TRENDS IN SCIENTIFIC COMMUNICATION IN INDIA THROUGH HISTORIC, SOCIOMETRIC AND BIBLIOMETRIC ANALYSIS OF THE SCIENTIFIC JOURNALS IN PHYSICAL SCIENCES SPECIALLY PHYSICS AND ASTRONOMY

A Thesis submitted to the
Karnatak University for award
of Ph. D. in Library and Information Science

By

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Guide

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A P P E N D I X

The following is the list of journals mentioned as of importance by Physicists and Astronomers who were interviewed :

For Physics:

1. American Journal of Physics
2. Annals of Physics
3. Applied Optics
4. Applied Physics
5. Applied Physics Letters
6. Bulletin of Materials Science
7. Chemical Physics
8. Chemical Physics letters
9. Classical and Quantum Gravity
10. Europhysics Letters
11. Foundations of Physics
12. Foundation of Physics Letters
13. Hyperfine Interaction
14. Indian Journal of Physics
15. Infra'red Physics
16. International Journal of Modern Physics
17. Japanese Journal of Applied Physics

18. JETP Letters
19. Journal of Applied Science Research
20. Journal of Chemical Physics
21. Journal of Crystallographic & Spectroscopic Research
22. Journal de Physique
23. Journal of Electrochemical Society
24. Journal of Fluid Mechanics
25. Journal of Low Temperature Physics
26. Journal of Magnetic Resonance
27. Journal of Material Science Letters
28. Journal of Mathematical Physics
29. Journal of Molecular Spectroscopy
30. Journal of Molecular Structure
31. Journal of Non-Crystalline Solids
32. Journal of Optical Society of America
33. Journal of Physics, (U.K) (All Sections)
34. Journal of Physics and Chemistry of Solids
35. Journal of Physical Society of Japan
36. Journal of Plasma Physics
37. Journal of Polymer Science
38. Journal of Rheology
39. Journal of Solid State Chemistry
40. Journal of Statistical Mechanics
41. Journal of Statistical Physics
42. Journal of Vacuum Science and Technology

43. Laser Spectroscopy

44. Liquid Crystals

45. Macromolecules

46. Modern Physics Letters

47. Molecular Crystals and Liquid Crystals

48. Molecular Physics

49. Nature

50. Nuclear Data Sheets

51. Nuclear Instruments and Methods in Physics Research

52. Nuclear Physics (A & B)

53. Optics and Spectroscopy

54. Optics Communication

55. Physica

56. Physics Letters

57. Philosophical Magazine

58. Physics and Chemistry of Minerals

59. Physics and Chemistry of Solids

60. Physical Review - A, B, C and D

61. Physical Review Letters

62. Physics Letters - A & B

63. Physics Reports

64. Pramana

65. Progress in Theoretical Physics

66. Radiation Effects and Defects in Solids

67. Reviews of Modern Physics

68. Solar Cells
69. Solar Energy Materials
70. Solid State Communications
71. Soviet Journal of Low Temperature Phys
72. Soviet Physics JETP
73. Soviet Physics JETP Letters
74. Soviet Physics Uspekhi
75. Spectrochemica Acta
76. Spectroscopy Letters
77. Stochastic Processes and their Applications
78. Thin Solid Films
79. Zeitschrift fur Physik - A, B & C

For **Astronomy**

1. Applied Optics
2. Astronomical Journal
3. Astronomy and Astrophysics
4. Astrophysical Journal
5. Astrophysics and Space Science
6. Bulletin of the Astronomical Society of India
7. Earth and Planetary Sciences Letters
8. Geochemica Cosmochemica Acta
9. Icarus
10. Journal of Astrophysics and Astronomy
11. Journal of Astrophysics and Space Sciences

12. Monthly Notices of the Royal Astronomical Society
13. Nature
14. Physical Review "D"
15. Physical Review Letters
16. Publications of the Astronomical Society of Japan
17. Publications of the Astronomical Society of the Pacific
18. Solar Physics
19. Soviet Astronomy
20. Soviet Astronomy Letters

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I N D E X

DEDICATED TO

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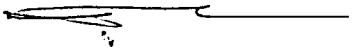
CERTIFICATE

I certify that the thesis entitled TRENDS IN SCIENTIFIC COMMUNICATION IN INDIA THROUGH HISTORIC, SOCIOMETRIC AND BIBLIOMETRIC ANALYSIS OF THE SCIENTIFIC JOURNALS IN PHYSICAL SCIENCES SPECIALLY PHYSICS AND ASTRONOMY presented by A. Ratnakar for the award of the degree of Doctor of Philosophy in Library and Information Science, is his original work carried out under my guidance. This thesis or any part thereof has not been submitted for any other degree.



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SYNOPSIS

As scientific journals form an important channel for communication of scientific research, a study has been made in this thesis to find out if Physics and Astronomy journals published in India reflect the status of research in these subjects in the country.

As a background to this study, the growth of scientific research in the country has been traced along with the growth of scientific journals. It is found that till the twentieth century there were no specialized periodicals in India for physics or astronomy and articles on these subjects were published in multi-disciplinary journals like the Journal of the Asiatic Society. It was only in the twentieth century that specialised journals for physics and astronomy were started. Some important journals started in India during the period 1700–1900 are given. A few important academies, societies, journals and institutions were established in the first half of the twentieth century.

The analysis of the publishing practices of some eminent scientists of the country during 1910–1930 has

indicated their clear preference for publishing in foreign journals. This trend continues into the post 1930 period. However, Raman was an exception to this to a certain extent and after 1931 he published most of his research results in Indian journals.

In spite of the recognition Indian science had received abroad at that time (1900-1940), not many Indian journals gained international recognition.

After 1940, we find a number of departments and councils being established to support research activities in the country. A number of new universities were also started. The Publication and Information Directorate and the Indian Academy of Sciences, the two leading publishers of science journals in the country, now publish over ten journals each in different disciplines. The publications from these organisations, specially those related to physics and astronomy have been discussed. Four physics journals - Indian Journal of Physics, Indian Journal of Pure and Applied Physics, Indian Journal of Radio and Space Physics and Pramana and an astronomy journal, Journal of Astrophysics and Astronomy have been studied in detail. The analysis of the publications of seven research institutions in India (the Indian Association for the Cultivation of Science,

the Indian Institute of Astrophysics, the Indian Institute of Science, the Physical Research Laboratory, the Raman Research Institute, the Saha Institute of Nuclear Physics and the Tata Institute of Fundamental Research) during the last few years has shown that eighty five per cent of the total number of articles published from these centres appear in foreign journals. It is concluded that majority of the Indian journals are not utilized by the scientists in the leading research centres in the country. Even the few journals utilized receive only bare minimum of articles from these centres.

