Full Length Research

Nobel Laureate Prof. Paul Greengard: A Scientometric Portrait

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Scientometrics is an application of quantitative methods used in the history of science. It is one of the techniques for documenting works of eminent scientists and researchers. In this study researchers analyzed 214 research papers authored by an eminent personality in medical science field and Nobel laureate Prof. Paul Greengard, appeared in Pub Med search engine. Which were also analyzed under Scientometrics framework i.e. Authorship Pattern, Year wise distribution of the articles, Channels of communication and alike.

Keywords: Scientometric Portrait, Paul Greengard, Medical Science, Nobel Prize

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INTRODUCTION

Scientometric studies deal with the biographical study of the individual career of scientists and researchers and correlates this with the bibliographical analysis of publications or academic and scientific achievements. For this study we choose Prof. Paul Greengard a well recognized personality in the field of Medical Science and also a Nobel Laureate. We studied their publications under Scientometric Framework like Authorship pattern, Communication Channels were used to publish research output, Year wise Distribution of the articles and multiple authorship pattern.

LITERATURE REVIEW

Govind Adhe and others (2014). Have been carried out the study is going to highlight G. K Kulkarni, the well known Zoological Scientist is widely recognized as a very successful scientist. His publications were analyzed by year, collaboration pattern; Channels of communication used, domain & Keywords, etc. The results (Impact factor, G- index, H- Index, h-b index, etc.) indicate that the temporal variation of his productivity and of the types of papers published by him is of such a nature that he is

eminently qualified to be taken as a ' role model' for the younger generation to try to do better. He has published 170 publications. He has published 95.76% publications when he was working with the funded research projects during 1977-87; 1989-92, 1995-99, 2001-2006 and 2008-2009. He has published most frequently during 3rd, 4th, & 6th decades of his life. He has a cluster of 49 collaborators. The highest collaboration coefficient (1.0) was observed during 1978-1982, 1984-1988, 1990-1994, 1996-1997, 2000-2001 and 2004.The Collaboration coefficient 0.8424 and productivity coefficient was 0.3636. The Collaborative Index 2.47, Equalence Index 0.0009603, and Salton index was 0.03099.His productivity age 33 and fifty percentile age 13 and Impact Factor is 25.33.

Another study carried out by Ramesk Kuri and Ravi. B. (2014). It reveals that Scientometrics is an application of quantitative methods used in the history of science. It is one of the techniques for documenting works of eminent scientist and researchers. In this paper an attempt has been made to identify Dr B Ramesh Babu's 236 articles distribute in various facets which include from single authorship to four authorship pattern; Domain wise contributions; Year wise Distributions, Authorship pattern & Collaboration and Channels of Communication.

B.S.Kademani and others (2001). Scientometric analysis of 246 papers by Ahmed Hassan Zewail, the Nobel laureate in chemistry (1999), published between 1976 and 1994 in diverse fields: femtochemistry (62), reaction rates and IVR (56), general reviews (49), coherence and optical dephasing phenomena (27), solids: magnetic resonance and optical studies (13), liquids and biological systems(9), local modes in large molecules (9), molecular structure from rotational coherence (8), solar energy concentrators(7), and other studies(6). Data was analyzed for authorship pattern with his 103 collaborators. Highest collaborations were with P. M. Felker (39), M.Dantus (19), and L.R.Khundkar (16). The highest numbers of collaborators (38) were during 1986 – 90, followed by 30 during 1981 – 1985. His productivity coefficient was 0.52 which is a clear indication of consistent publication productivity behaviour throughout his 19 years of research.

Somashekara Y L and others (2014). A study of chemical science research output of Prof. Syed Akheel Ahmed. He is a renowned chemical science, polymer and environmental science. He has credited about 100 research publications in International and National Journals. His articles are published during 1976 to 2010 and above years. Prof. Syed Akheel Ahmed published in four domains Biochemistry and Biotechnology (21), Environmental science (22), Polymer science (15), Chemistry (14). He published 58 articles in International journals.

