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SUSPECTED NEW STARS RECORDED IN OLD CHRONICLES AND AMONG RECENT MERIDIAN OBSERVATIONS

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Before it was known that the stars had motions of their own and that their physical state was changing with time, those bodies were often taken as symbols for the eternal and the unchangeable. We therefore are not surprised that even before science had shown the importance of studying the novae for the solution of problems in sidereal astronomy the sudden and unexpected appearance of a new star should have attracted men's interest. We see, for example, in Tycho Brahe's work what an amount of literature he cites about the famous star of 1572. In the older historical records of many peoples events are sometimes mentioned that seem to refer to the outbursts of novae, but the observations are crude and incomplete and generally the nova of 1572 is the first temporary star which has been included in the statistics of novae.

There are recorded, especially in the voluminous chronicles of the ancient Chinese, many events which really seem to be the sudden appearances of novae. Most of these records occur in the encyclopedia *Wen-Hieng-Tong-Kao* collected by Ma-Tuan-Lin. The observations of comets and related phenomena in this work were for the first time translated by Biot in the *Connaissance des Temps* for 1846. In his *Kosmos* Humboldt discussed these and other observations and concluded that a nova might have appeared in each of the years—134, 123, 173, 369, 386, 389, 393, 827, 945, 1012, 1203, 1230, 1264, 1572, 1584, 1600, 1604, 1609. For a long time our knowledge of suspected novae was based upon Humboldt's opinions. Recently E. Zinner has given in *Sirius* a valuable short history of the novae and he concludes that besides 36 novae since 1572 which may be considered as real, a nova may have appeared in each of the years 369, 386, 393, 827, 837 (two), 1230, 1430, 1431, 1783, and with less probability in 222, 290, 304, 561, 829, 945, 1006, 1264, 1388, 1584, 1612, 1621.

Altho a great many of the suspected cases of novae have therefore already been discussed it has been considered of interest to go over the material again. If the positions of the suspected novae in the heavens can be derived and compared with the law of distribution found by the writer to exist for known novae[1] we may get a basis for testing the validity of the old records. An inspection of these records may contribute to the question what has become of ancient novae which must exist in thousands in the heavens. Two classes of objects present themselves for first consideration as perhaps former novae: the planetary nebulae and the Wolf-Rayet stars. It may therefore be possible if we get positions of the old novae, to find near their inferred places planetaries or Wolf-Rayet stars.

It is well known that more than two thousand years before the Christian era the Chinese had developed an advanced astronomical knowledge and made observations which are still of value. Their observations of comets are generally descriptions of the comet's path among the stars. They divided the visible heavens in 31 portions, of which 28 have been termed stellar divisions and receive their names from, or are determined by an asterism generally forming the central or principal one of the division. The divisions are very irregular in their extent both from north to south and from east to west. Therefore it is sometimes difficult to locate the position of a celestial body from the description in the Chinese annals; but many times it is possible to get the place with an accuracy not inferior to that of astronomical observations of the middle ages. For the statistical purposes of this paper it is generally sufficient if we know the positions within a few degrees.

In the Chinese records of comets "Ke-Sings" (strange stars, étoiles-hôtes) are frequently mentioned. Biot has shown that often the observations in question were of comets without tails, since reference was made to the motion of the object. Even where it is explicitly stated that the object had no motion and no tail occasional allusion may have been made to a comet. On the other hand it has sometimes happened that an object in the heavens has been considered to be a comet when it really was a nova; for example, several authors mistook Kepler's nova of 1604 for a comet and some

[1]*Publ. A. S. P.* **33**, 219, 1921.

of them moreover thought they had detected motion in the object.[2]

The Chinese observations of comets have also been translated by Williams[3]. He had more available sources than Biot (especially the *She-Ke* and the *Tung-Keen-Kang-Muh*) but the latter's translation seems to deserve a somewhat higher weight. Sometimes it happens, moreover, that Williams has not mentioned cases given by Biot so that the translations are supplementary to each other.

In addition to Williams's and Biot's work the Chinese chronicle *Se-Ma-Tsien* translated by E. Chavannes, and the Japanese chronicle *Nahongi* partly translated by E. Knobel have been examined.

In various European and Arabian sources some suspected cases of novae have been found. The Hindoos do not appear to have recorded any novae.

In the meridian observations of recent times there appear to have been recorded some faint stars which may have been novae not otherwise seen. The difficulty is to distinguish in the suspected cases the observations of actual stars from errors in the readings of the instruments, or errors in recording and reducing. Of all the cases recorded only 6 have been considered in this paper as the others need further examination.

The table on pages 233 and 234 contains the data drawn from the sources described concerning the epoch of the outburst, the position in the sky, the brightness and duration of visibility. In column 10 the estimated probability is set down: zero indicates that there seems to be no probability that the object in question was a nova; 1 that it is rather uncertain whether or not a nova is referred to; 2 that the object was probably a nova; and 3 that the probability is very great that the object is a genuine nova. λ and β are the galactic longitudes and latitudes.

