

*Prominences.*—The mean daily areas and numbers of calcium prominences as derived from photographs taken at Kodaikanal on 258 days during the year are as follows:—

	Areas			Numbers		
	North	South	Total	North	South	Total
January to June	2.64	1.94	4.58 sq. mins.	5.17	4.70	9.87
July to December	1.61	1.54	3.15 "	4.79	3.89	8.68

Compared with figures of the previous year, the areas show an increase in the first half of the year and decrease in the second half; the numbers show a slight decrease. Both areas and numbers show a general preponderance over the northern hemisphere. The distribution of areas in latitude shows a maximum between  $55^\circ$  and  $60^\circ$  in the northern hemisphere and between  $50^\circ$  and  $55^\circ$  in the southern hemisphere. The numbers are maximum between  $55^\circ$  and  $55^\circ$  of latitude in both the hemispheres.

35 metallic prominences were observed with the prominence spectroscope, 24 in the northern and 11 in the southern hemisphere. Four of these appeared in the latitude zone  $50^\circ$  to  $55^\circ$  and the rest in lower latitudes.

Doppler displacements of the  $H\alpha$  line in prominences were observed on 171 occasions, 56 towards the red, 59 towards the violet and 56 in both ways. The largest displacement of 8 A. towards the red was shown by a prominence on the South-east limb of the Sun at latitude  $52^\circ$  on 1946 September 29.

Observations with the spectrohelioscope showed Doppler displacements in prominences in 80 cases, 26 being towards red, 14 towards violet and 40 both ways. An eruptive arch-type prominence of height  $6'$  was photographed on the North-west limb of the Sun at latitude  $42^\circ$  on 1946 December 20.

The mean daily area of hydrogen absorption markings (without foreshortening correction) was 4907 millionths of the Sun's visible hemisphere—i. e. more than double the value for the previous year. The latitudinal distribution showed maxima between  $35^\circ$  and  $40^\circ$  N. and  $20^\circ$  and  $30^\circ$  S.

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## COMETS

Three comets under observation at the end of 1945 were recorded also at the beginning of 1946, by G. van Biesbroeck at the Yerkes Observatory, before they were lost in twilight: the periodic comet Kopff 1945 b at magnitude 15 and the comet Väisälä 1944 b at magnitude 16.5, both on January 2, and that periodic comet of special interest, Schwassmann-Wachmann (1) = 1925 II, which was also under observation by H. M. Jeffers at the Lick Observatory.

This last-named comet, which has been photographed nearly every year since its discovery in 1927, and is noted for its extraordinary physical behaviour, experienced one of its most remarkable outbursts. It was 18<sup>m</sup> in 1945 December and 16<sup>m</sup> on January 1 when it showed a broad tail but hardly any coma. It then brightened rapidly from 13<sup>m</sup> on January 11th to 9<sup>m</sup>.4 on the 26th, during which time it developed a coma of  $30''$  and the nucleus lost its stellar appearance and appeared as a disk which expanded by the end of the month to about  $20''$ . On January 26, while it was at its brightest, George H. Herbig successfully obtained plates with the nebular spectrograph of the Crossley telescope at Lick. These showed a solar type spectrum with no evidence of conspicuous bright lines. The comet then faded rapidly and by February 8 had dropped to 15<sup>m</sup>, a fuzzy coma  $45''$  in diameter. On March 1, when last observed by Jeffers, it was a faint

coma 40" diameter and of 18<sup>m</sup>. It came under observation again in October, before opposition in December, and appeared nearly stellar, 19<sup>m</sup> brightening to 15½<sup>m</sup> in November.

The interesting nature of this object, and the possible connection of these outbursts with variations in solar activity, make it important to keep it under continuous observation. Van Biesbroeck and others have appealed for this to be done.

During 1946 four new comets were discovered and there was a further one announced, Johnson's Object, whose cometary nature has been in doubt. In addition three periodic comets were observed on their return to perihelion, and two others not at perihelion, Schwassmann-Wachmann (1) already mentioned, and Oterma 1943 a.

1946 a was discovered by Matthew Timmers, a Dutch Jesuit lay brother working at the Vatican Observatory at Castel Gandolfo, on the edge of a plate he had exposed on February 1 on the Selected Area No. 29 in Ursa Major. It was an object of the ninth magnitude with a well-marked central condensation in a coma about 2½' in diameter. A short tail was faintly recorded on photographs but could only be traced visually in a large telescope before moonlight interfered. Subsequently a fainter narrower second tail was photographed by Van Biesbroeck with the 24-inch reflector at Yerkes and found to be nearly in the normal direction, that is away from the Sun, the first and brighter tail being at 42° to it. Pre-discovery images, the earliest on January 23, were found by Whipple on Harvard patrol plates. The comet was well observed during the spring and summer when it was circumpolar. It reached 7<sup>m</sup>.8 on March 3 but started to fade slowly even before perihelion passage in April, on account of its increasing distance from the Earth. In August it appeared as tenth magnitude with a nearly stellar nucleus, round coma and no tail. By October 27 it was reduced to 15<sup>m</sup> or 16<sup>m</sup>, with little coma. A long series of photographs of it, 130 in all, covering practically the whole period of visibility in 1946, was obtained with the Zeiss astrographic telescope at the Vatican Observatory. The last observation in 1946, so far published, is for October 28 by L. Boyer at Algiers.

1946 b was the periodic comet Tempel (2), detected by Van Biesbroeck with the 24-inch reflector at Yerkes on May 1, magnitude 17, close to the position predicted by P. Ramensky. It brightened rapidly and by the time it reached perihelion, early in July, it was between 9<sup>m</sup> and 10<sup>m</sup>. Jeffers observing it at Lick found the coma fan-shaped, several minutes of arc across and with a sharp nucleus. On August 30 he estimated it as 8<sup>m</sup>, easily visible in the 4-inch finder, a round coma 3' in diameter and strongly condensed. Thereafter it slowly faded and was about 10<sup>m</sup> to 11<sup>m</sup> in mid-October. The last known observation was by H. L. Giclas at the Lowell Observatory on November 28.