An analysis of the Current Contents has indicated that it is not just the seven institutions whose publications were studied which publish in foreign journals but other institutions also publish to a certain extent, in foreign journals. It is found that physicists and astronomers in India publish majority of their work in foreign journals.

To place the Indian situation in an international perspective and to find out the reasons behind the success of journals, study of two journals in physics (The Physical Review and Physical Review Letters) was

undertaken. These started as national journals and are now successful and have gained importance in the international community. This study has shown that the support of the scientific community is very essential for the success of any journal and that it is absolutely important that journals maintain high standards of refereeing and editing and the journal is published on time.

For any national journal to be successful the prerequisite is a critical mass of good research activity in the country and the journals receiving good papers for publication from scientists working in the country,

It was also felt that a direct sampling of opinion of the Indian scientific community would complement the other studies reported here. A majority of the physicists and astronomers who were interviewed expressed the view that journals published from abroad were of importance to them. Scientists working in certain areas like particle physics, astronomy and to a limited extent condensed matter physics observed that for nascent information in their field, they depended more on informal channels like preprints, discussion with fellow scientists and attending conferences. The poor visibility of Indian journals in the international commun-

ty, the uneven standards of refereeing and the attitude of those recruiting scientific personnel towards publication in Indian journals were cited as some of the reasons for Indian scientists not publishing in Indian journals. The editors interviewed expressed the difficulties they were facing in publishing good journals and one point shared by most of them was the fact that they were not receiving a sufficient number of good papers from the scientists in the country.

Based on the analysis of the publication pattern of the scientists in India and the four physics journals and an astronomy journal, it is concluded that the journals published in India do not truly reflect the quality of research done in these subjects in the country. Some suggestions have been made by the author as to how this situation may be improved.

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CHAPTER 1

INTRODUCTION

Purpose of this study:

This thesis is an enquiry into whether physics and astronomy journals in India reflect the status of research in these subjects in the country. If not, why not, and what could be done to improve matters.

One of the important channels of communication of scientific results is the scientific journal. The end product of any basic research work is its publication. If the research results are not written up and made available to the community by way of publication, they become sterile. Priority for a piece of research work is established by publishing the results soon after the discovery. Establishing priority for a work done is also considered important for getting peer recognition, awards and rewards. All these factors motivate a scientist to publish his research work. Thus, scientific journals play an important role in providing a medium for the scientist to communicate his/her research work

to others in the field and have become a part of scientific activity. To quote Meadows :

> *" The journal has become an essential component in the organisation of science, in the apportionment of recognition to scientists, and in simply reaching agreement on what constitutes acceptable science."* (Meadows, **1978).**

The growth of science journals in a country depends mainly on the level of scientific activity in the country, which in turn is a product of the interplay of different forces like the level of higher education, funding for research, the existence of professional scientific or academic bodies, and last but not the least, public support for science and technology.

P.L.Kapitza, one of the most **well** known Russian Physicists, wrote at the time of the centenary of the Russian journal Journal of **Experimental** and Theoretical Physics (in **1973):**

> *" It is obvious that a close connection exists between the growth of the number of scientific journals and the scale of development of scientific work. This points to the possibility that useful data can be had about the organization of scientific work from a study of the number and character of the scientific journals."* (Kapitza, **1973).**

However, this is not true in all cases and there

could be exceptions. In this respect, India is a unique case and therefore, merits discussion.

If one identifies important journals published in a particular field and examines the articles published in them, it should be possible to get a picture of the level of the subject. This is true on a global scale. Similarly, when one restricts the choice of the journals to those published from a particular country and assesses the articles published in those journals, one would expect them to reflect the level of that subject in that country.

The broad features of the Indian scene are fairly well known. Too many journals are chasing a modest amount of scientific research output, a large part of which anyway goes to journals published in other countries. However, a detailed study of the phenomenon has not been reported so far. Hence the present study. As journals are an integral part of library collection in any scientific library, this study is of importance in the information field as it would indicate the role of Indian science journals as a medium of communication for Indian science.

SCOPE OF THE STUDY:

The present study is restricted to journals dealing with physics and astronomy, partly to achieve some focus and partly because it is in these fields that many major contributions have been made by Indian scientists, particularly the early pioneers. Moreover, some of the journals under discussion have been founded by these very pioneers.

The paradigm that the caliber of journals reflects the caliber of scientific research is applicable mostly to the United States and perhaps Western Europe. It applies to a certain extent to the USSR for two reasons: (a) the Soviet scientists publish mostly in Russian and (b) they are usually discouraged from publishing outside the country (however, this situation is rapidly changing in recent times). In China too, the forces of language and state restrictions restrain scientists from publishing outside. In Japan, the main reason for publishing within the country is the language barrier. But if one wishes to, one can publish in English and there are in fact English language journals published from Japan which many of the Japanese scientists use. (In recent years, Astronomers had to depend on Japanese journals to learn the results obtained from the Japanese

X-ray Satellite Ginga). Along with India, Latin America presents another example of an exception to the paradigm mentioned above. While it would be interesting to make a detailed comparative study of all the evolutionary patterns, that would be far big a task to be undertaken at present. Hence, the restriction in the scope of the work.

Methodology

The study analyses the emergence and the growth of scientific periodicals in India. A historical method of research has been adopted for the investigations. A chronological and developmental approach to the publication of periodicals has been followed. The socio-scientific context is used as an additional criterion. Further, in order to ascertain the status of science communication, interviews were held with both senior as well as junior scientists in the field, editors of scientific journals and science administrators. Lastly, inferential analysis has been used to derive information from the data so obtained.

Structure of the thesis:

The results of this study are presented in nine chapters as follows:

Chapter 1:

This sets the background for the study and defines the goals and scope of the thesis.

Chapter 2:

An analysis of the periodicals in science and technology in India from 1700 to 1900 is presented. It describes the contexts and the emergence of scientific research in India during the early period. One of the findings of this study is that in this epoch there were no "specialized" journals in Physics, Mathematics, Astronomy or Chemistry. Articles on these subjects were published in "genera1 periodicals". In particular, there were no research periodicals in India during this period devoted exclusively to physics or astronomy.

Chapter 3:

The trends in scientific research during the period 1901 to 1940 are described here. It is found that organised research activity started during this period and a number of scientific academies and universities began to emerge. This period also saw the founding of journals in the field of Physics. Several eminent scientists used them as vehicles for announcing their scientific results.

Chapter 4:

This deals with the period from 1941 to the present day. It is argued here that during this period, the approach to scientific research had changed significantly. The growth of various scientific departments and research institutions in governmental and other sectors during the period are closely followed.

