

Comet Bappu–Bok–Newkirk – the only comet with an Indian’s name to it

R. C. Kapoor

This note celebrates the discovery of the Comet Bappu–Bok–Newkirk 1949 IV, the only one with an Indian’s name to it. Then a research student at Harvard, M. K. Vainu Bappu (1927–82) was destined to set modern astronomy in newly independent India on an ambitious path to progress.

What do we know about the Comet Bappu–Bok–Newkirk 1949 IV (1949c, C/1949 N1), the only one with an Indian’s name to it? M. K. Vainu Bappu, Bart J. Bok and Gordon A. Newkirk made a serendipitous discovery of a comet in 1949 on a photographic plate of a certain region of the sky taken with the 24–33 inch Jewett–Schmidt telescope at the Oak Ridge Station of the Harvard College Observatory (HCO) (Figure 1). The plate, given a 55 min exposure, was taken in the early hours of 2 July 1949 by Vainu Bappu under the direction of Bok, while he was a research student at HCO. Announced as a ‘New Comet’ by Harlow Shapley¹ in the *Harvard College Observatory Announcement Card (HAC)* 1006, the positions and description that were given corresponded to its being situated in the constellation of Cygnus:

1949	R.A.	Dec.	Mag.
July 2.30537	19 ^h 47 ^m .0	+38°36′	13
Daily motion: 3 ^m .6 west; 29′ north			
Description 7 (no tail; diffuse; central condensation).			

Two Jewett plates taken by Bok and Vainu Bappu on the following night confirmed the discovery. The positions that were noted indicated that by then, the object had moved slightly westwards by 3 min in RA and north by 25′ in Dec.

The HACs, one may note, served back then as a quicker means to disseminate information and announce discoveries. On July 8, Shapley¹ reported again the positions the comet was at on 2 July, 4 July and 5 July (HAC 1007), this time under the heading ‘Comet Bappu–Bok–Newkirk’. In a week’s time since the discovery, orbital elements and a preliminary ephemeris of the comet had been calculated by Hamid and Vainu Bappu, Maxwell and Cunningham¹ (HAC 1008), as also by van Biesbroeck²; see also Harris³. Hamid was then a Harvard graduate

student whose 1950 thesis was on the formation and evolution of the Perseid meteor stream. The deliberations indicated that the comet had a parabolic orbit and retrograde motion for an inclination 108°24′, a perihelion distance $q = 1.36538$ AU and that it would pass its perihelion on 22 November 1949 (1 AU, the astronomical Unit, is the mean distance of the Earth from the Sun and is 149,597,870.691 km). The comet was noticed moving west, through the constellation of Lyra in July and then through Hercules in August. Through September to December, it lay in the constellation of Bootes. In November and December, the comet moved north. It passed by Thuban (α -Draconis), a 3.65 mag star in February 1950. Magnitude, readers may recall, is a logarithmic measure of brightness of a celestial object, where the next value differs by a

factor of 2.512 such that the fainter the object, the larger is its magnitude. The faintest star the human eye sees on a clear dark night has magnitude +6.

Though not so bright as to cheer up its observers, the comet remained observable for many months on. van Biesbroeck², at the Yerkes Observatory and well known for his expertise in astrophotography, predicted the brightness of the comet to improve from 12.6 mag. to 12.3 mag. between 31 July and 24 August 1949. Cunningham provided a short ephemeris of the comet for the second half of August⁴ that placed it at approximately 1.7 AU from the Earth and about 1.9 AU from the Sun, and predicted that the magnitude of the comet would be between 11 and 12. It did not brighten up. As the comet was rather favourably positioned with respect to the Earth, it was followed for quite some time at many observatories such as the Yerkes and Lick, Hamburg and Engelhardt, at Algiers, etc. and eventually lost⁵.

