

Shaping of Science in India: Role of Indian Science Congress

Association, 1914-1947 Sneha Sinha

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Abstract

The Indian Science Congress Association (ISCA) occupies a unique place among various scientific institutions in India during late nineteenth and early twentieth century. It has been a pivotal organisation in shaping science in India. The paper aims at assessing ISCA's role in progress of science from the time of its inception in 1914 until India's Independence in 1947. It will analyse ISCA's contribution towards institutionalisation and professionalisation of science in India. ISCA occupies a centre-stage in the establishment of various scientific institutions, societies, academies of science and specialised laboratories, etc. Its members have played a crucial role in advancing scientific knowledge. At the same time, it has been the only all-India platform catering to numerous specialisms of science as well as showcasing their progresses and needs. It enabled the shaping of a viable scientific community which increasingly became internationally recognised for its contributions. ISCA has also provided a medium for greater realisation of the social responsibility of science in advancing and applying science and technology for national reconstruction.

Keywords: Indian Science Congress, Indian Science Congress Association, Science in India, Institutionalisation of science, Professionalisation of science, Scientific Community and Social Responsibility of Science.

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1. Introduction

The development strategy of a country is greatly influenced by maturity of modern S&T. Scientific institutions play a crucial role in shaping S&T and provide both infrastructure and human resource for cultivation and advancement of science. These institutions provide ground for shaping and nurturing the scientific community, which lie at the core of scientific development and influence the direction of scientific progress. Institutions like professional societies or associations enable personal intercourse and facilitate communication between scientific workers. Indian Science Congress Association (ISCA) chosen for this study, is an important professional association which caters to various disciplines of science and has played a crucial role in the overall progress of science.

During the late nineteenth and early twentieth century, most of the scientific institutions were result of European endeavours and were primarily European enclaves with very few Indian members and contributors and were not aimed towards the cause of science in India¹. During the last quarter of nineteenth century, as a result of indigenous efforts towards popularising science, Aligarh Scientific Society (1864) and Bihar Scientific Society (1868) came up. But, they couldn't sustain themselves for long and remained largely local². Amongst these, Indian Association for Cultivation of Science (IACS)³ can be viewed as a concrete step undertaken by Indians for the cultivation and advancement of science in India. But, its early history witnessed numerous struggles and obstacles in fostering pure research⁴. Amidst this, along with greater realisation of problems facing scientific teaching, research and administration of scientific institutions led to the establishment of ISCA in 1914⁵. Modelled on the lines of the British Association for the Advancement of Science (BAAS)⁶, ISCA organises annual meeting of scientists of varied disciplines of science in different parts of the country for promoting, popularising and advancing the cause of science in India⁷. This meeting is presided by the General President and the sectional meetings representing different specialisms of science is presided by the sectional presidents.

ISCA occupies a unique place among scientific institutions of the early twentieth century. Its historical analyses embody the direction of scientific progress in India. Often the study of such scientific institutions is neglected within the larger scope of history of science and STS hence, the study of such institutions is still at a rudimentary stage in India. Professional bodies like American Association for the Advancement of Science⁸ (AAAS), Australian and New Zealand Association for the Advancement of Science⁹ (ANZAAS) and British Association for the Advancement of Science (BAAS) have been adequately studied. But, such a study of ISCA

is lacking. ISCA has enabled the development of numerous scientific societies, academies of science, specialised institutions and laboratories, journals, etc. It provided a platform for shaping and nurturing the Indian scientific community which increasingly became internationally recognised. It provided medium for greater realisation of social responsibility of science in solving glaring problems facing the country. During this period, ISCA remained the single most important forum for showcasing advances made in various disciplines of science and their needs. This paper aims at assessing ISCA's role in shaping science in India from the time of its inception until India's independence.

2. Methodology

A comprehensive assessment of ISCA's role in progress of science in India during 1914 and 1947 requires both primary and secondary sources. The study is primarily based on archival research undertaken at the Asiatic Society of Bengal (ASB), ISCA's headquarters in Calcutta and National Archives of India, New Delhi. The ASB acted as the parent organisation during early years of ISCA. As a result, the proceedings, journals and annual reports of the ASB help in understanding the early history of ISCA. The chief source used for the study are the publications of the ISCA especially, its proceedings. The proceedings of the National Institute of Sciences of India (NISI), journals like *Current Science* were also crucial for the study. The secondary sources include, literature available within the broader field of history of science in India. The biographies and autobiographies of the scientists associated with ISCA are critical for assessing their role in the establishment of various scientific institutions and their contributions towards advancing scientific knowledge.

3. ISCA's role in shaping the Indian scientific community

The national scientific community comprises of the scientists of a country who have similar education and share similar culture of science¹⁰. An effective organisation and efficient functioning of the community is pivotal in building the scientific and technological capability of the country. ISCA annual sessions acted as a significant platform for catalysing 'community' consciousness and integrated the scattered specialist groups on a national scale¹¹. It was observed that the value of scientific research loses its importance or gets duplicated as a result of being scattered and isolated. It was believed that a close association among the scientific workers¹² from different parts of the country and belonging to different specialisms of science will be fruitful for advancement of not just specific sciences but, will also open up the field for coordination of different sciences to solve the general issues facing the country¹³.

At the time of inception of ISCA, Indians among the scientific workforce of the country were limited and were largely scattered and isolated in specific parts of the country. Most of the scientific workforce emerged from the British scientific services which had very limited number of Indian scientists as members or contributors. Thus, at the time of its inception the number of Indian scientific workers contributing to scientific research, were few¹⁴. However, the President of the Mathematics and Physics section of the fourth Congress, D. Mackichan stated that the number of Indian workers participating in the Congress had increased and it represented a science Renaissance in India¹⁵.

An empirical study of ISCA's proceedings certainly attest to its centrality in shaping and nurturing an Indian scientific community. Its annual sessions gained wide scale participation from scientific workers in India both, English and Indians. A marked increase is witnessed in the membership of ISCA especially of the Indian scientists and papers contributed by them under different sections. (See Table no. 1). During 1914 and 1947 there were fifteen English General Presidents and the rest were Indians. During this period, Indians have increasingly joined the rolls of the organisation and administration of the Congress. There is a rising trend seen in the participation of scientists from the universities which was earlier restricted to the government officials from various scientific services¹⁶.

Table 1: Membership of Indian Science Congress Association (1914-1947)

Serial No	Year of the Indian Science Congress Association	Place	Number of Members (honorary, permanent, ordinary, full sessional, associate and student members)
1	1914	Calcutta	60
2	1916	Lucknow	70
3	1917	Bangalore	270
4	1926	Bombay	716
5	1927	Lahore	815
6	1934	Bombay	900
7	1941	Benares	1594
8	1946	Bangalore	1925

Source: Proceedings of Indian Science Congress Association, 1914-1947

Table 2: Papers presented under different sections at the Indian Science Congress Association (1914-1947)

Serial No.	Year of the Indian Science Congress Association	Place	Total Number of Papers presented
1	1916	Lucknow	65
2	1917	Bangalore	74
3	1920	Nagpur	100
4	1926	Bombay	436
5	1927	Lahore	481
6	1930	Allahabad	727
7	1931	Nagpur	697
8	1933	Bombay	703
9	1935	Calcutta	776
10	1941	Banares	775

Source: Proceedings of Indian Science Congress Association, 1914-1947

Most of the noted as well as newly-emerging scientists participated and presented their papers during the sectional meetings of the Congress, it certainly provided a platform for junior research scholars. Young research scholars like Mudlagiri Nayak and C. V. Raman presented their papers in Chemistry and Physics sections at the second session of ISCA¹⁷. A number of research groups emerged¹⁸ around scientists closely associated with ISCA. This was reiterated by D. Mackichan, President of the Physics and Mathematics sections of the Fourth Indian Science Congress, who observed that number of able students are gradually building an environment for greater appreciation of scientific pursuits¹⁹. The scientists associated with ISCA formed research groups by involving their students and contributed immensely towards cultivation and advancement of scientific knowledge. S. S. Bhatnagar was instrumental in the creation of research groups for physico-chemical research in Banaras Hindu University²⁰.