Plotting the suspected novae in the table according to their galactic coordinates (Fig. 2), we find that they show a distribution similar to that of known novae, excluding the novae in spirals and clusters. Thus we find that the 45 objects from our table have a somewhat symmetrical distribution with respect to the galactic plane. Between galactic longitudes 320° and 330° we find a concentration, which indicates that the ancient novae are distributed

[2]*Krabbe Johannes.* Cometa so Anno 1604, den 3 Tag Octobris am Himmel erchienen sampt desselben Lauff Höhe Grösse und Effect. Observiret und beschrieben. Magdeburg 1605.

Möller Alb. Gründlicher und warer Bericht von den newen Cometstern so in der Lufft unter dem Himmel gesehen nach dem Niedergang der Sonnen in October und Novemb. des M.DC. IV Jahre. Eisleben 1605.

[3]Observations of Comets from B. C. 611 to A. D. 1640 extracted from Chinese annals. London 1871.

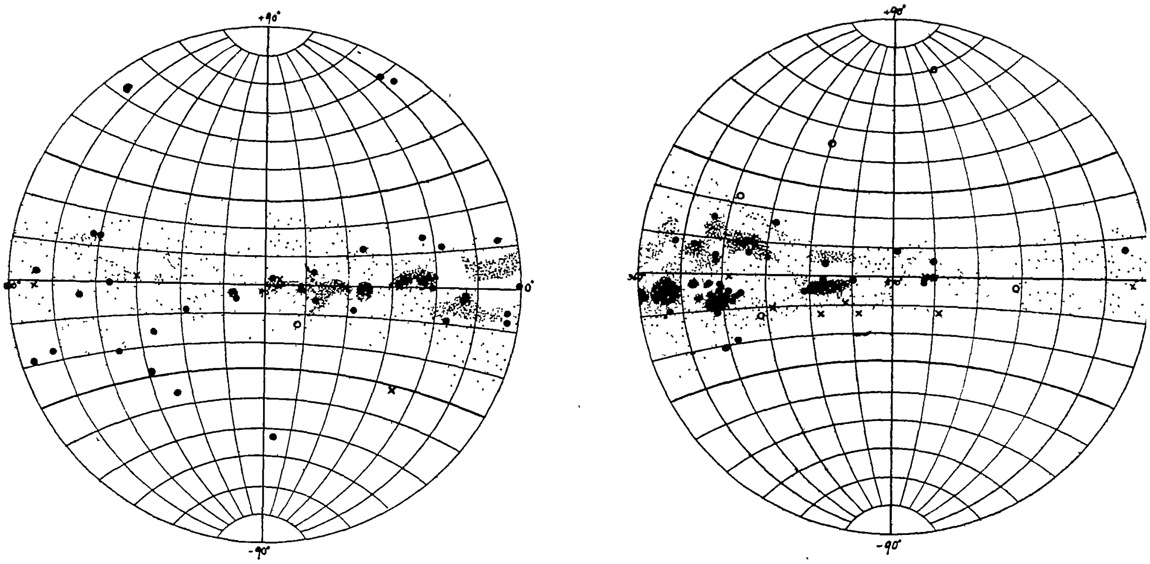

FIG. 1
Galactic Distribution of 41 Known Novae (Solid Circles) and 6 Novae Suspected in Recen
Times (Open Circles), the P Cygni Stars (Crosses), and Some Irregular Long Period
Variables (Crossed Circles)

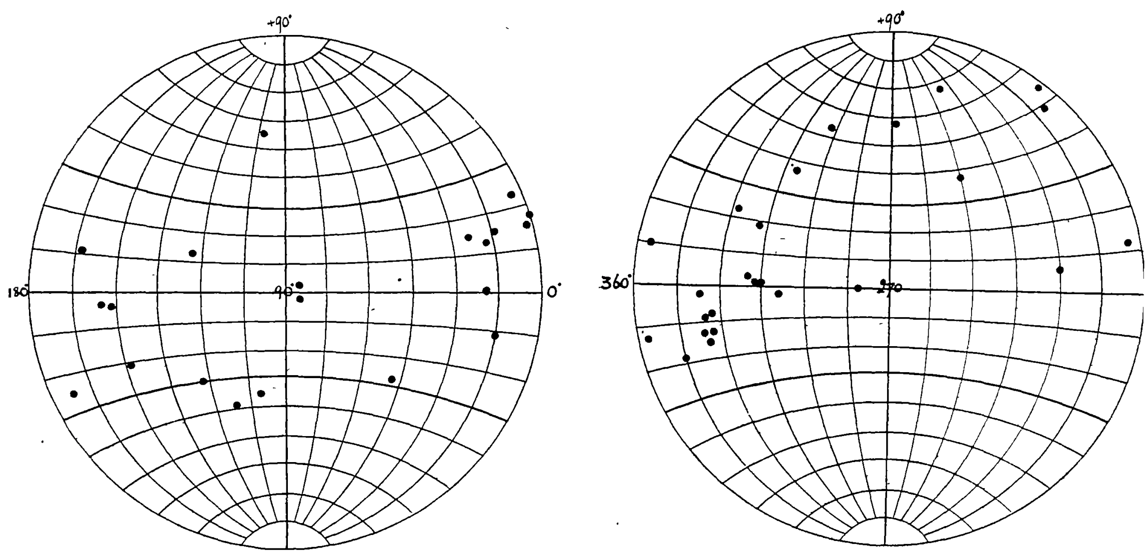

FIG. 2
Galactic Distribution of Novae from Ancient Records and Meridian Observations

about the center of the stellar system in the same manner as that in which the known novae are arranged as pointed out by the writer[4]. Since the suspected novae with which we are dealing in this paper must obviously have had high apparent magnitudes to have been observed their correlation with the far away center of our

[4] *Publ. A. S. P.*, **33**, 219, 1921.

stellar system strengthens the writer's former conclusion that the absolute maximum magnitude of the novae is very high.

