

USING SCOPUS DATA TO DRAW THE SCIENTOMETRIC PROFILE OF NOBEL LAUREATES IN CHEMISTRY(2014 - 2018)

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The Nobel Prize for Chemistry has been conferred to outstanding individuals for their epoch-making works since the inception of the Nobel Prize in 1901. The Nobel Laureates in Chemistry is selected by the Royal Swedish Academy of Sciences. Fifteen outstanding individuals have been conferred the Nobel Prize from 2014 till 2018. This study attempts to draw a bio-bibliographic picture of all Nobel Laureates in Chemistry from 2014 till 2018 considering various aspects like their productivity, h-index, collaboration, preferred co-author, and channels of communication. Analysis of the data shows the high productivity of the authors and the high h-index. The authors preferred to work in collaboration which is evident from high values of collaboration index. This study has also observed the relevance of high productivity and high number of citations on the h-index.

Keywords : Bio-bibliography; Chemistry; Citation; Co-authors; Collaboration; H-index; Nobel laureates, Productivity; Profile; Scientometrics; Scopus

INTRODUCTION

The contributions of individual scientists including the scientists who have been honoured with the prestigious Nobel Prize have always been the subject of discussion among the young scientists who emulate them and make them their role model. With the development of scientometry, focus is now being laid on conducting scientometric studies on Nobel Laureates (Kalyane and Sen, 1996). There exist a plethora of literature concerning scientometric studies on scientists hailing from various backgrounds and in various disciplines. The prestige associated with the Nobel Prize has also increased the number of scientometric studies on Nobel Laureates (Sinha, 2017). Scientometrics has been defined as the study of the quantitative attributes and characteristics related to science and research on science. The word Scientometrics gained popularity in 1978 after Tibor Braun published the journal Scientometrics from Hungary. Presently, the journal is published from Amsterdam. The scope of Scientometrics have been detailed in the sub-title of the journal which describes Scientometrics as the study of all quantitative attributes of science, including all forms o scientific communication and scientific policies (Wilson, 2001).

Sen and Gan (1990) introduced the word bio-bibliometrics to amalgamate methods of quantitative analysis of biographical data and bibliographic data to discover and establish functional correlation between them. This study analyzes the publications of any individual, any department, or any domain using statistical tools (Qayyum and Naseer, 2013). Kalyane and Kalyane (1994) conducted bio-bibliometric studies on scientists and classified their works under the head Scientometric Portrait.

While most of the existing literature concern themselves to studying individual scientists including the Nobel Laureates, or scientists hailing from any particular institution or geographical location, literature combining several Nobel Laureates spread across different geographical locations are rare. This study is an attempt to analyze the bio- bibliometric data of Nobel Laureates in Chemistry from 2014 till 2018.

While the present section introduces the subject to the readers, the subsequent sections have been classified as detailed. This study begins by looking at extant literature to understand the areas of focus and the methodologies used by previous authors. Based on understanding of the previous literature, the subsequent section spells out the scope of this study. Objectives are an integral and vital part of any study as these help in keeping the contents in track and prevents deviation. As such, the next section outlines the objectives of this study. The subsequent sections are bifurcated into methodology, where I have discussed the methods adopted for this study, and results and discussion. The study ends with concluding the

findings of the study and discussing the limitations of the study.

LOOKING AT PAST LITERATURE

There exist abundant literature correlating the biographic and bibliographic data of eminent personalities, scientists, authors, and Nobel Laureates. This section uses some extant works to understand the main areas of focus of those studies and the methodologies used.

Kumar, Ruhela and Kumar (2018) have analyzed the publications of Nobel Laureate Jeffrey C Hall during 46 years of his productive life beginning 1972 and ending in 2017. While the author has published 201 papers, his productivity has witnessed an increase in the years between 1990 and 1999. The author published 179 papers in collaboration and has 22 single- authored papers. His collaboration coefficient has been calculated at 0.89. One of his papers published in 1999 was cited in 632 different papers, Jeffrey C Hall published his papers in 50 renowned journals having high impact factor. Among the different authors with whom he had collaborated, M Rosbash was the most productive collaborator.

