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Productivity of Indian Telescopes: Impact Analysis through Scientometric Methods

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Abstract. This paper aims to study the productivity of modern Indian telescopes that were installed after India attained independence from colonial rule. (The study also includes one telescope built under colonial rule that is still in operation today.) Productivity is measured by the number of papers published from the fourteen telescopes included in the study. Researchers make use of the astronomical data generated by these telescopes and write research papers, which are then used by other researchers and cited in subsequent papers. This study quantifies the impact that the telescopes have on scholarship and analyzes the data using scientometric indicators.

1. Introduction

After the East India Company's political entry into the subcontinent, nine observatories were established in India. The majority of these observatories were founded in the 19th century: Madras Observatory was the first to be established in the late 18th century, and the Solar Observatory and the Nizamiah Observatory were both established in the first year of the 20th century. Of all of these, only the Solar Observatory at Kodaikanal still exists. The rest of the observatories have ceased operations.

This study aims to identify the different telescopes that are installed in India — there are currently 14 major telescopes (Rajan 2009).

2. Methodology

When we say productivity, we are referring to the number of papers published that use a specific telescope facility. We collected this data for most of the telescopes from the observatory's own web sites or from their institutional repositories. For the other telescopes, we searched in the Astrophysics Data System (ADS) by telescope name. From this data, we set up "private libraries" for each of the telescopes in ADS, which was a helpful tool for our scientometric analysis. The "private libraries" also helped in extracting other data required for our impact analysis, including the total number of papers published, the total number of citations received, the average citations per paper, and h-index.

3. Data representation and analysis

3.1. Analysis of Table 1

Table 1 lists 14 major telescopes: there are two solar telescopes (532 papers), five radio telescopes (675 papers), three optical telescopes (104 papers), two optical infrared telescopes (258 papers), one infrared telescope (95 papers), and one high energy gamma ray telescope (20 papers). The telescopes are listed in the table by the year they were established. The most productive telescope is the Giant Meterwave Radio Telescope (GMRT), which was established in the year 1999, indicating that telescope age has no correlation with the productivity. All together, there are 1,643 papers published using Indian telescopes. The highest number of citations is associated with the GMRT papers, followed by the Himalayan Chandra Telescope (HCT) and the Udaipur Solar telescope. The h-indexes of these telescopes are also commensurate with their respective number of publications and citations.

Table 1. Data from the 14 Indian telescopes used in our study.

Telescope Name	Telescope type	Year established	Year of publication of first article	Total No. of papers published	Total No. of citations received	Average citations per paper	H-Index	Total Number of authors	No. of Authors with Foreign affiliation (%)
Kodaikanal Solar Observatory, Kodaikanal	Solar Observatory	1899	1904	361	689	1.9	15	395	165 (41%)
Ooty Radio Telescope, Ooty	Radio Telescope	1970	1971	114	792	6.9	16	132	30 (23%)
Sampurnanand Telescope, ARIES, Nainital	Optical Telescope	1972	2010	6	47	7.8	5	42	23 (55%)
Mauritius Radio Telescope	Radio Telescope	1972	1994	20	40	2.0	3	30	18 (60%)
Udaipur Solar Observatory, Udaipur	Solar Observatory	1975	1993	170	1284	7.6	18	194	97 (50%
Raman Research Institute	Radio Telescope	1975	1991	23	92	4.0	6	15	3 (20%)
Gauribidanur Radio Observatory Gauribidanur	Radio Telescope	1976	1975	82	405	4.9	12	87	21 (24%)
Vainu Bappu Observatory, Kavalur	Optical observatory	1986	1986	84	395	4.7	12	241	117 (49%)
Mount Abu Observatory, Mount Abu	Infrared telescope	1990	1991	95	865	9.1	16	178	91 (51%)
Giant Meterwave Radio Telescope, Pune	Radio Telescope	1995	1999	436	6923	15.9	39	1184	958 (81%)
Himalayan Chandra Telescope, Hanley	Optical Infrared telescope	2001	2000	185	1891	10.2	24	1079	938 (87%)
HAGAR Telescope, Hanley	High Energy Gamma ray Telescope	2001	2001	20	126	6.3	6	91	6 (6%)
IUCAA Girawali Observatory, Pune	Optical Telescope	2006	1999	76	291	3.9	9	330	200 (60%)
130cm Devastal telescope, ARIES, Nainital	Optical Telescope	2007	2010	14	43	3.1	5	88	57 (64%)

In this paper, we also study telescope usage by Indian authors and by foreign authors. For the HCT, 87% of authors are foreign. For GMRT, the percentage of foreign authors is 81%, and for the Devastal telescope the figure is 64%. We obtained this data by using the author affiliation field in ADS.