Chapter 5:

This chapter deals with the present scene in the publication of science journals in India and goes into the functioning of four important journals of Physics

and one of Astronomy. The origin of these journals, the respsnse of the scientists to them, then and now, the refereeing system employed, composition of the editorial boards, their visibility, etc. are examined in detail.

Chapter 6:

This chapter goes into further detail concerning the five journals considered in the previous chapter. Also studied is the publication pattern of the Indian physicists and astronomers working in seven research institutions in the country.

Chapter 7:

A careful study of the growth, organisation and the success of two of the most well known Physics journals in the world **The** Physical **Review** and **Physical Review** Letters is made in this chapter. This is done mainly to highlight what makes a journal succeed and also to see if there are any lessons to be learnt from it as far as Indian journals are concerned.

Chapter 8:

This presents a summary of opinions expressed by scientists, editors and administrators concerning Indian journals and how they might be improved. These opinions were obtained during in depth interviews. It also summarizes the opinions expressed in this regard in publications and at conferences.

Chapter 9:

Consolidates the findings reported in the earlier chapters and gives the conclusion of the study. Suggestions of the author for possible improvements in the existing situation are also given.

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CHAPTER 2

BEGINNINGS OF MODERN SCIENCE AND SCIENTIFIC JOURNALS IN INDIA (1700 - 1900)

We discuss briefly in this chapter the early beginnings of science in India starting around 1700 till the end of the nineteenth century. This background will place in perspective the growth of science journals in India.

Though we begin our study from the eighteenth century, it is well known that some branches of knowledge like agriculture, astronomy, medicine, alchemy were being pursued in India much before this time. Scientific activity did not start in India all of a sudden but slowly over centuries. However, the beginning of modern science (as it is practised today all over the world), started in India in the 1700's with the European traders, missionaries and administrators getting interested in the natural resources of the country. Even before the British empire started its conquest over others in India (Portuguese, Dutch and French), attempts had been made to collect information

about India, specially its flora and weather and to survey the land and coastal areas. This activity was enlarged after the East India Company got a firm foothold in the country and wanted to consolidate its position.

Towards the end of the eighteenth century, the first of the organized schools/institutions came into being in India. The Royal Botanic Garden (1787) at Calcutta, an Observatory at Madras (1792) to promote astronomy, a survey school for Trigonometric work, also at Madras (1794) and the most important society of the country for a very long time, the Asiatic Society (1784) were also started during this period. The starting of this latter society was mainly to facilitate exchange ideas among those who were investigating in different fields. About thirty Europeans came together at Calcutta to form this Society, the driving force being William Jones, the founder President. The objective of the Society was to enquire into all spheres of activity of Man and Nature in the geographical area of Asia. Till the Society got its own building in early 1800, its activities were carried on at the Supreme Court building in Calcutta. The members of the Society were interested in the studies pertaining to the geography and geology

of the country. As we shall see a little later, this Society started the first scientific journal, **Asiatic Researches**, in the country, in 1832.

The Madras Observatory which functioned for over a hundred years before it was shifted to Kodaikanal in 1900, was an important centre for astronomical work in the country. Observations on asteroids and stars resulted in the discovery of a few asteroids by Pogson and the variable nature of the star R.Reticuli (Bhattacharyya, 1985).

Though investigations had started on scientific lines in the country by the eighteenth century, it was only in the following century that Indians slowly entered the field. The nineteenth century saw rapid developments, and as Majumdar says :

> *" The Nineteenth century was the great dividing line, and these hundred years changed the face of India far more than did the preceding thousand years".* (Majumdar, 1961).

In the first two decades of this (19th) century, the education imparted to the natives was mostly limited to languages and English was not the medium of instruction, excepting at the Hindu College, Calcutta (started in 1817) where not only was English given prominence

but other subjects like astronomy, arithmetic and chemistry were also taught. The scene elsewhere changed with the Macaulay Committee recommending in 1835 the use of the English language as the medium of instruction and active promotion of western learning. A number of educational institutions came into being soon after the Macaulay report, and western science became accessible to people of Indian origin.

Three universities were established in 1857 at Bombay, Calcutta and Madras. Before this, first of the medical colleges in the country had been started at Calcutta in 1835 followed by a Medical School at Madras in 1843 and the Grant Medical College at Bombay in 1845. Engineering education also began around the same time with the founding of the Engineering Institution at Roorkee (1847), an Engineering school at Poona (1854), an Engineering College at Calcutta (Sibpur) in 1856 and the Victoria Jubilee Technical Institute at Bombay (1887).

Along with the starting of university and college education, attention was paid to consolidating different types of survey work. Towards this end, the Great Trigonometrical Survey (1818), the Geological Survey

of India (1851) and the Botanical Survey of India (1890) were started.

Around and after the middle of the nineteenth century, Calcutta had a nucleus of educationists, doctors and engineers. We should recall the efforts of Raja Ram Mohan Roy, the social reformer, who contributed significantly in the 1830's towards inducting science education in India. In 1844, four Indian doctors were sent to England for medical training. The Hindu College, Calcutta mentioned earlier became a centre for young Indians to learn about western literature and science. The college became a forum for discussion not only of new knowledge but also topics like women's education, superstition and its ill effects, proper justice, etc.

P.C.Ray, a noted Chemist of the country who got his doctoral degree in Chemistry from the University of Edinburgh describes the scene thus :

> *" There was ferment all round. A new world had been opened out; new aspirations were awakened. Roused from a period of stupor and stagnation, Young Bengal began to realize that there were immense possibilities in the Hindu nation. The literature of this period breathes lofty patriotism. Political associations and newspapers had also been started to give expressions to the pent-up feelings and*

ventilate the grievances of a subject people." (Ray, 1932).

Thus, we see a trend of nationalistic feelings developing among the intellectuals in the country. There emerged an intelligentsia in Bengal brought up on western education but fired with a patriotic zeal.

Mahendra Lal Sircar, an eminent doctor in Calcutta, was one among those who had strong nationalistic feeling. He also believed that introducing science in educational curriculum alone would not be sufficient and that for science to take firm roots in the country, it should be promoted at a different level too. Thus he felt the need for of institutions which could create interest in science among the masses and train scientists to undertake original research. Though various surveys had been established by then, they were all dominated by Britishers and the Indians could not, on their own, do research there. This was due to the impression among the then rulers that Indians did not have sufficient training in the science. Mahendra Lal Sircar wrote an article in 1869 on the desirability of a national institution for the cultivation of science by the natives of India, in which he pointed out that the

backwardness of a country was due to the backwardness of the natives in science and that scientific research was the only salvation (Indian Association for the Cultivation of Science, 1976).