In Fig. 2 another concentration is suggested in the constellation *Aries* and we find traces of such a concentration in the distribution of the known novae. It is peculiar that we find nearly the same gap in the distribution of ancient and recent novae, between the galactic longitudes 187° and 255° for the latter and 210° and 240° for the former.

There seems to be an indication that more of the older novae are situated in high galactic latitudes than is the case for modern novae. Now we have in recent times had some suspected cases of novae in high latitudes (see the table of variable stars below) and it is possible that observations extending over a comparatively short period only will not be representative for the regions around the galactic poles. If novae occur in our solar cluster they must be comparatively bright as they are near us but probably they do not occur very often as the occurrence of a nova seems to be dependent upon the presence of nebular matter. Therefore we must have observations over a long interval of time in order to get a true idea of the distribution of novae in our part of the universe.

The good agreement between the apparent distribution of the suspected and the known novae shows that most of the suspected objects are probably genuine novae. Of course we can not in every case be sure about the real nature of the object, but the material we used as the basis for our diagram must mostly refer to novae.

The comets recorded by the Chinese have no preferential arrangement with respect to the galaxy. If we consider the cases of comets where no motion is mentioned and which one might be led to suspect as possible novae, we find for them no special concentration towards the galaxy. This fact shows that there probably are not many more novae to be expected in the Chinese annals.

There is reason to believe that the novae occur in the regions of dark and bright nebulae[5]. We find that the ancient novae satisfy this condition as far as the concluded positions are able to show it; they occur at the borders of the bright star clouds or in regions where the star density is comparatively low.

In that connection it is of interest to note that Tycho Brahe in his work *Progymnasmata*, mentioned that his nova was situated at the border of the Milky Way (quo factum est quod nova stella in

[5]*Publ. A. S. P.* **33**, 219, 1921, *Astr. Nach.* **213**, 315, 1921

ipso Galaxiae margine constiterit). This fact seems to have given him the idea that stars were generated from cosmical dust in the Milky Way. Kepler's drawing of the nova of 1604 shows that he considered the nova to be situated at one border of the Milky Way. The star was really situated in a small dark lane. After this time the law for the apparent distribution of the nova seems to have been overlooked.

A compilation of the durations of naked-eye visibility for some of the novae of recent times and for six of the ancient novae is given in the following table together with the mean decrease in brightness per day during the interval.

Name	Maximum brightness	Duration of naked eye visibility	$\frac{\Delta m}{\Delta t}$
Nova 11 Vulpeculae 1670	3.0	14 months	$0^m.008$
Nova B Cassiopeiae 1572	−5	15	0 .024
Nova Serpentarii 1604	−4	12	0 .028
Nova Aurigae 1892	4.5	2	0 .027
Nova Persei 1901	0.0	6	0 .033
Nova Aquilae 3, 1918	−0.4	6	0 .041
Nova Cygni 1920	1.6	1	0 .140
Nova Q Cygni 1876	3.0	0.3	0 .300
Nova T Coronae 1866	2.0	0.4	0 .560
Nova 173	−6 ?	8	0 .040
Nova 369	−3 ?	6	0 .040
Nova 1604	−4	6	0 .050
Nova 1006	−3	3.5	0 .090
Nova 827	−10 ?	4	0 .130
Nova 1431	3	0.5	0 .500

The table shows that novae may be divided into various classes according to the rapidity of their light variations. There seems to be a fair agreement between durations of visibility of the old novae and of the recent ones. The mean time of visibility is a little shorter for the Chinese novae, but the Chinese observers certainly did not continue to observe the novae until they reached the 6th magnitude[6] and in some cases the novae seem to have been in such positions that they soon disappeared in the Sun's rays and therefore had shorter times of visibility.

The question of a connection between novae and other classes of stars is of considerable interest. There is some evidence in favor of the opinion that novae may develop into planetary nebulae. *Nova Persei* No. 2 and *Nova Aquilae* No. 3 have at present many features in common with planetaries. In other cases novae seem

[6]Holetschek, Grösse und Helligkeit der Kometenschweifen I. *Wien Denkschr.* **53**, 1896.