4. Collective productivity

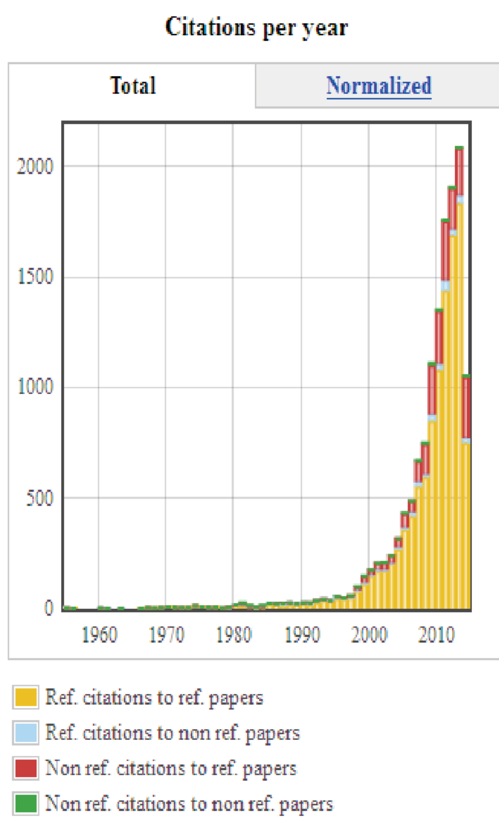
Table 2 includes data from all telescopes as a measure of collective productivity.

Table 2.

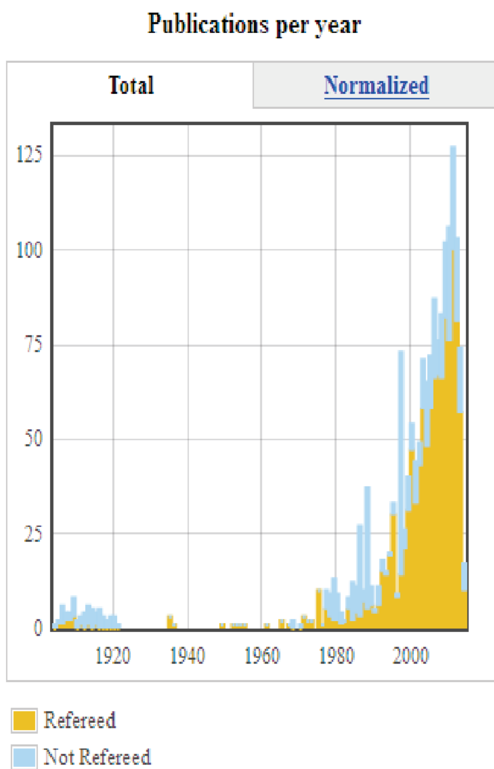
Total Productivity of 14 Indian Telescopes	Total Metrics	Refereed
Number of papers	1,643	1,144
Total reads	326,351	310,594
Average reads	198.6	271.5
Number of citations	13,599	13,083
Average citations	8.3	11.4
h-index	46	46

4.1. Analysis of Table 2

To do the analysis for this section, we merged all of our "private libraries" in ADS. In total, there are 1,643 papers published using Indian telescope facilities since 1889. The first such paper was published in 1904 by the Kodaikanal Observatory for their



bulletin. The first international publication from India was in the "Monthly Notices of Royal Astronomical Society" in 1906. On average, these papers have 8.3 citations. The h-index for the collective productivity of all of the telescopes is 46 — it should be noted that the h-index is age-dependent, it increases monotonously with time. There



are few papers reporting productivity of individual telescopes. While there are a few comparative studies of selected telescopes: Crabtree and Bryson (2001); Trimble at al. (2005); Grothkopf and Stevens-Rayburn (2006); Abt (2012), none of the authors could find any publications that reported on the total productivity of all of a nation's telescopes. The h-index we found for Indian telescopes seems to be a good quality measure of national telescope productivity.[1]

5. Conclusion

This study aimed to address the productivity of telescopes of a nation, defining productivity as the sum of the papers published using telescope facilities for astronomical studies. The collective productivity is defined as a list of all of the publications gener-

[1]Editors' remark: for meaningful comparison the length of the period of the operation should be factored in.

ated by all the telescopes in the nation. Therefore, a study of this kind can be the first step in generating a "telescope bibliography" of a nation.

Telescopes are significant investments for a country. The number of papers published using these telescopes is a quantitative measure of their outcome as compared in light of the investment made for their installation. The impact of these papers in terms of the number of citations, the h-index, and the g-index speak for quality of the output. We feel that studies like this can best be appreciated when it is possible to compare the data from multiple countries.

References

Abt, H.A., 2012, OPSA I. ed. Heck, A., (Duttlenheim: Venngeist), Vol.1, 242

Crabtree, Dennis R. & Bryson, Elizabeth P. 2001, The Effectiveness of the Canada–France–Hawaii Telescope, arXiv:astro-ph/0108430v1

Grothkopf, Uta & Stevens-Rayburn, Sarah 2006, Introducing the H-Index in Telescope Statistics, arXiv:astro-ph/0610274v1

Rajan, M. S. 2009, Telescopes in India, (New Delhi: National Book Trust)

Trimble, Virginia, Zaich, Paul & Bosler, Tammy 2005, PASP, 2005, 117, 111