

Nobel Laureate Anthony J Leggett: A scientometric portrait

Mallikarjun Angadi¹, M M Koganuramath², B S Kademani³, B D Kumbar⁴, Suresh Jange⁵

¹Information Scientist, Tata Institute of Social Sciences, V Purav Marg, PBNo. 8313,
Deonar, Mumbai – 400088, Email: mallikarjun@tiss.edu

²Librarian, Jawaharlal Nehru University, New Mehrauli Road, New Delhi – 110 067,
Email: koganuramath@rediffmail.com

³Scientific Officer (E), Scientific Information Resource Division, Bhabha Atomic Research Centre,
Trombay, Mumbai - 400 085, Email: bskademani@yahoo.co.in

⁴Reader, Dept. of Library & Information Science, Karnataka University,
Dharwad - 580 003, Email: bdkumbar@yahoo.com

⁵Assistant Librarian, Gulbarga University Library, Gulbarga University, Gulbarga – 585106,
Email: suresh_jange@rediffmail.com

This paper attempts to analyse the publication productivity of Anthony J. Leggett, the 2003 Nobel Prize winner in physics. His contributions peaked in 1987, 1994, and 1998 with 10 papers each. He had 194 publications during 1964 – 2004 in domains like Superfluid ^3He (65), Foundations of Quantum Mechanics (36), Dissipative Quantum Systems (24), Atomic Alkali Gases (18), and Miscellaneous (51) which were analysed for authorship pattern with his 70 collaborators. Most active collaborators with Anthony J Leggett were: A. Garg with six papers and A. O. McAldeira, D. M. Ginsberg, D. J. Vanharlingen, F. Sols, S. Takagi and D. A. Wollman with five papers each. His productivity coefficient was 0.60 which clearly indicates that his productivity increased after 50 percentile age. The highest degree of collaboration (1) for Anthony J. Leggett was found during 1964, 1971 and 1983. Journals have been the most preferred channel of communication, where as many as 139 papers out of 194 have been published. The core journals publishing his papers were: *Phys. Rev. Lett.* (42), *Phys. Rev. B* (9), *J. Low Temp. Phys.* (8), *Phys. Rev. A* (7), *Ann. Phys.* (6), *Foundations of physics* (6), *J. Phys.*(5), *Prog. Theor. Phys.* (5), and *Rev. Mod. Phys.* (5). Publication density was 3.02 and publication concentration was 3.59.

Introduction

The Royal Swedish Academy of Sciences has awarded to Anthony J Leggett, as one of the three recipients the Nobel Prize (2003) in Physics for pioneering contributions to the theory of superconductors and superfluids. Leggett's co-recipients of the 2003 Nobel Prize are Alexei A. Abrikosov, Argonne National Laboratory Argonne, IL, USA (born 1928), and Vitaly Ginsburg, P.N. Lebedev Physical Institute Moscow, Russia (born 1916). Srinivasan and Narayanan have briefly reviewed the work of three Nobel laureates on understanding the phenomena of superfluidity and superconductivity¹.

Sir Anthony James Leggett (born March 26, 1938 in Camberwell, London, England), is John D. and Catherine T. MacArthur Chair and Center for Advanced Study Professor of Physics at the University of Illinois at Urbana-Champaign. He is widely recognized as a world leader in the theory of low-temperature physics, and his pioneering work on superfluidity was recognized by the 2003 Nobel Prize in physics. He has shaped the theoretical

understanding of normal and superfluid helium liquids and other strongly coupled superfluids. He set directions for research in the quantum physics of macroscopic dissipative systems and use of condensed systems to test the foundations of quantum mechanics.

He is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Russian Academy of Sciences (foreign member), and is a Fellow of the Royal Society (U.K.), the American Physical Society, and the American Institute of Physics. He is an Honorary Fellow of the Institute of Physics (U.K.). He was knighted (KBE) by Queen Elizabeth II in 2004 "for services to physics." He holds dual US/UK citizenship. His current research focuses on cuprate superconductivity, conceptual issues in the foundations of quantum mechanics, and superfluidity in highly degenerate atomic gases.

The term 'Bio-bibliometrics' was first coined by Sen and Gan for the quantitative and analytical method for

discovering and establishing functional relationships between bio-data and biblio-data elements². There are many bio-bibliometric studies, but have hardly used the term 'bio-bibliometrics' in the titles of the papers³.

Recently the term 'Bio-bibliometrics' is being used by Stapley and Benoit for a method of retrieving and visualizing biological information that uses co-occurrence of gene naming terms in Medical Sciences to generate semantic links between genes⁴. Therefore, it is suggested that 'Scientometric portrait' is the appropriate phrase for the studies on scientists, and 'Informetric portrait' for the studies on researchers in other disciplines such as arts, humanities, and social sciences.

A few scientometric studies on Nobel laureates⁵⁻¹⁹ and others²⁰⁻⁵¹ have been published. Kademani et al have studied the publication productivity, collaboration and authorship trend among eight Nobel laureates of past and present⁵².

Presently, individual scientists including the Nobel laureates, are becoming the focus of scientometric studies. Nobel prize is regarded as the most honourific recognition of scientific achievement. The prestige of Nobel prize is so great that it enhances the standing of nations and institutions as well as reputation of its "laureates"⁵³⁻⁵⁵.