Max Beyer observed the comet from the Hamburg Observatory in Bergedorf to make precise photometric estimates. A well-known amateur astronomer, Beyer had devised an ingenious method to determine comet magnitudes. He reported the comet 1949 IV showing off a jet on 23 July and a coma 2′.0 in diameter. It touched mag. 11.8 on 24 July and reached its brightest at 11.2 mag. in September⁵. Merton⁶ cites Beyer describing that on 17 August the coma appeared round, having grown to 2′.5 in diameter, with a condensation and stellar nucleus at 13.9 mag. and a faint 5′ long tail. By December 1949, the comet was reported to be a morning object. It gradually dimmed to about 13 mag. Reporting in the ‘Comet Notes’ of the *Publications of the Astronomical Society of the Pacific (PASP)* for the year 1950, Cunningham⁷ noted that the comet 1949c had gone fainter, yet within the reach of the 60-inch reflector at the Mount Wilson



Figure 1. The three discoverers, Vainu Bappu (left), Bok (seated) and Newkirk (right), also a Harvard student, inspect the comet plate (Photograph: Indian Institute of Astrophysics (IIA) Archives). This photograph had appeared in *The Science Newsletter*, 1949, **56**, 250–251.

Observatory and so it would have been of the 19th mag. in brightness. In a subsequent note⁷, he indicated that the comet had departed too far from its ephemeris in January for it to be easily observed. A new orbit was determined, with a period of about 60,000 years, and the comet could be recovered in March again. More recently, based on collected photometric observations of long-period comets and allowing for systematic differences between individual observers and their methods of estimation, Svoren⁸ from the Astronomical Observatory, Skalnaté Pleso provided in 1985 precise photometric parameters like absolute brightness and the photometric exponent at large heliocentric distances for comets, including those for Bappu–Bok–Newkirk.

The comet has since turned out to be a periodic one. Certain parameters of the comet Bappu–Bok–Newkirk are as follows⁹: aphelion $Q = 3033.60$ AU, perihelion $q = 2.058177$ AU, eccentricity $e = 0.998644$, period (yrs) $= a^{1.5} = 59,134.75$ yrs, where a is semi-major axis $= 1517.8296460$ AU.

The particular spot where the comet was discovered on 2 July 1949 is a few degrees SW of γ -Cygni (2.2 mag.) and lies close to the star 19 Cygni (5.12 mag.; J2000: 19h50m34s, 38°43'21"). An inclination angle of 105°.7686 suggests the comet arrived into the inner solar system nearly vertically, and its path is so oriented that it approached from below the ecliptic plane. Computing its orbit with Jet Propulsion Laboratory's (JPL's) Horizons system⁹, we find that at the time of discovery, the comet was leading the Sun, its solar elongation then being 116°.5802/L, the heliocentric distance $r = 2.472157$ AU and geocentric distance $\Delta = 1.843890$ AU. Beginning 11 July, the comet began to trail the Sun, leading it again from 18 November. It passed closest to the Earth on 16 July 1949 around 08:00 UT, from a distance of 1.79618838 AU and passed its perihelion on October 26.5491, 1949.

In July 2013, 64 years after the discovery, the comet reached ~ 87 AU from the Earth, a distance well past Pluto's orbit (mean distance from the Sun = 39.537 AU). From its orbit computations, we find its present location to be at the border of the southern constellation Columba with Pictor and Puppis, and $\sim 10^\circ$ north of the bright star Canopus. As we have in hand an estimate of the reduced magnitude of the comet, what it

would have been when at a distance of 1 AU from the Sun and the Earth ($r = \Delta = 1$ AU) both⁵, the visual magnitude at its distance in July 2013 can be computed. It turns out to be ~ 37 mag. What telescope can 'see' it? An object at 37 mag. is far beyond the power of the existing facilities. Probably a 20-m space telescope might 'see' it. That telescope belongs to the future. According to another estimate of its absolute brightness⁸, the visual magnitude should be ~ 31 mag. This value is close to 'The HST eXtreme Deep Field XDF... reaching... to 31.2 AB mag 5σ (32.9 at 1σ) in a 0.35" diameter aperture' – the deepest image ever taken with the Hubble Space Telescope in the optical/near-IR¹⁰, what more plainly put is ~ 31 mag.

'Ever discover a comet?'

The Harvard Crimson, the oldest daily college newspaper in the US since 24 January 1873, carried an anecdotal account of the discovery of the comet Bappu–Bok–Newkirk in its issue dated 28 April 1956. The relevant part of the paper retrieved from the archival issue does not attribute the write-up to any writer. It is entitled 'It's Easy' and makes for a joyful reading, as reproduced here:

'Ever discover a comet? Experience isn't always necessary. M. K. Vainu Bappu, an Indian graduate student, proved that a few summers ago. Observing for the first time at Agassiz Station, Bappu exposed a plate for sixty minutes in the small hours of the morning of 2 July 1949. Plates such as these are ordinarily sent back to Cambridge for processing, but Professor Bart Bok suggested that Bappu develop it himself. When the plate was developed, the graduate student announced, "now I'm going to look for a comet." Bok, amused, chuckled. "Ha, ha, everyone looks for comets." But upon inspection Bappu spotted one, and Gordon A Newkirk and Bok confirmed his discovery. The comet, of only the thirteenth magnitude, is now known as the Bappu–Bok–Newkirk comet.'