With this in mind, he established using the Royal Institution of London as a model, the Indian Association for the Cultivation of Science, in 1876. There was clearly a nationalistic outlook in his approach.

Though the Association was established in 1876, it was only after 1907 that research activity picked up at this centre. The activities of the Association during that period (1907 onwards) is discussed in the next chapter.

Towards the end of the century, Bengal became a major centre for scientific research in India. Asuthosh Mookherjee, J.C.Bose and P.C.Ray, all at Calcutta, were some of the important personalities who contributed to research and education in the country. Asuthosh Mookherjee, was really a lawyer but so deep was his interest in mathematics that he became an active member of the Asiatic Society. He gave a proof for the 25th proposition of the First Book of Euclid which was published in

the Messenger of Mathematics from Cambridge University in 1881 (Subbarayappa, 1971). He also lectured extensively at the Indian Association for the Cultivation of Science and later gave shape to the promotion of science at the Calcutta University. J.C.Bose started teaching and researching at Presidency College after completing his study at Cambridge and returning to India in 1885. He joined the Physics Department where the facilities for research were minimal. But undeterred by it, he continued to work here and contributed significantly to the study of electric waves. He published his research paper on "Polarisation of Electric Ray by a Crystal" in the Journal of the Asiatic Society of Bengal in 1896. He is well known for building a compact microwave receiver. His interest turned from Physics to Biophysical investigation and plant physiological investigation. His scientific papers appeared abroad in prestigious journals such as the **Proceedings of the Royal Society** and the **Philosophical Magazine.** He continued to work at Presidency College even after his retirement in 1915 and later at the Bose Institute (named after him).

P.C.Ray was a Chemist who had his post graduate education in England and returned to India in 1888. Like J.C.Bose, he also joined the Presidency College, but as Assistant Professor in the Chemistry department.

Ray contributed significantly as a leader in education (chemical), chemical research and chemical industry. He was an inspiring teacher.

Thus, we see that around the end of the nineteenth century, with five universities and about 170 colleges functioning, there was a growing interest in science in India. But the research activity took firm root in the country only in the present century. This will be discussed in the next chapter.

Scientific Journals:

The Global Scene

The early scientific communication was in the form of letters written by scientists to their counterparts in other cities using the postal system. These letters were distributed through clearing houses for scientific correspondence such as the salon of Father Marin Mersenne in Paris or the office of Henry Oldenburg in London. The letters were copied at these centres for further distribution and replies were sent similarly.

The communication thus received by a scientist was read out at gatherings of local scientists. (Manten, 1980).

As the quantum of scientific research grew, it was felt more convenient to print the research findings for dissemination instead of communicating by hand-written letters. This was, perhaps, a spin off of newspaper publication.

The first scientific journal to be printed in the world was the French journal "Le Journal des Scavans" in January 1665. This was started by Denis de Sallo de la Coudrays, a counselor in France. This was followed by the Philosophical Transactions of the Royal Society (London) in May 1665. Within a few decades of starting of general journals, specialised journals started appearing, specially in the field of Medicine and a little later in other fields. By 1714, secondary journals (abstracting journals and review journals) came into existence, and the volume of publications increased very rapidly. By the end of eighteenth century, around 755 titles appeared (in all European languages) out of which 401 were published from Germany, 96 in France, 50 in Great Britain, 43 in the Netherlands. (Garrisson, 1934). This number varies slightly from the one given by the historian of science Derek de Solla Price

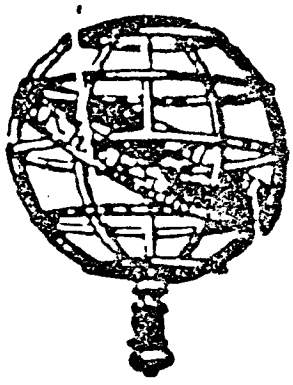
L E

JOURNAL DES SÇAVANS,

De l'An M. DC. LXV.

Par le Sieur

DE HEDOUVILLE.



A AMSTERDAM,

Chez PIERRE LE GRAND.

M. DC. LXXIX.

Figure 1

(Taken from Meadows, A.J.: Development of Science Publishing in Europe. Amsterdam, Elsevier, 1980)

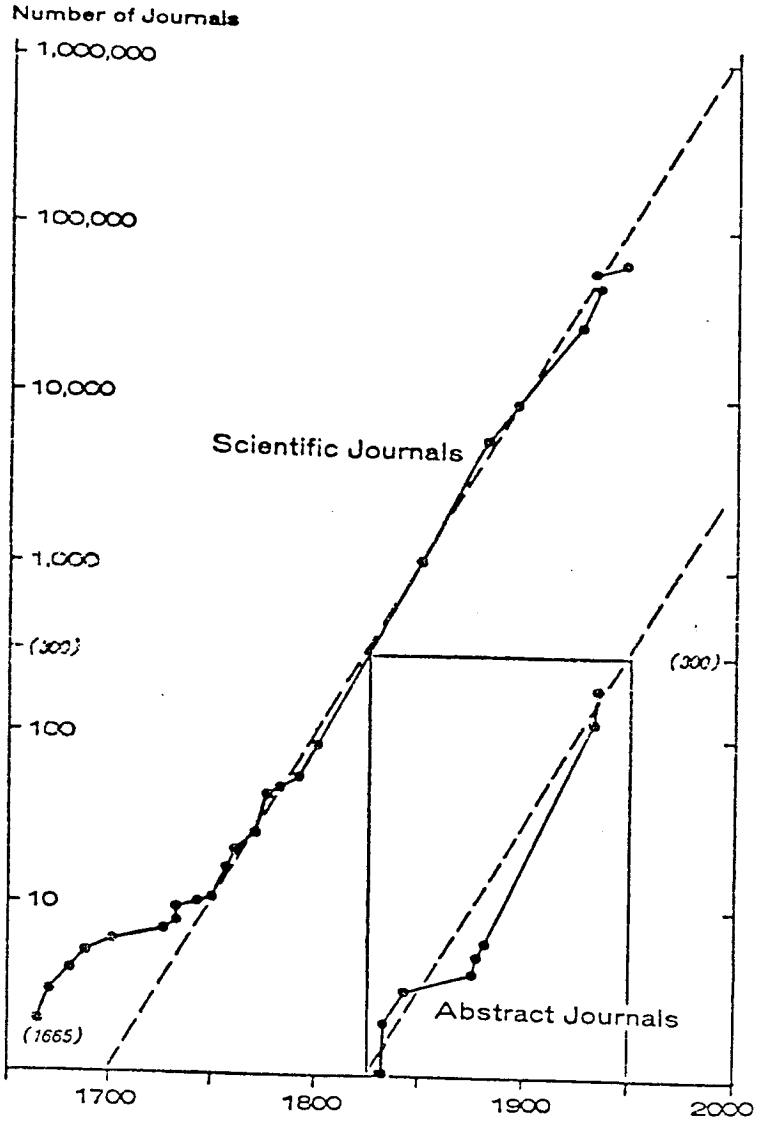
(Price,1975) which is reproduced in figure 2 wherein the number of journals founded (not necessarily surviving) as a function of date is shown. However, there was a feeling that there were too many journals. Reviewing a new journal in 1789, a writer says :

> *" This is truly the decade of the journal, and one should seek to limit their number rather than to increase them, since there can also be too many periodicals"* (Kronick, 1976).