G. Saravanan and S. Prasad (2012). The present paper is an output of a study carried out to know the

scientific work done by Dr. G. Thanikaimoni in the field of Palynology. The choice of the protagonist is based on his immense contributions at a young age to the field of Palynology. The study shows that Dr. G. Thanikaimoni has published 35 single authored and 21 multiauthored papers during 1965-1991. The paper examines his contributions in the fields of Botany, Palynology and Pale environmental studies, magnitude of his collaborations, and year-wise distribution of his productivity. The paper also highlights the unfinished works left behind by him, due to untimely death at the prime of his career that took five years to be published.

OBJECTIVES OF THE STUDY

Objectives of this paper quantitatively document the publication behaviour of Prof. Paul Greengard appeared in pub Med search engine.

1.   To find out authorship pattern;
2.   To tabulate collaborative activity with top ten collaborators;
3.   To know the communication outlets used.
4.   To find out year wise distribution of the articles
5.   To represent Multiple authorship pattern

METHODOLOGY

The study entitled "Nobel Laureate Prof. Paul Greengard: A Scientometric Portrait" is a case study, encompassing records output available online (PubMed Search Engine). The authorship pattern and author productivity are examined to identify the pattern of research contribution. Further, an attempt is made to measure the performance of Researchers and their research concentration. The study is mainly exploratory in nature in identifying research output of Prof. Paul Greengaurd and it is also analytical in nature in strengthening the empirical validity due to application of suitable statistical tools.

SCOPE AND LIMITATION OF THE STUDY

This study is limited to the analysis of 214 papers (2002 – 2015) appeared in pub Med search engine by Nobel laureate Prof. Paul Greengard. The bibliographic fields were analyzed by normal count procedure for authorships, year wise distribution, channels of communication, top ten contributors with Paul Greengard and multiple authorship patterns. This available data is analyzed in MS Excel 2007 and represented in an appropriate pie charts and bar charts.

Brief Introduction of Paul Greengard

Greengard was born in New York City, the son of Pearl (née Meister) and Benjamin Greengard, a vaudeville comedian. His older sister was actress Irene Kane, who later became a writer by the name of Chris Chase; she died in 2013, aged 89. Their mother died in childbirth and their father remarried in 1927. The Greengard siblings' parents were Jewish, but their stepmother was Episcopalian. He and his sister were "brought up in the Christian tradition".

During World War II, he served in the United States Navy as an electronics technician at the Technology working on an early warning system against Japanese kamikaze planes. After WWII, he attended Hamilton College where he graduated in 1948 with a bachelor's degree in mathematics and physics. He decided against graduate school in physics because most post-war physics research was focusing on nuclear weapons, and instead became interested in biophysics. He began his graduate studies at Johns Hopkins University in the lab of Haldan Keffer Hartline. Inspired by a lecture by Alan Hodgkin, Greengard began work on the molecular and cellular function of neurons. In 1953 he received his PhD and began postdoctoral work at the University of London, Cambridge University, and the University of Amsterdam.

He then became director of the Department of Biochemistry at the Geigy Research Laboratories. After leaving Geigy in 1967 he worked briefly at the Albert Einstein College of Medicine and Vanderbilt University before taking a position as Professor in the Department of Pharmacology at Yale University. In 1983 he joined the faculty of The Rockefeller University. Greengard is a member of the Board of Scientific Governors at The Scripps Research Institute. He is the acting chairman of the Fisher Center for Alzheimer's Research Foundation and serves on the board of the Michael Stern Parkinson's Research Foundation. Both internationally renowned foundations support the research conducted in the Greengard Laboratory at The Rockefeller University.