In analyzing the bibliometric data of George Pearson Smith, Maurya (2020) observed that Smith had a productive life spanning 48 years commencing 1971 when the author had published 55 papers in different domains. Of the published papers, 17 were single authored. The highest productivity of the author was during the decade beginning 1991. George Pearson Smith loved to work in collaboration with other authors, a fact that can be gauged from his collaboration index which has been calculated at 1.45. Smith had

published his papers in 32 peer-reviewed journals having a high impact factor. His collaboration with V A Petrenkvo was the highest, while a paper published in 1985 received the highest number of citations.

Mukherjee (2013) used Scopus and Web of Science to study the articles published by Prof. Lalji Singh during the period 1987 till 2011. The study observed that Prof. Singh had published 222 articles and had an h-index of 30. Though most of the articles published by Prof. Lalji Singh were published i foreign journals, only 18 papers were published in Indian journals. Regarding his productivity, the study observed that the author produced 7 to 8 articles every year.

The scientometric profile of Prof. Amartya Sen, Nobel Laureate in Economic Sciences was attempted by Sinha (2017). The author used 43 books published by Prof. Sen during the period 1960 till 2015 and had observed that most of his works were in collaboration with Jean Dreze. While the maximum number of books were published in the period 2000 till 2009, Prof Sen had written on a variety of subjects that included economics, politics, social problems, etc.

SCOPE OF THE STUDY

This study is an attempt to draw the scientometric portrait of those Nobel Laureates in Chemistry who had been awarded the Nobel Prize from 2014 till 2018. 15 persons were awarded the Nobel Prize in Chemistry during the period under study. The names of the Nobel Laureates and the reasons for being considered for the award have been detailed below.

(i) The Nobel Prize in Chemistry for 2014 was awarded to William Esco Moerner, Stefan Walter Hell, and Eric Betzig for their works on developing high -resolution fluorescence microscopy.

(ii) During 2015, the Nobel Prize in Chemistry was awarded to Tomas Robert Lindahl, Paul Lawrence Modrich, and Aziz Sancar for their works on the mechanistic studies of DNA repair.

(iii) Jean-Pierre Sauvage, Sir James Fraser Stoddart, and Bernard Lucas Feringa received the Nobel Prize for Chemistry for 2016 for their works on the design and synthesis of molecular machines.

(iv) Determining the structure of biomolecules in solution using cryo-electron microscopy prompted the Nobel Committee to award the Nobel Prize in Chemistry for 2017 to Jacques Dubochet, Joachim Frank, and Richard Henderson.

(v) The Nobel Prize in Chemistry for 2018 was awarded for two different studies. While Frances Hamilton Arnold received the Nobel Prize for his works on the development of enzymes, George Pearson Smith and Sir Gregory Paul Winter received the award for their works on phage display.

AIMS AND OBJECTIVES

The study is an attempt to draw the bio-bibliographic portrait of Nobel Laureates mentioned above. The bibliographic portrait includes year wise productivity, channels of communication, author-wise productivity, most

preferred co-author, h-index, and citation analysis.

METHODOLOGY

The data regarding the publications have been extracted from www.scopus.com and analyzed using the library Biblioshiny from R package. All relevant data have been fed into Microsoft Excel to get the graphical representation of the same. The period of study for each Nobel Laureate has been considered from the commencement of their productive life till 2020.

Biographical Sketch

(I) Eric Betzig, an American physicist and a professor of physics and molecular biology at the University of California, Berkeley Campus was born on 13th January 1960. Betzig is also a senior fellow at the Janelia Farm Research Campus in Ashburn, Virginia (University of California, Berkeley, n.d.). Betzig is known for his works on fluorescence microscopy and photoactivated localization microscopy. Besides the Nobel Prize, Betzig is also a Member of the National Academy of Sciences in 2015.