Garfield and his colleagues have continuously published many studies inspired by the Nobel prize and other awards⁵⁶. The earliest is a paper presented at the Office of Naval Research Conference on Research Productivity in 1965 in which Sher and Garfield have demonstrated with data, the key characteristics of Nobel prize winners. It has been noticed that they publish five times more number of papers than the average scientist and their papers are cited 50 times more than the average⁵⁷.

There are many papers by Garfield forecasting of Nobel Prize winners⁵⁸⁻⁶². There are also many studies conducted by other noted scholars⁶³⁻⁶⁶ in this area of scientometrics.

Objectives

Anthony J Leggett has been taken as a case study for the present scientometric analysis. The detailed

biographical details and his brief resume can be found at (<http://www.physics.uiuc.edu/People/Faculty/profiles/Leggett/>).

This study highlights A J Leggett's:

- domainwise contributions
- domainwise authorships
- prominent collaborators
- use of channels of communications, and
- documentation of keywords from titles of the papers.

The main concept of working on individual scientists especially on Nobel laureates is to provide an example of 'Role Model Scientist' for the younger generation to emulate and create scientific temper among them. Success of others may teach many things to follow their path. Knowledge is valuable for its own sake and research has cultural values. Narrating success stories will always have an encouraging effect on the younger generation who aspire to be scientists.

Methodology

Present study is limited to the 194 papers by A J Leggett (1964-2004). A list of publications was obtained from Prof. A J Leggett. The database of publications of A J Leggett was created using CDS - ISIS software and the data was analysed as per the requirements of the study. The bibliographic fields were analysed by normal count procedure. Full credit was given to each author regardless of whether he happens to be the first author or the last author. Similarly one score was allotted to subject, journal, and keyword etc.

Results and discussion

Domainwise contributions

A J Leggett had research communications in the following domains:

- A = Superfluid 3He
- B = Foundations of Quantum Mechanics
- C = Dissipative Quantum Systems
- D = Atomic Alkali Gases
- E = Miscellaneous

Domainwise and Decennial distribution of publications by Leggett is presented in Table 1.

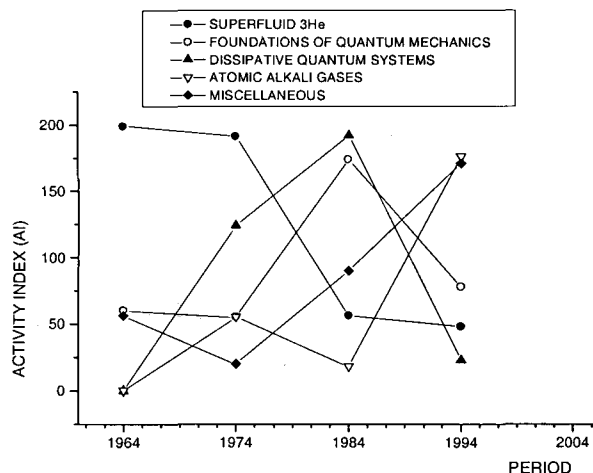


Figure 1 - Domainwise activity index in decennial blocks

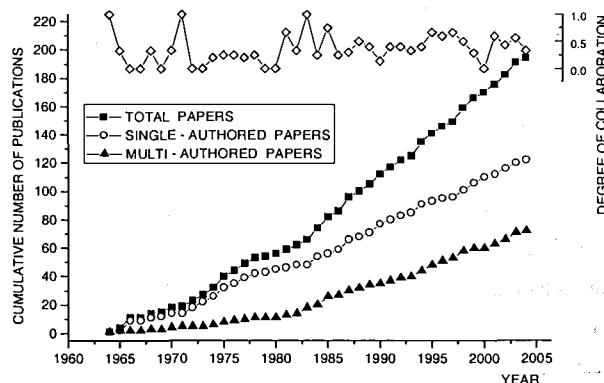


Figure 2 - Growth pattern of single-authored and multi-authored papers and degree of collaboration of papers of A J Leggett

Table 1 - Domainwise and decennial distribution of publications of A J Leggett

Period	Domains					Total A+B+C+D+E	%
	A	B	C	D	E		
1964-1973	18 (199)	3(60)	2(-0)	- (0)	4(56)	27	13.9
1974-1983	25(191)	4(55)	69(124)	2(55)	2(20)	39	20.1
1984-1993	11(56)	19(174)	14(192)	1(18)	14(90)	59	30.4
1994-2004	11(48)	10(78)	2(23)	15(176)	31(171)	69	35.6
Total	65	36	24	18	51	194	100

Figures within parenthesis indicate Activity Index (AI)

Domain wise contribution of Leggett’s output has been grouped into four distinct periods (1964-1973, 1974-1983, 1984-1993, and 1994-2004). The highest publication output was (69) in the last block (1994-2004) closely followed by the third block (1984-1994) with 59 publications. The domain Superfluid 3He has topped the list with 18 and 25 papers during the first and second period respectively. During the third period maximum 19 papers were published in the domain Foundations of Quantum Mechanics. The domain Miscellaneous topped during the fourth period with 31 papers.

Activity Index (AI)⁶⁷ was calculated for Leggett’s papers in four ten year blocks in different domains. Fig.1 gives the graphical representation of AI. In the first and second blocks, maximum emphasis was on domain A (Superfluid 3He), while in the third block the emphasis has shifted to domains B (Foundations of Quantum Mechanics) and C (Dissipative Quantum Systems). In

the last block the emphasis was on domains D (Atomic Alkali Gases) and E (Miscellaneous).

