

## Contribution of Willard S. Boyle to the Global Science and Technology: A Scientometric Portrait

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### ABSTRACT

The present paper undertakes a scientometric analysis of Willard S Boyle's 48 publications published during 1950-1982. The result of the study shows that Willard S Boyle had 11 single authored and 37 multi-authored publications during 1950-1982. The multi-authored papers include: two authored (31), three authored (05), and four authored (01). Table 1 shows that the first paper of the author was published in 1950 when he was 26. Boyle had no publications during 1952, 1964, 1967, 1969, and 1972. His highest publication productivity was in 1955 with the output of 9 publications (age 31), followed by 6 papers in 1959 (age 35), 5 papers in 1968 (age 44). The 50 percentile productivity life was 16 at the age of 44. The total productivity life of the author spans 33 years from the age of 26. To his credit Boyle has 1347 citations and his h-index is 18.

**Keyword:** Scientometric; portrait; publication productivity; research collaboration.

### INTRODUCTION

Scientometric portrait studies deal with mathematical and statistical study of individual career of scientists and researchers, and correlating bibliographical analysis of publications, academic and scientific achievements. According to Sangam et al [1] scientometric portrait study has received much attention in the recent years by proving to be of great value to the concerned scientists by highlighting various aspects of their career, such as productivity according to biological age, collaborative pattern, authorship and other characteristics. Bio-bibliometrics is a term that was first coined by Sen and Gan [2] to

mean the quantitative and analytical method for discovering and establishing functional relationships between bio-data and biblio-data elements. Kademani and Kalyane [3-4] were the first to use the phrase "Scientometric portrait" to carry out bio-bibliometric studies on scientists including Nobel laureates [5]. In the present paper, an attempt has been made to investigate the scientific work of Willard S Boyle (Canada), Noble Laureate of 2009, and his contribution to the world of science and technology.

Willard S. Boyle, Nobel Prize Winner in Physics, was born in Amherst, Nova Scotia, in 1924. He was home schooled by his mother until the age of fourteen. He attended Montreal's Lower Canada College to complete his secondary education. Boyle joined McGill University, but his education was interrupted in 1943, when he joined the Royal Canadian Navy during World War II. He was loaned to the Britain's Royal Navy, where he was learning how to land Spitfires on aircraft carriers. He obtained B.Sc. (1947), M. Sc. (1948) and PhD (1950) degree from McGill University. He received the prestigious Nobel Prize in Physics (2009) for the invention of an

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imaging semiconductor circuit—the CCD sensor [6].

- 3) To identify various channels of communication of his research output
- 4) To scale his h-index

### AIMS AND OBJECTIVES OF THE STUDY

The main aim of the present paper is to give a scientometric portrait of Willard S Boyle. The objectives of the paper are as follows:

- 1) To identify the number of citations received for the works of Willard S Boyle
- 2) To analyze Boyle's publication productivity and authorship pattern

### DATA AND METHODOLOGY

The data source for the study is *ISI Web of Science, Science Citation Index*, published by Thomson Scientific. It is the world's leading abstracting and indexing service provider on all aspects of science. By using suitable strategy related to literature produced by Willard S Boyle (Canada), the bibliographic details for