This story was related by Bok himself to the *Associated Press* that published it entitled 'Harvard Tyro Finds Comet' (Figure 2), signed from Harvard, Mass.

Still a student back home, Vainu Bappu had published papers on the spectrum of night airglow obtained with a spectrograph when 16, and on variable stars, and had even constructed a spectrograph. The first paper 'The effect of colour on the visual observations of long

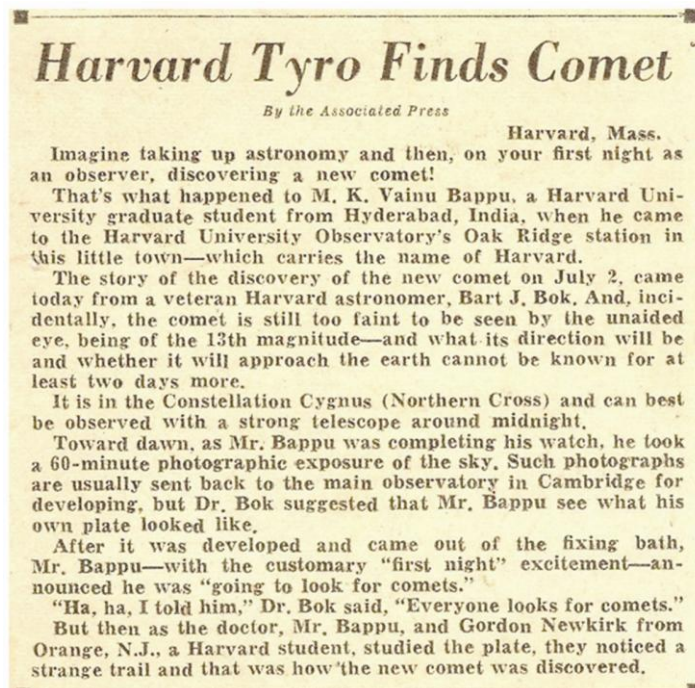


Figure 2. The newspaper cutting about the comet's discovery; paper and date not known (IIA Archives).

HISTORICAL NOTES

period variable stars', dated 19 November 1945, Nizam College, Hyderabad, appeared in the January 1946 issue of *Current Science* as a letter. The next one, 'On the visual light curve of RT. Eridani', dealt with an individual long-period variable star and appeared in the same journal in July 1946. It was addressed from Begumpet, 4 June 1946, where the author expressed in the end 'his gratitude to Dr Akbar Ali, Director, Nizamiah Observatory, for having kindly provided facilities and for his valuable guidance'. Vainu Bappu had inspirational meetings with Harold Spencer Jones and Harlow Shapley when they came to Hyderabad and went over to Harvard in 1949 after his Master's in physics from the Madras University, on a scholarship from the Government of Hyderabad to pursue work on photoelectric photometry of eclipsing variable stars. The place had stalwarts like Shapley, Bok, Payne-Gaposchkin, Donald Menzel and Fred Whipple (Figure 3).

The discovery fall-out

Curiously, upon learning of the discovery, Vainu Bappu was reprimanded by an over-zealous Government of Hyderabad for deviating from his main goal, i.e. research. He received a letter dated 13 July 1949 from the Deputy Educational Liaison Officer, Education Department of the



Figure 3. Vainu Bappu with his professors at Harvard in 1950. (L-R) F. L. Whipple, M. K. Vainu Bappu, Harlow Shapley, Bart Bok and Donald Menzel (IIA Archives).

Embassy of India in Washington, DC as follows (IIA Archives):

'My dear Bappu:

The Hyderabad Government has cabled to say that you should undertake research on 'Photoelectric Photometry of Eclipsing Variables'. Please note this carefully and see that your Government's wishes are carried out in every respect. Should there be any difficulty, however, the matter should be reported to us immediately, together with your Supervisor's expert advice and comments.