(ii) Stefan Walter Hell is a Romanian born German physicist and one of the several directors of the Max Planck Institute of Biophysical Chemistry located at Gottingen in Germany. Stefan Walter Hell was born on 23rd December 1962 and, besides the Nobel Prize, has received numerous awards including the Kavli Prize in Nanoscience in 2014, Otto Hahn Prize in 2009, and Gottfried Wilhelm Leibniz Prize in 2008.

(iii) Born on 24th June 1953, William Esco Moerner is an American physical chemist who is known for his works on biophysics. Moerner is

credited with spectroscopic detection of molecules in condensed phases. Among the awards conferred to Moerner include the Wolf Prize in Chemistry in 2008, Irving Langmuir Award in 2009, Peter Debye Award in 2013, besides the Nobel Prize.

(iv) Tomas Robert Lindahl is a Swedish-British scientist born on 28th January 1938 who specialising in cancer research. Besides the Nobel Prize, Lindahl has been conferred with the EMBO Membership in 1974, Fellow of the Royal Society in 1988, the Royal Medal in 2007, the Copley Medal in 2010.

(v) Paul Lawrence Modrich is an American biochemist and a professor of biochemistry at Duke University and investigator at the Howard Hughes Medical Institute. Modrich was born on 13th June 1946 and is credited with researching on repair of DNA mismatch. Among the other awards received by Modrich include getting the membership of the National Academy of Sciences in 1993.

(vi) Aziz Sancar was born on 8th September 1946 in Turkey. He is a molecular biologist who has specialized in DNA repair, circadian clock, and checkpoints related to cell cycle. Sancar has been conferred with several awards other than the Nobel Prize. These awards and recognition include the TUBITAK Science Award in 1995, the membership to the National Academy of Sciences in 2005, and the Vehbi Koc Award in 2007.

(vii) Jean-Pierre Sauvage is a pioneer in coordination chemistry and was born in France on 21st October 1944. Sauvage specializes in the

chemistry of supra-molecules. Sauvage has been awarded by the French Academy of Sciences in 1990.

(viii) Sir James Fraser Stoddart is an American chemist who was born in Great Britain on 24th May 1942. He teaches Chemistry at the Northwestern University located in the United States of America. Stoddart is known for his works on nanotechnology and supra-molecules. Sir James Fraser Stoddart received the Fellowship of the Royal Society of London in 1984 and won the Nagoya Gold Medal in Organic Chemistry in 2004. Among the other awards conferred to Sir James Fraser Stoddart include the King Faisal Prize in 2007, Albert Einstein World Award of Science, Knight Bachelor, and the Feynman Prize in Nanotechnology in 2007, the Arthur C Cope Award, the Davy Medal, and Fellowship of the Royal Society of Edinburgh in 2008, Membership of the National Academy of Sciences in 2014, and Fellowship of the National Academy of Investors in 2019.

(ix) Bernard Lucas Feringa is an organic chemist born on 18th May 1951 in the Netherlands. Feringa specializes in nanotechnology at the molecular level and catalysis. Bernard Lucas Feringa is a distinguished professor at the University of Groningen and the Royal Netherlands Academy of Arts and Sciences.

(x) Jacques Dubochet was born on 8th June 1942 and is a retired Swiss biophysicist. Dubochet is a researcher at the European Molecular Biology Laboratory located at Heidelberg in Germany and holds the post of honorary professor of biophysics at the University of Lausanne in Switzerland.

(xi) Born on 12th September 1940, Joachim Frank is a German born American professor of biophysics attached to the Columbia University. Joachim Frank is the founder of cryo-electron microscopy. Among the awards and recognition include the Benjamin Franklin Medal in Life Science in 2014, the Wiley Prize in Biomedical Sciences in 2017, and the Honorary Fellow of the Royal Microscopical Society in 2018.