1946 c was the periodic comet Giacobini-Zinner, detected by Jeffers at Lick on May 29, magnitude 16½ and diameter 20", very close to the position predicted by F. R. Cripps. By mid-August, when it was circumpolar, it had brightened to tenth magnitude, a small round coma with a trace of tail. It was at its brightest, 6<sup>m</sup>, after perihelion in mid-September, declining to 11<sup>m</sup> in November. A short broad tail was still visible at the end of October. Observations have been continued into the new year.

The return of this comet was chiefly remarkable for the meteor shower it occasioned on October 10, and this shower in turn was notable for being the first big shower to be well recorded by means of radar. As a spectacle the shower was not as brilliant as had been expected, even allowing for moonlight, and although the Earth was much closer to the comet and to its orbit than in 1933 the rate of naked eye meteors was only a

fraction of the rate on that occasion, and of unexpectedly short duration. The maximum, at the rate of 3000 to 4000 naked eye meteors an hour, was very sharply marked and lasted only a few minutes around 03.45 hours U.T. October 10.

1946 d was a new comet discovered on May 30 with a binocular comet seeker by Miss Ludmilla Pajdušáková at the Czechoslovakian Mountain State Observatory, Skalnaté Pleso, the reward of many hours of systematic sweeping. It was also found by David Rotbart, an amateur near Washington, D.C., while he was looking at some star clusters with a pair of 80 mm. binoculars; and by Weber in Germany. At discovery it was in Cygnus, an object of about seventh magnitude with a central condensation around a stellar nucleus of  $10^m$ , and a tail about a degree long. It passed within 15 million miles of the Earth, retrograde motion carrying it across the sky at the rate of  $14^\circ$  a day. After brightening for a few days to  $6^m$ , it faded rapidly, and when last photographed, by Jeffers at Lick on July 28, it was  $17^m$ . Spectroscopic observations made at Sonneberg on June 3 showed a strong CN band  $\lambda$  3880, and a continuous spectrum from  $\lambda$  3970 to  $\lambda$  4960; but the C band  $\lambda$  4700 was not visible.

1946 e was the periodic comet Brooks (2), detected on June 28,  $17^m.5$ , also by Jeffers at Lick, close to the position predicted by F. R. Cripps. It remained faint throughout and few observations of it appear to have been made other than by Jeffers. Even after perihelion in August, when it was expected to reach about  $12^m$ , it seems to have been no brighter than  $14^m$ . L. E. Cunningham has remarked that the observed magnitudes of the comet at previous apparitions have indicated some abnormality. However, though faint, it was still under observation at the end of the year.

1946 f was the designation given to the interesting periodic comet Oterma 1943 a (=1942 VII) observed again during the summer by Van Biesbroeck and Jeffers. It was discovered in 1943 at the Turku Observatory in Finland but, owing to the small eccentricity of its orbit (0.14) which lies between Mars and Jupiter, it can be followed throughout its path. The observations this year are notable in that they were made while the comet was at aphelion. It appeared as a small coma, nearly stellar and of  $18^m$ , with a faint tail about  $2'$  long.

1946 g referred to an object of  $12^m$  detected by Cecilio at La Plata on July 31 while searching for the periodic comet du Toit-Neujmin-Delporte (1941 e). It was mistaken for this comet but later thought to be a new comet. L. E. Cunningham however identified it as the minor planet 135 Hertha.

1946 h was a new comet, discovered on August 6 by Albert F. Jones, an amateur astronomer at Timaru, New Zealand, while locating the field of the variable star U Puppis. The coma appeared about  $1'$  in diameter, with a central condensation, the total magnitude being 9.0. It was observed till October 3, by which time it had brightened to seventh magnitude, increased in size and showed a short tail; but it then became too near the Sun in the morning twilight for further observation before perihelion. It was recovered on 1947 January 3 by an exceptional observation, at very low altitude and within  $23^\circ$  of the Sun, made by H. L. Giclas at the Lowell Observatory. It was then  $10^m$ .

1946 i was the object of  $12^m$  discovered by E. L. Johnson at the Union Observatory, Johannesburg, on a photograph taken on August 21. His plates taken on September 3 and 15 showed "diffuse" images and, as the object could not be identified with any known planet, it was provisionally classified as a comet. The cometary nature has however not been confirmed, and eight plates taken with the Crossley reflector at Lick recorded the images as always stellar. It is considered therefore that the object is a

minor planet, and this conclusion is supported by the nature of its orbit with its small eccentricity (0.25) and short period (3.6 years).

1946 j refers to cometary images found by D. C. Berry at Dunedin, N.Z., on photographic plates exposed for comet Jones on September 3, 4 and 5. Although Berry himself doubted the evidence, the Carter Observatory considered it justified the announcement of a new comet. L. E. Cunningham however found the positions given could not be represented by an orbit and, from further examination of the plates, it seems the images were photographic faults which by coincidence lay nearly along a line.

1946 k was a new comet detected by Michiel Johan Bester at the Boyden Station of the Harvard College Observatory, at Bloemfontein, on a plate taken with the 3-inch Ross-Fecker patrol camera on October 31. It was in Caelum, an object of eleventh magnitude. It brightened to between 9<sup>m</sup> and 8<sup>m</sup> by December, by which time it had come sufficiently north in declination to be followed by observatories in northern latitudes. It was then seen as a coma about 2' in diameter with a nucleus.

The periodic comets Wolf (2), Borrelly, and Schwassmann-Wachmann (3) of 1930, were due at perihelion during the year but were not seen. The first two were very badly placed for observation, but it was expected that the last-named would have been detected by southern observatories after perihelion in September when it was likely to have been between 13<sup>m</sup> and 14<sup>m</sup>.