Collaboratorship

Domainwise authorship pattern and number of publications and authorships in each domain are presented in Table 2. Anthony J Leggett had 122 single – authored (62.88%) papers in various domains such as Superfluid 3He (45), Foundations of Quantum Mechanics (28), Miscellaneous (25), Dissipative Quantum Systems (13) and Atomic Alkali Gases (11). Year - wise collaboration trend of Anthony J Leggett is shown in Fig. 2.

To measure the collaborative research pattern, a simple indicator called Degree of Collaboration is used⁶⁸. The degree of collaboration in a discipline was defined as the ratio of the number of collaborative research papers

Table 2 - Domainwise productivity of number of papers and authorship pattern of the Nobel Laureate A J Leggett (1964 – 2004)

Authorships	Domains					Total No. of papers	%	No of Authorships	%
	A	B	C	D	E				
Single-authored	45	28	13	11	25	122	62.9	122	37.5
Two-authored	16	4	9	4	11	44	22.7	88	27.1
Multi-authored	4	4	4	4	15	28	14.4	115	35.4
Total	65	36	24	18	51	194	100	325	100
Percentage	33.50	18.55	12.37	9.27	26.28				
Authorships per paper	1.4	1.36	1.67	1.56	2.29				

A = Superfluid 3He, B = Foundations of Quantum Mechanics, C = Dissipative Quantum Systems, D = Atomic Alkali Gases, E = Miscellaneous

to the total number of research papers published in the discipline during a certain period of time. This definition of collaboration can be expressed as follows:

$$C = N_m / N_m + N_s$$

Where

C = Degree of Collaboration,

N_m = Number of Multi-authored research papers in the discipline published during a year,

N_s = Number of Single-authored research papers in the discipline published during the same year.

The highest degree of collaboration (1.00) for Anthony J Leggett was found in 1964, 1971 and 1983.

The productivity coefficient was obtained by the simple formula – 50 percentile age per total productivity age⁶⁹. The productivity coefficient was 0.60 which clearly indicates that Leggett's productivity increased after 50 percentile age. He had published highest (10) number of papers in 1987, 1994 and 1998. He did not publish any paper in the year 1967.

Domainwise Authorships

Table 2 shows domainwise authorship pattern and distribution of papers in various domains. The research group of A J Leggett had the credit as' number of authorships in various domains: Superfluid 3He (91), Foundations of quantum mechanics (49), Dissipative

quantum systems (40), Atomic Alkali gases (28) and Miscellaneous (117).

Prominent Collaborators

Researchers and their authorships in collaboration with A J Leggett in chronological order of their association are documented in Fig. 3.

Most active researchers having number of publications with Anthony J Leggett were : A. Garg (6); A. G. Caldeira (5); D. M. Ginsberg (5); D. J. Vanharlingen (5); F. Sols (5); S. Takagi (5) and D. A. Wollman (5). Two scientists having collaboration in four papers each were: Yu, C C and Lee, W C. Five scientists had collaboration in three papers each. Sixteen scientists had collaboration in two