**Table 1. Publication productivity of Willard S Boyle in chronological order.**

APL	Year	Single & multi-authored papers				MT	TP	AA
		1	2	3	4			
1	1950	-	1	-	-	1	1	26
2	1951	-	1	-	-	1	1	27
3	1952	-	-	-	-	-	-	28
4	1953	-	1	-	-	1	1	29
5	1954	-	1	-	-	1	1	30
6	1955	1	6	2	-	8	9	31
7	1956	-	2	-	-	2	2	32
8	1957	-	1	-	-	1	1	33
9	1958	-	2	1	-	3	3	34
10	1959	2	3	-	1	4	6	35
11	1960	-	1	1	-	2	2	36
12	1961	1	1	-	-	1	2	37
13	1962	-	2	1	-	3	3	38
14	1963	-	1	-	-	1	1	39
15	1964	-	-	-	-	-	-	40
16	1965	-	1	-	-	1	1	41
17	1966	1	-	-	-	-	1	42
18	1967	-	-	-	-	-	-	43
19	1968	3	2	-	-	2	5	44
20	1969	-	-	-	-	-	-	45
21	1970	-	1	-	-	1	1	46
22	1971	-	1	-	-	1	1	47
23	1972	-	-	-	-	-	-	48
24	1973	1	-	-	-	-	1	49
25	1974	-	1	-	-	1	1	50
26	1975	1	-	-	-	-	1	51
27	1976	-	1	-	-	1	1	52
28	1977	1	-	-	-	-	1	53
29	1978	-	-	-	-	-	-	54
30	1979	-	-	-	-	-	-	55
31	1980	-	-	-	-	-	-	56
32	1981	-	-	-	-	-	-	57
33	1982	-	1	-	-	1	1	58
<b>Total</b>		<b>11</b>	<b>31</b>	<b>5</b>	<b>1</b>	<b>37</b>	<b>48</b>	

(APL- Age of Productive Life; MT- Total of Multi-authored Publications; TP- Total Publications. AA-Biological age of the author).

each record including author, title, citation, h-index and country of input were collected. Collected data has been analyzed according to the objectives of the study.

Willard S Boyle had 11 single authored and 37 multi-authored publications during 1950-1982. The multi-authored papers include: two

authored (31), three authored (05), and four authored (01). The above table shows that the first paper of the author was published in 1950 when he was 26. Boyle had no publications during 1952, 1964, 1967, 1969, 1972, 1978, 1979, 1980, and 1981. His highest productivity was in 1955 with the output of 9 publications (age 31), followed by 6 papers in 1959 (age

**Table 2. Publication productivity & authorship patterns of Willard S Boyle in various scientific domains**

No. of authors	Domains				Total no. of papers	%	Total no. of authorship	%
	A	B	C	D				
1- Author	3	1	3	4	11	22.91	11	11.95
2- Authors	20	5	3	3	31	64.58	62	67.39
3- Authors	5	-	-	-	5	10.41	15	16.3
4- Authors	1	-	-	-	1	2.08	4	4.34
<b>Total</b>	<b>29</b>	<b>6</b>	<b>6</b>	<b>7</b>	<b>48</b>	<b>100</b>	<b>92</b>	<b>100</b>

35), 5 papers in 1968 (age 44). The 50 percentile productivity life was 16 at the age of 41. The total productivity life of the author spans 33 years from the age of 26.

- A= Physics: Applied Physics & Optics
- B= Engineering: Electrical & Electronics
- C= Biology: Genetics, Heredity, Biophysics, Nuclear Medicine & Microbiology
- D= Miscellaneous (Multidisciplinary Sciences, Plant Sciences & Social Sciences)

Willard S Boyle had 11 single-authored publications in various domains: Miscellaneous (4), Engineering (1), Physics (3) and Biology (3).

Willard S Boyle’s 48 research publications have been published in 22 different journals. Journal wise-distribution of Boyle’s publications is presented in Table 3. Top ranking journals with a number of publications are: *Physical Review* (11), *Journal*

*of Applied Physics* (5), *Physical Review Letters* (5), and *Journal of Heredity* (4).

Boyle has collaborated with 24 researchers till 1982. It has been observed that Germer LH has collaborated with Boyle in maximum number of papers, i.e. 6 published during 1955; Kisluk P and Smith GE follow next with 4 papers during 1955-1982; Brailsford AD & Rodgers KF with 3 papers published during 1957-1960. Total authorship credit for 25 authors’ count 91, each collaborating author being given one authorship credit for each paper. Willard S Boyle to his credit has 48/91 (52.74%) of total authorship credit.