Since 1937 a number of definitive elements of the orbits of comets have been published which have not been recorded in these Notes. Those that are now known to the writer have been tabulated below, together with some other reliable orbits; and the best available for recent comets are also included as usual. It seems desirable also to publish here a list of the annual numerical designations of comets (in order of perihelion passage) in order that they may be used, especially where the letter designations are uncertain. During the war, owing to the difficulties of communication, the announcements of new discoveries were sometimes greatly delayed or even lost. In consequence

#### Numerical Designations of Comets

Comet	T	Name	Year and letter
1939 I	Feb. 6.9	Kozik-Peltier	1939 a
II	Mar. 12.8	P/Kopff	1939 e
III	Apr. 10.2	Jurlof-Achmarof-Hassel	1939 d
IV	Apr. 26.1	P/Väisälä	1939 b
V	June 22.7	P/Pons-Winnecke	1939 c
VI	Aug. 9.5	P/Herschel-Rigollet	1939 h
VII	Sept. 15.4	P/Brooks (2)	1939 g
VIII	Oct. 3.5	P/Kulin	1940 a
IX	Nov. 5.6	Friend	1939 n
X	Nov. 10.8	P/Tuttle	1939 k
1940 I	Feb. 17.4	P/Giacobini-Zinner	1939 l
II	Apr. 23.5	P/Faye	1939 m
III	Aug. 15.8	Okabayasi-Honda	1940 e
IV	Oct. 7.9	Whipple-Paraskevopoulos	1940 d
1941 I	Jan. 16.2	Cunningham	1940 c
II	Jan. 20.4	Friend-Reese-Honda	1941 a
III	Jan. 22.5	P/Whipple	1940 b
IV	Jan. 27.7	de Kock-Paraskevopoulos	1941 c
V	Apr. 18.3	P/Encke	1941 b
VI	June 9.4	P/Schwassmann-Wachmann (1)	1941
VII	July 21.2	P/du Toit-Neujmin-Delporte	1941 e
VIII	Sept. 3.2	Van Gent	1941 d

## Numerical Designations of Comets (Continued)

1942 I	Feb. 14.3	P/Schwassmann (2)	1941 f
II	Feb. 15.8	Väisälä	1942 c
III	Apr. 16.4	P/Forbes	1942
IV	Apr. 30.8	Whipple-Bernasconi-Kulin	1942 a
V	May 23.3	P/Grigg-Skjellerup	1942 d
VI	June 23.6	P/Wolf (1)	1942
VII	Aug. 21.8	P/Oterma = "Oterma (3)"	1943 a
VIII	Sept. 27.5	Oterma = "Oterma (1)"	1942 b
IX	Dec. 19.2	P/Stephan-Oterma = "Oterma (2)"	1942 f
1943 I	Feb. 6.7	Whipple-Fedke-Tevzadze	1942 g
II	Aug. 21.5	Daimaca	1943
III	Sept. 22.6	P/d'Arrest	1943
IV	Nov. 22.5	P/Daniel	1943
V	Nov. 26.0	P/Schaumasse	1944
1944 I	Jan. 12.5	Van Gent-Peltier-Daimaca	1943
II	Apr. 11.5	P/Comas Sola	1943
III	June 17.5	P/du Toit	1944 c
IV	July 17.7	Van Gent	1944

the letter designations were not always applied and confusion occurred in a few of the cases in which they were given. For completeness of reference the list given above has been extended to cover the years 1939 to 1944.\* The symbol P/ has been introduced to denote a periodic comet, excluding however any with nearly parabolic orbits for which the dates of return are not predictable.

As a result of the difficulties of communication referred to, or for other reasons, the following comets were not noted in the previous annual reports :

1939 VIII P/Kulin 1940 a, discovered by G. Kulin at Budapest on 1940 January 6, an

Table of the Elements

Comet	$T$		$q$	$e$
	G.M.T. before 1925.0	U.T. from 1925.0		
1889 I	Barnard-Brooks	1889 Jan. 31.1686	1.814918	1.001255
1908 III	Morehouse	1908 Dec. 25.7561	0.945300	1.000692
1910 III	Metcalf	1910 Sept. 16.2813	1.948009	0.999812
1916 II	P/Neujmin (2)	1916 Mar. 11.3161	1.339828	0.566494
1919 V	Metcalf-Borelly	1919 Dec. 7.3097	1.115272	1.000215
1925 II	P/Schw.-Wach. (1)	(1925 Mar. 2.734)	5.5466	0.13672
1927 I	P/Neujmin (2)	1927 Jan. 16.2273	1.338187	0.566819
1927 VI	P/Gale	1927 June 14.5681	1.213456	0.757425
1927 VIII	P/Schaumasse	1927 Oct. 1.3529	1.172087	0.705860
1929 I	P/Schw.-Wach. (2)	1929 Mar. 23.1300	2.090521	0.394547
1929 II	P/Forbes	1929 June 26.0463	1.528364	0.555822
1930 I	Schw.-Wach.-Peltier	1930 Jan. 15.6336	1.087102	0.999655
1930 II	Wilk	1930 Jan. 22.3098	0.672235	0.999028
1930 III	Wilk	1930 Mar. 28.8001	0.481816	0.992215
1930 VI	P/Schw.-Wach. (3)	1930 June 14.1955	1.011426	0.672477
1931 V	Carrasco	1931 Nov. 30.6696	2.330580	1.002217
1932 I	Houghton-Ensor	1932 Feb. 28.9294	1.254441	0.972148
1932 III	P/Kopff	1932 Aug. 21.4108	1.254433	0.972130
1932 VI	Geddes	1932 Sept. 21.0747	1.688183	0.518130
1935 II	P/Reinmuth	1935 Apr. 29.765	2.313566	1.001376
1936 I	Van Biesbroeck	1936 May 11.6340	1.857376	0.503299
1936 II	Peltier	1936 July 8.9551	4.04335	1.00197
			1.099870	0.991760

\* Up to and including 1940 they will be found in the Vierteljahrsschrift of the Astronomische Gesellschaft, and in the International Astronomical Union Circulars (UAIIC). The present list is given in UAIIC, No. 1098 (and No. 1104) but some perihelion dates have here been corrected.



object of 16<sup>m</sup> at first taken to be a minor planet (1940 AB) but confirmed by three later observations, the only others, as cometary.

1941 III P/Whipple 1940 b, was detected on its return to perihelion by Leland E. Cunningham at the Oak Ridge Station of the Harvard College Observatory on 1940 September 1, about 15<sup>m</sup>, within 6' of the position predicted from the elements in the Planetary Coordinates, 1940-1960 volume, of the Nautical Almanac Office.