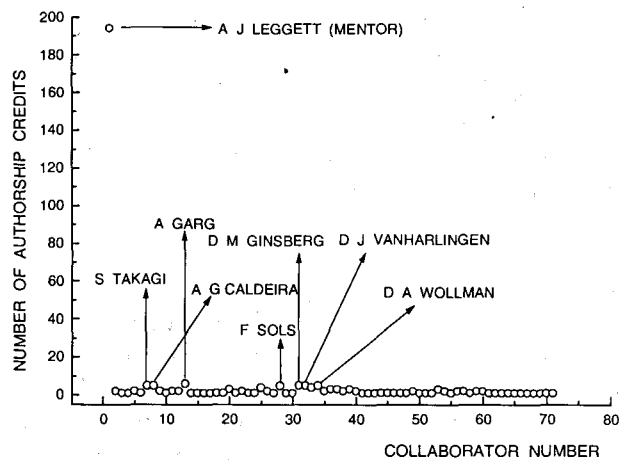


Figure 3 - Authorship credits to collaborators with A J Leggett

Table 3 - Channels of communication preferred by A J Leggett during 1964 - 2004

Sl. No.	Channel of communication	No. of papers	Cumulative	FPY- LPY	TY	IF	Country
1	<i>Phys. Rev. Lett.</i>	42	42	1965-2000	36	7.035	USA
2	<i>Phys. Rev. B</i>	9	51	1981-2003	23	2.962	USA
3	<i>J. Low Temp. Phys.</i>	8	59	1970-2002	33	1.171	USA
4	<i>Phys. Rev. A</i>	7	66	1965-2003	39	2.589	USA
5	<i>Ann. Phys.</i>	6	72	1968-1983	16	2.525	USA
6	<i>Found. Phys.</i>	6	78	1988-2003	16	0.601	USA
7	<i>J. Phys.</i>	5	83	1970-2001	32	-	England
8	<i>Prog. Theor. Phys.</i>	5	88	1966-1980	15	2.188	Japan
9	<i>Rev. Mod. Phys.</i>	5	93	1975-2003	29	28.172	USA
10	<i>Phys. Scr.</i>	3	96	1982-2002	21	0.688	Sweden
11	<i>Endeavor</i>	2	98	1975-1976	2	0.024	England
12	<i>J. App. Phys.</i>	2	100	1988-1993	6	2.171	USA
13	<i>J. Stat. Phys.</i>	2	102	1998-2003	6	1.214	USA
14	<i>Nature</i>	2	104	1977-1989	13	30.979	England
15	<i>Phys. Bull.</i>	2	106	1974-1975	2	-	England
16	<i>Prog. Surf. Sci.</i>	2	108	2002-2003	2	3.744	USA
17	<i>Science</i>	2	110	1996-2002	7	29.162	USA
18	<i>Can. J. Phys.</i>	1	111	1987-1987	1	0.777	Canada
19	<i>Chemphyschem</i>	1	112	2004-2004	1	3.316	Germany
20	<i>Collective Phenomena</i>	1	113	1975-1975	1	-	USA
21	<i>Comments Cond. Matt. Physics</i>	1	114	1988-1988	1	-	England
22	<i>Comments Solid Stat. Physics</i>	1	115	1976-1976	1	-	England
23	<i>Contemp. Phys.</i>	1	116	1984-1984	1	1.543	England
24	<i>Current Sci.</i>	1	117	1994-1994	1	0.694	India
25	<i>Int., J. Mod. Phys.</i>	1	118	2003-2003	1	-	Singapore
26	<i>Intl. School Low Temp. Phys.</i>	1	119	1978-1978	1	-	Netherlands
27	<i>J. Magn. Magn. Mat.</i>	1	120	1987-1987	1	0.910	Netherlands
28	<i>J. Phys. Chem. Sol.</i>	1	121	1998-1998	1	1.026	USA
29	<i>J. Phys. Cond. Matt.</i>	1	122	2002-2002	1	1.757	England
30	<i>J. Supercond.</i>	1	123	2000-2000	1	0.794	USA
31	<i>Mod. Phys. Lett.</i>	1	124	2000-2000	1	-	Singapore
32	<i>New J. Phys.</i>	1	125	2001-2001	1	2.480	England
33	<i>New Scientist</i>	1	126	1976-1976	1	0.277	England
34	<i>Nihon Buturi Gakkai Si</i>	1	127	1966-1966	1	-	Japan
35	<i>Phil. Mag. B</i>	1	128	1996-1996	1	1.413	England
36	<i>Physica A</i>	1	129	1983-1983	1	1.180	Netherlands
37	<i>Physica B</i>	1	130	1994-1994	1	0.908	Netherlands
38	<i>Physica B & C</i>	1	131	1994-1994	1	-	Netherlands
39	<i>Physica C</i>	1	132	1994-1994	1	1.192	Netherlands
40	<i>Phy. Lett.</i>	1	133	1964-1964	1	-	Netherlands
41	<i>Phys. Today</i>	1	134	2004-2004	1	5.020	USA
42	<i>Physica Fenn.</i>	1	135	1973-1973	1	-	Finland
43	<i>Proc. Nat. Acad. Sci.</i>	1	136	1999-1999	1	0.335	USA
44	<i>Prog. Low Temp. Phys.</i>	1	137	1995-1995	1	-	Netherlands
45	<i>Prog. Theor. Phys. Suppl.</i>	1	138	1985-1985	1	0.368	Japan
46	<i>Synth. Met.</i>	1	139	2004-2004	1	1.303	Switzerland
47-101	Others in Books, Conf/Sem., etc	55	194				

(FPY = First Paper Year, LPY = Last Paper Year, TY = Total Years, and IF=Impact Factors taken from *Journal Citation Reports* – 2003)

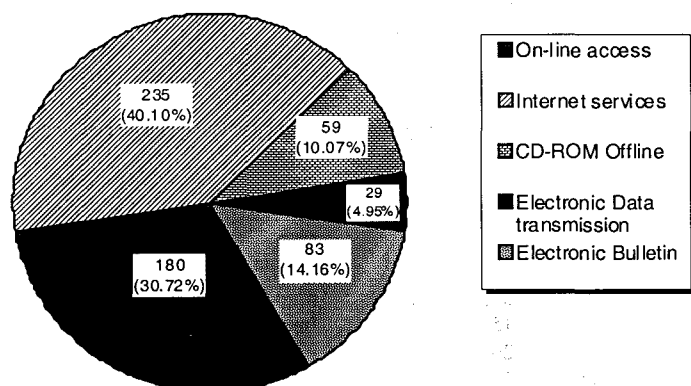


Figure 4 - Bradford – Zipf Bibliograph for A J Leggett

papers each. Forty scientists could collaborate in only one paper each. Total number of authors in the research group were 71 and total number of authorships were 325.

Use of Channels of Communication

Distribution of Anthony J Leggett's 194 publications were spread over 139 journal articles, 26 conference papers, 26 edited books and 3 translations. Channelwise scattering of publications of Anthony J Leggett is provided in Table-3 and Fig.4. He has published 42 papers in *Phys. Rev. Lett.* (1965 – 2000), 9 papers in *Phys. Rev. B* (1981 – 2003), 8 papers in *J. Low Temp. Phys.* (1970-2002), 7 papers in *Phys. Rev. A* (1965 – 2003), 6 papers each in *Ann. Phys.* (1968-1983) and *Foundations of Physics* (1988-2003), and 5 papers each in *J. Phys.* (1970-2001), *Prog. Theor. Phys.* (1966-1980), and *Rev. Mod. Phys.* (1975-2003). More than 50 per cent of the publications were published in the journals with impact factors ranging from 0.0 to 0.49 and rest were published in the journals having impact factors ranging from 0.50 to 30.98. The distribution of journals as per impact factors is given in Fig.5. Publication density was 3.02 and publication concentration was 3.59. Publication Density is defined as the ratio of total number of papers published to the total number of journals in which the papers were published and publication concentration is the ratio in percentage of the channels having half of the papers published to the total number of journals in which those papers were published⁷⁰.