(xii) Richard Henderson is a molecular biologist and a biophysicist who was born in Scotland on 19th July 1945. Henderson is regarded as a conceiver of electron microscopy. Besides the Nobel Prize, Richard Henderson won the Louis-Jeantet Prize in 1993, the Copley Medal in 2016.

(xiii) Frances Hamilton Arnold is an American born chemical engineer. Arnold was born on 25th July 1956 and is the Linus Pauling Professor of Biochemistry, Biotechnology, and Chemical Engineering, Caltech which is the popular name of the California Institute of Technology. Arnold has been conferred with several awards and recognitions. Among the awards received by the scientist include the Garvan-Olin Medal in 2005, the FASEB Excellence in Science Award in 2007, the Draper Prize in 2011, the National Medal of Technology and Innovation in 2013, the Millennium Technology Prize in 2016, and the Sackler Prize in Convergence Research in 2017.

(xiv) George Pearson Smith was born on 10th March 1941 in America. Smith is a biologist and a Professor Emeritus at the University of Missouri in the US where he teaches biological sciences.

(xv) Sir Gregory Paul Winter is a molecular biologist born on 14th April 1951 in Britain. Sir Gregory Paul Winter is known for his works on monoclonal antibodies. Besides being honoured with the prestigious Nobel Prize, Sir Gregory Paul Winter received the Colworth Medal in 1986, the EMBO Membership in 1987, the Louis-Jeantet Prize for Medicine in 1989, the Knight

Bachelor in 2004, the Royal Medal in 2011, and the Prince Mahidol Award in 2016.

RESULTS AND DISCUSSION

7.1 Analyzing the year-wise productivity: The year-wise productivity of the Nobel Laureates has been provided in Table 1 and a graphical representation is provided in Figure 1.

Table 1: Year-wise productivity

AUTHOR	YEAR						TOTAL
	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	
ERIC BETZIG	0	0	8	28	22	79	137
STEFAN WALTER HELL	0	0	2	73	194	176	445
WILLIAM ESCO MOERNER	0	3	55	109	150	135	452
TOMAS ROBERT LINDAHL	17	56	47	68	41	10	239
PAUL LAWRENCE MODRICH	12	10	46	61	45	14	188
AZIZ SANCAR	0	10	81	141	101	81	414
JEAN PIERRE SAUVAGE	4	31	78	183	162	53	511
JAMES FRASER STODDART	13	54	108	291	334	287	1087
BERNARD LUCAS FERINGA	0	8	42	170	344	291	855
JACQUES DUBOCHET	0	17	34	38	48	6	143
JAOCHIM FRANK	9	15	75	76	125	88	388
RICHARD HENDERSON	5	26	29	33	25	30	148
FRANCES HAMILTON ARNOLD	0	2	18	94	118	117	349
GEORGE PEARSON SMITH	0	12	10	16	10	7	55
GREGORY PAUL WINTER	0	4	45	100	31	23	203