Yours sincerely,

Sd/
A.S.G.....'

On behalf of Vainu Bappu's 'Supervisor', a reply from Whipple dated 26 July 1949, and reproduced in full below, sought to correct the view of the Hyderabad Government so:

'Dear Mr G.....:

I am informed by Mr K. Vainu Bappu that he has been reprimanded by the Hyderabad Government, presumably for not holding strictly to his undertaken research on "Photoelectric Photometry of Eclipsing Variables". By implication, I gather that the Hyderabad Government disapproves of Mr. Bappu's participation in the recent discovery of a comet. This is the first occasion in my experience in which a foreign government has taken onto itself the criticism of our educational methods in the Astronomy Department of Harvard University. I feel that if the Hyderabad Government chooses to criticize our methods, it should do so by direct communication with us rather than by reprimanding the student in such a way that he finds it difficult to follow our guidance in his advanced education.

I may mention that the discovery of this comet was of an accidental nature in conjunction with photographic work that is an essential part of Mr. Bappu's training as a graduate student in Astronomy. For him to have failed to note this unusual object on his photographic plates would have been a sin of scientific omission; to have failed to announce the discovery

would have been a serious neglect of his duty to the scientific world.

Our policy of education for graduate students in Astronomy includes thorough background training in classical and positional astronomy, in stellar astronomy, in cosmogony and in modern astrophysics. We will not grant the degree of Doctor of Philosophy to a student who does not have a well-rounded background in all of these areas. If it is actually true that that the Hyderabad Government wishes Mr. Bappu to study "Photoelectric Photometry of Eclipsing Variables" and nothing else in his graduate work, they have certainly erred in sending him to Harvard University. We would be glad to assist him in such a narrow study, if necessary, but we could not grant the degree of Doctor of Philosophy in Astronomy on that basis alone.

Our experience has shown that independence of mind, a broad background in mathematics and the physical sciences and freedom in choosing research problems are essential to a physical scientist who is to produce creative work.

Mr. Bappu is doing excellent work as a graduate student and has established himself as an intelligent, able and well-liked personality. I feel personally that it is a great mistake for him to be handicapped psychologically by ill-founded reprimands that should be directed, if at all, to those who have assumed the responsibility for his graduate education.

Sincerely yours,

Fred L. Whipple, Chairman
Department of Astronomy'.

Mr. G... sent back a reply dated 3 August 1949, where words speak for themselves, and as congratulatory as could be:

'Dear Dr Whipple,

I thank you for your kind and detailed letter dated 26th July, 1949, concerning Mr. V. Bappu. I am to inform you that we have already written to Dr. Harlow Shapley on the subject, and hope that it will clarify the point in case there was any misunderstanding.

We are, however, very glad to hear that Mr. Bappu has done satisfactory work, so far, and we have no doubt, that with the able guidance and

supervision of his professors, he will show still better results. We appreciate your willing co-operation with us and the personal interest you are taking in Mr. Bappu's welfare.

Yours sincerely,

A. S. G...'

Vainu Bappu completed his Ph D and joined the Mt Wilson and Palomar Observatories as a Fellow of the Carnegie Institution of Washington. He presented in 1952 an up-to-date picture on comets through the immensely popular leaflets of the Astronomical Society of the Pacific (ASP)¹¹. Here, he talked about the recent major contributions to the understanding of the nature and origin of comets by Whipple through his dirty snow-ball model and the comet cloud model proposed by Jan H. Oort.

In the times to come, Vainu Bappu was destined to lay the foundations of modern astronomy in India, build observatories and lead a researcher's career few can match, culminating in his election as President of the Astronomical Society of India during 1973–1974, the Vice-President of the International Astronomical Union during 1967–1973 and its President for the period 1979–1982, award of Padma Bhushan in 1981, etc. He was awarded the Donohoe Comet-Medal in 1949 by the Astronomical Society of the Pacific (ASP) for the discovery (Figure 4). Vainu Bappu's father M. K. Bappu was also an astronomer at the Nizamiah Observatory, who observed variable stars and had participated in the Carte du Ciel programme and in Vainu

Bappu's own words, 'I learnt my astronomy on the lap of my father', as quoted in his obituary by Kochhar and Menon¹². On 6 January 1986 the then Prime Minister Rajiv Gandhi visited the Kavalur Observatory to watch the comet Halley. He named the Observatory and the then newly installed and indigenously built 2.34 m telescope after M. K. Vainu Bappu, the founder-director of the Indian Institute of Astrophysics. The telescope was Vainu Bappu's brainchild that he could not live to see in its place. While reminiscing in his Founder's Day Lecture during the Silver Jubilee Meeting of the Vainu Bappu Telescope during 10–12 August 2011, M. G. K. Menon said Vainu Bappu was passionate about comets.