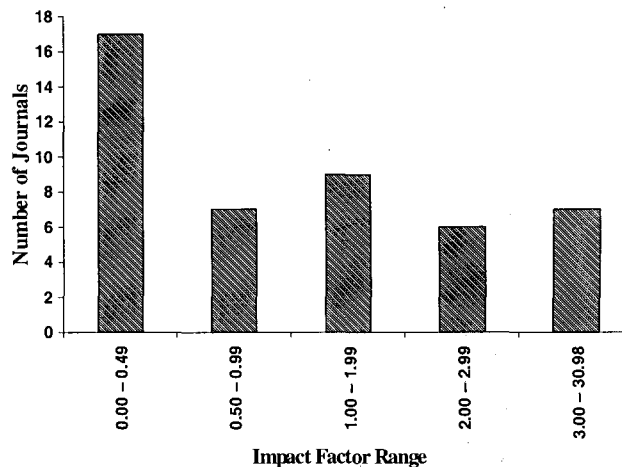


Figure 5 - Distribution of journals as per Impact Factor

Country-wise Distribution of Journals

The publications have been spread over 46 journals published in 11 countries. Fig.6 gives the country-wise distribution of journals. The largest numbers of journals are from USA with 96 publications in 16 journals, followed by England with 18 publications in 11 journals, Netherlands with 8 publications in 8 journals and Japan with 7 publications in 3 journals.

Distribution of A J Leggett's Publications in Different Types of Communication Channels

It is clearly evident from the Table-3 that his 71.65 percentage of publications were published in scientific journals followed by 28.35 percentage of publications in conferences, books, translations etc.

Keyword Tomography

Titles of publications convey precisely the thought contents of the papers. The potency of information concentration on the titles of the papers is more than the rest of the sections of the papers. Therefore, if a word occurs more frequently than expected to occur, then it reflects the emphasis given by the author about the domain of his research. These important words called 'keywords' are one of the best indicators to understand and to grasp instantaneously the thought content of the papers, methodologies used and areas of research addressed to. The keyword frequencies appeared in the titles of the papers is provided in Table-4.

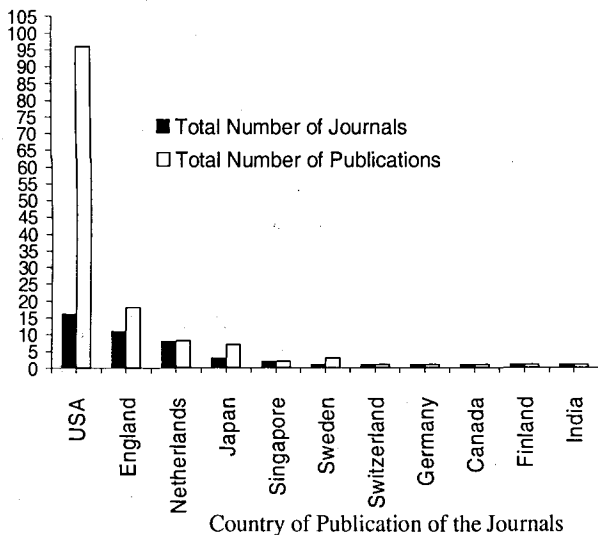


Figure 6 - Country-wise distribution of journals

Conclusion

A J Leggett has published 194 papers during 1964–2004. He published his first paper in 1964 when he was 26 years of age. The percentage of collaborative work (37.12) of the scientist was found to be low though he had as many as 71 collaborators whom he guided as a mentor. The percentage of solo research papers (62.88) has been found to be very high. His highest degree of collaboration 1.0 was found during 1964, 1971 and 1983. A J Leggett worked in highly specialised fields such as Superfluid ^3He , Foundations of Quantum Systems, Dissipative quantum systems and Atomic Alkali gases. He has received several professional awards and honours which is indicative of his highly specialized and original work in his field. His productivity coefficient was 0.60 which is a clear indication that his productivity increased after 50 percentile age. His papers have been scattered

Table 4 - Keyword frequency from the titles of publications by A J Leggett during 1964 – 2004

Keywords	Frequency	Keywords	Frequency
Quantum mechanics	16	Anisotropic superfluid	2
^3He	13	Bose condensates	2
New phases	8	Condensed matter physics	2
Quantum tunneling	7	Cosmic-ray effect	2
Cuprate superconductivity	6	Dissipation	2
Macroscopic level	6	Helium	2
Superfluidity	6	High energy	2
Liquid ^3He	5	Klemm	2
$^3\text{He-A}$	4	Measurement	2
$^3\text{He-B}$	4	Metals	2
Bose-Einstein condensation	4	Noziers	2
Interaction	4	Orbital dynamics	2
Liquid helium	4	Oriental dynamics	2
NMR	4	Philippe-Feenberg	2
Nucleation	4	Quantum many-body systems	2
Pairing state	4	Quantum measurement paradox	2
Physics	4	Quantum measurement problem	2
Superfluid ^3He	4	Quasiparticles	2
Alkali gases	3	Realism	2
Cuprate superconductors	3	Spin diffusion	2
Dynamics	3	Superconducting pairing state	2
Low temperatures	3	Superconductivity	2
Macroscopic quantum tunneling	3	Superfluid phase	2
Phase coherence	3	Two fluid model	2
Spin echoes	3	Two-state system	2
Superfluid fermi liquid	3	YBCO-Pb	2
Superfluid He-3	3		
YBCO	3		
Amorphous materials	2		

in 140 high impact factor scientific journals. It will be very interesting if one attempts to study the sociological aspects and citation studies on A J Leggett which may give many interesting insights into his scientific career. Nobel laureates are an altogether different kind of intellectual geniuses highly dedicated to unravel the mysteries of nature. Studying the lives of Nobel laureates and documenting systematically the varied experiences may help to inspire the younger generation.