The sectional meetings of ISCA provided a medium for greater intra-discipline interaction and cooperation. The analyses of the sectional presidents' addresses attest to shaping and advancement of the direction of future course of development of their respective scientific disciplines²¹. They also emphasised at utilization of science for solving problems facing the specific field as well as those facing the country. The president of the agriculture section in 1927, Prof. H. K. Sen calls ISCA's chemical section as the most representative body of chemists in India²². These sessions provided a scope for collaborations which is attested to by a number of papers which were co-authored by two or more Indians as well as by Indian and

European scientific workers²³. Various scientific institutions or departments organised social gathering of their respective disciplines of science during these Congresses which enabled greater personal intercourse between scientific workers of same field²⁴. Many scientific institutions, societies, academies of science scheduled their annual sessions during ISCA's sessions²⁵.

Apart from the cooperation and interpersonal communication of scientists of a particular field of science, ISCA was a forum for communication and cooperation among scientists of similar as well as different fields²⁶. The ISCA committee arranged numerous functions in connection with the Congress like garden parties, receptions, excursions, "science dinners", "science conversazione", etc. which effected greater personal and social intercourse between scientific workers²⁷. ISCA became a meeting ground for delegates from different scientific institutions and universities of the country²⁸. The joint meetings of ISCA provided scope for greater coordination and collaboration between various sciences. It became the largest and most representative organization of scientific workers in India. The delegates from the British Association were invited by ISCA to hold a joint session. In addition to BAAS delegates, a number of eminent scientists from numerous international scientific institutions, academic bodies and universities attended the silver jubilee meeting of the Congress²⁹. Foreign delegates from AAAS and Ceylon attended the ISCA's session in 1940³⁰. ISCA certainly provided a platform for greater visibility of the Indian scientific community internationally.

Since ISCA's yearly meetings were held in different parts of the country, it enabled greater interaction and brought together the scattered and isolated scientific workers. Out of the thirty-four sessions of ISCA, six meetings were held in Calcutta, four times each it met in Bangalore and Madras, thrice in Bombay, Lahore and Nagpur, twice each it was held in Lucknow, Banares and Delhi and it once in Allahabad, Patna, Indore, Hyderabad and Baroda. The significance of the city chosen and its contributions towards the advancement of science was reiterated during the opening proceedings³¹. The diversity in the choice of places suitable for the annual Congress syncs well with the Congresses' objective to promote and advance the cause of science in different parts of India based on the model of BAAS. But, it can also be seen that till the time of independence the annual meetings of the Congress remained restricted to cities that were already identified as important centres for scientific learning and research along with few lesser emerging ones. A study of zonal distribution of ordinary members represent a greater influence of ISCA in the east as compared to south, west, central and north-west zones. Therefore, a need for felt for strengthening influence of the Association in these zones³².

ISCA's annual sessions facilitated intra-discipline cooperation and also provided greater scope for coordination amongst workers of different sciences for solving the glaring problems facing the country. The General Sectional Presidents' addresses' have highlighted the importance of collaboration and cooperation between different specialisms of sciences for progress of the field, for solving the problems facing a particular field and larger problems facing the country. It helped in mitigating the geographical and specialised isolation. ISCA certainly acted as a platform for catalysing 'community' consciousness. ISCA acted as a unique forum which enabled the young emerging scientists to interact with noted scientists of their field as well as those of the other disciplines of science. The presence of notable names among the General Presidents, Sectional Presidents validates its position as a viable association. ISCA was the only national platform for showcasing the advancement in varied scientific fields during this period. It certainly provided a medium in order to impress upon the needs of the scientific community to the government. The resolutions adopted by the zoology section at the silver jubilee session of the Congress urged upon the government, the necessity and importance of constituting an all-India department of fisheries. It helped in granting professional status to statisticians and defined the pay of scientific workers and handed it over to the Planning and Development department of GOI. Its sectional committees supported decimalisation of currency and few members also supported decimalisation of weights and measures³³. ISCA certainly provided a platform for shaping and strengthening the scientific community.

4. ISCA's Role in the establishment of Scientific Institutions

The scientific institutions, associations, societies, etc. are essential for providing infrastructure and human resource for cultivation and advancement of science which certainly influences the direction of scientific progress. Professional societies or associations facilitate communication between the scientific workers of various disciplines of science. ISCA has played an instrumental role in the establishment of numerous scientific institutions like scientific societies³⁴, academies of science and specialised institutions and laboratories between 1914 and 1947.

4.1. Scientific Societies

The sectional meetings of ISCA have played an important role in the growth and organization of various disciplines of science. This can be attested to by the foundation of numerous scientific societies during 1914 and 1947. The Institution of Engineers³⁵, Calcutta was formally inaugurated in 1920 at ASB, Calcutta a month after ISCA's annual meeting. In 1921, Rajendranath Mookerjee presided over sessions of both ISCA and the Institution of

Engineers³⁶. The founder President of ISCA also founded the Anthropological Club, later renamed as Anthropological Society³⁷. The Indian Chemical Society³⁸(ICS), national forum for chemists was founded in 1924 by J. N. Mukherjee, J. C. Ghosh and S. S. Bhatnagar who were closely associated with ISCA. Meghnad Saha presided over ISCA's session in 1924³⁹. In the same year, he along with other council members, closely associated with ISCA founded the Indian Physical Society. The Geological, Mining and Meteorological Society of India was also founded in 1924. The Science Congress Association supported the proposal for the establishment of a central Institute of Applied Psychology in India⁴⁰.

ISCA has been instrumental in the foundation of numerous scientific societies. The resolution for inception of the Indian Botanical Society was passed by the section of botany at ISCA's Nagpur session in 1920. The efforts of the participants of the twelfth annual meeting of ISCA led to the foundation Indian Psychological Association⁴¹ in 1925. The Indian Society of Pathology and Microbiology was formally inaugurated during ISCA's session in 1938. ISCA certainly provided an atmosphere for the growth of a number of other scientific societies catering of various specialisms of science like the Society of Biological Chemists, Bangalore (1931), Calcutta Geographical Society (1933), Indian Society of Soil Science (1934) and Indian Psychological Society (1935), etc. In few cases, ISCA members played a significant role and in majority of the cases ISCA formed a platform for proposing and discussing the foundation of numerous societies.

4.2. Academies of Science

Amongst increasing demands for organisation of scientific research and greater needs for cooperation and consolidation of scientific work in India, there was a need felt for establishment of academies of science⁴². Numerous science academies came up during this period ranging from regional to national academies of science. The proposals for United Provinces Academy of Science (renamed as National Academy of Science) and National Institute of Sciences of India (later renamed as Indian National Science Academy) were presented at the annual session of ISCA. As a result, C. V. Raman who was also associated with ISCA, established the Academy of Science in Bangalore in the same year. The ISCA and well as scientists associated with it played a crucial role in the establishment of these academies of science.