1942 II Väisälä 1942 c, discovered by Y. Väisälä at the Turku Observatory in Finland on 1942 March 11, 13<sup>m</sup>, and as far as known under observation there for just over a month.

1945 g du Toit, referred to as 1945 f in the U.S.A.\*, was discovered by du Toit at the Boyden Station of the Harvard College Observatory on 1945 February 11, 7<sup>m</sup>. It appears to have been observed for only a few days. A preliminary orbit (ref. 56 in the following table) indicated the very small perihelion distance of 0.006 unit.

The comet du Toit 1945 c, which it was stated (*M.N.*, **106**, 77) was not seen again after discovery, was in fact under observation in South Africa for two months, and was there known as du Toit (4). It has been found by L. E. Cunningham (ref. 51 in the following table) to have an interesting orbit, the period, 4½ years, being the shortest known for a comet, excepting Encke.

In the main table which records the elements of the orbits, the predicted ones are marked with a "p" after the perihelion date, and are given only when the comet has been observed at that return. When so given, the perihelion date deduced from observation will be found either in another set of elements following the predicted, or in the notes appended under the reference number.

#### of Cometary Orbits

Period- years	$\omega$	$\Omega$	$i$	Equinox	Computer	Ref.	Comet
...	340°4597	357°4204	166°3689	1889°0	v. Biesbroeck	1	1889 I
...	171°5770	103°1614	140°1789	1908°0	v. Biesbroeck	2	1908 III
...	50°9703	289°5298	121°0504	1910°0	Viaro	3	1910 III
5.43	193°7833	327°6716	10°6290	1925°0	Neujmin	4	1916 II
...	185°7431	120°9743	46°3884	1919°0	Przybylski	5	1919 V
16.29	357°594	321°799	9°515	1932°0	Behrens	6	1925 II
5.43	194°7268	328°0024	10°6323	1950°0	Neujmin	7	1927 I
11.19	209°8458	67°0961	11°6216	1927°0	Cunningham	8	1927 VI
7.95	46°0045	90°6039	14°7194	1927°0	Kanda, Hirose	9	1927 VIII
6.42	357°7120	126°3273	3°7284	1950°0	Rasmussen	10	1929 I
6.38	259°4923	25°4905	4°6370	1929°0	Makarov	11	1929 II
...	325°0870	147°5566	99°9037	1930°0	Kulikov	12	1930 I
...	157°4951	178°9948	124°5194	1930°0	Koebeke	13	1930 II
...	46°9512	90°2624	67°1427	1930°0	Rechtenstamm	14	1930 III
5.43	192°3189	76°7797	17°4018	1930°0	Cripps	15	1930 VI
...	110°3080	17°8382	58°0662	1932°0	Carrasco	16	1931 V
302.3	303°5228	212°5321	74°2853	1932°0	Przybylski	17	1932 I
302.0	303°5222	212°5320	74°2847	1932°0	v. Schrutka	18	1932 I
6.56	19°7395	263°8353	8°7062	1925°0	Kepinski	19	1932 III
...	329°7014	215°1479	124°9959	1932°0	v. Biesbroeck	20	1932 VI
7.23	8°6885	124°9681	8°0667	1935°0	Kanda, Hirose	21	1935 II
...	44°9007	299°8609	66°1083	1950°0	v. Biesbroeck	22	1936 I
1542	148°4696	134°0482	78°5508	1936°0	Bobone	23	1936 II

\* And 1945 f Friend-Peltier was called 1945 e in the U.S.A.

Table of the Elements

Comet	T	q	e
1938 I	1938 June 18.4700	1.182918	0.760735
1939 I	1938 June 18.4733	1.182888	0.760730
1939 III	1939 Feb. 6.8538	0.716503	0.994871
1939 V	1939 Apr. 10.1686	0.528271	0.998620
1939 VI	1939 June 22.7230	1.101472	0.669486
1939 VII	1939 Aug. 9.4640	0.748492	0.974176
1939 VIII	1939 Sept. 15.4169	1.871443	0.486062
1939 IX	1939 Oct. 3.5212	1.749439	0.447694
1941 III	1939 Nov. 5.647	0.94546	1.0
1941 IV	1941 Jan. 22.69p	2.4848	0.34995
1941 VI	1941 Jan. 27.6535	0.790003	0.998854
1941 VII	1941 June 9.4237	5.522843	0.135507
1942 I	1941 July 21.2077	1.304632	0.582224
1942 II	1942 Feb. 13.761p	2.143815	0.385449
1942 IV	1942 Feb. 15.8162	1.24442	0.93369
1942 VI	1942 Apr. 30.8333	1.445303	1.000893
1942 VII	1942 June 23.606p	2.437330	0.404797
1942 VIII	1942 Aug. 21.8085	3.389625	0.144425
1942 IX	1942 Sept. 27.516	4.112741	1.0
1943 I	1942 Dec. 19.0991	1.594664	0.859947
1943 II	1942 Dec. 19.1067	1.595861	0.861140
1943 III	1943 Feb. 6.7187	1.353628	0.992172
1943 IV	1943 Aug. 21.546	0.75830	1.0
1944 I	1945 Jan. 3.6557	2.400280	1.0
1944 b	1945 Apr. 20.3046	1.234907	0.550617
1945 c	1945 May 17.1456	0.998063	1.0
1945 d	1945 July 10.031p	1.159535	0.654672
1945 a	1945 July 10.5837	1.159164	0.654566
1945 b	1945 Aug. 11.293p	1.495712	0.556068
1945 g	1945 Dec. 28.012	0.006305	1.0
1946 a	1946 Apr. 13.2531	1.724230	1.001312
1946 d	1946 Apr. 13.2698	1.724196	1.001341
1946 b	1946 May 11.4359	1.018251	1.0
1946 e	1946 July 2.268p	1.393220	0.542254
1946 c	1946 July 2.3440	1.393252	...
1946 h	1946 Aug. 25.940p	1.878739	0.484637
1946 k	1946 Aug. 25.979p	1.879484	0.484440
	1946 Aug. 25.7796	1.879383	...
	1946 Sept. 18.634p	0.995692	0.716683
	1946 Sept. 18.4871	0.995653	0.716683
	1946 Oct. 26.7938	1.136037	1.0
	1947 Feb. 7.4665	2.407127	1.0
	1947 Feb. 7.3988	2.407410	1.0
	1947 Feb. 7.4216	2.407373	1.0