The Donohoe Comet-Medal

In its report, the Donohoe Comet-Medal Committee of the ASP described the discovery formally. The Committee was considering comet discoveries for the years 1949 and 1950 during which six new comets had been reported. For reasons of history, it is fair that the concerned long passage in the report by Shane¹³, Chairman of the Committee (Cunningham and van Biesbroeck were the other members) be just reproduced:

'The committee was faced with a perplexing case in regard to comet 1949c which was announced as discovered by three observers at the Harvard Observatory. The circumstances of the discovery have been described by B. J. Bok and partly published in Merton's "Report on Progress of Astronomy" (*M.N.* **110**, 175, 1950). The plate on which the comet was found was the first long exposure obtained by Vainu Bappu with the Jewett-Schmidt telescope at the Oak Ridge Station in the early morning of 2 July 1949. It was developed the following

afternoon and examined by Bok and Bappu for image quality and focus. In the process of their investigation Gordon Newkirk, an undergraduate student who happened to pass by, was called in to look at the good quality of the images. After slightly adjusting the inspection frame he looked through the binocular microscope and suddenly exclaimed, "Hey, that looks like the trail of an asteroid or something!" Upon which Dr. Bok took a look and commented, "That is no asteroid – that is a hairy comet."

Without Newkirk's detection of the trail the other two observers might have missed the early discovery of the comet. Without Bok's correct identification of the object it might have been passed up as a casual asteroid. Without Bappu's interest in taking the plate the object would certainly have remained undetected. In the opinion of the committee the only fair solution is a triple award.'

The award numbers, extracted from a full list by the Committee are given in Table 1.

In his report, Merton⁶ had this to add –

'The next day, just as they started to examine the plate, Gordon A. Newkirk, Jr., an undergraduate who chanced to pass by – it had been a hot day and he was looking for his shirt! – was invited to note the excellent quality of the plate and, on inspecting it, noticed the trail of the comet.'

Merton⁶ lists out the orbital elements of the comets of 1949 also, wherein the Bappu-Bok-Newkirk comet has a parabolic orbit.

Incidentally, Shane's report mentions also of Akbar Ali's communication from the Nizamiah Observatory about an object: 'A purported cometary object reported by A. Ali, Hyderabad Observatory (India) on November 27, 1950, was sub-



Figure 4. M. K. V. Bappu's Donohoe Gold Medal (IIA Archives).

Table 1. The award numbers, extracted from a full list by the Committee

Award	Designation	Discoverer	Date
242	1949c	Vainu Bappu, Harvard College Observatory, Oak Ridge Station, Mass.	July 2, 1949
243	1949c	Bart J. Bok, Harvard College Observatory, Oak Ridge Station, Mass.	July 2, 1949
244	1949c	Gordon Newkirk, Harvard College Observatory, Oak Ridge Station, Mass.	July 2, 1949

HISTORICAL NOTES

sequently retracted by him'. Akbar Ali's annual reports for 1950 and 1951 did not carry reference to such an observation.

The discovery plate

The original discovery plate of the Comet Bappu–Bok–Newkirk lies in the vast Harvard College Observatory Astronomical Plate Stacks that have been maintained all along with great care (Figure 5). These are being digitized under an ongoing project called 'DASCH: Digital Access to a Sky Century at Harvard'. Alison Doane, Curator of Astronomical Photographs, HCO sifted out the discovery plate recently, in May 2013. It is reproduced here, along with its jacket, courtesy HCO. As Doane described in her e-mails to this author: 'I looked through our compilation of plate series (we have many series) and saw the "Jewett–Schmidt," The plate that says "Discovery Plate Comet Bappu–Bok–Newkirk 1949c" also lists "Bok and VB" as the observers. This plate is J3064, a blue-sensitive plate 8" × 8" in size. RA: 19h59, Dec: +39.0; Date: July 1–2, 1949 Exposure 55 minutes.