The United Provinces Academy of Science was constituted in 1930⁴³ and Meghnad Saha who was closely associated with ISCA played a leading role in drafting its objectives, rules and regulations. Saha increasingly began to feel the need to organise the largely scattered

scientific force and give them a voice in matters related to development. Saha was not satisfied with the regional character of the Academy and felt the need for an all-India academy of science. Therefore, he proposed for an Indian Academy of Science during his presidential address at the annual session of ISCA in 1934 supporting the resolution put forward by Fermor at ISCA's session in 1933. The attendees of the annual session of Indian Science Congress Association in 1934 were provided with the full history of the movement as well as the proposal for the foundation of the same. The objectives⁴⁴, organisation and structure of the National Institute of Sciences of India were also discussed and justified by the General President of ISCA in 1934. In 1934, Saha asked for support for Indian Academy of Science on the lines of the Royal Society. The committee of ISCA unanimously accepted the proposal⁴⁵. As a result, the National Institute of Sciences of India was established as an all-India body of scientists on the January 7th, 1935 at a meeting held in the Senate House of the Calcutta University under the chairmanship of J. H. Hutton who was during the same time presiding over ISCA's annual session⁴⁶. The proceedings of ISCA clearly attest to centrality of ISCA and its members in the foundation of the Academies of Science during this period.

4.3. Specialised Scientific Institutions and Laboratories

The scientists actively involved with ISCA contributed immensely to the foundation of specialised institutions of science⁴⁷. Prior to the Second World War, there was little or no attention given to the need for coordination between scientific and industrial research. The fundamental research remained restricted to a few universities and research institutes. The industries did not develop research programmes of their own barring a few⁴⁸. The Second World War brought to light the unorganised state of scientific and industrial research in India. There were repetitive appeals made by Indian scientific workers like Meghnad Saha and few others for the establishment of CSIR on the lines of DSIR in Britain for coordination between scientific and industrial research, and national laboratories. The urgent need was voiced by J. C. Ghosh at the Lahore session of ISCA in 1939 and later reiterated by M. Visvesvaraya in his address at IISc, Bangalore. As a result, Board of Scientific and Industrial Research was set up in 1940 for enabling a planned liaison between industry and science. The efforts made by Mudaliar and S. S. Bhatnagar led to the establishment of Council of Scientific and Industrial Research in 1942⁴⁹.

During 1940s, S. S. Bhatnagar started persuading the government to accept the proposals for establishing national research laboratories in India which could undertake assessment of resources, conduct tests and evolve standards and advice the government as well as the

industry.⁵⁰ He considered setting up of national laboratories and research institutes crucial for India as most industrial production comes from small and medium-scale industries who could not afford research on their own. Thus, a number of national laboratories came up in India and scientists associated with ISCA and ISCA as a platform contributed significantly to the establishment of these specialised institutions and national laboratories which were critical at a juncture when India was aiming for self-governance, self-reliance and national reconstruction.

5. ISCA's Role in Professionalisation of Sciences

Proliferation of a number of science departments in universities, growth in specialisation and sub-specialisations within scientific fields, scientific journals and international recognition for knowledge production attest to professionalisation of science. The presidential and sectional presidents' addresses showcased that the Congress certainly formed a medium for expression of the importance of science - both pure and applied in the overall development of India and as well as for solving various problems facing India. The Sectional Presidents' address was largely discipline-centric after which papers were presented by a number of scientific workers. These sectional meetings provided a national platform for showcasing the advances made in different specialisms of science as well as hindrances of the field and attest to growing specialisation of scientific fields. The members as well as scientists associated with ISCA have been increasingly recognized internationally for advancing scientific knowledge. This period is also marked by a proliferation of scientific journals by various scientific societies and inception of the journal, *Current Science*, *Science and Culture*, etc.

5.1 Institutionalisation of Science

Institutionalisation of science is the precursor to its professionalisation. The institutionalisation of science is marked by growth in scientific departments, university chairs, discipline-centric courses and syllabi. The scientists associated with ISCA played a major role in institutionalisation of science during 1914-1947. Until 1906, universities were merely seen as examining bodies and only few colleges like the Presidency College, Scottish Church College were entitled to conduct post-graduate classes in Calcutta. Asutosh Mookerjee, first General President of ISCA felt the need for post-graduate teaching departments both in arts and science⁵¹. Two months after the first ISCA meeting, he established the University College of Science in Calcutta⁵² which served as the cradle for Indian science.⁵³

The scientists associated with ISCA played a critical role in founding numerous departments, institutions catering to different specialisms of science. M. S. Visvesvaraya established school

for agriculture and mechanical engineering at the University of Mysore in 1916⁵⁴. The President of the fourth session of ISCA strived for inclusion of biology in the curriculum at Madras. He had to initially take classes for both zoology and botany⁵⁵. N. R. Dhar's efforts resulted in the establishment of the chemistry department at Allahabad University⁵⁶. SSB inaugurated a new research school on colloidal and magneto chemistry for higher teaching and research in chemistry. As a result of these efforts admissions in applied chemistry increased⁵⁷. C. V. Raman founded the physics department at IISc. He also made continuous efforts to make the laboratory at IACS well equipped for scientific work⁵⁸. The department of botany was started for the first time in the University of Lucknow in 1921 and instruction of geology was initiated in 1943. Birbal Sahni became the first professor the department and also taught geology⁵⁹. With the discovery of nuclear fission in 1939, M. N. Saha included nuclear physics in M.Sc. syllabi for keeping his students' adept with the latest developments and keep Indian physics in sync with the progresses made in the West.

5.2. Specialisations and sub-specialisations within scientific disciplines

The growth of sections and sub-sections in the sectional meetings of ISCA clearly attest to growth in new sciences and increasing specialisation and sub-specialisation. At the first annual session of ISCA held at Calcutta, a total number of thirty-five papers were presented under six sections⁶⁰. During the period of study a marked growth is witnessed in numerous sciences like, geography, geodesy, psychology, statistics, engineering, metallurgy, anthropology, etc. illustrated by an increase in number of sections at the Congress⁶¹. The number grew from six to thirteen between the first and thirty-third session held in 1946⁶². At the initial meetings of the congress few associated sciences were clubbed into one section. But, they were soon segregated into independent sections⁶³ clearly attesting to growing specialisation which is a crucial indicator of professionalisation of science.

Table 3: Number of Sections at Indian Science Congress Association (1914-1947)

Serial No	Session/Year	Number of sections
1	Third/1916	7
2	Fourth/1917	6
3	Seventh/1920	7
4	Thirteenth/1926	9
5	Fourteenth/1927	9
6	Seventeenth/1930	9
7	Eighteenth/1931	9
8	Nineteenth/1932	9
9	Twentieth/1933	9
10	Twenty-First/1934	8
11	Twenty-Second/1935	9
12	Twenty-Third/1936	10
13	Twenty-Sixth/1939	11
14	Twenty-Seventh/1940	13
15	Twenty-Eighth/1941	14
16	Twenty-Ninth/1942	14
27	Thirty-Third/1946	13
18	Thirty-Fourth/1947	13

Source: Proceedings of the Indian Science Congress Association, 1914-1947

Table 4: Number of sub-sections within the section of Agriculture (1914-1947)

Serial No	Year/Session of Indian Science Congress Association	Number of sub-sections
1	1930/ Seventeenth	9
2	1931/ Eighteenth	9
3	1932/ Nineteenth	10
4	1933/ Twentieth	11
5	1934/ Twenty-First	10
6	1939/ Twenty-Sixth	7
7	1940/ Twenty-Seventh	12
8	1941/ Twenty-Eighth	7
9	1942/ Twenty-Ninth	9
10	1946/ Thirty-Third	6
11	1947/ Thirty-Fourth	6

Source: Proceedings of the Indian Science Congress Association, 1914-1947

Table 5: Number of section within the section of Chemistry (1914-1947)

Serial No	Year/ Session of Indian Science Congress Association	Number of sub-sections
1	1936/ Twenty-Third	5
2	1939/ Twenty-Sixth	6
3	1940/ Twenty-Seventh	7
4	1941/ Twenty-Eighth	6
5	1942/ Twenty-Ninth	6
6	1947/ Thirty-Third	5
7	1947/ Thirty-Fourth	5

Source: Proceedings of Indian Science Congress Association, 1914-1947

ISCA provided a platform for the growth and development of scientific disciplines. This is illustrated by an increase in number of sections as well as sub-sections during this period. The formation of a tree-like model is a crucial indicator of professionalisation of science. Thus, the growth of number of sciences along with development of its numerous sub-branches attests to professionalisation of science, in which ISCA has played a critical role. Until the fourteenth meeting of ISCA held in Lahore, no section had sub-sections⁶⁴. Clearly, ISCA sectional meetings saw a move towards greater specialisation during the period of study.