Acknowledgements

Authors are thankful to Dr. A. P. Mishra, Spectroscopy Division, BARC for his valuable comments and encouragement.

References

1. Srinivasan R and Narayanan A, Nobel Prize for physics-2003: Matter close to absolute zero, *Resonance*, (9) (2004) 50 –60.
2. Sen S K and Gan S K, Biobibliometrics: Concept and application in the study of productivity of scientists, *International Forum on Information and Documentation*, 15(3) (1990) 13 – 21.
3. Tiew W S, Khoo Kay Kim, Professor of Malaysian History: A biobibliometric study, *Malaysian Journal of Library and Information Science*, 4 (2) (1999) 47 – 57. <http://mjcs.fsktm.um.edu.my/ArticleInformation.aspx?ArticleID=148>
4. Stapley B J and Benoit G, Bio-bibliometrics: Information retrieval and visualization from co-occurrence of gene names in Medline abstracts. <http://www.ncbi.nlm.nih.gov/PubMed/>
5. Angadi M, Koganuramath M M, Kademani B S, Kalyane V L and Sen B K, Scientometric Portrait of Nobel laureate Leland H. Hartwell. *WIS-2004, International Workshop on Webometrics, Informetrics and Scientometrics*, (eds.) Hildrun Kretschmer, Yogendra Singh, and Ramesh Kundra, (2-5 March, 2004), Organised by Society for Information Science, New Delhi, and Indian Institute of Technology, Roorkee, India, 2004; 10-30. <http://eprints.rclis.org/archive/00001442/>
6. Angadi M, Koganuramath M M, Kademani B S, Kumbar B D and Jange S, Scientometric portrait of Nobel laureate Anthony J Leggett, 10th International Conference of the International Society for Scientometrics and Informetrics, 24-28 July, 2005, Karolinska Institute, Stockholm, Sweden. 2; 2005; 706-707.
7. Cawkell T and Garfield E, Assessing Einstein's impact on today's science by citation analysis. In : *Einstein : The first hundred years*, ed. by M. Goldsmith et al., Pergamon, Oxford, 1980; 31 – 40.
8. Gupta D K, Chandrasekhar, Winner of the 1983 Nobel prize for Physics: A citation analysis study of his works, *Annals of Library Science and Documentation*, 30 (3-4); (1983) 177-184.
9. Kademani B S, Kalyane V L and Kademani A B, Scientometric portrait of Nobel laureate Dr. C. V. Raman, *Indian Journal of Information, Library and Society*, 7 (3-4) (1994) 215 – 249. <http://eprints.rclis.org/archive/00001377/>
10. Kademani B S, Kalyane V L and Kademani A B, Scientometric portrait of Nobel laureate S. Chandrasekhar, *JISSI : The International Journal of Scientometrics and Informetrics*, 2 (2-3) (1996) 119 –135. <http://eprints.rclis.org/archive/00001516/>
11. Kademani B S, Kalyane V L and Jange S, Scientometric portrait of Nobel laureate Dorothy Crowfoot Hodgkin, *Scientometrics*, 45 (2) (1999) 233 – 250. <http://eprints.rclis.org/archive/00001519/>
12. Kademani B S, Kalyane V L and Vijai Kumar, Scientometric portrait of Nobel laureate Ahmed Hassan Zewail, *Malaysian Journal of Library and Information Science*, 6 (2) (2001) 53-70. <http://eprints.rclis.org/archive/00001515/>
13. Kademani B S, Kalyane V L and Vijai Kumar, Scientometric portrait of Nobel laureate Harold W. Kroto, *SRELS Journal of Information Management*, 39 (4) (2002) 409 – 434. <http://eprints.rclis.org/archive/00001391/>
14. Kademani B S, Kalyane V L and Vijai Kumar, A.H. Zewail : Research collaborator par excellence, *Scientometrics*, 53 (1) (2002) 113 – 121. <http://eprints.rclis.org/archive/00001505/>
15. Kalyane V L and Sen B K, Scientometric portrait of Nobel laureate Pierre – Gilles de Gennes, *Malaysian Journal of Library & Information Science*, 1 (2) (1996) 13 – 26.
16. Kalyane V L and Kademani B S, Scientometric portrait of Barbara McClintock: The Nobel laureate in physiology, *KELPRO Bulletin*, 1 (1) (1997) 3 – 14. <http://eprints.rclis.org/archive/00001247/>
17. Koganuramath M M, Angadi, Mallikarjun, Kademani B S, Kalyane V L and Jange S, Scientometric portrait of Nobel Laureate Wolfgang Ketterle. Knowledge Management in Special Libraries in Digital Environment, XXIV All India Conference of IASLIC, Dehra Dun, 15-18 December, 2003. SIG: Informetrics, Theme: Biobibliometrics; Special publication 43; 2003; Abstract; 447. <http://eprints.rclis.org/archive/00001058/>
18. Koganuramath M M, Angadi, Mallikarjun, Kademani B S, Kalyane V L and Jange, Suresh. Nobel laureate Wolfgang Ketterle: A Scientometric portrait, *Malaysian Journal of Library and Information Science*, 9 (2) (2004); 35-61.
19. Kragh H, Dirac bibliometrics. In : *Dirac : A scientific biography*. Cambridge University, Cambridge, 1990; 293 – 301.
20. Brittain J M, A highly visible scientist – Jack Meadows, *Journal of Information Science*, 26 (4) (2000) 267 – 27.
21. Devarai R S and Ramesh L S R C V, Informetrics on M. N. Srinivas, *Annals of Library Science and Documentation*, 45 (4) (1998) 125-135.
22. Dieks D and Slooten W J, Historic papers in physics : The case of Hugo Martin Tetrode, 1895 – 1931, *Czechoslovak Journal of Physics-B*, 36 (1986) 39 – 42.
23. Gupta D K, Plate Tectonics : A study of transmission of ideas, *Annals of Library Science and Documentation*, 25 (1-4) (1978) 86-92.
24. Gupta D K, Citation analysis : A case study of a most cited author and his most cited article on sea – floor spreading, *IASLIC Bulletin*, 28 (1) (1983) 1 – 12.

