seven plates of various series made between December 9, 1937, and March 6, 1938. Later it was learned that the object had already been noted by Dr. Zwicky on a Palomar plate of early April, 1938, the magnitude then being about 16.8, three magnitudes fainter than the maximum recorded on the Harvard plates. The object does not appear on any other plates examined at Palomar, Mount Wilson, Lick or Harvard.

No. 2.—“During the examination of the old plates, however, Zwicky and Hubble found a bright star on a 100-inch plate taken by Duncan on April 6, 1921, in the position $160''$ south and $32''$ following the nucleus of 3184.”³ This second object does not appear on the Harvard patrol plates of 1921 which were unfortunately less sensitive that year than before or after. From a print of the Mount Wilson 100-inch plate the magnitude can be estimated at 13.9 on the basis of a comparison star sequence derived from sequences in Selected Areas 29 and 30. Harvard plates show that it must have been fainter than

magnitude 13.0 on March 29, 1921

11.0 April 5

12.0 12

11.2 20

and the Mount Wilson observation of April 6, 1921, was therefore probably not far from the time of maximum brightness.

No. 3.—When seeking further images of No. 2 on Harvard plates, at the request of Dr. Zwicky, Miss R. Jones found a third supernova. With reference to the nucleus of the spiral it is $236''$ south, $79''$ east, not far from the position of the other two supernovae. It lies at the edge of a faint outlying spiral arm, 1500 parsecs from the nucleus if in the plane of the spiral arms. All of the positive observations obtainable from Harvard plates are given in the following tabulation, together with some significant negative observations.

OBSERVATIONS OF SUPERNOVA No. 3

PLATE	DATE	MAGNITUDE	PLATE	DATE	MAGNITUDE
AC 23756	June 4, 1921	[12.5	AI 21438	Dec. 19, 1921	[10.8
AI 21306	Oct. 29, 1921	[11.4	AI 21452	21	11.5
AI 21372	Dec. 5, 1921	11.1	AI 21461	27	11.8
I 40780	7	11.1	AC 24549	30	[12.1
AC 24449	7	11.1	AC 24553	31	[11.5
AI 21393	7	11.1	AI 21494	31	[12.6
AI 21404	8	11.1	MC 18301	Jan. 1, 1922	12.8
AC 24462	8	11.0	AI 21502	2	[12.6
AI 21416	11	11.0	AI 21551	23	[12.8
AC 24497	19	11.2:	I 40912	26	14.1

For more than two weeks in December, 1921, supernova No. 3 equaled or exceeded in brightness the whole spiral nebula in which it appeared.

The various position coördinates in NGC 3184 were measured by Mr. Cunningham and Miss Boyd; for No. 2, in agreement with Zwicky and Hubble, they obtain the coördinates 162" and 34".

To test the possibility that any one of these three stars might have been bright at some time other than indicated above, we have examined 1393 Harvard photographic plates distributed throughout the interval 1890 to 1939, with all the years represented except 1895. Thirty-one per cent of these plates show stars fainter than the thirteenth magnitude; seventy-one per cent, fainter than the twelfth magnitude. No further images of the three objects were found. The negative results of this detailed search, and the position of the images in the arms of the spiral, leave little doubt but that the objects are actual members of the spiral.

¹ *Harv. Ann.*, 88, No. 2 (1932).

² *Mt. Wilson Contr.* 548 (1936).

³ Letter from Zwicky and Hubble, July 31, 1939.

DISTRIBUTION OF INDUCED BREAKS ALONG THE
X-CHROMOSOME OF *DROSOPHILA MELANOGASTER*¹

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Introduction.—A study of the distribution of induced breaks along the chromosomes of *Drosophila melanogaster* was made by Bauer, Demerec and Kaufmann.² From the data accumulated at that time it appeared that break frequency was proportional to length within the limits of the euchromatic portion of each salivary chromosome limb, but that the frequency