5.3. Scientific Journals

Scientific journals are great indicator of scientific productivity. Prior to the twentieth century, scientific journals were practically non-existent and most of the researches done in India were published in journals abroad⁶⁵. However, the growth in number of research papers resulted in delay in their publication. Therefore, with the foundation of scientific societies numerous journals⁶⁶ came up during this period but they were largely discipline-centric. Indian scientific workers started demanding a journal similar to 'Nature' in Britain. ISCA played a critical role in the inception of *Current Science*⁶⁷.

The journal *Current Science* was a result of the resolution passed at the special meeting held during the 1932 session of ISCA. Its inception was a combined effort of the stalwarts of Indian science which included C. V. Raman, Birbal Sahni, Meghnad Saha, Martin Forster and S. S. Bhatnagar who were closely associated with ISCA. Its parentage and annual donation came from the ISCA. "Rupee Fund" was also initiated to secure financial position before the launch of the journal and rates of advertisements were also fixed the following months. The journal was unique and an important one as no other journal was published in India at that time that catered to all branches of scientific work. It was realised that a publication of this nature would

assist in coordinating research and in supplying up-to-date scientific information to the scientific workers as well as among those interested in science and progress and development of science in general within the country. The journal became a medium for discussion and communication on a number of issues concerning science and scientific activities within the country as a whole. It is a leading inter-disciplinary science journal of India till date.

Meghnad Saha and P. C. Ray who were both General Presidents and Sectional Presidents of sessions of ISCA established the Indian Science News Association in 1935. The objective was to disseminate scientific news, in order to achieve this the Association started publication of the journal *Science and Culture*. Alongside, it also organised symposiums, seminars, endowments and memorial lectures well. The first council of the Association included P. C. Ray, U. N. Brahmachari and Meghnad Saha. The Association received personal donations from Brahmachari and Ray. Apart from individual scientists, institutions like University College of Calcutta, IACS, ISCA along with few others extended their support. A number of editorial written by Saha himself along with other leading scientific intelligentsia in *Science and Culture* addressed to various problems associated with post-war organisation of research during 1939 and 1942.⁶⁸

5.4. ISCA's Role in Knowledge Production

The Indian scientific community was shaped during this period and it also became increasingly recognised for advancing scientific knowledge. The President of the seventeenth Congress stated that the congress provided most important stimulus to scientific research in the country⁶⁹. ISCA became a national platform for showcasing scientific productivity and knowledge production. The participation of scientific institutions across the world in ISCA session attest to its fame. As against 35 papers presented at the first session⁷⁰, 800 papers were read at the silver jubilee session of the Congress⁷¹. In 1946, a proposal for the award of prizes for manufacture of scientific apparatus was put forth. A number of India scientific workers were recognised internationally for advancing scientific knowledge.

By the time of independence, although the scientific community of India was small as compared to other countries but it was well-organised in fields like physics, chemistry, mathematics, medicine, geology and biological sciences. Many scientists associated with ISCA like J. C. Bose, P. C. Ray, C. V. Raman, M. N. Saha, etc. have played critical role in advancing pure science and have published numerous papers in international journals. Many Indian scientists like S. S. Bhatnagar⁷², P. C. Ray⁷³, J. C. Bose⁷⁴, S. K. Mitra, B. B. Ray, etc. received international recognition for their contribution towards advancing scientific knowledge. P. C.

Ray's efforts in setting up Bengal Chemical and Pharmaceutical Limited enabled S. S. Bhatnagar to work in the direction of greater liaison between university and industry between pure and applied science in his laboratories⁷⁵. This period saw a marked advancement in basic research but also witnessed need for application of science for solving the problems facing the country which was also pressed upon numerous times at the annual meetings of ISCA. At the inception of the twentieth century, there was hardly any visibility of Indian scientists in the international sphere. But by the third decade of the twentieth century they started receiving international recognition and fame⁷⁶. A number of Indian scientific workers were sent on delegations and conferences abroad and many became fellows of international societies like the Royal Society of London and received international awards. S. S. Bhatnagar represented ISCA at Dundee on the invitation of BAAS.

All these certainly indicate a marked increase in scientific productivity of the scientific workers in India as well as recognition and fame of these efforts by the international scientific community transforming the almost non-existent community consciousness of the Indian scientific workers into a viable community. ISCA provided a platform for the scientific community to impress upon their needs to the government and facilitated communication to solve the problems faced by the scientific community and the general problems facing the country. It helped in recognition of professional status to statisticians.

6. ISCA's Role in Recognising Social Responsibility of Science

There was a growing realisation that science was increasingly becoming a specialists' job and specialisation of scientific disciplines would divorce the scientists from the social needs of the country. ISCA sessions constantly reiterated the importance of science and social responsibilities of science and scientists towards service of the nation. The period under study is marked by the experience of the twin World Wars, Bengal famine, coming up of the Bombay plan, amidst which India's struggle for independence against the colonial rule was gaining momentum which resulted in India's independence in 1947.

ISCA played a critical role in showcasing importance of science to general public. The evening public/popular lectures became a special feature of its session since 1916⁷⁷. It also organised exhibitions for displaying scientific apparatuses⁷⁸. The importance of social sciences and teaching of sociology in universities was reiterated at various ISCA sessions. In order to cater to the problem of specialisation, ISCA instituted the committee of science and its social relations in 1939. It aimed at drawing public attention to the achievements of science and its social application for human welfare through papers and articles in journals and newspapers⁷⁹.

The addresses of the General and Sectional Presidents' also recognised the need to popularise science.

ISCA provided a platform for intercourse between scientific community and the officials of GOI, provincial governments and states, commercial bodies as well as political leaders. Numerous dinners, "At Home" were arranged during these sessions by government officials which facilitated greater social and personal intercourse⁸⁰. ISCA sessions have showcased greater realisation by government officials of increasing importance of science in solving the problems facing the country as a result of exigencies of the First World War. ISCA's opening proceedings saw participation of high-ranked officials of GOI like Lt. Governor of the United Provinces, Sir James Meston during the third Congress recognised the importance of science and scientists' and need for advise from the scientific community on the questions of industrial advance and also on matters of public health, in dealing with diseases and problems of education and agricultural productivity⁸¹. The President of the Medical Research section at the eleventh Science Congress emphasised that government cannot combat diseases without knowledge of sanitary and medical relief and without allocating a fair proportion of revenue for medical research⁸². The titles of the General presidents' addresses suggest a satisfactory assemblage of general issues pertaining to the nature of scientific development in India and advancement of specialised sciences apart from few discipline-centric ones. The importance of science in solving primary problems relating to health, hygiene, food security and agriculture were discussed by numerous general presidents of ISCA.

The historical context is also reflected in few sessions of ISCA. The solution to problems of agricultural productivity, industrial advance, importance of post-war zoology and 'next war-man versus insects' attest to the exigencies of the First World War⁸³. The need for applying research in soil chemistry, social bacteriology, physiology, geology and physics and use of new farm implements in agriculture was emphasized to increase agricultural productivity. There are few sciences that have received greater attention after the war like, meteorology which would enable reliable fore-knowledge of failing monsoon and could solve the problems of scarcity and famines⁸⁴. Numerous joint meetings, symposia and discussions aimed at solving the problems facing the country through coordination and cooperation between sciences and between research and its application were held during ISCA sessions. For example, a joint meeting was held in 1925 by sections of agriculture, chemistry and botany in order to discuss the true path of Indian industrial development⁸⁵.