To get adequate exposure to work, the authors used to send their papers to more than one journal. This practice prevailed during 17th and 18th century and only later in the 19th century was it opposed by many scientists (Manten, 1980). Today such a practice is not accepted.

The dissemination of science at a popular level for the general public also got started quite early. **Guardian** (1713), **The Spectator** (1711), **The Tatler** (1709) were among the early ones. These were just leaflets and were published for only a short period.

In the United States, publications of the scientific journals started around 1800's. As in Europe, there were no specialized journals here also for quite some time and the journals were multi-disciplinary to begin



Number of journals founded (*not* surviving) as a function of date. The two uppermost points are taken from a slightly differently based list.

Figure 2

(Price, 1975)

with. Some of these were, the **Connecticut Academy of Science and Arts Transactions**(1810) **American Journal of Science and Arts** (1818), **Scientific American** (1845), and **Journal of the Franklin Institute** (1825). The specialized journals started with **American Anthropologist** (1888), **Physical Review**(1893) (we discuss this journal in detail in Chapter 7) and **Astrophysical Journal**(1895). The first Physics journal to be published from Russia was by the Russian Physical Society in 1873 and was titled **Journal of the Russian Chemical Society and Physical Society.**

Scientific journals both in Europe and the United States were started either by an individual, institution or a learned Academy/Society. Publication of scientific journals was a scholarly activity carried out by the academies as a part of their objectives. There was hardly any commercial angle in science journals publication till about the middle of this (20th) century barring the example of **Nature** (London) published by McMillan. The situation has changed dramatically now (1990), with the society publications having been pushed into the background to a certain extent by commercial publishers. This is seen very much more in Europe with a number of commercial publishers vying with each other for establishing their journals. In the United States,

learned academies and societies like the American Institute of Physics, American Chemical Society, Institute of Electrical and Electronic Engineers, still have a strong hold. But in the last few years, learned societies have got into legal battles with commercial publishers of journals (Ratnakar, 1990). In China and USSR, science publication is entirely a state controlled activity. In India, (we discuss the Indian situation in detail in Chapter 5) though it is not formally state controlled, the major portion of science journals publication is undertaken either by learned academies or Government agencies.

Some of the early periodicals of relevance to Physics and Astronomy of this period were **Proceedings of the Royal Society, (London),(1854) Nature (1869), Philosophical Magazine (1789), Annales de Physique (1789), Annalen der Physik (1799), Compte Rendus (1835), Physical Review (1893) and Astrophysical Journal (1895).**

The Indian Scene

Almost one hundred and twenty-five years after the first journal was started in France, the first journal was published in India.

Asiatic Researches was the first scientific journal to be published in India. The Asiatic Society started this publication in 1788. This was a multi-disciplinary journal and was published till 1839. In 1832, the Asiatic Society started publishing the **Journal of the Asiatic Society of Bengal**. This journal was a continuation of **Gleanings in Science** which had been started in 1829 by J.D.Herbert. Though the journal included articles of a general literary kind, a number of scientific papers in different subjects like Botany, Zoology, Geology, mathematical and physical sciences were also published. An important paper in Physics that appeared in this journal was one by J.C.Bose in 1896 on "Electric Waves".

Medicine was one of the first disciplines to have journals devoted totally to that subject. A number of journals were started during the nineteenth century in the field of medicine. **Indian Journal of Medical Sciences** (1834), **Indian Annals of Medical Science** (1853), **Madras Monthly Journal of Medical Science** (1870) were a few of the important early publications in this field.

ASIATICK RESEARCHES:

OR,

TRANSACTIONS

OF THE

SOCIETY,

INSTITUTED IN BENGAL,

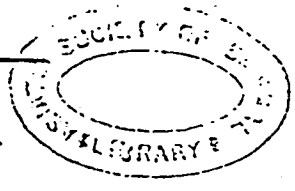
FOR INQUIRING INTO THE

HISTORY AND ANTIQUITIES, THE ARTS, SCIENCES, AND LITERATURE,

OF

ASIA.

VOLUME THE FIRST.



CALCUTTA:

PRINTED AND SOLD BY MANUEL CANTOPHER,

AT THE HONOURABLE THE COMPANY'S PRINTING-OFFICE;

AND SOLD AT LONDON BY P. ELMSLY.

M DCC LXXXVIII.

Figure 3

Title page of the first Indian scientific periodical

The various survey departments brought out their publications. These recorded the findings of the survey. Notable among them were, **Memoirs of the Geological Survey of India** (1856), **Records of the Geological Survey of India** (1867), and **Records of the Botanical Survey of India** (1843). Some of the other periodicals started during the nineteenth century were **Transactions of the Agriculture** (1821), **Proceedings of Agri-Horticultural Society of Madras** (1839), **Journal of the Bombay Natural History Society** (1886) and **Indian and Eastern Engineer** (1858).

It may be pointed out here that during this period, there were no special journals devoted only to Physics, Chemistry or Mathematics. Papers on these subjects were published in the **Journal of the Asiatic Society**. This could, perhaps, be due to the fact that Field sciences, Medicine, Agriculture and Engineering subjects were promoted in the country much before the other subjects. It was only in the present century that journals devoted to Physics, Chemistry, Astronomy and Mathematics were started. It is observed that the majority of the journals started during that period were published from Calcutta. Table 1 lists some of the important journals started in India during the years 1700 - 1900. Though a few of the journals of this period (like the **Journal of**

the Asiatic Society, Indian Textile Journal, Journal of the Bombay Natural History Society) are still being published, except for the Journal of the Bombay Natural History Society, the others no longer command the same importance they did previously.

An exhaustive list of journals published in India during the period 1780 - 1947 is given by Kumar (1985). A comprehensive bibliography of the Indian Scientific Periodicals (1788 - 1965) is being compiled (Sen, 1988).