Figure 5. Discovery plate (J3064) of the Comet Bappu–Bok–Newkirk. The brightest star in the image is 19 Cygni and the comet is located along the tiny star pair, lower-left of it and a little above the bottom of the image, above where the handwritten '1' appears; the words were written in the dark; plate scale 98 arcsec/mm and north-south are along the diagonal. Rotate the plate about the horizontal line, the writing '39000 103aO J3064' can be read; '103aO' denotes the emulsion used. The comet is just a tiny fuzzy form and we cannot help it, but appreciate the eyes of its discoverers. The Julian date for the plate J3064: 2433099.808, calculated for the middle of the exposure, heliocentric-corrected (Image courtesy: Harvard College Observatory (HCO)).

It was broken and has a single crack, and has been repaired. There are no ink markings on the glass to indicate the comet. Luckily, I searched for later plates and see it marked, though it is very faint. The Jewett–Schmidt had a 24"–33" aperture with a plate scale of 98 arcsec/mm'.

That makes the plate field to be ~5.5°. We can easily identify 19 Cygni (5.12 mag), the brightest star in the image (Figure 5). We first looked into the image for the comet near the position corresponding to that given in *HAC 1006*. That point is about half a degree west of 19 Cygni. The ephemeris of the comet computed with JPL's Horizons system for the night of 2 July 1949 also places it near 19 Cygni, and a little west of the star HD187638 (6.11 mag). However, in the plate, the comet turns out to be about a degree east of 22 Cygni and one-fourth of a degree east of the star HD189235 (6.676 mag). It is a faint trail, but noticeable. The jacket of the plate carries coordinates that rightly correspond to the comet's apparent position, not to some particular epoch (Figure 6).

What made Bok and Vainu Bappu choose to photograph that night the star field around 19 Cygni? The constellation of Cygnus spreads right over the rich column of the Milky Way, but 19 Cygni, a 5th mag. red giant star, lies in a less spectacular region. With the Sun still ~22° below horizon and Cygnus passing the meridian, the early hours of 2 July 1949 at the Oak Ridge turned out to be for Vainu Bappu an opener of the grand innings ahead.

David Levy, the discoverer and co-discoverer of 22 comets and 41 asteroids, and best known for the co-discovery in 1993 of the comet Shoemaker-Levy 9 (D/1993 F2), provides a delightful re-rendering of one of T. S. Eliot's poems, 'The naming of Cats' from his *Old Possum's Book of Practical Cats* published in 1939. Levy replaces the word *cat* by *comet* to convey that the 'idea is analogous to the naming of comets'. The lines relevant here are reproduced below¹⁴:

'The naming of comets is a difficult matter,
It isn't just one of your holiday games;