The experience of the twin World Wars highlighted the problems facing the country and need for coordination between science and industry. Ardeshir Dalal presided ISCA's session

in 1941 and reiterated the importance of symbiotic relation between science and industry⁸⁶. At various sessions of ISCA, the need for coordination between universities and industry for applying fundamental knowledge in order to solve the practical needs of the country was constantly reiterated. It acted as an important platform for such coordination as numerous learned societies, universities, research institutes participated in its annual sessions⁸⁷. With the Freedom struggle gaining momentum and increased demands for self-rule from 1930s, ISCA sessions repeatedly emphasised on planning or utilisation of India's resources and centrality of science as India was entering the phase national reconstruction.

The National Planning Commission was inaugurated in 1939 for an effective coordination between science and industry and planning for solving the glaring problems facing the country which was also discussed in ISCA's session. In 1940, general discussion on 'role of science in national planning' and a popular lecture by J. C. Ghosh was titled 'national planning with respect to India's development'⁸⁸. In 1941, there was a discussion on 'food planning'. With increasing demands of self-rule, greater emphasis is reflected in ISCA sessions on utilisation of scientific research in power production, efficient utilization of natural resources, etc. A joint discussion by sections of geology, geography and geodesy was held on the 'utilisation of Indian mineral reserve'⁸⁹ and 'utilization of low grade indigenous raw materials for metallurgical industries'⁹⁰. D. N. Wadia's address in 1943 at Calcutta explicitly pointed out that there was a need for awakening social responsibility of science and applying science to the everyday needs and problems facing the country. Food security, utilization of science for service of the nation became extremely crucial topics of General Presidents' addresses after the Bengal famine in 1943. ISCA's general president Ardeshir Dalal was a key figure in shaping the Bombay Plan. The General Presidents addresses after 1943 are synonymous with the Bombay plan which aimed at the development of economy by state intervention in post-independence era in which science would play a pivotal role. As a result of repeated demands from scientific intelligentsia, Council of Scientific and Industrial Research (CSIR) was established in 1942 and government funded the establishment of its affiliated national research laboratories like National Metallurgical Laboratory, Jamshedpur, and National Physical Laboratory. In 1946 there was a joint discussion on 'grow more food campaign' by agriculture science and botany sections. The influence of Russian model on Indian scientists is reflected in M. N. Saha's popular lecture on 'Science in Russia' in the same year⁹¹. Post-War era also witnessed a greater realization of the utilization of science for human welfare rather than destruction of mankind. There was also a discussion on 'psychological conditions of peace' by the psychology and educational science section in 1946. In the same year, sub-committee of science and its social relations emphasised

controlled use of atomic energy for social welfare rather than its anti-social utilisation and demanded restricted knowledge concerning the secrets of atomic bombs⁹². The communal trouble in Calcutta and wave of political frenzy that swayed Bengal before and after partition had repercussions and paralysed acts of Association⁹³

Jawaharlal Nehru presided the annual session in 1947 annual meeting of ISCA. He became the architect of Indian science and believed that the development of scientific research, both pure and applied and scientific method was the basis and foundation for all other work (NISTADS, CSIR: 1989). But, M. K. Gandhi who also an important political face in the freedom struggle is completely absent from the records of ISCA. ISCA certainly became a platform for showcasing the importance of a socially responsible science in which science and scientists play a pivotal role in national reconstruction.

7. Conclusion

The attempt of the paper was to analyse ISCA's role in shaping of science in India. ISCA during the period of study proves to be the only professional association of science that caters to a variety of disciplines of science. The growth of ISCA's membership, number of papers presented at its sessions, increase in volume of the proceedings of ISCA and shifting of its headquarters from the Asiatic Society of Bengal to a permanent habitation clearly demonstrates an increase in its activities. The association of notable scientists and researchers with ISCA confirms its importance as a viable professional association. Many of the scientists like S. S. Bhatnagar, Ardeshir Dalal associated with ISCA have played an instrument role in planning for national reconstruction.

ISCA has played a critical role in shaping and nurturing the Indian scientific community. It has provided a platform for scientific workers to showcase the advances made in their field of science. It also acted as an important medium for impressing the needs of the scientific community upon the government. The annual sessions of ISCA played a critical role in bringing together the largely scattered and isolated scientific workforce. It provided visibility for Indian scientific workers and also a meeting ground for them. A number of scientists associated with ISCA formed research groups. It provided a common platform for discussion for scientists from different fields of science. It also provided a forum for peer-review as both young and senior scientists of the different disciplines of science attended the sectional meetings of the Congress. ISCA has been an importance actor during the period of study in developing a community consciousness. It has also enabled collaboration and cooperation between Indian scientists as well as Indian and European scientists. As a result of shaping of a

scientific community, there were increased efforts made towards made by them for scientific development.

ISCA has played an important role in providing infrastructure and human resource which form the basis of scientific development. ISCA as a platform and through its associated scientists has played an instrumental role in establishment of a number of scientific societies, academies of science, scientific institutes and research laboratories which inturn have played an immensely important role in organisation and development of science. These scientific institutions have played a critical role in cultivation and advancement of science in India. Apart from the foundation of these scientific institutions, ISCA has acted as an important platform for showcase of knowledge production which have been internationally recognised during the period of study.

ISCA also through its annual sessions and addresses of General Presidents constantly reiterated the importance of social responsibility of science. As a result of the experience of the twin World Wars and efforts towards self-rule, scientists during ISCA sessions demanded a fair balance between basic and applied science and reasserted the importance of cooperation of science and industry. These sessions also drew attention of the vitality of science for solving the problems of health, hygiene, agriculture, population, poverty and food security especially in the wake of the Bengal famine. As the National Planning Commission came up, scientists attested to the importance of scientific development for utilizing the natural resources of the country for national reconstruction. Apart from the scientists, ISCA also became a forum for expression of importance of science in service of the nation by political leaders like Jawaharlal Nehru.

The Indian example of ISCA and its contribution in shaping of science is unique. ISCA proved to be an important professional association during the period of study and has been an important platform and actor in shaping science in India. Therefore, it is imperative to cater to this gap in literature which ignores the historical evaluation of scientific institutions within the scope of STS. In the contemporary times, there is growing criticism of ISCA within the scientific community. In light of this, an assessment of institutional histories can enable us to understand not just progress of science and technology, but also help us gauge why and how few institutions fail to continue in the same vigour, how some institutions adapt to newly emerging scenarios and few don't, which is important within the larger scope of STI.

Endnotes

¹ The scientific societies include Asiatic Society of Bengal, Calcutta; Literary and Scientific Society, Madras; Agricultural and Horticultural Society of India; Agricultural and Horticultural Society of Punjab; Bihar and Orissa Research Society; Panjab History Society and Bombay Natural History Society. Most of these societies were regional in nature and did not cater of all disciplines of science. They were not aimed at cultivation, advancement and popularisation of science in India, rather they propagated only those sciences which could cater to the economic interests of the colonial government. For example, the Asiatic Society was founded by William Jones in 1784 for studying all the aspects of relationship between “Man and Nature” within the geographical limits of Asia (Home, Public, no. 49, 11 May 1826). Initially, its organisational structure and membership remained restricted to Europeans. In 1829, the rules of the society were altered and its membership became open to Indians (ASB: 1829). Not before the latter half of the nineteenth century, Indians began joining its organisational structure and started contributing papers in the journal of the Asiatic Society.