Awards and Honours

- Dickson Prize and Medal in Medicine, (1977) University of Pittsburgh
- CIBA-Geigy Drew Award (1979)
- The New York Academy of Sciences Award in Biological and Medical Sciences (1980)
- Pfizer Biomedical Research Award (1986)
- 3M Life Sciences Award of the Federation of American Societies for Experimental Biology (1987)
- Mental Health Research Achievement Award,

- (1987) National Mental Health Association
- Robert and Adele Blank Award Lecture, (1988) New York University
- NAS Award in the Neurosciences from the National Academy of Sciences (1991)
- Goodman and Gilman Award in Receptor Pharmacology (1992)
- Karl Spencer Lashley Prize, (1993) American Philosophy Society
- Ralph W Gerard Prize in Neuroscience, (1994) Society for Neuroscience
- Thudichum Medal, (1996) The Biochemical Society
- Lieber Prize for Outstanding Achievement in Schizophrenia Research (1996)
- Charles A Dana Award for Pioneering Achievements in Health (1997)
- Metropolitan Life Foundation Award for Medical Research (1998)
- Ellison Medical Foundation Senior Scholar Award (1999)
- Nobel Prize in Physiology or Medicine (2000)
- Member (elected) (2006) Serbian Academy of Sciences and Arts
- Member of the Norwegian Academy of Science and Letters.

DATA INTERPRETATION

Table No. 1 describes that, Prof. Paul Greengard has collaborated 58 articles with 1 to 5 Authors, more than 50% (108) articles has been collaborated with 6 to 10 authors, 37 (17.28%) articles were collaborated by 11 to 15 authors, 9 articles were written by 16 to 20 authors. Only two articles were collaborated by more than 20 authors, are also represented in bar graph.

Table No. 2 represents year wise distribution of the articles been authored by Paul Greengard. Among 214 articles, he has published 25 articles in the year 2004, 23 articles in the year 2002 and 2003 respectively. In the year 2010 he has published 21 articles where as 19 and 18 articles were published in 2008 and 2005 respectively. Only one article has been published in the year 2015.

Table No. 3 signifies the communication channels used by Paul Greengard to publish research output. The above pie chart represents the frequently used journals. Highest numbers of the articles were published in Pro Nat Acad Science USA with 45 articles. Journal of Neuroscience is used to publish 25 articles where as 16 articles were published in Journal of Neurochem.

Table No. 4 represents top ten authors contributed with Paul Greengard in his research publications. Flajolet M. contributed with Paul Greengard in 29 (13.55%) articles, Svenningsson P. Contributed in 28 articles, where as

Table 1

S.No.	No. Of Authors	No. Of Articles	Percentage
	Authorship pattern		
1	1 TO 5	58	27.1028037
2	6 TO 10	108	50.4672897
3	11 TO 15	37	17.2897196
4	16 TO 20	9	4.20560748
5	MORE THAN 20	2	0.93457944
	Total	214	100
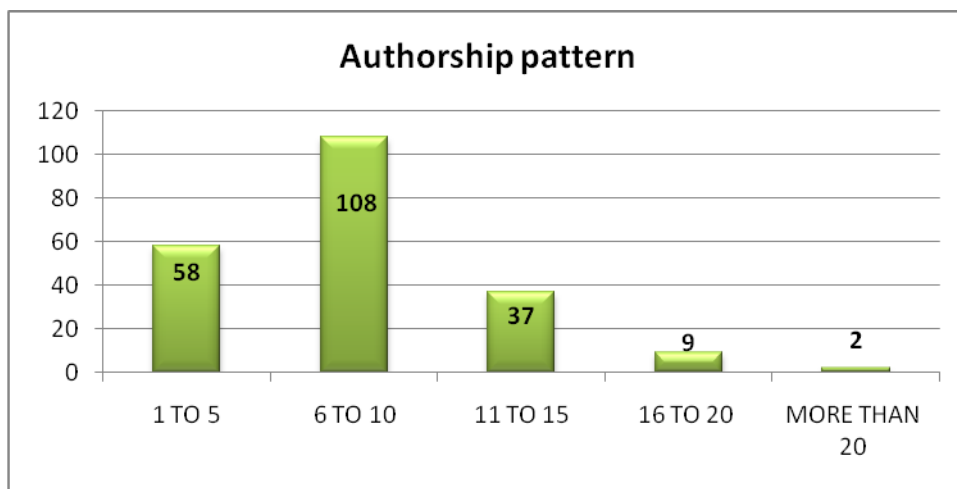
Figure 1