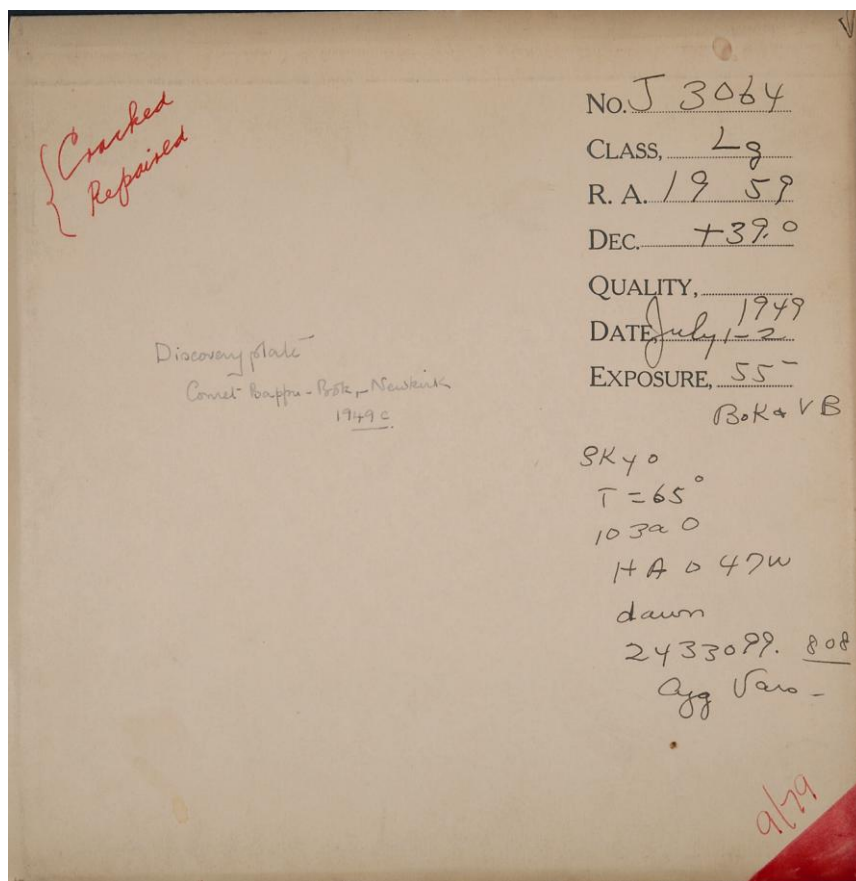


Figure 6. Jacket of the comet discovery plate J3064 (Image courtesy: HCO).

You may think at first I'm mad as a hatter
When I tell you, a comet has THREE
DIFFERENT NAMES.

First of all, there's the name that the
family use daily.

Such as Whipple, Wilk-Peltier, Wirtanen
or Wolf,

Such as Hubble or Humason, Honda,
P/Halley-

All of them sensible everyday names.

There are fancier names if you think they
sound sweeter.

Some for the gentlemen, some for the
dames:

Such as Grigg-Skjellerup, de Kock-
Paraskevopoulos,

Schwassmann-Wachmann, Herschel-
Rigollet, Tsuchinshan I,

Churyumov-Solodovnikov, Bappu-Bok-
Newkirk-

But all of them sensible everyday names.

But I tell you, a comet needs a name
that's particular,

A name that's peculiar, and more digni-
fied.

Else, how can he keep up his tail anti-
solar,

Or spread out emissions, or cherish his
pride?...'?

1. Shapley, H., *Harvard College Observatory Announcement Cards*, 5 July 1949, **1006**; 8 July, **1007**; 11 July, **1008**.
2. van Biesbroeck, G., *Pop. Astron.*, 1949, **57**, 350–351.
3. Harris, D. L., *Pop. Astron.*, 1949, **57**, 410.
4. Jeffers, H. M., *Publ. Astron. Soc. Pac.*, 1949, **61**, 195; 267–268.
5. Vsekhosvyatskii, S. K., In *Physical Characteristics of Comets*, Israel Program for Scientific Translations, Jerusalem, 1964, pp. 539–540.
6. Merton, G., *MNRAS*, 1950, **110**, 175–178.
7. Cunningham, L. E., *Publ. Astron. Soc. Pac.*, 1951, **63**, 42; 153–154.
8. Svoren, J., *Contrib. Astron. Obs. Skalnaté Pleso*, 1985, **13**, 165–216.
9. Jet Propulsion Laboratory, Small-body database browser; <http://ssd.jpl.nasa.gov/sbdb.cgi>
10. Illingworth, G. D. *et al.*, arXiv:1305.1931 [astro-ph.CO]; submitted on 8 May 2013.

11. Bappu, M. K. V., *Astron. Soc. Pac. Leaflets*, 1952, 229–235.
12. Kochhar, R. K. and Menon, M. G. K., *Bull. Astron. Soc. India*, 1982, **10**, 275–279.
13. Shane, C. D., Cunningham, L. E. and van Biesbroeck, G., *Publ. Astron. Soc. Pac.*, 1952, **64**, 39–40.
14. Levy, D. H., *Natl. Newsl. R. Astron. Soc. Can. (Suppl.)*, 1986, **80**, L92–L93.

ACKNOWLEDGEMENTS. I thank the Director, Indian Institute of Astrophysics (IIA), Bangalore for permission to use material from the IIA Archives. I am grateful to Drs Christina Birdie, A. Vagiswari and the Library IIA for help with accessing various references. I thank Prof. Tushar Prabhu for discussions. I am grateful to the Harvard College Observatory for making available the images of the Comet Bappu-Bok-Newkirk including the discovery plate for reproduction here. E-mail exchanges with Dr Alison Doane, Curator of Astronomical Photographs, HCO were very helpful.

R. C. Kapoor lives at # 31, 4th 'B' Block, Koramangala, Bangalore 560 034, India. e-mail: rckapoor@outlook.com