² Kumar Deepak (1995), *Science and the Raj*, New Delhi: Oxford University Press, pp. 196-198.

³ The latter quarter of the nineteenth century witnessed increasing curiosity among Indian intelligentsia towards the achievements and spirit of science. This growing intellectual ferment led to greater realisation of the importance of science as a social and national force. IACS was founded by an Indian, Mahendralal Sircar and it became the only place where Indians could undertake scientific research work independently.

⁴ Lourdasamy, John Bosco (Dec. 2003), “The Indian Association for the Cultivation of Science: A Tortuous Tryst with Modern Science”, *Journal of Science Education and Technology*, Vol. 12, No. 4 (Dec., 2003), pp. 381-396.

⁵ The credit for the genesis of ISCA is attributed to two British chemists- John Lionel Simonsen and P. S. MacMahon who were appointed as professors of chemistry in Madras and Lucknow respectively in 1910. In addition to his interest in scientific research, J. L. Simonsen was greatly involved with the problems of teaching in science particularly, chemistry and administration of scientific institutions in India. As a result, he decided to establish an organisation similar to BAAS in India. In his initiative, he was joined by Prof. MacMahon who was also immensely disappointed with the appalling state of teaching and research in chemistry and lack of proper laboratory training in Indian universities. In order to stimulate scientific research in India, they proposed ISCA in 1911. The proposal met an overall general consensus and the first meeting of ISCA was held under the aegis of the Asiatic Society of Bengal in 1914 (ASB: 1917).

⁶ The British Association for Advancement of Science was founded by Sir David Brewster in 1831. The Association aims to support, grow and diversify the community of people interested and involved in science and to strengthen their influence over the direction of science and its place within the society. The Association played an important role in the progress of different specialisms of science and their application for material well-being of the general public. The sections of the Association shaped numerous corresponding specialised scientific societies in Britain like Glasgow Geographical Society, Norfolk and Norwich Naturalists’ Society (Howarth: 1931).

⁷ The objectives of ISCA include, (i) to advance and promote the cause of science; (ii) to hold annual Congress at a suitable place in India; (iii) to publish proceedings, journals, transactions and other publications as may be considered desirable; (iv) to secure and manage funds and endowments for the promotion of science, etc. (ISCA:1954-55 pp.1-5)

⁸ The American Association for Advancement of Science was founded in 1848. It marked the beginning of the formation of the American scientific community and represented all sciences at a national level (Kohlstedt: 1976).

⁹ The Australian and New Zealand Association for Advancement of Science was established in 1888. Roy MacLeod calls it as the largest and the most successful gathering of scientists witnessed in Australasia. ANZAAS played a critical role in advancement of various sciences and shaping of scientific community. It has played a pivotal role in application of science in serving the society (MacLeod: 1988).

¹⁰ Gaillard, J., Krishna, V. V. and Waast, R. (eds.) (1997). “Introduction: Scientific Communities in the Developing World”, *Scientific Communities in the developing world*, New Delhi: Sage Publication, pp. 19.

¹¹ Krishna, V. V. (1997), “The Scientific Community in India”, Gaillard, J., Krishna, V. V. and Waast, R. (eds.) (1997). *Scientific Communities in the developing world*, New Delhi: Sage Publication, pp. 243.

¹² The Governor of Madras, Lord Pentland in his speech at the opening proceedings of the second session of the Congress talked about ISCA’s importance in encouraging workers in science and bringing them together in a country so large in area as India through personal and social intercourse (ASB: 1916). Its importance in mitigating the twin isolations – namely geographical and specialization of scientific workers in India was reiterated by L. L. Fermor in his inaugural address of National Institute of Sciences of India (NISI: 1935).

¹³ Asutosh Mookerjee’s presidential address at the first meeting of the ISCA in “The First Indian Science Congress”, *Proceedings and Journal of the Indian Science Congress Association, 1914*, Calcutta: Asiatic Society of Bengal.

¹⁴ Until 1829, all members of the ASB were Europeans. Rajendralal Mitra was the first Indian to be elected as one of the secretaries in 1846. There is a similar absence of papers contributed by Indian scientists in journal of the ASB. As compared to British scientists who contributed 1021 papers during 1836 and 1895, Indians could publish only eighteen papers (Krishna et. al: 243). At the second session of the Congress, the Governor of Bengal, Lord Pentland also observed that the papers contributed by Indians under various sections are quite limited and major share of the papers were read by Europeans (ASB: 1915).

¹⁵ Asiatic Society of Bengal (1917), *Journal and Proceedings of the Asiatic Society of Bengal*, Calcutta: Asiatic Society of Bengal, pp. clxii.

¹⁶ Proceedings of twenty-seven years' annual sessions of ISCA were consulted.

¹⁷ Asiatic Society of Bengal (1915), *Proceedings of the Asiatic Society of Bengal*, Calcutta: Asiatic Society of Bengal, pp. xcvi.

¹⁸ Krishna, V. V. (1997), "The Scientific Community in India", Gaillard, J., Krishna, V. V. and Waast, R. (eds.), *Scientific Communities in the developing world*, New Delhi: Sage Publication, pp. 243.

¹⁹ Asiatic Society of Bengal (1917), *Proceedings of the Asiatic Society of Bengal*, Calcutta: Asiatic Society of Bengal, pp. clxii.

²⁰ Krishna, V. V. (1993), *S. S. Bhatnagar on Science, Technology and Development, 1938-1954*, New Delhi: Wiley Eastern Limited.

²¹ Indian Science Congress Association (1924), *Proceedings of the Eleventh Indian Science Congress*, Calcutta: Indian Science Congress Association, pp. 69-77, pp.101-108.

²² Indian Science Congress Association (1927), *Proceedings of the Fourteenth Indian Science Congress*, Calcutta: Indian Science Congress Association.

²³ At the section of Agriculture and Applied Science, collaborated paper between two Europeans and one co-authored by an Indian and a European was read. In the same year, chemistry section had three collaborated papers between European and Indians, two between Europeans and four between Indians (ASB:1916).

²⁴ During the Twenty-First session of ISCA, "At Home" was organised for the members of the botany section by the staff and post-graduate students of the Royal Institute of Science. A similar "At Home" was given to the members of the chemical section of ISCA by President and fellows of Bombay branch of Indian Chemical Society (ISCA: 1933).

²⁵ These include National Institute of Sciences of India, Society of Bio-chemists, Indian Psychological Association, Indian Physical Society, Physiological Society of India, Indian Botanical Society, Indian Chemical Society, Indian Society of Soil Science, Institute of Chemists of Great Britain and Ireland. The opening session of Indian Statistical Conference was organised at the same time during the twenty-seventh annual session of ISCA (ISCA: 1940).

²⁶ At the eleventh session, joint meeting of the sections of mathematics and physics, chemistry agriculture was organised to discuss the role of surface forces in physics, chemistry and agriculture. During the same session, resolutions were discussed by the sections of zoology and botany for the need of Marine Biological Station in India (ISCA: 1923). In 1930, joint meeting was arranged by sections of agriculture and botany to discuss the rice and plant physiology and organization of agriculture research in India. It was also realised that the chemical section should also have been formally associated with the joint discussion since chemical research form a great part of agricultural research (ISCA: 1930). A number of symposia, joint meetings, were arranged at annual session of the Congress in 1924 (ISCA: 1924). The silver jubilee session of the Congress organised a total of thirty-two joint discussions involving different sections (ISCA:1938).

²⁷ Indian Science Congress Association (1927), *Proceedings of the Fourteenth Indian Science Congress*, Calcutta: Indian Science Congress Association.

²⁸ Indian Science Congress Association (1938), *Proceedings of the Twenty-Fifth Indian Science Congress, Silver Jubilee*, Calcutta: Indian Science Congress Association.