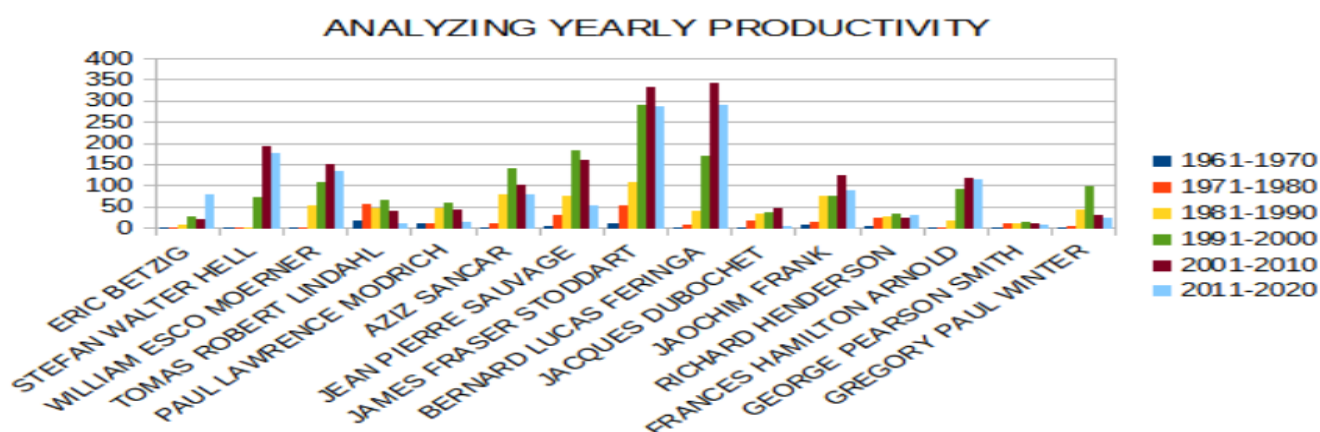


Fig. 1: Year-wise productivity

An analysis of Table 1 shows that among the Nobel Laureates in Chemistry for 2014, Eric Betzig produced 137 papers during his productive life from 1981 till 2020, of which the maximum 79 papers have been published in the decade commencing 2011. Stefan Walter Hell had a productive life from 1989 till 2020, when the author produced 445 papers of which the maximum 194 papers were published in the decade beginning 2001. William Esco Moerner began his productive life during 1974. The author has published 452 papers of which the maximum 150 papers have been published during 2001 till 2010.

Among the Nobel Laureates in Chemistry for 2015, Aziz Sancar has the highest number of publications at 414 followed by Tomas Robert Lindahl at 239 and Paul Lawrence Morich at 188. The productive lives of the authors started at 1971 for Sancar, 1960 for Lindahl, and 1970 for Modrich. All the Nobel Laureates have recorded the highest productivity during the decade beginning 1991, with Sancar producing 141 publications, Lindahl producing 68 publications and Modrich producing 31 publications.

The productive life of James Fraser Stoddart began in 1964 and the author has produced 1087 publications making him the most productive among the 1916 Nobel Laureates. He is followed by Bernard Lucas Feringa whose productive life began in 1971 when the author produced 855 publications. Jean Pierre Sauvage, however, began his productive life in 1964 and has produced 511 publications. Table 1 shows that Stoddart had produced the maximum publications (334) in the decade beginning 2001, while Feringa recorded his highest productivity (344) in the decade beginning 2001. The highest

productivity of Sauvage is recorded (183) in the decade beginning 1991.

Joachim Frank whose productive life began at 1969 and has produced 388 publications followed by Richard Henderson who produced 148 in his productive life commencing 1967, and Jacques Dubochet who produced 143 documents in his productive life beginning 1971 were the three Nobel Laureates for 1917. Frank produced 125 publications in the decade beginning 2001 and is the highest productivity of the author. The highest productivity of Henderson is recorded in the years 1991 till 2000, when the author produced 33 publications. Dubochet, however, produced 48 publications (the highest) in the decade beginning 2001.

Among the authors who had been conferred the Nobel Prize for Chemistry for 2018, Frances Hamilton Arnold produced the highest number of publications (349) during her productive life which began in 1980. The most productive years of Arnold was during 2001 till 2010, when the author had produced 118 publications. Sir Gregory Paul Winter's productive life began at 1971 and the author has produced 203 publications in all, the highest being 100 in the decade beginning 1991. George Pearson Smith began his productive years in 1971 and the author produced 55 publications. The most productive year of Smith is the decade beginning 1991 when the author produced 16 documents.