25. Gupta D K and Gupta S A, Citography on LePichon's article on sea – floor spreading and continental drift : Application of Bradford's Law, *IASLIC Bulletin*, 28 (2) (1983) 49 – 58.
26. Kademani B S, Kalyane V L and Balakrishnan M R, Scientometric portrait of P. K. Iyengar, *Library Science with a slant to Documentation and Information Studies*, 31 (4) (1994) 155 – 176. <http://eprints.rclis.org/archive/00001283/>
27. Kademani B S and Kalyane V L, Bibliometric indicators of publication productivity analysis of an individual scientist, *JISSI : The International Journal of Scientometrics and Informetrics*, 2 (4) (1996) 49 -58. <http://eprints.rclis.org/archive/00001246/>
28. Kademani B S and Kalyane V L, Outstandingly cited and most significant publications of R. Chidambaram , a nuclear physicist, *Malaysian Journal of Library and Information Science*, 1 (1) (1996) 21 – 36. <http://eprints.rclis.org/archive/00001277/>
29. Kademani B S, Kalyane V L and Kademani A B, Scientometric portrait of Sir K. S. Krishnan, *Indian Journal of Information, Library and Society*, 9 (1– 2) (1996) 125- 150. <http://eprints.rclis.org/archive/00001313/>
30. Kademani B S and Kalyane V L, Scientometric portrait of R. Chidambaram, the Indian Nuclear Physicist : A citation analysis, *KELPRO Bulletin*, 2 (1) (1998) 13 –29. <http://eprints.rclis.org/archive/00001242/>
31. Kademani B S, Kalyane V L and Vijai Kumar, Scientometric portrait of Vikram Ambalal Sarabhai: A citation analysis, *SRELS Journal of Information Management*, 37 (2) (2000) 107 – 132. <http://eprints.rclis.org/archive/00001237/>
32. Kalyane V L. Scientometric Portrait of L. L. Narayana, In: *Knowledge Societies and Libraries: Papers in Honour of Prof. A.A.N. Raju*, ed. by Laxman Rao, N, Sudarshan Rao, S. and Prafulla Chandra, T. V., Ess Ess Publishers, New Delhi; 2004; 362-388. (ISBN: 81-7000-353-9) <http://eprints.rclis.org/archive/00002264/>
33. Kalyane V L, Scientometric portrait of P. M. Bhargava, *Lucknow Librarian*, 27 (1 – 4) (1995) 42 – 70. <http://eprints.rclis.org/archive/00001398/>
34. Kalyane V L and Kademani B S, Scientometric portrait of R. Chidambaram : A publication productivity analysis, *Journal of Information Sciences*, 5 (3) (1995) 101 – 140. <http://eprints.rclis.org/archive/00001332/>
35. Kalyane V L and Kalyane S V, Scientometric portrait of Vinodini Reddy, *Journal of Information Sciences*, 4 (1) (1993) 25 – 45. <http://eprints.rclis.org/archive/00001304/>
36. Kalyane V L and Kalyane S V, Scientometric portrait of M.S. Swaminathan, *Library Science with a slant to Documentation and Information Studies*, 31 (1) (1994) 31 – 46. <http://eprints.rclis.org/archive/00001288/>
37. Kalyane V L and Munnolli S S, Scientometric portrait of T.S. West, *Scientometrics*, 33 (2) (1995) 233 – 256. <http://eprints.rclis.org/archive/00001402/>
38. Kalyane V L, Prakasan E R and Vijai Kumar, Scientometric portrait of Ranjit Kumar Mitra, *ILA Bulletin*, 37 (2) (2001) 39 – 53. <http://eprints.rclis.org/archive/00001067/>
39. Kalyane V L and Samanta R K. Informetrics on K. Ramiah, In: *New Vistas in Library and Information Science*, ed. by A. A. N. Raju *et al.*, Delhi ; Vikas; 1995; 565 – 578. <http://eprints.rclis.org/archive/00001278/>
40. Kalyane V L and Sen B K, Scientometric portrait of C. R. Bhatia, a geneticist and plant breeder, *Malaysian Journal of Library and Information Science*, 3 (1) (1998) 25 – 42. <http://eprints.rclis.org/archive/00001239/>
41. Kalyane V L and Sen B K, Research productivity of Tibor Braun : An analytical chemist – cum scientometrician, *Annals of Library and Information Studies*, 50 (2) (2003) 47 – 61. <http://eprints.rclis.org/archive/00001374/>
42. Koley, S and Sen B K, A biobibliometric study on Prof. B. N. Koley, an eminent physiologist, *Annals of Library and Information Studies*, 53 (2) (2006) 74-82.
43. Lancaster F W, Zeter M J and Metzler L, Ranganathan's influence examined bibliometrically, *Libri*, 42 (3) (1992) 268 – 281.
44. Muddiman, Dave, Red information Scientist: the information career of J. D. Bernal, *Journal of Documentation*, 59 (4) (2003) 387 – 409. <http://dois.mimas.ac.uk/DoIS/data/Articles/julkokltny:2003:v:59:i:4:p:387-409.html>
45. Munnolli S S and Kalyane V L, Scientometric portrait of Ram Gopal Rastogi, *Annals of Library and Information studies*, 50 (1) (2003) 1-17. <http://eprints.rclis.org/archive/00001352/>
46. Rusthon J P, A scientometric appreciation of H. J. Eysenk's contributions to psychology, *Personality and Individual Differences*, 31 (2001) 17 – 39.
47. Sangam S L, Kiran Savanur, Manjunath M and Vasudevan, Scientometric portrait of Prof. Peter John Wyllie, *Scientometrics*, 66 (1) (2006) 43–53.
48. Sen B K and Karanjia A, Dr. Biman Bagchi – A bibliometric portrait. Knowledge Management in Special Libraries in Digital Environment, XXIV All India Conference of IASLIC, Dehra Dun, 15-18 December, 2003. SIG: Informetrics, Theme: Biobibliometrics ; Special publication, 43; 2003; 437 - 446. <http://eprints.rclis.org/archive/00001412/>
49. Sinha S C and Dhiman A K, Bibliometric study of Dr. R. C. Sinha, A plant pathologist, *Annals of Library and Information Studies*, 48 (2) (2001) 73-84.
50. Sinha S C and Ullah M F, Citation profile of Dr. V. S. Ramachandran : A bibliometric analysis of his highly cited articles and books in the area of cement and concrete chemistry, *Annals of Library Science and Documentation*, 40 (1) (1993) 21 – 31.
51. Todorov R and Winterhager M, An overview of Mike Moravcsik's publication activity in physics, *Scientometrics*, 20 (1) (1991) 163 – 172.
52. Kademani B S, Kalyane V L, Vijai Kumar and Lalit Mohan, Nobel laureates: Their publication productivity, collaboration and authorship status, *Scientometrics*, 62 (2) (2005) 261– 268.
53. Zuckerman H, Nobel laureates in science : Patterns of productivity, collaboration and authorship, *American Sociological Review*, (32) (1967) 391 – 403.
54. Zuckerman H, The sociology of Nobel prizes, *Scientific American*, 217 (5) (1967) 25 – 33.
55. Zuckerman H, *Scientific elite : Nobel laureates in the United States*, Free Press; New York; 1977.