## REFERENCES AND NOTES TO TABLE OF ELEMENTS

- 1889 I Barnard-Brooks. (1) G. van Biesbroeck, *Pub. Yerkes Obs.*, **8**, No. 4, 24, 1940. Definitive, from about 1100 observations covering 735<sup>d</sup>. Osc. epoch 1889 February 5. Original orbit found to be elliptical:  $e=0.9999235$  on 1870 January 1.
- 1908 III Morehouse. (2) G. van Biesbroeck, *Pub. Yerkes Obs.*, **8**, No. 5, 17, 1943. Definitive, from about 1300 observations covering 249<sup>d</sup>. Osc. epoch 1908 December. 28 Original orbit found to be elliptical:  $e=0.999850$  on 1888 June 11 ( $r=41$ ).

## of Cometary Orbits (continued)

Period- years	$\omega$	$\Omega$	$i$	Equinox	Computer	Ref.	Comet
10.99	209.1129	67.2556	11.7251	1950.0	Cunningham	24	1938 I
10.99	209.1162	67.2537	11.7254	1950.0	Cripps	25	1938 I
1650	169.0342	288.7561	63.5252	1939.0	Przybylski	26	1939 I
7500	89.2473	311.4283	138.1054	1939.0	Przybylski	27	1939 III
6.08	169.3590	96.7998	20.1178	1950.0	Porter	28	1939 V
156.0	29.2989	355.1295	64.1994	1939.0	Maxwell, Kaster	29	1939 VI
6.95	195.6839	177.7045	5.5461	1950.0	Dubiago	30	1939 VII
5.64	292.7546	137.6336	4.8020	1950.0	Kulin	31	1939 VIII
...	126.85	196.27	92.93	1939.0	Vergnano	32	1939 IX
7.47	190.468	188.814	10.223	1950.0	Sadler, McBain	33	1941 III
...	268.6693	42.2619	168.1947	1941.0	Chang, Li	34	1941 IV
16.15	356.2213	322.0041	9.5165	1950.0	Hergert	35	1941 VI
5.52	69.2948	229.6448	3.2576	1950.0	Naur	36	1941 VII
6.52	358.0084	126.0433	3.7252	1950.0	Rasmusen	37	1942 I
85.5	335.2178	171.5925	38.0067	1950.0	Vaisälä	38	1942 II
...	223.4177	340.1241	79.4447	1942.0	Iannini	39	1942 IV
8.29	160.9654.	204.3426	27.3019	1950.0	Kamienski	40	1942 VI
7.89	354.8058	155.1708	3.9899	1950.0	Hergert	41	1942 VII
...	163.6970	280.3839	172.5138	1942.0	Oterma	42	1942 VIII
38.42	358.2728	78.5068	17.8849	1942.0	Bobone	43	1942 IX
38.96	358.3611	78.4946	17.8908	1943.0	Dubiago	44	1942 IX
2274	39.8195	100.0230	19.7140	1943.0	Dubiago	45	1943 I
...	36.390	82.568	161.318	1943.0	Popovici	46	1943 II
6.71	174.4003	143.6293	18.0114	1950.0	Recht	47	1943 III
6.79	6.1035	70.4328	19.8461	1950.0	Dubiago	48	1943 IV
...	33.3983	57.9250	136.0544	1944.0	Möller	49	1944 I
...	239.1321	28.4314	17.2726	1950.0	Hergert	50	1944 b
4.56	203.3740	358.7246	6.4618	1945.0	Cunningham	51	1945 c
...	280.1413	254.2932	156.5093	1945.0	Bobone	52	1945 d
6.15	170.1065	94.4621	21.7136	1950.0	Ananieva	53	1945 a
6.15	170.1108	94.4553	21.6909	1950.0	Porter	54	1945 a
6.18	31.5410	253.0539	7.2246	1945.0	(Kepinski)	55	1945 b
...	50.93	321.62	137.02	1945.0	Cunningham	56	1945 g
...	54.3162	128.9125	72.8497	1946.0	Schmitt	57	1946 a
...	44.3268	128.9113	72.8484	1946.0	Cunningham	58	1946 a
...	22.2671	301.2365	169.5581	1946.0	Cunningham	59	1946 d
5.31	190.8586	119.4142	12.4306	1950.0	Ramensky	60	1946 b
5.31	...	...	...	...	Cunningham	61	1946 b
6.96	195.6049	177.6090	5.5398	1950.0	Dubiago	62	1946 e
6.96	195.5840	177.7058	5.5395	1950.0	Cripps	63	1946 e
6.96	...	...	...	...	Cunningham	64	1946 e
6.59	171.8518	196.2586	30.7402	1950.0	Cripps	65	1946 c
6.59	171.8200	196.2319	30.7264	1946.0	Cunningham	66	1946 c
...	320.4322	237.6283	56.9686	1950.0	Cunningham	67	1946 h
...	348.6609	34.8242	108.1619	1947.0	Bobone	68	1946 k
...	348.6335	34.8204	108.1661	1947.0	Schmitt	69	1946 k
...	348.6415	34.8615	108.1684	1950.0	Cunningham	70	1946 k

1910 III Metcalf. (3) Maria Viaro, *Capodimonte Contrib.*, 2, No. 12, 1936. Definitive, from 656 observations covering 278d. The comet is here called 1910 IV, following *V.J.S.*, 48, 254; but this requires correction as perihelion preceded by 0d.117 that of P/d'Arrest (*cf. Recht, A.J.*, 48, 75) which becomes 1910 IV, as given in Crommelin's catalogue *Mem. B.A.A.*, 26 (2), 16, and in Yamarnato's Preliminary General Catalogue of Comets, *Pub. Kwasan Obs.*, 1, No. 4, 22, 1936.

1916 II P/Neujmin (2). (4) G. N. Neujmin, *Pouikovo Obs. Circ.*, 32, 53, 1941. Definitive, after combining 1916-1927. Osc. epoch 1916 April 10.