	YEARWISE DISTRIBUTION OF ARTICLES														
YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
No. Of Articles	23	23	25	18	14	16	19	14	21	8	11	11	10	1	214
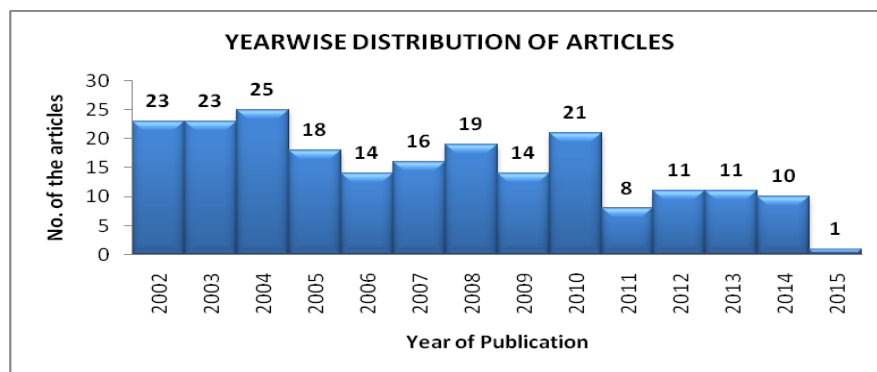
Figure 2

Table 2

S. No.	NAME OF THE COMMUNICATION CHANNEL	NO.OF THE ARTICLES	%
1	AAPS J	1	0.46729
2	Proc Natl Acad Sci U S A	45	21.02804
3	J Neurosci	25	11.68224
4	J Neurochem	16	7.476636
5	J Biol Chem	10	4.672897
6	Science	8	3.738318
7	Neuron	7	3.271028
8	J Comp Neurol	6	2.803738
9	Nat Neurosci	6	2.803738
10	Biol Psychiatry	5	2.336449
11	Nature	5	2.336449
12	Neuropharmacology	5	2.336449
13	Neuropsychopharmacology	5	2.336449
14	Cell	4	1.869159
15	Cereb Cortex	3	1.401869
16	J Med Chem	3	1.401869
17	Trends Pharmacol Sci	3	1.401869
18	Annu Rev Pharmacol Toxicol	2	0.934579
19	EMBO J	2	0.934579
20	Eur J Neurosci	2	0.934579
21	FASEB J	2	0.934579
22	Front Neuroanat	2	0.934579
23	J Exp Med	2	0.934579
24	J Pharmacol Exp Ther	2	0.934579
25	PLoS One	2	0.934579
26	Am J Pathol	1	0.46729
27	Am J Psychiatry	1	0.46729
28	Anal Chem	1	0.46729
29	Anesthesiology	1	0.46729
30	Ann Neurol	1	0.46729
31	Arch Gen Psychiatry	1	0.46729
32	Arch Neurol	1	0.46729
33	Autophagy	1	0.46729
34	Cell Metab	1	0.46729
35	Chem Biol	1	0.46729
36	Commun Integr Biol	1	0.46729
37	Curr Opin Pharmacol	1	0.46729
38	Exp Cell Res	1	0.46729

