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Some statistical aspects of comet orbits and their discoveries

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The study of cometary orbits and their discoveries reveals various interesting features. Some of these are discussed here.

The tenth edition of 'Catalogue of Cometary Orbits' (Marsden and Williams, 1995) which hereafter will be written as 'Catalogue 1995', contains 1472 orbital elements of 878 individual comets which made 1444 apparitions since 239 B. C. Out of these comets, 694 are Long Period (LP) comets having periods greater than 200 years and 184 are Short Period (SP) comets having periods less than 200 years. Of these 184 SP comets, 116 have been observed to make 682 apparitions in all, each of them making two or more apparitions.

Considering the lowest value of the density of cometary nuclei as 0.1 g cm^{-3} (Moroz, 1989), the maximum value of Roche's Limit of the Sun is 0.01618 AU and that of Jupiter is 0.001624 AU. The Catalogue - 1995 shows that out of the 25 comets which made perihelion passage through the Roche Limit of Sun, only two comets C/1882 R_1-A, B, C, D and C/1965 S_1-A, B were observed to have split nuclei, and as many as, seven Jupiter Family Comets have been observed to be with multiple nuclei (Festou et al., 1993).

The closeness in the values of the set of orbital elements, viz. q, e, w, Ω and i including the heliocentric longitude, L and latitude, B of some comets, enabled Porter (1963) to isolate 39 comets into 15 groups. Each of these 15 groups is marked by the letters A to Q omitting O and I, and contains at least two sets of above elements. The 'Catalogue, 1995' has enabled to increase the component orbits by only one set of elements in Group F. But, astonishingly, as many as, 18 such sets of elements have been added with those of five others already present in Group M. This Group M is conspicuous for having the largest number of component orbits with most lower values of perihelion distances. May be, these component orbits of the comets, which are also known as the 'Sun-grazing Comets', are the fragments of the same primitive nucleus which suffered tidal disruption at a great distance from the Sun.

The practice of discovering a comet was initiated by Gottfried Kirch who discovered the Sun-grazing comet C/1680 V_1 on 14 November, 1680 with the help of a telescope (Festou et al., 1993). The intensive comet search began in the mid-eighteenth century under the leadership of a French astronomer Charles Messier (1730-1817). Thus the first comet named after a discoverer was C/1760 B_1 Messier. The most successful comet observer was Eugene Shoemaker (1928 - 1997) who discovered 14 comets individually and 18 with others.

The first recovery of a periodic comet was made by a well-to-do German farmer named Johann Georg Palitzsch (1723-88) on 25 December, 1758. With this first recovery of the comet 1P/1758 Y_1, not only the validity of prediction for the return of the comet 1P/1682 Q_1 made by Edmund Halley (1656 - 1742) was proved, but also it conclusively demonstrated the practical verification of the Law of Gravitation formulated by Isaac Newton (1642 - 1727). Among the recoverers, E. Roemer tops the list, recovering the periodic comets as many as 79 times. What a hard luck it was for this observer who could not earn the glory of discovering even a single comet !

It is not possible to state the rate at which the comets are discovered. But the following table gives an idea about the frequency of cometary discoveries for the period of fifty years since 1945 :

Period	1945-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94
No. of Comets	31	21	18	16	26	25	46	46	69	61

The actual rate of perihelion passage of both the periodic and non-periodic comets per ten years for the years from 1700 to 1989 A. D., as studied from the 'Catalogue, 1995' has been shown in Fig. 1 by bar diagrams.

With the advent of more sophisticated observational techniques and enhanced interest among the amateur and professional astronomers for the observation of comets, it has been possible to detect the ever increasing number of perihelion passages of discovered and recovered comets.

The increased rate of perihelion passage of comets.

Period	No. of Comets	Period	No. of Comets	Period	No.of Comets
1700-09	4	1800-09	10	1900-09	42
10-19	1	10-19	15	10-19	47
20-29	2	20-29	20	20-29	51
30-39	3	30-39	11	30-39	54
40-49	7	40-49	35	40-49	75
50-59	6	50-59	39	50-59	84
60-69	6	60-69	35	60-69	95
70-79	7	70-79	38	70-79	144
80-89	13	80-89	51	80-89	214
90-99	14	90-99	55		