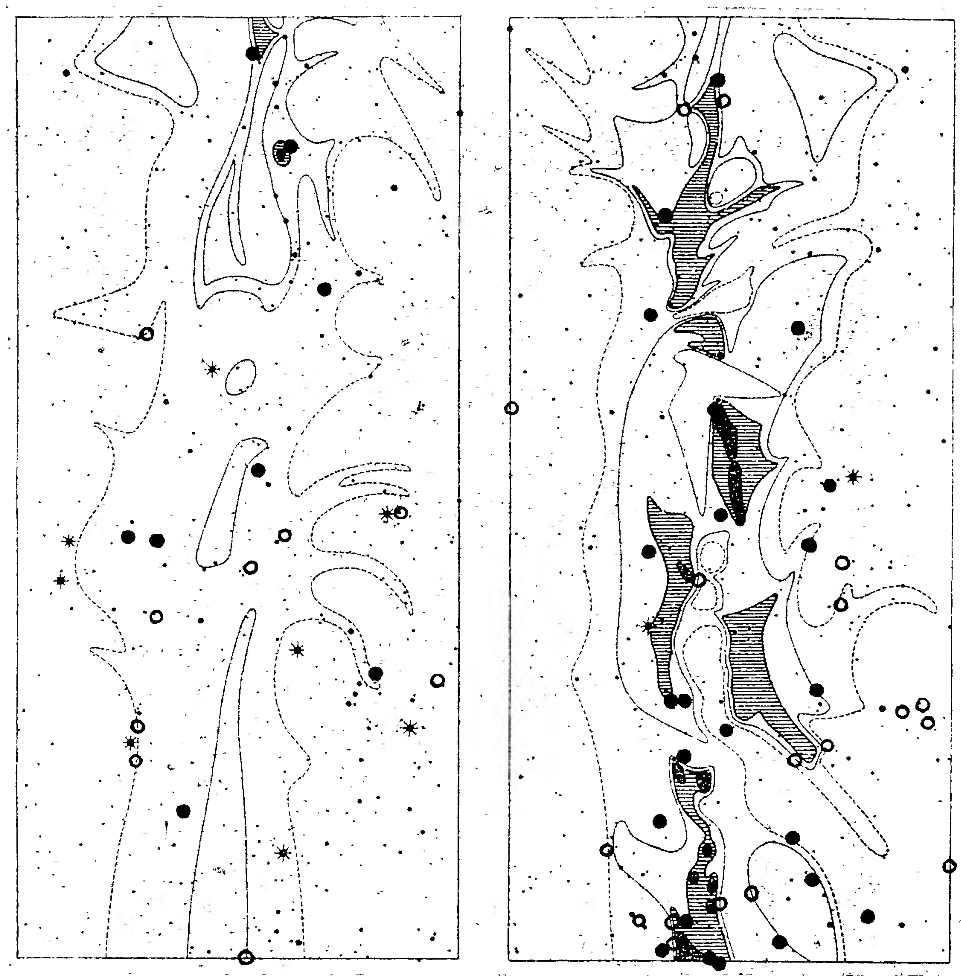

FIG. 3

Curves for Equal Light Intensity in the Milky Way (from Graff's Paper, Ast. Abh. d. Hamburger Sternwarte, II, No. 5, 1920), with Positions of Known and Suspected Novae to evolve into Wolf-Rayet stars. Recent investigations by the writer, described in a note on a later page, show that *Nova T Coronae* this year, 55 years after outburst, has a spectrum of Class Ma peculiar (absorption spectrum similar to a typical Ma star; bright hydrogen lines and λ 4686 and λ 4363 bright). Long exposure photographs with the Crossley reflector give no traces of nebulosity surrounding the star such as we have about *Nova Persei* No. 2 and *Nova Aquilae* No. 2. My attempts to find planetaries in the positions of Tycho's, Kepler's and Anthelmus's novae have failed. Spectrograms of the suspected stars show, according to preliminary examination, no peculiar spectra and it seems as if these novae now do not differ from ordinary stars. At present it is difficult to say what will ultimately become of novae, even tho the spectroscopic evidence sometimes points in the direction of their developing into planetaries, a conclusion which finds some support in the accordant apparent distribution of the two classes of objects.

As far as parallax measures of novae and a discussion of their distribution in space can determine the novae before outburst have been in some cases giant and in others dwarf stars. It seems probable that the development in the subsequent nova stages will not follow the same lines in the two cases.

A dependence of the development of an object upon its position with regard to the galaxy seems also suggested. A nova in high galactic latitude, such as *T Coronae* or the nova of 1860 in the globular cluster M80 (where no trace of nebulosity can be found) is probably not subject to the same physical conditions as a nova connected with the nebular matter in the Milky Way.

An inspection of our table shows that in 9 cases we find a planetary nebula and in 3 or 4 cases a Wolf-Rayet star near where we have evidence of an ancient nova. That in some cases we find nothing near the inferred place of an old nova will obviously not militate against its reality.

In some cases we should perhaps search for former novae among certain classes of variable stars (e. g. stars of the type of *R Coronae Borealis*) which may be former novae in the same stage as the present stage of *Nova Ophiuchi* 1848 or *Nova Cygni* 1876.

The following table gives some irregular variable stars which are possibly former novae, whose outbursts have not been recorded. As the alleged irregularity of a variable star frequently may have been caused by insufficient observations we shall give only comparatively well-known irregular variables which seem to be novae in later stages[7]. Their distribution in the sky shows a close relation to the distribution of novae.