56. Kademani B S, Kalyane V L, Vijai Kumar and Lalit Mohan, Letter to the editor, *Scientometrics*, 66 (3) (2006) 615- 617.
57. Sher I H and Garfield E, New tools for improving and evaluating the effectiveness of Research, *Research Program Effectiveness*, M.C. YOVITS, D.M. Gilford, R.H. Wilcox, E. Staveley And H.D. Lemer (Eds), 1966, Proceedings of the Conference Sponsored by the Office of Naval Research Washington, D.C., July 27-29, (New York: Gordon and Breach, 1966); 1965; 135- 146.
58. Garfield E and Malin M V, Can Nobel prize winners be predicted? Presentation (Unpublished), No:166. Paper presented at 135th Annual Meeting, AAAS, Dallas, TX. December 26-31; 1968; 1-17.
59. Garfield E, Citation indexing for studying science, *Nature*, 227 (5259) (1970) 669-671.
60. Garfield E, More on forecasting Nobel prizes and the most cited scientists of 1972! *Essays of an Information Scientist*, 1 (41) (1973) 487.
61. Garfield E, Forecasting the Nobel prize winners: Some caveats are in order, *The Scientist*, 4 (19) 1990.
62. Garfield E, Of Nobel class: Part 2, Forecasting Nobel prizes using citation data and the odds against it, *Essays of an Information Scientist*, 15 (35) (1992) 127.
63. Karazija A and Momkauskaite A, The Nobel prize in physics: Regularities and tendencies, *Scientometrics*, 61 (2) (2004) 191-205.
64. Braun T, Szabadi -Peresztzegi Z and Kovács-N É Meth É, Nobells for ambiguous list of ranked Nobelists as science indicators of national merit in physics, chemistry and medicine, 1901-2001, *Scientometrics*, 56 (1) (2003) 3-28.
65. Stephen P E and Levin S G, Age and the Nobel prize revisited, *Scientometrics*, 28 (3) (1993) 387-399.
66. Vlachy J, Nobel prizes : A bibliography of scientometric papers and data sources, *Scientometrics*, 1 (3) (1979) 295-301.
67. Schubert A and Braun T, Relative indicators and relational charts for comparative assessment of publication output and citation impact, *Scientometrics*, 9 (1986) 281-291.
68. Subramanyam K, Bibliometric studies of research collaboration: A review, *Journal of Information Science*, 6 (1) (1983) 33 - 38.
69. Op cit 2
70. Vinkler P, Bibliometric analysis of publication activity of a scientific research institute, In: *Informetrics 89/90*. Ed. Egghe L and Rousseau R. Elsevier Science Publishers, B. V.; 1990; 309-334.