7.2 Channels of Communication:

The Nobel Laureates in Chemistry whose productivity is being studied have used various channels to publish their works. They published most of their publications in several peer-reviewed international journals which have a high

impact factor. Table 2 tabulates the names of the the Nobel Laureates during their productive life. journals which published the maximum works of

Table 2: Channels of Communication

AUTHOR	JOURNAL	PRODUCTION	IF
ERIC BETZIG	Science	18	41.84
STEFAN WALTER HELL	Optical Express	25	3.894
WILLIAM ESCO MOERNER	Optics Infobase Conference Papers	31	0.02
TOMAS ROBERT LINDAHL	Journal of Biological Chemistry	25	5.157
PAUL LAWRENCE MODRICH	Journal of Biological Chemistry	70	5.157
AZIZ SANCAR	Journal of Biological Chemistry	92	5.157
JEAN PIERRE SAUVAGE	Journal of the American Chemical Society	62	15.42
JAMES FRASER STODDART	Journal of the American Chemical Society	176	15.42
BERNARD LUCAS FERINGA	Journal of the American Chemical Society	92	15.42
JACQUES DUBOCHET	Journal of Microscopy	23	1.575
JOACHIM FRANK	Journal of Structural Biology	42	3.489
RICHARD HENDERSON	Journal of Molecular Biology	31	4.76
FRANCES HAMILTON ARNOLD	Proceedings of the National Academy of Sciences in the United States of America	23	11.2
GEORGE PEARSON SMITH	Biotechniques	6	1.993
GREGORY PAUL WINTER	Journal of Molecular Biology		4.76

An analysis of Table 2 indicates that most of the Nobel Laureates have published a major portion

Author-wise Productivity:

All the 15 Nobel Laureates in Chemistry from 2014 till 2018 had varying degrees of collaboration with other authors. They have also

of their works in journals having a comparatively lower impact factor.

produced certain number of single-authored documents. While Table 3 shows the number of single-authored document vis-a-vis total publication, Table 4 represents the collaboration index of the authors.

Table 3: Number of Single-Authored Documents vis-a-vis Total Documents

AUTHOR	TOTAL DOCUMENTS	SINGLE AUTHORED	% OF SINGLE AUTHORED DOCUMENTS
ERIC BETZIG	137	20	14.6
STEFAN WALTER HELL	445	28	6.3
WILLIAM ESCO MOERNER	452	38	8.41
TOMAS ROBERT LINDAHL	239	35	14.65
PAUL LAWRENCE MODRICH	188	14	7.45
AZIZ SANCAR	414	20	4.84
JEAN PIERRE SAUVAGE	511	18	3.53
JAMES FRASER STODDART	1087	30	2.76
BERNARD LUCAS FERINGA	855	21	2.46
JACQUES DUBOCHET	143	15	10.49
JAOCHIM FRANK	388	58	14.95
RICHARD HENDERSON	148	20	13.52
FRANCES HAMILTON ARNOLD	349	22	6.31
GEORGE PEARSON SMITH	55	17	30.91
GREGORY PAUL WINTER	203	10	4.93

Table 3 is indicative of the fact that single authored documents are very less as compared to the total documents published by the authors. Among the Nobel Laureates considered for the study, George Pearson Smith has the highest

number of single-authored publication as against James Fraser Stoddart who has the lowest percentage of single-authored documents. This fact can be understood from Table 4 which shows the collaboration index.

Table 4: Collaboration Index

AUTHOR	NUMBER OF CO-AUTHORS	COLLABORATION INDEX
ERIC BETZIG	456	3.99
STEFAN WALTER HELL	848	1.97
WILLIAM ESCO MOERNER	923	2.22
TOMAS ROBERT LINDAHL	405	2.03
PAUL LAWRENCE MODRICH	359	2.26
AZIZ SANCAR	616	1.52
JEAN PIERRE SAUVAGE	534	1.13
JAMES FRASER STODDART	1429	1.24

BERNARD LUCAS FERINGA	1065	1.09
JACQUES DUBOCHET	270	2.16
JAOCHIM FRANK	631	1.91
RICHARD HENDERSON	272	2.20
FRANCES HAMILTON ARNOLD	482	1.43
GEORGE PEARSON SMITH	69	2.87
GREGORY PAUL WINTER	420	0.20

7.4 Most Preferred co-author:

Table 3 and 4 shows that all the Nobel Laureates considered for the study have collaborated with several co-authors for publication of their documents. The most preferred author with whom

the Nobel Laureates have co-authored the maximum number of documents is mentioned in Table 5.