		α	δ	λ	β
X	Persei	$3^h 49^m.1$	+30°45′	131	−16
T	Tauri	4 16 .2	+19 8	144	−21
T	Orionis	5 30 .9	− 5 32	175	−19
SU	Tauri	5 43 .2	+19 2	156	− 4
R	Monocerotis	6 33 .7	+ 8 50	171	+ 2
RX	Puppis	8 10 .7	−41 24	226	− 3
R	Crateris	10 55 .6	−17 47	237	+38
X	Virginis	11 56 .7	+ 9 38	234	+69
UW	Centauri	12 37 .6	−53 59	269	+ 9
R	Coronae Borealis	15 44 .5	+28 28	13	+50
U	Lupi	15 54 .5	−29 38	313	+17
U	Scorpii	16 16 .7	−17 38	327	+22
Y	Cor. Austr.	18 7 .2	−42 52	137	−13
R	Cor. Austr.	18 55 .2	−37 6	327	−18
RY	Sagittarii	19 10 .1	−33 42	331	−21
SY	Cephei	22 10 .3	+62 2	73	+ 4
UV	Cassiopeiae	22 58 .1	+59 4	77	− 1
Z	Andromedae	23 28 .9	+48 16	77	−13

It is possible that we may have to examine still other classes of objects than the planetaries, Wolf-Rayet stars and irregular variables to find older novae. Suppose the outburst of *Nova T Coronae* were not known. An examination of the star now would not show any light variability and from an investigation of its spectrum one would scarcely suspect that the star had been a nova. The relation between spectra of novae and spectra of the types of *α Cygni* and *γ Orionis* suggests other possibilities for the recognition of former novae. Nevertheless it might be profitable to look for planetary nebulae, Wolf-Rayet stars or irregular variables, especially in the positions of Nos. 5, 32, 35, 40, 41, 44, 49, 54, 55, 58, 59 and 60 in the table.

[7]Compare Ludendorff, *Astr. Nach.* **209**, 273, 1919; Miss A. J. Cannon, *Harv. Annals*, *81*, No. 3, 1920.

LIST OF SUSPECTED NOVAE

No.	Epoch	Position	Inferred Coordinates α	δ	λ	β	Time of visibility in months	Concluded maximum brightness	Probability of reality of the object	References
1	B. C. 134 July	Between β, π and ρ Scorpii	$15^h.9$	−23°	319°	+20°	......	......	0	Williams, No. 31. Biot p. 61. Fotheringham, M. N. 79, 162, 19. Zinner, Sir. 52, 26, 1919.
2	B. C. 77 Oct.	Between α and δ Urs. Maj	11 .6	+60	103	+56	......	......	1	Williams No. 38. Biot p. 61.
3	B. C. 76 May	Between α, β, γ Arietis and β, δ, ε Andromedae	1 .4	+26	101	−36	......	......	1	Williams No. 39.
4	B. C. 48 May	East of or near μ Sagittarii	18 .3	−21	337	− 2	......	......	2	Williams No. 47. Biot p. 61.
5	A. D. 64 May 3	South of η Virginis	12 .6	− 5	267	+58	2.5	......	2	Biot p. 62.
6	66 Jan. 31	......	......	......	......	......	......	......	1	Biot p. 62.
7	70 Dec.	Between α, γ, ε, η, and ζ Leonis	10 .1	+20	184	+54	1.8	......	2	Biot p. 62
8	101 Dec.	Between α, γ, η, ζ and κ Leonis	9 .8	+18	191	+49	......	2^m-3^m	2	Biot p. 62.
9	107 Sept. 13	Southwest from δ, ε and η Can. Majoris	7 .4	−30	210	+ 6	......	......	1	Biot p. 63.
10	123 Dec.	Near α Herculis and α Ophiuchus	17 .3	+13	3	+23	......	......	2	Biot p. 63.
11	130	......	......	......	......	......	......	......	0	Humboldt Kosmos III.
12	185 Dec. 7	Between α and β Centauri	14 .2	−60	282	0	8	......	3	Williams No. 76. Biot p. 63.
13	222 Nov. 4	Between η and β Virginis	12 .0	+ 1	248	+61	......	......	0	Williams No. 88. Biot p. 64.
14	290 May	Circle of perpetual apparition	......	......	......	......	......	......	1	Williams No. 115.
15	300 April	......	......	......	......	......	......	......	1	Williams No. 117.
16	304	In the Hyades	4 .4	+16	148	−21	......	......	1	Williams No. 122. Biot p. 64.
17	369 Mar.	Circle of perpetual apparition	0 ±	60 ±	85	− 2	6	......	3	Williams No. 132.
18	386 April	Between λ, μ and φ Sagittarii	18 .5	−25	336	− 9	3	......	3	Williams No. 134. Biot p. 64.
19	389	Near α Aquilae	19 .8	+ 8	15	−11	0.7	m = ♀	0	Lynn, Observatory 7, 17, 75, 1884.
20	393 Mar.	Near μ^2 Scorpii	16 .8	−38	315	+ 1	8	......	3	Williams No. 136. Biot p. 64.
21	561 Oct. 8	Near α Crateris	10 .9	−18	240	+37	......	......	1	Williams No. 164. Biot p. 64.
22	568 June 28	Near α Librae	14 .6	−16	309	+37	......	......	1	Biot p. 64.
23	684 Sept. 12	......	......	......	......	......	......	......	0	Williams No. 187.
24	827	In Scorpius	17 ±	−30 ±	335 ±	−16 ±	4	-10^m?	3	Wolf, *Gesch. d. Astronomie.*
25	829 Nov.	Between ζ, θ and ο Can. Min	7 .6	+ 2	184	+12	......	......	2	Williams No. 203. Biot p. 65.
26	837 April 29	Between γ, ε, ζ, μ and λ Geminorum	6 .9	+20	163	+11	0.3	......	1	Williams No. 206, 208. Biot p. 65.
27	837 May 3	Near ν Virginis	11 .8	+ 8	232	+67	1.5	......	2	Williams No. 207, 209. Biot p. 65.
28	837 June 26	Near λ and δ Sagittarii	18 .3	−27	333	− 8	......	......	1	Williams No. 210. Biot p. 65.
29	900 Feb.	Near the group Houan-tche	17 .0	+12	0	+28	......	......	2	Biot p. 66.
30	911 June	Near α Herculis	17 .2	+14	2	+26	......	......	2	Biot p. 66.
31	945	Between Cepheus and Cassiopeia	0 .0	+64	86	+ 2	......	......	0	Leovitius, C. von, Von den Neuen Stern Laugingen 1573; Brahe Progymnasmata. Mayer J. Sir. 46, 159, 191. Lynn, Observatory 6, 126, 151, 1883.
32	962 Jan. 28	East from k, n, o, p, q, Taurus Poniatowski	18 .1	+ 1	356	+10	......	......	2	Biot p. 66.
33	1006 At begin.	The Southern border of Scorpius	16.7-18.0	−45	309	− 2	3.5	m = ♀	3	Schönfeld. Astr. Nach. 127, 153.
34	1006 April 3	......	......	......	......	......	......	......	1	Biot p. 67.