²⁹ Ibid.

³⁰ Indian Science Congress Association (1940), *Proceedings of the Twenty-Seventh Indian Science Congress*, Calcutta: Indian Science Congress Association.

³¹ Indian Science Congress Association (1929), *Proceedings of the Nineteenth Indian Science Congress*, Calcutta: Indian Science Congress Association.

³² Indian Science Congress Association (1948), "Annual Report of the ISCA, 1947", *Proceedings of the Thirty-Fifth Indian Science Congress*, Calcutta: Indian Science Congress Association, pp. 40.

³³ Indian Science Congress Association (1938), *Proceedings of the Twenty-Fifth Indian Science Congress, Silver Jubilee*, Calcutta: Indian Science Congress Association.

³⁴ Krishna, V. V. (1997), "The Scientific Community in India", Gaillard, J., Krishna, V. V. and Waast, R. (eds.) (1997). *Scientific Communities in the developing world*, New Delhi: Sage Publication, pp. 243.

³⁵ Institution of Engineers, available at https://ieindia.org/PDF_IMAGES/royalchar/HistoryIEI.pdf, accessed on December, accessed on December 1, 2016.

³⁶ ISCA (1921), *Proceedings of the Indian Science Congress Association*, Calcutta: ISCA

³⁷ The Indian Anthropological Society, available at <http://indiananthropologicalsociety.org>, accessed on December 1, 2016.

³⁸ The Indian Chemical Society, available at <http://www.indianchemsoc.org/aboutus.htm>, accessed on December 1, 2016.

³⁹ ISCA (1924), *Proceedings of the Indian Science Congress Association*, Calcutta: ISCA.

⁴⁰ Indian Science Congress Association (1946), *Proceedings of Thirty-Third Indian Science Congress*, Calcutta: Indian Science Congress Association.

⁴¹ Chatterjea, Ram G., (1968) "Indian Psychological Association", *International Journal of Psychology, Volume 38, Issue 1*, pp. 77-78.

⁴² In 1933, Sir Richard Gregory who was the editor of *Nature* visited various scientific departments and universities in the main cities of India and drew attention of Sir Samuel Hoare, Secretary of State for India towards the lack of appropriate research organisations in India equivalent to those of the British DSIR for the development of natural resources and new industries. Gregory's view strengthened the initiatives of C. V. Raman, Seymour Sewell and J. C. Ghosh who proposed for the creation of an Advisory Board of Scientific Research for Indian and later, National Institute of Science of India came up in 1934.

⁴³ During the annual meeting of the Indian Science Congress Association held at Allahabad in 1930, scientists from all over the United Provinces met to exchange ideas and Saha proposed the coordination of all scientific activities undertaken by the scientists through the establishment of an Academy of Science. The object of the Academy was scholarly exchange of ideas and application science and technology in solving various problems facing India. This was the first occasion where the Indian scientific workers became aware of their role in finding solution to glaring national problems facing the country. The membership of the Academy soured and soon extended beyond geographical limits of the United Provinces. The United Provinces Academy of Science was remained as National Academy of Sciences in 1934.

⁴⁴ The objectives of the organisation includes promotion of science and its application for national welfare. It aims at safeguarding the interests of the scientists and also establishing links with international bodies to foster collaboration on national issues. It also aims to coordinate between scientific societies, academies, institutions as well as government scientific departments.

⁴⁵ Indian Science Congress Association (1934), *Proceedings of Twenty-First Indian Science Congress*, Calcutta: Indian Science Congress Association

⁴⁶ National Institute of Sciences of India (1935) *Proceedings of National Institute of Sciences of India*, Calcutta: NISI.

⁴⁷ These include Bose Institute which came up in 1917, proposal for the foundation of Marine Biological Station was put forth at ISCA's session in 1927, N. R. Dhar founded the Sheila Dhar Institute of Soil Sciences. S. S. Bhatnagar inaugurated a research school in magneto chemistry, P. C. Mahalanobis founded the Indian Statistical Institute in 1931, Institute of Textile Chemistry and Chemical Engineering was started in Bombay under the leadership of Chandavarkar and guidance of Dr. Forster, Indian School of Pathology and Microbiology was formally inaugurated in 1938, Indian Institute of Science, Bangalore also witnessed rapid growth in new branches of sciences like aeronautical engineering, internal combustion engineering, fermentation technology, high pressure technology, etc. under the leadership of J. C. Ghosh in 1939. Birbal Sahni established the Institute of Palaeobotany in 1946. After the Second World War, Meghnad Saha realised the need for a separate institute of nuclear research and established the Institute of Nuclear Physics in 1948.

⁴⁸ In 1937, the Tata Iron and Steel Company initiated research on steel and established a research laboratory at Jamshedpur which served as a nucleus for National Metallurgical Laboratory later (ISCA: 1937). A similar organisation named the Kala Bhavan played an important role in the development of Baroda as an industrial town in 1940s.

⁴⁹ Indian Science Congress Association (2003), *The Shaping of Indian Science: Indian Science Congress Association Presidential Addresses, Volume I: 1914-1947*, Hyderabad: University Press.

⁵⁰ Ibid.

⁵¹ Indian Science Congress Association (2003), *The Shaping of Indian Science: Indian Science Congress Association Presidential Addresses, Volume I: 1914-1947*, Hyderabad: University Press, pp. 1-3.

⁵² The institution received no support in the form of financial aids by the colonial government as a result it utilised donations made by Taraknath Palit and Sir Rasbehari Ghosh for the foundation of university chairs in physics and chemistry. P. C. Ray and C. V. Raman were the first Palit Professors of Chemistry and Physics respectively. Rash Behari Ghosh's cash gift instituted four professorships in applied mathematics, physics, chemistry and botany. These positions were occupied by Ganesh Prasad, D. M. Bose, P. C. Mitter and S. P. Agarkar. Another gift from Rash Behari Ghosh led to the foundation of a Technology Faculty with a department each in applied physics and applied chemistry. The first batch of teachers at the University College included Prafulla Chandra Ray, C. V. Raman and S. K. Mitra. The first batch of students of M.Sc. included S. N. Bose, Meghnad Saha, J. C. Ghosh, J. N. Mukerjee, etc.