Continuation of Table 2

39	J Biomol NMR	1	0.46729
40	J Cell Biol	1	0.46729
41	J Clin Invest	1	0.46729
42	J Neurophysiol	1	0.46729
43	J Physiol	1	0.46729
44	Med Sci (Paris)	1	0.46729
45	Methods Cell Biol	1	0.46729
46	Methods Enzymol	1	0.46729
47	Mol Cell Biol	1	0.46729
48	Mol Pharmacol	1	0.46729
49	Nat Cell Biol	1	0.46729
50	Nat Commun	1	0.46729
51	Nat Med	1	0.46729
52	Nat Protoc	1	0.46729
53	Nat Rev Neurosci	1	0.46729
54	Neurobiol Dis	1	0.46729
55	Neuroimage	1	0.46729
56	Neuromolecular Med	1	0.46729
57	Neurosci Res	1	0.46729
58	Oncogene	1	0.46729
59	Pflugers Arch	1	0.46729
60	PLoS Biol	1	0.46729
61	Prog Drug Res	1	0.46729
62	Psychopharmacology (Berl)	1	0.46729
63	Sci Signal	1	0.46729
64	Sci Transl Med	1	0.46729
65	Synapse	1	0.46729
66	Trends Neurosci	1	0.46729
	TOTAL	214	100
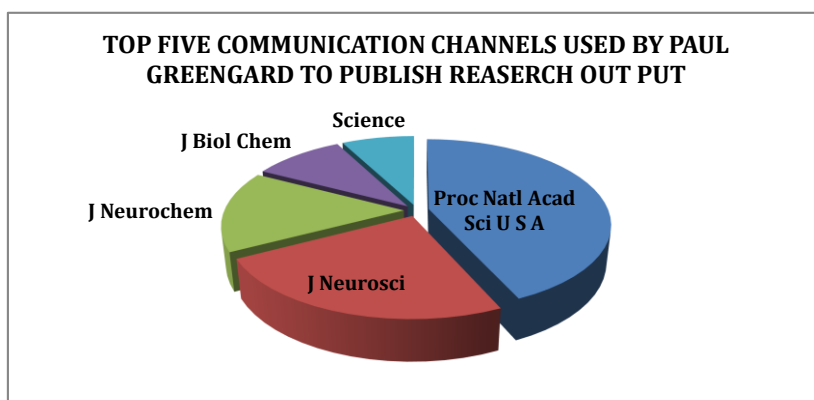
Figure 3

Table 3

S. No.	Name of the Author	No. Of the Articles	Percentage
Top Ten authors contributed with Paul Greengard			
1	Heintz N.	11	5.140186916
2	Surmeier DJ.	11	5.140186916
3	Fienberg AA,	12	5.607476636
4	Heiman M,	13	6.074766355
5	Kim Y.	14	6.542056075
6	Fisone G.	17	7.943925234
7	Allen PB,	19	8.878504673
8	Nishi A.	21	9.813084112
9	Svenningsson P.	28	13.08411215
10	Flajolet M.	29	13.55140187
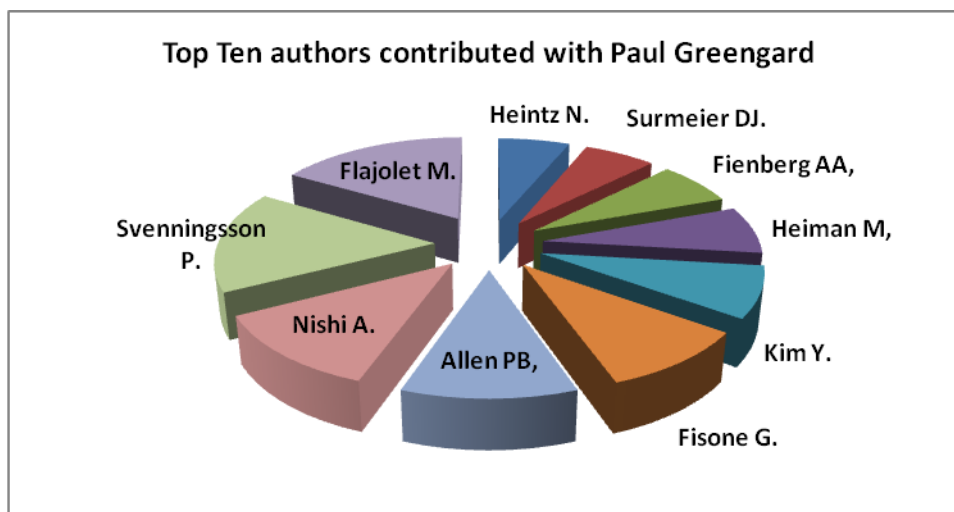
Figure 4

Nishi A. collaborated with Paul Greengard in 28 articles Allen PB. contributed in 19 articles though Heintz N. contributed in 11 articles (5.14%). It is also represented in Pie chart.