- 1919 V Metcalf-Borelly. (5) A. Przybylski, *Acta Astron.* (a), **4**, 59, 1939. Definitive, from 274 observations covering 180<sup>d</sup>. Osc. epoch 1919 September 18.5. He intends to investigate the original orbit.
- 1925 II P/Schwassmann-Wachmann (1). (6) J. G. Behrens, *A.N.*, **245**, 309, 1932. Orbit based on preliminary investigation 1902-1931. Osc. epoch 1932 January 1. See also *A.N.*, **266**, 45.
- 1927 I P/Neujmin (2). (7) G. N. Neujmin, *Poulkovo Obs. Circ.*, **32**, 54, 1941. Preliminary orbit using 20 observations covering 97<sup>d</sup> best fit to the definitive orbit of 1916 II with perturbations to 1927. Osc. epoch 1927 March 4. Residuals of the order of  $\pm 10''$  remained.
- 1927 VI P/Gale. (8) L. E. Cunningham, *HAC*, No. 444.\* Definitive determination before linking to 1938. He plans to compute definitive elements combining 1927 and 1938. Osc. epoch 1927 July 19.
- 1927 VIII P/Schaumasse. (9) S. Kanda and H. Hirose, *UAIC*, No. 579.\* From 5 observations combining 1919-1928. Osc. epoch 1927 November 1.
- 1929 I P/Schwassmann-Wachmann (2). (10) Hans Q. Rasmussen, *Pub. Copenhagen Obs.*, No. 106, 1935. From 4 normal places covering 1929-1935. Osc. epoch 1929 February 18. Another investigation, by N. M. Voronov, is noted in *Poulkovo Obs. Circ.*, **16**, 21, 1936.
- 1929 II P/Forbes. (11) Mrs N. Makarov, *A.J.*, **59**, 37, 1942. Definitive, from 72 observations covering 94<sup>d</sup>. Osc. epoch 1929 September 6. Prediction for 1942 is given.
- 1930 I Schwassmann-Wachmann-Peltier. (12) D. K. Kulikov, *Pub. Obs. Astron. Univ. Leningrad*, **12**, 231, 1941. Definitive, from 30 observations covering 28<sup>d</sup>. Cf. F. Koebecke quoted in *M.N.*, **97**, 334, 1937.
- 1930 II Wilk. (13) F. Koebecke, *Poznan Obs. Reprint*, No. 10, 35, 1946. Definitive, from 212 observations covering 38<sup>d</sup>.
- 1930 III Wilk. (14) G. von Schrutka-Rechtenstamm, *UAIC*, No. 1081. Definitive, from 244 observations covering 103<sup>d</sup>. Osc. epoch 1930 April 2.
- 1930 VI P/Schwassmann-Wachmann (3). (15) F. R. Cripps, MS. From 142 observations. Perturbations and corrections to Sun's tabular places applied.
- 1931 V Carrasco. (16) R. Carrasco, *Bol. Astron. Obs. Madrid*, **3**, No. 5, 1946. Definitive, from 65 observations covering 85<sup>d</sup>.
- 1932 I Houghton-Ensor. (17) A. Przybylski, *UAIC*, No. 1081; and to appear in *Acta Astron.* Definitive, from 113 observations covering 64<sup>d</sup>. (18) Mrs. Erna von Schrutka, *UAIC*, No. 1081. Definitive, from 121 observations covering 64<sup>d</sup>. Osc. epoch 1932 April 1.
- 1932 III P/Kopff. (19) F. Kepinski, *Pub. Inst. Astron. pratique* (Varsovie), No. 20, 1938, and *Bul. Ac. Pol. Sci. (A)*, **1938**, 180. Definitive, from observations of 1932 (5 normal places) linked to 1926. Osc. epoch 1932 October 13.5.
- 1932 VI Geddes. (20) G. van Biesbroeck, *Pub. Yerkes Obs.*, **8**, No. 3, 13, 1937. Definitive, from 303 observations covering 1070<sup>d</sup>. Osc. epoch 1932 October 23. Original orbit found to be elliptical:  $e=0.9994868$  on 1927 December 6.
- 1935 II P/Reinmuth. (21) S. Kanda and H. Hirose, MS., and (?) *Tokyo Astron. Obs. Report*, **4**, 20-24, 1936. From 5 observations combining 1928-1935. Osc. epoch 1935 January 30. *UAIC*, No. 574 gives 1936 elements presumably derived from these. The period indicated by these elements is 32 days shorter than that given in the prediction by Foxell and Levin in *B.A.A. Handbook*, 1935 (quoted in *M.N.*, **96**, 346). It appears that it is the latter which is in error, and hence, too, the 1942 prediction by H. Summer (*B.A.A. Handbook*, 1942) which was based on it.
- 1936 I Van Biesbroeck. (22) G. van Biesbroeck, *Pub. Yerkes Obs.*, **8**, No. 4, 7, 1940. Definitive, from 125 observations covering 830<sup>d</sup>. Osc. epoch 1936 May 2. Original orbit found to be elliptical:  $e=0.99917$  on 1916 April 6 ( $r=38$ ).
- 1936 II Peltier. (23) Jorge Bobone, *Res. Obs. Nac. Argentino*, **36**, No. 1, 52, 1938. Definitive, from 636 observations covering 159<sup>d</sup>. Osc. epoch 1936 May 23.
- 1938 I P/Gale. (24) L. E. Cunningham, *HAC*, No. 452. From 12 observations covering 27<sup>d</sup> with assumed period 10.99294 years linking the orbit to 1927. He intends to revise the orbit 1927-1938. (25) F. R. Cripps, MS. Provisional revision of orbit using 7 observations covering 55<sup>d</sup>, and new computation linking it to 1927. Osc. epoch may be taken as 1938 July 1.
- 1939 I Kozik-Peltier, 1939 a. (26) A. Przybylski, *UAIC*, No. 752. From 89 observations covering 26<sup>d</sup>. He has undertaken the definitive orbit.
- 1939 III Jurlof-Achmarof-Hassel, 1939 d. (27) A. Przybylski, *UAIC*, No. 781. From 26 observations covering 30<sup>d</sup>. The definitive orbit has been undertaken by M. Bielicki.