TABLE 1

Journals started in India during 1700-1900

Year	Journal
1788	Asiatic Researchers, Calcutta
1819	Transactions of the Literary Society, Bombay
1821	Transactions of Agriculture, Calcutta
1823	Transactions of the Medical and Physical Society, Calcutta
1829	Gleanings from Science, Calcutta
1832	Journal of the Asiatic Society of Bengal, Calcutta
1833	Journal of Literature and Science, Madras
1834	Indian Journal of Medical Sciences, Calcutta
1837	Indian Review & Journal of Foreign Science and Arts, Calcutta
1839	Proceedings of Agricultural Horticultural Society of Madras
1843	Records of the Botanical Survey of India
1853	Indian Annals of Medical Science, Calcutta
1855	Memoirs of Geological Survey of India
1858	Indian & Eastern Engineer, Calcutta
1867	Records of the Geological Survey of India
1875	Indian Forester, Allahabad
1886	Journal of the Bombay Natural History Society, Bombay
1890	Indian Textile Journal, Bombay

Source : (Arunachalam, 1979; Kumar, 1985)

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CHAPTER 3

Entry of Indians Into Scientific Research and The Indian Scientific Journals during 1900-1940

As scientific journals are closely intertwined with Science, they cannot be discussed In isolation. Their growth and success/failure have to be viewed vis-a-vis the growth and development of the subject at any particular period. Since there was a tremendous change in the scientific environment in the country during the twentieth century and more so after Independence, we make a brief survey of the development of Science, particularly Physics and Astronomy during that period in the country.

Scientific research had taken roots in the West, especially in Europe in the early nineteenth century. But in India it got organized only in the first three decades of the twentieth century. During this period, seeds for research were laid by a few philanthropists, educationists and scientists who had a nationalistic fervor and commitment to science. The main centre of action was at Calcutta. The Indian

Association for the Cultivation of Science and the University College of Science at Calcutta, both established during the last century nurtured early scientific research in the country.

Sir Asutosh Mookerjee, a judge of the Calcutta High court and Vice Chancellor of the Calcutta University, did much to promote science in the University of Calcutta. Thanks to the generous contributions made by Rash Bihari Ghosh and Tarak Nath Palit, two lawyers of Calcutta, Asuthosh Mookerjee could create new chairs like the Palit Professorship and Rash Bihari Endowment to be occupied by eminent Indians.

C.V. Raman and K.S. Krishnan at the Indian Association, S.N.Bose and M.N.Saha at University College, J.C.Bose and P.C.Ray at the same place were the leading personalities who transformed Indian science during this early period. J.C. Ghosh, P.C.Mahalanobis, N.R.Dhar names well known in Indian Science were all at Calcutta during this period. From about 1906 till the 1930's, the Calcutta School of Physics played a significant role in building a research culture in the country.

C.V.Raman, who had taken up the job of Deputy Accountant General in the Finance Department after

passing his M.A examination from Madras University, came across the Association at Calcutta quite by chance. With his deep interest in research work (he had already published scientific papers in leading research journals abroad even as a student at the Presidency College, Madras) he started research at the Association from 1907. This was the beginning of almost a quarter century of intimate connection between Raman and the Association. He did research work before and after office hours until 1917 when he gave up his lucrative job at the finance department and accepted the Palit Professorship offered by Calcutta University at a lower salary. This indicates his interest in research and commitment to science. The Association which was not very active till Raman started working there, became a centre of intense research activity. A number of scholars both from Calcutta and outside joined the centre. Some of the physicists who worked with him were D. Banerjee, S. K. Banerjee, S. Bhagavantam, A. Ganesan, K.S.Krishnan and K.R.Ramanathan. While working at the Association Raman also lectured in Calcutta University where Bose and Saha were teaching. A good school of Physics developed at the University. To quote Raman:

" .... *the Calcutta University can* **claim** *to possess a real school of physics, the like of which* **certainly** *does not exist in any other Indian University, and which, even now will not compare very* **unfavourably** *with those existing in the best European and American Universities"* (Raman,1917).

Raman invited the German physicist Sommerfeld to Calcutta in 1928. Sommerfeld lectured at the University and visited the Association with which he was impressed. He wrote in his diary in German:

" *Jeden Morgen lectures 8-10 mit* **unzerlegbar** *discussion.* **Raman,** *S.N. Bose, D.M. Bose. Auch Gosh von Dacca geschen. Im* **Institut** *scattering* **blau-grin** *in einem Eis block gesehen;* **deutlicher** *modified scattering. Alles* **im Inst.** *sehr gut". (Sommerfeld, 1928) :*

" *Every morning lectures 8-10 with* **simple** *discussion.* **Raman,** *S.N. Bose, D.M. Bose.* **Also** *seen Gosh from Dacca. Seen blue-green scattering in an ice-block in the Institute;* **clearly** *modified scattering. Everything is very good in the Institute".*

During the same year S.Chandrasekhar who was just a student at that time and who won the Nobel prize decades later for his work in astrophysics, attracted by the scientific atmosphere prevailing at Calcutta, visited the Association. It is understood that while at the Association he started thinking about stars and his work related to this was presented at the meeting of the Indian Science Congress at Madras in 1929 (Venkata-

raman, 1988). It was during his days at the Association that Raman attracted world wide attention for his work on Acoustics and Optics and, in particular, scattering of light, which led to the discovery of the effect now known by his name (Raman Effect) ; it was in the same period he received many prestigious awards - Fellowship of the Royal Society, the Hughes Medal, Knighthood of the British Government, and to top it all, the coveted Nobel prize in 1930. Raman, as we shall see later believed in publishing our own journals and was instrumental in starting the Bulletin of the Indian Association for Cultivation of Science, Proceedings of the Indian Association for Cultivation of Science, Indian Journal of Physics and later on at Bangalore, the Proceedings of the Indian Academy of Sciences. He was also closely associated with Current Science.

Sathyendranath Bose and Meghnad Saha two other well known physicists of the country were both lecturers at the University College, Calcutta. Bose worked here during 1916-1921, and again from 1945 till he retired in 1956, and Saha from 1916 till 1919, and 1938 to 1953 . Bose came to prominence with his work on Photon Statistics and much 1ater recognising his contributions to the field, certain types of elementary parti-

cles were named after him as "Bosons". He and Saha translated from German to English Einstein's paper of 1916 on the Foundations of Genera1 Relativity. He left Calcutta University and joined Dacca University in 1921. He sent two of his papers to Einstein and requested him to give his opinion on them, translate them into German and help get them published in the German periodical Zeitschrift fur Physik. Einstein in fact did comply with Bose's request. Bose returned from Dacca University to Calcutta University in 1945 as Khaira Professor.