Table No. 5 represents the multiple authorship pattern of Prof. Paul Greengard. It reveals that highest no. Of articles were published when he was 79 years old. Bar chart helps the readers to understand the multiple authorship pattern, here y axis represents the biological age of the author and x axis represents that no. Of articles were published during 2002-2015.

CONCLUSION

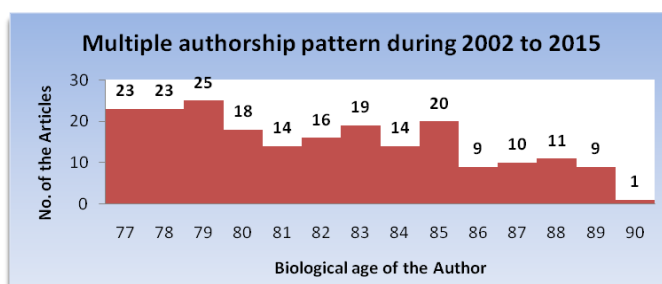In this study researchers found that 214 research papers were published by Prof. Paul Greengard, out of which 2 articles authored as single author and 212 authored by Multiple authors. This Nobel Prize winner as selected 66 reputed journals to publish his research output. Among these 25 articles were published in Pro Nat Acad Science USA. He published 108 articles with 6 to 10 authors. It's clearly evidenced that Prof. Paul Greengaurd published 25 articles in the year 2004.

Abbreviations Used:-

*= Author
TP= Total Publications
MT= Total number of Multi-authored Publications
AAP= Biological Age of the Author

Table 5 Note- (1*= Single Author, 2A- 25A= Multiple author, TP= Total Publications, MT= Total no. Of Multi-authored Publications, AAP= Biological Age of the Author

YEAR	MULTIPLE AUTHORSHIP PATTERN																											
	1*	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A	17A	18A	19A	20A	21A	22A	23A	24A	25A	MT	TP	AAP
2002	-	-	1	2	5	2	2	3	3	3	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	23	23	77
2003	-	-	1	2	-	3	5	3	4	2	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	23	23	78
2004	-	2	2	1	5	3	4	3	-	-	2	2	-	-	-	1	-	-	-	-	-	-	-	-	-	25	25	79
2005	-	-	2	-	-	4	3	2	1	1	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	18	18	80
2006	-	1	-	-	2	3	1	1	3	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	14	14	81
2007	-	1	-	1	-	4	2	1	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	16	82
2008	-	-	-	4	1	1	2	-	-	3	1	2	2	1	1	1	-	-	-	-	-	-	-	-	-	19	19	83
2009	-	-	-	1	1	3	2	2	1	1	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	14	14	84
2010	-	1	1	3	1	1	1	6	1	1	2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	20	20	85
2011	-	-	1	3	2	-	1	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	9	9	86
2012	-	-	-	-	2	2	1	-	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	10	10	87
2013	2	-	1	-	3	-	-	1	-	-	1	1	1	1	-	-	1	-	-	-	-	-	-	-	1	11	13	88
2014	-	1	-	1	1	-	-	-	-	2	1	-	-	-	2	-	-	-	-	-	1	-	-	-	-	9	9	89
2015	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	90
	2	6	9	18	23	26	24	23	18	17	16	7	7	3	4	4	3	2	0	0	1	0	0	0	1	212	214	

Multiple authorship pattern during 2002 to 2015

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