\* *HAC*=*Harvard College Observatory Announcement Card*.

*UAIC*=*Union Astronomique Internationale Circulaire*.

- 1939 V P/Pons-Winnecke, 1939 c. (28) J. G. Porter, *B.A.A. J.*, **54**, 137, 1944. Definitive, from 225 observations covering 7 months. Osc. epoch 1939 August 5. Orbit not linked to previous apparitions. Close approach to Earth:  $0.10725$  A.U. on July 1.
- 1939 VI P/Herschel-Rigollet, 1939 h. (29) A. D. Maxwell and Katherine P. Kaster, *A. J.*, **49**, 59, 1940. Definitive, from 89 observations covering  $146^d$ ; and a normal place 25 days later, from 4 subsequent observations, is represented to  $2''$ . Osc. epoch 1939 August 5. Identity with Caroline Herschel's comet 1788 II is now considered certain.
- 1939 VII P/Brooks (2), 1939 g. (30) A. Dubiago, *Astron. Circ. (U.S.S.R.)*, No. 47, 1946. Elements deduced after combining 1925, 1932-33 and 1939-40. He finds a secular acceleration to the mean motion  $+3733'' \times 10^{-9}$  ( $t-t_0$  days).
- 1939 VIII P/Kulin, 1940 a. (31) G. Kulin, *UAIC*, Nos. 810 and 904. From the only 4 observations available; they cover  $24^d$ . *V. J. S.*, **77**, 76, 1942 gives account. (See also p. 108).
- 1939 IX Friend, 1939 n. (32) A. M. Vergnano, *UAIC*, No. 805. From observations covering  $22^d$ . 1941 III P/Whipple, 1940 b. (33) D. H. Sadler and Miss F. M. McBain, *Pub. N.A. Office "Planetary Coordinates 1940-1960"*, xvi., 1939. Predicted elements. Observations indicated *T* 1941 January  $22.464$ ,  $0^d.23$  earlier than predicted (L. E. Cunningham, *HAC*, No. 531).
- 1941 IV de Kock-Paraskevopoulos, 1941 c. (34) Y. C. Chang and C. C. Li, *A. J.*, **51**, 51, 1944. Improved orbit from 15 observations covering  $5\frac{1}{2}$  months, perturbations neglected. Residuals of the order of  $15''$  remain.
- 1941 VI P/Schwassmann-Wachmann (1)=1925 II. (35) Paul Herget, *B.A.A. Handbook*, 1948. Definitive elements from observations 1934-1944. Osc. epoch 1941 January 6,  $M=350^\circ.57422$ .
- 1941 VII P/du Toit-Neujmin-Delporte, 1941 e. (36) Peter Naur, *Pub. Copenhagen Obs.*, No. 141, 1945. Definitive, from 54 observations covering  $86^d$ . Osc. epoch 1941 August 29. Jupiter perturbations only included.
- 1942 I P/Schwassmann-Wachmann (2), 1941 f. (37) H. Q. Rasmusen, *Pub. Copenhagen Obs.*, No. 128, 1941. Prediction from his 1935 orbit previously noted (*M.N.*, **96** 346). Observations indicated *T* 1942 February 14.29.
- 1942 II Väisälä, 1942 c. (38) Y. Väisälä, *UAIC*, No. 910. From observed arc  $32^d$ .
- 1942 IV Whipple-Bernasconi-Kulin, 1942 a. (39) G. M. Iannini, *Pub. La Plata Obs.*, **21**, No. 2, 19, 1945. Definitive, from 228 observations covering  $376^d$ . Osc. epoch 1942 May 1. Original orbit found to be elliptical:  $1/a = +0.0002613$  on 1937 September 24 ( $r=14$ ).
- 1942 VI P/Wolf (1). (40) M. Kamienski, *Warsaw Obs. Circ.*, No. 22, 1946. Improved prediction (cf. *A. J.*, **49**, 164, 1942) based on his previous very exact investigations of the orbit from 1884 onward. Osc. epoch 1942 June 10. Baade's observation 1942 November 5 (mag. 19.3) indicates *T* 1942 June 23.55. Kamienski has previously found a secular deceleration to the mean motion:  $\Delta n = -0''.0000042$  ( $t-t_0$ ). See also *M.N.*, **106**, 269 where *M* for 1942 June 10.0 should read  $358^\circ.22' 54''.10$ .
- 1942 VII P/Oterma, 1943 a, which was called Oterma (3). (41) Paul Herget, *HAC*, No. 698, and *B.A.A. Handbook*, 1947. Definitive, from observations (7 normal places) covering  $440^d$ , 1943-44. Osc. epoch 1943 October 3.0.
- 1942 VIII Oterma, 1942 b, which was called Oterma (1). (42) Miss L. Oterma, *UAIC*, No. 923. From observed arc  $67^d$ .
- 1942 IX P/Stephan-Oterma, 1942 f, which was called Oterma (2), and Tevzadze (1) in U.S.S.R. It is identical with 1867 I Stephan. (43) Jorge Bobone, *HAC*, No. 646. From observed arc  $28^d$ . (44) A. D. Dubiago, *Astron. Circ. (U.S.S.R.)*, No. 17, 1943. From observed arc  $36^d$ .
- 1943 I Whipple-Fedke-Tevzadze, 1942 g, which was called Tevzadze (2) in U.S.S.R. (45) A. D. Dubiago, *Astron. Circ. (U.S.S.R.)*, No. 21, 1943. From 72 Soviet observations covering  $171^d$ ; perturbations were neglected.
- 1943 II Daimaca. (46) Calin Popovici, *UAIC*, No. 970. Elements from a  $2^d$  arc, in close agreement with those by P. Naur from the same observations (cf. *M.N.*, **104**, 108, 1944).
- 1943 III P/d'Arrest. (47) A. W. Recht, *HAC*, No. 655. Prediction based on his 1923 elements which gave the best fit 1910-1923. Osc. epoch 1943 April 2. Observations indicate *T* 1943 September 22.6. His investigation covering eight apparitions 1851-1923 (*A. J.*, **48**, 65, 1939) showed secular increases in the semi-major axis and eccentricity:  $\Delta a = +0.000151$  and  $\Delta e = +0.0000169$  per revolution.
- 1943 IV P/Daniel. (48) A. Dubiago, *A. J.*, **52**, 88, 1946. From 7 observations covering  $140^d$ . Perturbations neglected and period not linked to previous apparitions.
- 1944 I Van Gent-Peltier-Daimaca. (49) J. P. Möller, *UAIC*, No. 980. From 7 approximate observations covering  $39^d$ . Residuals average about  $1'$ . Elements are in accord with J. Jackson's preliminary orbit (*HAC*, No. 673).
- 1944 b Väisälä. (50) Paul Herget, *HAC*, No. 695. From 5 observations covering  $116^d$ .