Meghnad Saha who taught at the University College, Calcutta till 1919 contributed substantially to physics and astrophysics by his work on "Thermal Ionization". Saha's ionization formula is well known in astrophysics. Kothari writing Saha's Biographical Memoirs for the Royal Society says : "His name would always remain associated with the theory of thermal ionization and its application to the interpretation of stellar spectra" (Kothari, 1966). Saha went to Europe in 1919 and after his return in 1921 worked for a short while at Calcutta. He then joined Allahabad University where he spent a number of years and built a school of physics He returned to Calcutta in 1938 to occupy the Palit Professorship which Raman had occupied earli-

er. K.S.Krishnan, one of the close associates of Raman at the Indian Association for Cultivation of Science was another leading physicist who worked not only at Calcutta but later on at Dacca University and New Delhi. Two other scientists, J.C.Bose and P.C. Ray, also contributed significantly to Indian science during this period. Though J.C.Bose was interested in Physics and worked on Electric waves and microwave receivers in his earlier days, (he published his paper on microwaves in the Journal of the Asiatic Society in 1896) his interest shifted to Biology after 1900. He founded the Bose Research Institute established in 1917 and published most of his research work in the Transactions of this Institute. P.C. Ray was the leading chemist in the country during that period. Both Bose and Ray taught S.N. Bose and Saha at the university. Thus we see scientific research getting organized on a sound footing at Calcutta under the able guidance of these scientists. Undoubtedly Raman was the central figure in this effort. Raman and Saha were also instrumental in starting scientific journals in the country. They not only started them but also contributed articles to these journals.

The period 1900 - 1930 could be called the "Golden Age" of Physics in the country. As has been mentioned earlier, important discoveries were made during this period (Raman effect, Bose's statistics, Ionization equation of Saha) and the work of the leading scientists were well received outside the country. But the stronghold of Calcutta with respect to physics research slowly declined due to the migration of the top physicists to other cities - with Bose, Saha and Raman going to Dacca, Allahabad and Bangalore respectively. Though Saha and Bose returned to Calcutta after their stints elsewhere, the Calcutta School did not regain its old glory.

Although research activity was gaining grounds in the country, specially in Physics, there was no journal in the country specifically devoted to physics. With the increase of scientific activity at the Indian Association, Raman started the first Indian publication devoted to Physics in 1909. It was the Bulletin of the Indian Association for Cultivation of Science. Till this was started, the research work done by the Calcutta School was reported in foreign journals, excepting for an occasional article in the Journal of the Department of Science of the Calcutta University. The first five numbers of the Bulletin of the Association

were just collection of reprints of the papers published in other journals like Nature, Philosophical Magazine etc. But from Number Six onwards, original articles started appearing in this publication. In all fifteen numbers were brought out till 1918. Some of the important work pub1ished by Raman in the Bulletin were on Acoustics and Musical Instruments. Two numbers, No. 11 and No.15, reported exclusively the work of Raman. In 1917 "Proceedings of the Indian Association for the Cultivation of Science" was started. This publication carried not only research articles but also the papers read at the scientific meetings of the Association and the Annual Report of the Association. In 1926, the Association started the Indian Journal of Physics. It is mentioned in the publication "Century" published by the Association in 1976 to mark its centenary that:

> ***" By 1926, the research activities greatly expanded and consequently it was imperative to make arrangements for regular and prompt pub7ication of research results within the country. As a result, the Indian Journal of Physics made its appearance in the same year with which was incorporated the Proceedings of the Association"*** (Century, 1976).

But it is not clear why a new title was given as the Proceedings published till then was also continued as a part of the Indian Journal of Physics. Perhaps it was felt by the Association that it would be more

appropriate to publish only scientific papers in a research journal. But as the Association wanted to continue "Proceedings" for other reasons such as publishing the annual report of the work of the Association and matters pertaining to the Association, it was also included in the journal. But Proceedings continued to have its own volume number.

Raman was very much involved in starting the Indian Journal of Physics. He published six papers in the Indian Journal of Physics including his famous paper "A New Radiation" in 1928. Indian Journal of Physics remained largely a channel for publication of the Calcutta School. We should note that research efforts in Physics elsewhere were either non existent or at a very low key. But when the Bangalore School got organized after Raman moved to that place, its contributions went to the Proceedings of the Indian Academy of Sciences started in 1934.

A study of the publication pattern of Raman, Saha, S.N.Bose and Krishnan during the period 1910-1930 has shown that most of their research findings were published in foreign journals. During the period 1906-1930 Raman published 146 papers in foreign journals

and 21 in *Indian Journals;* S.N.Bose (1918–1930) *5* in *foreign journals* and 2 in *Indian journals;* Saha (1917–1930) 42 in *foreign journals* and 10 in *Indian journals* and Krishnan (1925–1930) 26 in *foreign journals* and *7* in *Indian.* In addition to journal articles Raman published one monograph on "Molecular Diffraction of Light" in 1922 (Calcutta University Press) and an article on Musical Instruments (translated into German by the publishers Springer Verlag) in Handbuk der Physik in 1927. Table 2 summarizes this information. The break up of the number of articles published by Raman on different topics during this period is shown in Table 3. This trend of publishing predominantly abroad was perhaps due to the fact that the Indian Journals had not taken root and were still in their infancy; the system of circulating preprints/reprints extensively was not yet a common practice. An exception to this was a particular case when Raman mailed a large number of reprints of his article "A new Radiation" published in the Indian Journal of Physics in 1928. He did this to establish priority for his work. It is found that it was the practice of Raman to send a brief note of his work to Nature and publish the details of the work in Indian Journal. This served the dual purpose of making his work known to scientists in other parts of the world (where perhaps there was a better audience for

TABLE 2

Number of Publications of Raman, Bose, Saha and Krishnan in Indian and Foreign Journals till 1930

		Indian	Foreign	Total
Raman	(1906–1930)	21	146	167
Bose	(1918–1930)	2	5	7
Saha	(1917–1930)	10	42	52
Krishnan	(1925–1930)	7	26*	33

* 20 joint papers with Raman

TABLE 3

Raman's Publication during 1906–39 on different Topics

	Foreign		Indian	
Wave Optics	27	(1906–1927)	2	(1926–1939)
Colloid State	8	(1909–1927)	1	(1927)
Molecular Scattering of Light	27 0	(1919–1931) (1932 onwards)	1	(1928–1931) (Book)
Raman Effect	13	(1928–1932)	3	(1928–1931)
Magnetism and Electro Optics	15	(1927–1929)	1	(1929)
Optical and Elastic Properties of Solids	9	(1918–1926)	5	(1934–1939)
Ultrasonics and Hypersonics	4	(1935–1938)	5	(1935–1936)
Vibration and Sound	20	(1909–1922)	3	(1914–1922)
Theory of Musical Instruments	12	(1914–1927)	7	(1914–1934)
Viscosity of Liquids and Surface Forces	8	(1907–1928)		-
Line Spectrum	4	(1922–1925)		-

such work) and at the same time nurturing Indian journals to gradually build them up.