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- ⁵³ Calcutta University (1986), *Commemorative Volume- Hundred Years of Post-Graduate Teaching in Chemistry under Calcutta University, 1886-1986*, Calcutta: The Organizing Committee, Celebration of Hundred Years of Post-Graduate Teaching in Chemistry under Calcutta University.
- ⁵⁴ Narayan Rao, V. S., (1973) *Mokshagundam Visvesvaraya: his life and work*, Mysore: Geetha Book.
- ⁵⁵ Indian Science Congress Association (2003), *The Shaping of Indian Science: Indian Science Congress Association Presidential Addresses, Volume I: 1914-1947*, Hyderabad: University Press.
- ⁵⁶ Indian Chemical Society (1982), *Acharya Nil Ratan Dhar: Short Life Sketch, Scientific Activities and List of Publications*, Indian Chemical Society: Calcutta.
- ⁵⁷ Krishna, V. V. (1993), *S. S. Bhatnagar on Science, Technology and Development, 1938-1954*, New Delhi: Wiley Eastern Limited.
- ⁵⁸ Indian Science Congress Association (2003), *The Shaping of Indian Science: Indian Science Congress Association Presidential Addresses, Volume I: 1914-1947*, Hyderabad: University Press.
- ⁵⁹ Gupta, Shakti M. (1978), *Birbal Sahni*, New Delhi: National Book Trust, India.
- ⁶⁰ Asiatic Society of Bengal (1914), *An Account of the Proceedings of the ISC held in the rooms of the ASB, January 15th, 16th and 17th, 1914*, Calcutta: Asiatic Society of Bengal.
- ⁶¹ As against six sections at the first session of the congress (NAI:1914), in 1927 papers were presented under nine sections at the Congress (ISCA: 1927). There were ten and eleven sections respectively in 1936 in Calcutta (ISCA: 1936) and 1939 in Lahore (ISCA: 1939).
- ⁶² Indian Science Congress Association (1946), *Proceedings of the Thirty-Third Indian Science Congress*, Calcutta: ISCA.
- ⁶³ For example, at the fourth Indian Science Congress, Physics and Mathematics formed one section under which the papers were presented (ASB: 1917) but, at the twenty-seventh session of the congress they were segregated into separate sections (ISCA: 1940). Similarly, Agriculture and Botany, Zoology and Ethnography, Geology and Geography, Medical and Veterinary Research were made independent sections at the later sessions of the Congress
- ⁶⁴ However, at the seventeenth session there were atleast three sections that had sub-sections. The section on Agriculture and Medical and Veterinary Research had nine sub-sections each and botany had seven under which papers were presented (ISCA: 1930). In the next two years, the growth of sub-sections remained restricted to sections of Agriculture, Botany, Medical and Veterinary Sciences but their numbers did increase (ISCA: 1931, 1932). At the Twenty-Third Session of the Congress the Section of Chemistry and Anthropology had five and eight sub-sections respectively apart from the sections that already had sub-sections earlier (ISCA: 1935). In 1939 sub-sections emerged in the sections of Mathematics, Physiology, Biology and Psychology as well (ISCA: 1939). Physics and Entomology had sub-sections in the following year (ISCA: 1940). The sub-sections emerged under the section of Engineering and statistics in 1941 (ISCA: 1941) and 1946 (ISCA: 1946) respectively.
- ⁶⁵ Krishna, V. V. (1997). "The Scientific Community in India", Jacques Gaillard, V.V. Krishna and Roland Waast (eds.), *Scientific Communities in the Developing World*, New Delhi: Sage Publications.
- ⁶⁶ These include journal of the Institution of Engineers in 1922 followed by its quaternary bulletin in 1923. At the eleventh session of the Congress, section of zoology considered a journal for zoology but, it wasn't accepted (ISCA: 1924). The Geological, Mining and Meteorological Society of India started its journal in 1929. The Indian Chemical Society published the first issue of its quarterly journal in November in the same year which became bi-monthly in 1928 and monthly in 1930. It received appreciation from leading organisations and scientific workers from other countries as well. Since its silver jubilee, Indian Physical Society published its quarterly journal of the Society, *Physics Teacher*. The Indian Journal of Psychology started in 1926 and remained the only Indian journal on psychology till 1950. The journal of Indian Botanical Society also published a journal.
- ⁶⁷ Current Science owes its origin to the genius and foresight of Dr. M. O. Forster. He presided over the inaugural meeting convened to consider the founding of the journal. In 1931, he as the Director of Indian Institute of Science, Bangalore issued a questionnaire with a view to elicit the amount of support which an Indian science news journal would receive. It received an encouraging response and thereafter the matter was placed before a meeting of the Indian Science Congress Association. The proposal was accepted by the members in 1932. A working committee was constituted to work out the details of the journal and the matter was consulted by a number of scientists thereafter. It was cumulatively decided that a monthly journal would be published under the name of "Current Science".
- ⁶⁸ Indian Science Congress Association (2003), *The Shaping of Indian Science: Indian Science Congress Association Presidential Addresses, Volume I: 1914-1947*, Hyderabad: University Press.
- ⁶⁹ Indian Science Congress Association (1930), *Proceedings of the Seventeenth Indian Science Congress*, Calcutta: ISCA.
- ⁷⁰ Asiatic Society of Bengal (1914), "First Indian Science Congress", *Proceedings of the Asiatic Society of Bengal*, Calcutta: ASB.

⁷¹ Indian Science Congress Association (1938), *Proceedings of the Twenty-Fifth Indian Science Congress*, Calcutta: ISCA.

⁷² Bhatnagar established himself in the sphere of chemistry and had published eight papers in internationally recognised journals. He also inaugurated a school on colloidal and magneto-chemistry, where higher teaching and research in chemistry were undertaken (Krishna: 1993)

⁷³ P. C. Ray's students were also contributing immensely towards constitution of research groups and advancement of scientific knowledge. P. C. Ray himself discovered mercurous nitrite and published numerous papers on the subject in scientific journals for which he was internationally recognised. The output of research was increasing and there were growing instances of Indian scientific workers presenting their research at international platforms. P. C. Ray presented papers on vapour density of ammonium nitrite in London. An enormous progress has been witnessed within several branches of chemistry during this period (Ray: 1958).

⁷⁴ J. C. Bose's research on electromagnetism was widely acclaimed. J. C. Bose invented the "Wireless Communication" but didn't patent it (Dasgupta: 1999). M. N. Saha's formulation of theory of Thermal Ionisation opened a new horizon in the field of astro-physics. It was not just a breakthrough for Indian science but it also paved his way into the virgin field of astro-physics as well as to an entry into an international sphere of science. By 1930s the research and developments on the field of Physics were in full swing (Royal Society of London).

⁷⁵ Ray, Prafulla Chandra, (1958), *Autobiography of a Bengali Chemist*, Calcutta: Orient Book.

⁷⁶ In 1918, J. C. Bose became the Fellow of the Royal Society of London followed by C. V. Raman in 1924. Raman was awarded the Matteucci Medal by the "Societa Italiana Della Scienza" of Rome in 1928. The British government in India conferred knighthood on him in 1929. In 1930, Raman was awarded the Nobel Prize in Physics for his work on scattering of light and for discovery of the "Raman effect". He became the honorary member of the Duestsche Academy of Munich, Hungarian Academy of Sciences, Royal Irish Academy, Royal Philosophical Society, Glasgow and Zurich Physical Society. He was also an honorary fellow of the Optical Society and Mineralogical Society of America. M. N. Saha was elected as FRS in 1928 and was also invited to the Volta centenary celebrations. In 1945, P. C. Mahalanobis was elected as the fellow of the Royal Society, London and in the following year he was appointed a member of the Statistical Commission of the United Nations. S. N. Bose became FRS in 1958. The foreign societies conferred the Back award and Lyell Medal on D. N. Wadia for which he later received Padma Bhushan (Royal Society of London).

⁷⁷ Asiatic Society of Bengal (1916), "Third Indian Science Congress", *Proceedings of the Asiatic Society of Bengal*, Calcutta: ASB.

⁷⁸ Indian Science Congress Association (1946), *Proceedings of the Thirty-Third Indian Science Congress*, Calcutta: ISCA.

⁷⁹ Indian Science Congress Association (1946), *Proceedings of the Thirty-Third Indian Science Congress*, Calcutta: ISCA.

⁸⁰ Indian Science Congress Association (1926), *Proceedings of the Thirteenth Indian Science Congress*, Calcutta: ISCA.

⁸¹ Asiatic Society of Bengal (1916), "Third Indian Science Congress", *Proceedings of the Asiatic Society of Bengal*, Calcutta: ASB, pp. xxx.

⁸² Indian Science Congress Association (1924), *Proceedings of the Eleventh Indian Science Congress*, Calcutta: ISCA.

⁸³ Asiatic Society of Bengal (1919), "Sixth Indian Science Congress", *Proceedings of the Asiatic Society of Bengal*, Calcutta: ASB

⁸⁴ Asiatic Society of Bengal (1921), "Eighth Indian Science Congress", *Proceedings of the Asiatic Society of Bengal*, Calcutta: ASB

⁸⁵ Indian Science Congress Association (1925), *Proceedings of the Twelfth Indian Science Congress*, Calcutta: ISCA.

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