LIST OF SUSPECTED NOVAE—Continued.

No.	Epoch	Position	Inferred Coordinates				Time of visibility in months	Concluded maximum brightness	Probability of reality of the object	References
			α	δ	λ	β				
35	1011 Feb. 8	At one side of the "square" σ, τ, ζ and φ Sag.	18h.8	−26°	336°	−13°	...	...	2	Biot p. 67.
36	1054 July 4	Southeast of η Tauri but near	5 .5	+20	152	− 4	6	...	2	Biot p. 67.
37	1070 Dec. 25	In Aries below Musca	2 .8	+24	122	−30	...	...	1	Biot p. 67.
38	1138 June	Near β Arictis	1 .9	+22	112	−39	...	...	1	Biot p. 68.
39	1139 June	Near κ Virginis	14 .1	−10	302	+53	...	...	1	Biot p. 68.
40	1203 July 28	Near μ^2 Scorpii	16 .8	−38	315	+ 1	...	m = ♄	3	Biot p. 68.
41	1230 Dec. 15	Below 98 and 109 Herculis	18 .2	+20	14	+16	3.5	...	2	Biot p. 45.
42	1264	Between Cepheus and Cassiopea	0 .0	+64	86	+ 2	...	...	1	Compare No. 31.
43	1388 Mar. 29	Between γ Pegasi and α Andromedae	22 .0	+20	47	+28	...	...	1	Williams No. 348.
44	1430 Sept. 9	Near α and β Can. Min	7 .4	+ 7	17	+13	1	...	2	Williams No. 349.
45	1431 Jan. 3	Near μ, ω and ψ Eridani	4 .9	− 6	173	−25	0.5	...	2	Williams No. 351.
46	1461 June 29	Near β and γ Ophiuchi	17 .8	+ 4	357	−13	1	...	2	Williams No. 354. Biot p. 58.
47	1578 Feb. 22	...	...	...	...	...	...	...	0	Williams No. 366. Biot p. 59. Danske Magazin København 1746 p. 204
48	1584 July 1	Near π Scorpii	15 .9	−26	317	+19	...	...	1	Williams No. 367. Biot p. 59.
49	1604 Sept. 30	Between ε, μ and ν Scorpii	17 .1	−35	319	+ 2	6	...	2	Williams No. 368. Biot p. 59.
50	1609	...	...	...	...	...	...	...	0	Williams No. 369. Biot p. 59.
51	1612	In Antinous	...	...	...	...	...	...	0	Zinner Sir. 52, 1919. Hagen, Astr. Nach. 208, 67, 72, 1919.
52	1618	...	...	...	...	...	...	...	1	Williams No. 371.
53	1621 May 12	...	...	...	...	...	...	...	1	Williams No. 372.
54	1667 April 18	$\alpha = 5^h 51^m 30^s$ $\delta = +20°15'.1$ (1855)	5 .9	+20.3	155	− 3	...	7	2	Hevelius, Prodromus Astronomicae Danzig 1690. Packer D. E., Jour. B. A. A. 4, 96, 1893.
55	1691 May 6	17 43 14 −17 5 52″ (1690)	17 .9	−17.1	333	−13	...	6	2	Baily-Flamsteed No. 2441.
56	1696 Jan. 22	5 20 +56 22 35 (1690)	5 .6	+56.5	123	+13	...	5.5	2	Baily-Flamsteed No. 756.
57	1783 July 26–28	19 23 47 .6 +17 19 42.8 (1800)	19 .4	+17.5	20	+ 0.6	...	6	3	Gould's d'Agelet. Mem. of Nat. Acad. Sc., Vol. I Wash. 1866.
58	1793 July 10	19 20 59 .74 −20 55 34.0 (1800)	19 .45	−20.9	345	−19	...	8	2	Lalande No. 36910. {See Ristenpart, Ast. Abh. No. 16, Kiel 1909
59	1824 June 28	16 13 59 .2 −14 33.6 (1855)	16 .28	−14.7	328	+23	...	9	2	Bessel Zones No. 253
60	1828 Aug. 18	18 23 41 .69 +27 57 36.6 (1825)	18 .45	+28.0	24	+16	...	9	2	Bessel Zones No. 433