**CONCLUSION**

Scientometric portrait study helps us understand the position and contribution of a researcher in terms of his or her publications. The present attempt to outline a scientometric

**Table 3. Dissemination of the channels of communication used by Willard S Boyle**

Sl No.	Channels of communication	No. of papers	Cumulative	Period of journal	TY
1	Physical Review	11	11	1951-62	12
2	Journal of Applied Physics	5	16	1953-56	4
3	Physical Review Letters	5	21	1958-60	3
4	Journal of Heredity	4	25	1968-74	7
5	Applied Optics	2	27	1962	1
6	BELL System Technical Journal	2	29	1959-70	12
7	Journal of Physics & Chemistry of Solids	2	31	1959-61	3
8	Radiation Botany	2	33	1968	1
9	AIAA Journal	1	34	1963	1
10	American Journal of Botany	1	35	1950	1
11	BELL Laboratories Record	1	36	1975	1
12	Current Contents / Engineering Technology & Applied Sciences	1	37	1982	1
13	Economic Botany	1	38	1966	1
14	Genetics	1	39	1955	1
15	IEEE Spectrum	1	40	1971	1
16	IEEE Transaction on Electron Devices	1	41	1976	1
17	Nature	1	42	1955	1
18	Proceedings of the Institute of Electrical & Electronics Engineers	1	43	1965	1
19	Radiation Research	1	44	1968	1
20	Review of Scientific Instruments	1	45	1954	1
21	Scientific American	1	46	1977	1
22	Stain Technology	1	47	1961	1

**Table 4. Authorship credits of researchers collaborating with Willard S Boyle in chronological order**

Sl No.	Name of the collaborators	Domains				Period of association	TY	No. of authorships
		A	B	C	D			
1	Willard S Boyle	29	6	6	7	1950-1982	33	48
2	Gransden, MM	1	-	-	-	1951	1	1
3	Baird, DC	1	-	-	-	1953	1	1
4	Brown, JB	1	-	-	-	1954	1	1
5	Germer, LH	5	-	-	1	1955	1	6
6	Holmgren, AH	-	-	1	-	1955	1	1
7	Kisliuk, P	4	-	-	-	1955	1	4
8	Haworth, FE	1	-	-	-	1956	1	1
9	Brailsford, AD	3	-	-	-	1957-1960	4	3
10	Galt, JK	1	-	-	-	1958	1	1
11	Nozieres, P	2	-	-	-	1958	1	2
12	Rodgers, KF	3	-	-	-	1959	1	3
13	Smith, JL	-	1	-	-	1959	1	1
14	Weinreich, G	1	-	-	-	1959	1	1
15	White, HG	1	-	-	-	1959	1	1
16	Hsu, FSL	2	-	-	-	1960-1962	3	2
17	Kunzler, JE	2	-	-	-	1960-1962	3	2
18	Howard, RE	1	-	-	-	1961	1	1
19	Nelson, DF	2	-	-	-	1962	1	2
20	Orrok, GT	-	1	-	-	1963	1	1
21	Berkowit, DA	-	1	-	-	1965	1	1
22	Boyle, R	-	-	1	-	1968	1	1
23	Verleur, HW	1	-	-	-	1968	1	1
24	Smith, GE	1	2	-	1	1970-1982	13	4
25	Evans, JO	-	-	1	-	1974	1	1
<b>Total</b>		<b>62</b>	<b>11</b>	<b>9</b>	<b>9</b>	<b>----</b>	<b>-</b>	<b>91</b>

**Table 5. Authorship pattern and collaborative measures**

Nobel Laureate	Authorship pattern & collaborative measures											
	1	2	3	4&>	Citations	h-Index	TP	TA	CI	DC	CC	
Willard S Boyle	11	31	05	01	1347	18	48	92	1.91	0.77	0.41	

**1= Single author; 2= Two author; 3= Three author; 4= 4 & above author;**

Table 5 indicates that Willard S Boyle has received 1347 number of citations for his articles having h-index 18.

portrait of Willard S Boyle undoubtedly proves the usefulness of his works to the field of science and technology and gives an indication about the inspiration to young scientists throughout the world.

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