Table 5: Most Preferred Co-author

AUTHOR	CO-AUTHOR	DOCUMENTS
ERIC BETZIG	D. LI	15
STEFAN WALTER HELL	EGGELING	73
WILLIAM ESCO MOERNER	R J TWEIG	64
TOMAS ROBERT LINDAHL	D E BARNES	34
PAUL LAWRENCE MODRICH	H S FRIEDMAN	12
AZIZ SANCAR	C P SELBY	69
JEAN PIERRE SAUVAGE	J P COLLIN	120
JAMES FRASER STODDART	D J WILLIAMS	211
BERNARD LUCAS FERINGA	W R BROWNE	116
JACQUES DUBOCHET	A STASIAK	22
JOACHIM FRANK	R A GRASSUCCI	51
RICHARD HENDERSON	D L HUGHES	16
FRANCES HAMILTON ARNOLD	S BRINKMANN	14
GEORGE PEARSON SMITH	V A PETRENKO	7
GREGORY PAUL WINTER	A R FERSHT	19

Analysing the h-index:

The Hirsch Index, popularly called the h-index is a quantitative metric used to measure the significance and the effect of any author. The h-index is calculated based on the number of publications made by the author and the number of citations that those publications have received. h-index was proposed in 2005 by Jorge Eduardo Hirsch, an eminent physicist attached to the University of California, San Diego and has been

named after him (Hirsch, 2005). A high h-index depends upon the number of publications and the number of citations that these publications have received. According to Hirsch, an h-index of 20 is equivalent to being a successful scientist, while an h-index of 40 makes for an outstanding scientist. In order to be considered truly unique, one has to have an h-index of 40 (Hirsch, 2005). The h-index of the Nobel Laureates in Chemistry from 2014 till 2018 is provided in Table 6 below.

Table 6: Analysing the h-index

AUTHOR	h-INDEX
ERIC BETZIG	61
STEFAN WALTER HELL	102
WILLIAM ESCO MOERNER	78
TOMAS ROBERT LINDAHL	99
PAUL LAWRENCE MODRICH	79
AZIZ SANCAR	107
JEAN PIERRE SAUVAGE	99
JAMES FRASER STODDART	139
BERNARD LUCAS FERINGA	120
JACQUES DUBOCHET	56
JAOCHIM FRANK	91
RICHARD HENDERSON	31
FRANCES HAMILTON ARNOLD	101
GEORGE PEARSON SMITH	29
GREGORY PAUL WINTER	86

A look into Table 6 shows that all the Nobel Laureates have an h-index of more than 20, with the lowest being 29 in case of George Pearson Smith. This makes Smith a successful scientist. The low h-index can be explained by the low productivity of the author. James Fraser Stoddart, who has published the maximum number of

documents has the highest h-index among the Nobel Laureates who have been included in this study. Comparing the number of documents published and the h-index leads to the conclusion that h-index depends upon the number of publications of the author.