2—N. G. C. 3587 in the vicinity.
4—Near N. G. C. 6578.
9—Near N. G. C. 2452.
12—Very close to W. R. star −61°.4431.
18—Very near N. G. C. 6644.
20—Near N. G. C. II 4637 and W. R. star −40°.10919.
21—Near R Crateris N. G. C. 3242 in the vicinity.
27—Near X Virginis.
28—Near N. G. C. 6620.
33—W. R. star −44°.11226 near the mean position.
36—Near N. G. C. 1952.
40—N. G. C. II 4637 and W. R. star −40°.10919 near.
49—N. G. C. 6302 near.

REMARKS

B. C. 134

Many authors have connected this Chinese record with a passage in Pliny's *Historia Naturalis*, where it is said that Hipparchus observed new stars and thereby derived the idea of making the catalog of stars which seems to be a part of the catalog that is given in Ptolemy's *Megale Syntaxis*.[8] An investigation by Fotheringham makes it probable that the Chinese record has reference to a comet. Zinner has shown that it is more probable that Hipparchus observed a maximum of *Omicron Ceti* and not a nova.

B. C. 77

This seems to be a nova, but the galactic latitude is high; yet this is no reason for excluding the star because *Nova T Coronae* and *Nova Piscium* also have very high latitudes.

B. C. 48

The statement in Williams's translation that the star had extension may indicate a comet, but it may also be an exaggerated description of the diffused appearance of the star. Thus Hevelius observed the nova of 1670 as a diffused star on the following dates: 1670 July 25, 1671 April 30 and May 17. Biot did not think that the star was a comet. His words, "elle pouvait en être éloigné de 4 degrés," can hardly be taken as a measure referring to the length of the tail. If such an observation was alluded to in the original text it is to be supposed that his translation here would have been similar to that in other cases.

A. D. 64

If a comet, the absence of motion and its appearance as a starlike object during 2.5 months would put it in a peculiar class of such objects. Biot said its extension was 2 degrees. The word "Chih," however, can not be translated by "degree" as this measure has apparently changed.[9] The expression may mean only that the star had a hazy appearance.

A. D. 70

Since the position and the duration of visibility are recorded it is evident that the object was actually under observation. As no motion is mentioned this fact is in favor of the object being a nova. The same remarks apply to many other objects in the table.

A. D. 101

"A small star" means probably that the appearance of the object was not at all exceptional. We may thus conclude that the maximum magnitude was not over 2^m—3^m.

A. D. 130

Humboldt mentions that a nova is said to have appeared about 130 A. D. under the government of Hadrian. At my request Professor H. Sjögren at Upsala has gone over the historical sources for Hadrian's administration, without finding any reference to a nova.

A. D. 173 AND 185

Both records evidently refer to the same star and it seems reasonable to follow Williams's translation in so far as it concerns the epoch. As we have probably to deal with a genuine nova we quote the translation as an example of the Chinese observations:

"In the second year of the epoch Ching Ping, the 10th moon, on the day Kwei Hae, a strange star appeared in the middle of Nan Mun. It was like a large bamboo mat. It displayed the five colours, both pleasing and otherwise. It gradually lessened. In the 6th moon of the succeeding year it disappeared."

[8]Dreyer *Mon. Not.*, **77**, 528, 1917 and **78**, 343, 1918.
[9]See Holetschek, *Op. cit.*

Attention should be called to the variation of the colors, the gradual diminution in brilliancy, the comparatively long time of visibility and the position in the heavens, which is very near that of the Wolf-Rayet star $-61°.4431$. The description that the star was "like a large bamboo mat" is perhaps to be interpreted as meaning that the great brightness of the star caused phenomena of diffraction that gave it a hazy appearance of the same kind as observed by Hevelius in the star of 1670.

A. D. 290

Position probably near or in Cassiopeiae.

A. D. 300

Williams thought that this star was a meteor. Sometimes such are certainly recorded.

A. D. 369

Zinner interprets the information in the text as indicating that the position of the star was in Cassiopeiae or the neighborhood. This seems to be reasonable. The long duration of visibility makes it probable that the object was a nova as the comets generally were not seen by the unaided eye for so long a time.

A. D. 386

Williams has "comet" but Biot "étoile extraordinaire." The words "elle y resta jusqu'a * * * disparut," combined with the fact that the star was seen a rather long time are favorable to the hypothesis that the object was a nova.

A. D. 389

Lynn's paper in *The Observatory* makes it very improbable that we are here dealing with a nova. The poor description does not permit the drawing of many conclusions. The alleged position is favorable for a nova, but Lynn's arguments make it safer to exclude the star from our list of suspected novae.

A. D. 393

Biot and Williams give different positions. Both are possible for novae. We have preferred Biot's position.

A. D. 684

"Resembling the half-moon" suggests that the object was a large meteor.

A. D. 827

Under the government of the Kalif Al Mamum, the Arabian astronomers Haly and Giafar Ben Mohamed Albumazar found a very bright new star whose light resembled in strength that of the Moon at quadrature. The star was situated in *Scorpio* and was observed for 4 months. The year but not the event is uncertain.