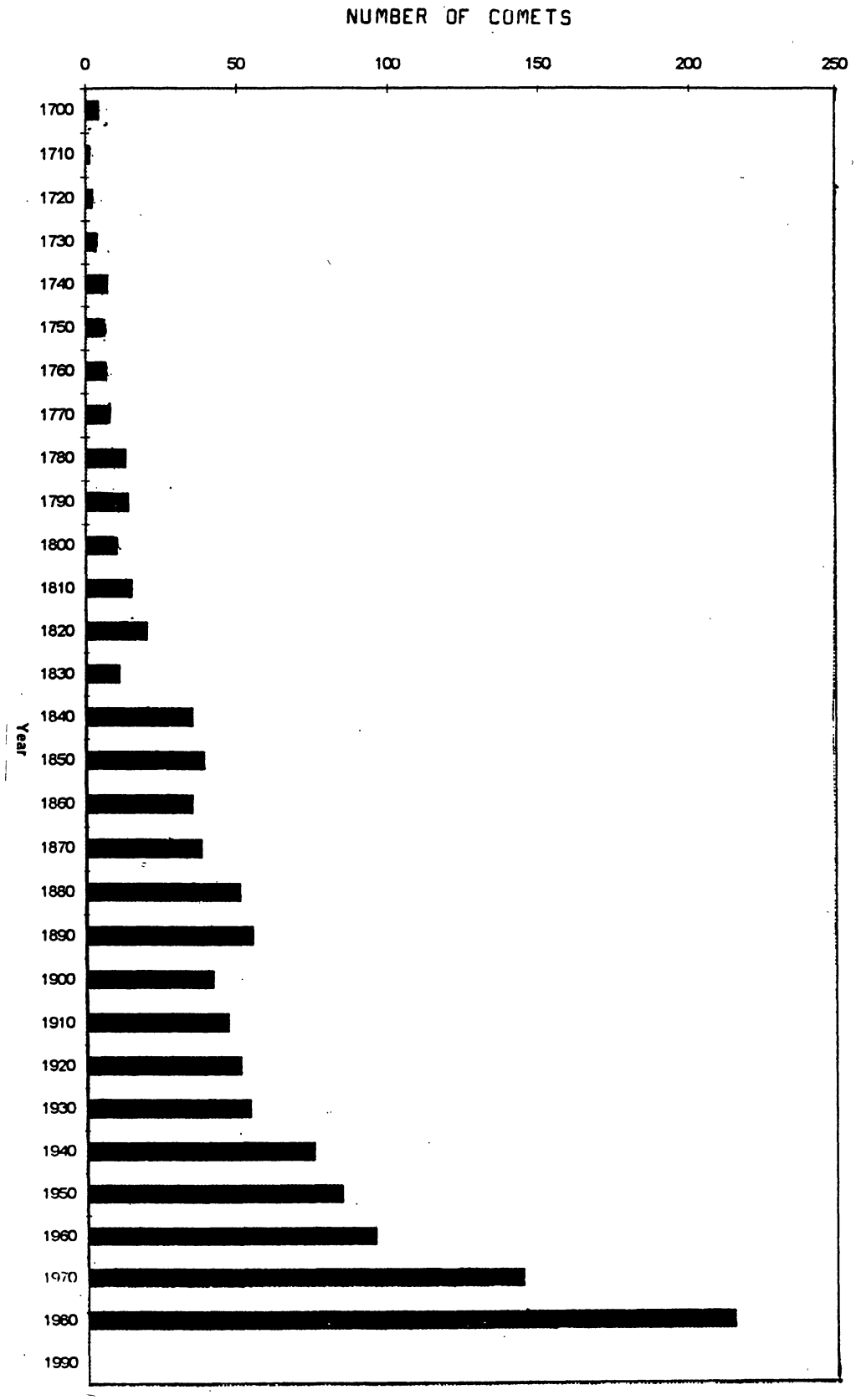

Figure 1. The increased rate of perihelion passage of comets.

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References

Marsden B. G., Williams G. V., 1995, 'Catalogue of Cometary Orbits', 10th ed. I. A. U. Minor Planet Centre, Smith. Astrophys. Obs. Cambridge, Mass.

Moroz V. I. et al., 1989, Halley's Comet (Part II) : Space Studies, I. A. U. Highlights Vol. 8 (E. S. O. Preprint No. 624).

Festou M. C., Rickman H., West R. M., 1993, Comet E. S. O. Scientific Preprint No. 960.

Porter J. G., 1963, The Statistics of Cometary Orbits. In the 'Moon, Meteorites and Comets' (Barbara M. M., Kuiper G. P.), The University of Chicago Press, 550-572.