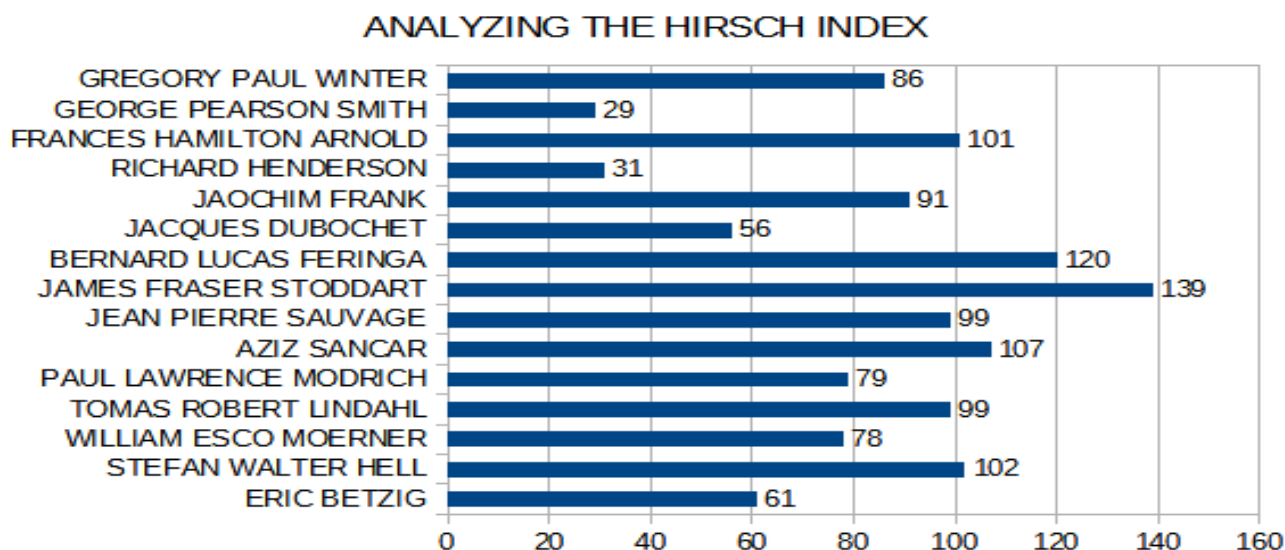


Fig 2: Analysing the h-index

7.6 Citation Analysis:

Citations are ways to judge the impact and the relevance of any scientific production. Citations are being used as indicators that show the performance of any author. Citations have their

own set of limitations in the way that evidence showing citations as reflecting the quality of research is rare. Table 7 shows the total citations received by the documents published by the authors and the number of documents in which these have been cited.

Table 7: Citation Analysis

AUTHOR	TOTAL CITATIONS	DOCUMENTS
ERIC BETZIG	25196	17238
STEFAN WALTER HELL	43698	20882
WILLIAM ESCO MOERNER	29636	17074
TOMAS ROBERT LINDAHL	38712	24010
PAUL LAWRENCE MODRICH	22755	11845
AZIZ SANCAR	38819	19443
JEAN PIERRE SAUVAGE	37192	17834
JAMES FRASER STODDART	102601	45452
BERNARD LUCAS FERGINGA	62721	33359
JACQUES DUBOCHET	12499	8396
JAOCHIM FRANK	29953	15022
RICHARD HENDERSON	21261	13277
FRANCES HAMILTON ARNOLD	36814	20700
GEORGE PEARSON SMITH	10395	7457
GREGORY PAUL WINTER	32198	17685

An analysis of Table 7 shows that the documents published by James Fraser Stoddart has received the highest citations while documents published by George Pearson Smith have been cited the

least number of times. Comparing the number of citations with h-index, it can be concluded that the h-index is dependent upon the number of citations.

CONCLUSION

This study has attempted to draw the bio-bibliographic sketch of Nobel Laureates in Chemistry who have received the award from 2014 till 2018 by analyzing the year-wise productivity, the channels of communication used by the authors, their productivity, most preferred co-author, h-index, and citations received. A total of 15 scientists were considered for the Nobel Prize during the period, and hence brought under the scope of this study. Analysis of the information available from Scopus show that the scientists have a high h-index and their works have been cited several times. All the scientists have worked in collaboration and have a small percentage of single-authored publications.

LIMITATIONS AND FUTURE SCOPE

This study suffers from the limitation that data have been extracted from Scopus ignoring other databases. Future studies may consider databases like Web of Sciences, SciFinder, Google Scholar, etc. and include other domains like physics, physiology, etc. to enable comparison among the disciplines and the scientists.

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