A. D. 837

The first two cases of extraordinary stars this year seem to have been novae. The third is more uncertain. "It was like a comet" is perhaps to be interpreted as meaning the object was a comet of somewhat peculiar type.

A. D. 900

The statement that the light of the group Houan-tche (clustering of stars near α *Hercules*) was obliterated by the nova makes it probable that the maximum magnitude was at least 2^m as the combined light of the group is $3^m.6$.

A. D. 945

This case has many times been mentioned in astronomical literature. Lynn has shown that Leovitius was not very credible and the contribution of J. Mayer shows that it is very questionable if Leovitius really had any authority for the two novae described by him.

A. D. 1006

It is possible that the star mentioned by Ma-Tuan-Lin is the same as that which Schönfeld discussed in *Astr. Nach.* Observed by Hepidanus and Barhebreäus.

A. D. 1203

The comparatively detailed description makes it very probable that the object was a genuine nova. The comparison with *Saturn* excludes every possibility of its being a comet and gives an estimate of the maximum brightness.

A. D. 1264

This is the second nova mentioned by Leovitius. The probability for its reality is very small.

A. D. 1431

The maximum brightness seems to have been comparatively low, as it is said that the star was not bright.

A. D. 1461

"Changed into a white vapor" may allude to a comet or to a more diffuse stage in the evolution of the nova.

A. D. 1578

Biot has "grand comme le soleil," and Williams "resembling the Sun," the latter of which must be preferred. The absence of any position and Williams's statement "surrounded by a number of stars," make it probable that the object was a very bright meteor. It is peculiar, if this was a nova, that the event was not mentioned by European astronomers who at that time were excited by Tycho's discovery of the nova of 1572. Now there is a letter from the Danish King Fredrik II to Tycho Brahe, dated 1578 Sept. 21, in which the king asks him whether he knows anything about a new star that the people speak of and believe they have seen. Unfortunately we do not know Tycho's answer.

A. D. 1584

The meteorological records of Tycho Brahe from 1582-1597 show that on those days he was on a journey. The southern position of the star and the bright sky at his observatory in Hven during this time of the year explain why the object was not seen by him.

A. D. 1604

Biot has different positions for the two appearances of this object. Williams gives definite evidence that in both cases the star division Wei is meant. The statement "it was seen in the southwest" and "it appeared in the southeast" could either allude to a motion of the object or be a record of two different novae. The simplest explanation is perhaps that the object at the first appearance was an evening star and at the second a morning star. The facts that it was not seen in Europe and that Kepler's nova is not mentioned by the Chinese suggest the hypothesis that the Chinese record refers to *Nova Serpentis* No. 1. The confusion as to whether the nova was located in the tail of the Scorpion (Wei) or the right foot of Ophiuchus (Nan) was quite easily possible. The Chinese description of the nova seems to have some analogy with the story of Kepler's nova.

A. D. 1621

The star is said to be "reddish."

A. D. 1612

According to Father Hagen's paper in *Astr. Nach.* it seems probable that no nova was observed that year by Bürgi.

A. D. 1667

A star observed by Hevelius in *Prodromus Astronomiae* and charted in his *Firmamentum Sobiescanum* but later not found. It is possible the same star was seen by Bevis but the position in his *Uranographia Britannica* 1738-45 is not accurate enough to make an identification possible or to say if Bevis observed another nova very close to the place of Hevelius's nova.

A. D. 1691 AND 1696

In his paper "On Flamsteed's Stars Observed but not Existing," C. H. F. Peters has given plausible explanations for most of the stars observed by Flamsteed but not found in other star catalogs. In the two cases in the table his explanation is somewhat hypothetical and strained. Much seems to be in favor of the hypothesis that Flamsteed actually observed two novae. A photograph of the region about B. Fl.2441 (No. 55 in the table) recently obtained by the writer with the Crossley reflector of the Lick Observatory shows only stars of 14^m-15^m in the place where this star was observed.

A. D. 1783

This star was observed as of the 6th magnitude on three consecutive evenings by d'Agelet, but afterwards never seen. Harvard photographs show that between 1882 and 1909 the star, if existing, was below 11^m. Photographs obtained this summer with the Crossley reflector, covering this region, show very near the position given by d'Agelet a star of 16th magnitude. Of course it is difficult to say whether the star is really the nova, but in general the difference between the maximum and minimum magnitude of novae is about 10 magnitudes. It seems probable that d'Agelet observed the nova near its maximum. If it had become considerably brighter other observers should have noticed the star. It is of interest to note that the star is situated in a somewhat starless region which projects like a bay into a corner of the Milky Way.

A. D. 1793

Five or six stars in Lalande's star catalog appear impossible of identification with known stars. That no object at all was observed in all these cases seems improbable especially as they are situated in or near the Milky Way and their magnitudes were between 7.5—8.5. In this paper we have considered only the case which is the most difficult to explain on any other hypothesis than that it was a genuine new star.

A. D. 1824 AND 1828

These stars were observed by Bessel but not found in any other star catalog. The proposed explanations of the observations are not very probable, but the best hypothesis seems to account for the stars as faint novae. None of the known asteroids, according to Berberich and Ristenpart, appear to have occupied at this time the positions given for the stars.

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