- 1945 c P/du Toit, was called du Toit (1), and du Toit (4) in South Africa. (51) L. E. Cunningham, MS. From observations covering 58<sup>d</sup>. The period, which he considers is uncertain by only a few days, is the shortest known for a comet other than P/Encke.
- 1945 d du Toit, was called du Toit (2). (52) Jorge Bobone, *HAC*, No. 719. From observations covering 25<sup>d</sup>.
- 1945 a P/Pons-Winnecke. (53) L. Ananieva, *Astron. Circ. (U.S.S.R.)*, No. 41, 1945. Prediction based on the *B.A.A. Handbook* 1939 prediction by A. E. Levin and J. G. Porter, with perihelion date and period corrected. Osc. epoch 1945 July 4. (54) J. G. Porter, MS. Provisional orbit from the 1945 observations after linking to the 1939 apparition. Osc. epoch 1945 July 4.
- 1945 b P/Kopff. (55) Elements deduced by J. G. Masters (MS) from the accurate ephemeris of perturbed places by F. Kepinski, *Pub. Inst. Astron. pratique (Varsovie)*, 23, 1946. Osc. epoch 1945 August 13. Observations indicated T 1945 August 11.275. Kepinski states that all his records of the computations of this comet from 1924-1944, except the ephemeris mentioned, were destroyed in the Warsaw insurrection of 1944 August. The comet made a close approach to Jupiter to 0.57 A.U., in the spring of 1943, which increased the mean motion by about 30" (*cf. ref. 19* above).
- 1945 g du Toit, was called du Toit (3) and designated 1945 f in the U.S.A. (56) L. E. Cunningham, *HAC*, No. 733. Elements from rough positions covering 4 days.
- 1946 a Timmers. (57) A. Schmitt, *UAIC*, No. 1043. From 3 observations covering 84<sup>d</sup>.
- (58) L. E. Cunningham, *HAC*, No. 809. From 5 observations covering 261<sup>d</sup>, with first order Jupiter perturbations included. Osc. epoch 1946 March 1.
- 1946 d Pajdusakova-Rothbart-Weber. (59) L. E. Cunningham and Miss E. L. Scott, *HAC*, No. 751. From observations covering 4<sup>d</sup>, but owing to the comet's proximity to the Earth and consequent large apparent motion, the elements proved very accurate and an observation 8 weeks later, on July 28, is represented to about 4". Cunningham is undertaking a definitive orbit.
- 1946 b P/Tempel (2). (60) P. Ramensky, *UAIC*, No. 1040. Predicted elements.
- (61) L. E. Cunningham, *HAC*, No. 747. He compared Ramensky's elements with observations and corrected the perihelion date and period (to 5.31016 years).
- 1946 e P/Brooks (2). (62) A. Dubiago, *Astron. Circ. (U.S.S.R.)*, No. 47, 1946. Prediction from the 1939 elements resulting from his investigation of the orbit 1925-1940; see ref. (30) above.
- (63) F. R. Cripps, *B.A.A. Handbook*, 1946. Prediction based on the previous one (*Handbook*, 1939) with perihelion date corrected. (64) L. E. Cunningham, *HAC*, No. 761. He compared Cripps's elements with observations and corrected the perihelion date and period (to 6.95992 years).
- 1946 c P/Giacobini-Zinner. (65) F. R. Cripps, *B.A.A. Handbook*, 1946. Prediction based on the previous one (*Handbook*, 1939) with perihelion date corrected. Perturbations by the Earth in 1939 were included with those of Jupiter and Saturn. (66) L. E. Cunningham, *HAC*, No. 775. He modified Cripps's elements, correcting the perihelion date and period (to 6.58799 years), and altered a direction cosine arbitrarily to fit the observations.
- 1946 h Jones. (67) L. E. Cunningham, *HAC*, No. 792. From two observations in 1946 August and one 1947 January, covering an arc of 143<sup>d</sup>.
- 1946 k Bester. (68) Jorge Bobone, *HAC*, No. 794. From 3 observations covering 66<sup>d</sup>.
- (69), A. Schmitt, *UAIC*, No. 1079. From observations covering 77<sup>d</sup>. (70) L. E. Cunningham, *HAC*, No. 811. From observations covering 130<sup>d</sup>.

## CORRIGENDA

The following corrections are to previous reports on comets in these Council Notes:

- 95, 386, Table. For "1934 II", for P/Encke, read "1934 III".
- 98, 348, Table. Under column heading for T, add "G.M.T. before 1925.0". In elements for 1929 I P/Schwassmann-Wachmann (2), for T 1929 "May 12.85339" read "March 23.19990". In elements for 1935 I Johnson, for period "1216.4" read "900.4".
- 99, 409, 2nd para., line 3. After "Association" add "Vol. 30".
- 100, 328, Table. In elements for 1939 m P/Faye, for perihelion distance q "3.80291" read "1.65046".
- 102, 107, line 25. After "Comet de Kock", for "1941 a" read "1941 c" and delete "(1941 c)" at end of line.
- 102, 108, Table. In elements for 1941 e du Toit-Neujmin, for period "5.44560" read "5.44538".
- In elements for P/Schwassmann-Wachmann (2), for year of perihelion "1941" read "1942".
- 106, 77, line 14 from bottom of page. For "not seen again" read "observed in South Africa for two months".

G. MERTON.