In the beginning of the 1930's there arose some conflict between Raman and the authorities of the Indian Association for the Cultivation of Science which eventually led to Raman leaving the Association, and Calcutta and moving over to Bangalore in 1933. It has already been mentioned that Bose, Saha and Krishnan had by now left Calcutta. And when Raman left Calcutta for Bangalore, Fermor, the well known Geologist, addressing the 20th session of the Indian Science Congress in 1933 remarked :

> *".....Calcutta's loss will be Bangalore's gain. At present Calcutta may be regarded as the centre of scientific research in India; but, with transference to Bangalore of one of her leading investigators, she will have to guard her laurels"* (Fermor, 1933).

Due to the foresight and benevolence of the Tatas, one of the leading industrialists and philanthropists of the country, a research institute had been established at Bangalore in 1907 and was called the 'Indian Institute of Science' (popularly called as the 'Tata Institute' even to this day). It started with two main disciplines - Chemistry (applied, general and organic) and Electro Technology and slowly enlarged its

scope. Raman was the first Indian to be appointed as the Director. It was during Raman's stay at the Institute that Physics got a boost. He was responsible for bringing the German Physicist Max Born to Bangalore. But unfortunately within a course of four years he ran into administrative problems and had to relinquish the Directorship. He continued to head the Physics department until 1947 when he retired and moved to his own institute (the Raman Research Institute).

Soon after coming to Bangalore, Raman founded the Indian Academy of Sciences in 1934. The Academy was formed under much controversy as there was already a move earlier during the Indian Science Congress Session to form a National body of this kind. This suggestion had been agreed upon by a number of scientists including Raman. But as things did not move in the direction he had hoped , Raman came out of the Committee which had recommended the formation of the National Academy and started another academy calling it "The Indian Academy of Sciences". This was very much resented by others and in 1935 a group of scientists which included Saha started the National Institute of Sciences of India, having its headquarters in Calcutta. Thus two organizations, each claiming the status of a National Academy were founded within a short time. Though the stated

functions of the two organizations differed, and do so even to date, it is not inconceivable that the starting of the two academies was a direct result of a personal feud in which Raman and Saha were on opposite sides. However, there were a large number of scientists who were Fellows of both the academies (and there are even more today) excepting for Saha who was not a fellow of the Indian Academy.

Raman was the founder president of the Indian Academy and remained so till his demise in 1970. The Academy had 65 Fellows when it commenced its activities and made provision to elect more Fellows from within the country and honorary Fellows from among distinguished scientists abroad (C.V.Raman, 1935). Today (1990) it has 608 Fellows, 45 Honorary Fellows and 35 Young Associates.

The National Institute of Sciences of India was started in 1935 with L.L Fermor as its first President. Saha was closely connected with it and was its second President. It had its headquarters in Calcutta and had the role of a federation for the existing academies and societies in the country. Both the Indian Academy of Sciences and the National Institute brought out their

own "Proceedings". The National Institute moved its headquarters from Calcutta to Delhi in 1945, and its name was changed to "Indian National Science Academy" in 1970.

One of the main objectives of the Indian Academy of Sciences was to publish journals. Since much of the work done in India was getting published outside the country, Raman made a case for Indian journals. He wrote in Current Science:

> *" It is true that individual scientific workers in India have by their indefatigable industry achieved great distinction for themselves, but the prestige of both official and non official research work is still slow in attaining that status of international importance reached by most European countries. This unsatisfactory position is in my opinion partly due to the tendency of many scientific men to export their more important contributions for publication in foreign journals, with a proportionate impoverishment of Indian Archives. Perhaps if the resources of an all India journal such as we contemplate in connection with the Academy of science, had been available for giving Indian scientific work suitable international publicity, the outflow of memoirs from this country would have been more restrained and less voluminous. Continuance of this practice will retard the process of building up a scientific tradition for India and keep her in a position of semi dependence in the world of science. While the foundations of the scientific reputation of a country is established by the quality of work produced in its institutions, the superstructure is reared by the national journals which proclaim their best achievements to the rest of the world "* (Raman, 1933).

(Surprisingly as far as Physics was concerned, the existence of such a journal Indian Journal of Physics which Raman himself started seems to have been ignored by him!). With this firm belief, Raman started the Proceedings of the Indian Academy of Sciences in 1934, soon after the Academy was established that year.

The first volume was in one section covering Physical, Mathematical and Biological Sciences. From Volume Two onwards, it was brought out in two sections - Section A covering Physical and Mathematical Sciences and Section B, devoted to Biological Sciences, somewhat on the 1ines of the Proceedings of the Royal Society (London). Raman edited the Proceedings ti11 his demise. He paid a great deal of attention to its publication on time. During his times the articles used to be communicated by Fellows. After the Proceedinas were started Raman published most of his work in it. He published 458 papers in all (during the period 1906-70) out of which 294 were published in Indian Journals. Of these 294 papers, 273 were pub1ished during 1931-1970, a majority of them (206 papers) in the Proceedings of the Indian Academy of Sciences during 1935-65.

The Proceedings became a vehicle for the physicists at the Indian Institute of Science, and also for various University departments in the country - specially Andhra University at Waltair, Annamalai University and Aligarh Muslim University. For example, in the first ten volumes there were 180 articles from the Indian Institute of Science (out of 727 articles). The Proceedings gradually gained the attention of scientists outside the country. It had gained sufficient status by 1938 that when the Academy decided to bring out a special issue in that year to commemorate the fiftieth birthday of Raman and ten years of research connected with the Raman Effect, it received articles from physicists in different countries - Brillouin (France), Hans Mueller (M.I.T., U.S.A), Jordan (Germany), Kohlrausch (Graz), Sutherland (Cambridge) and San-Ichiro (Japan), to name a few. Homi Bhabha, the architect of Atomic Energy in the country, patronized the Proceedings. He published thirteen articles in it during the period 1939 - 1951. It is interesting to note that there were very few *articles* from Calcutta, specially from the Indian Association and the University. Perhaps their own publication Indian Journal of Physics was being used by them. Neither Bose nor Saha published in the Proceedings of the Indian Academy ! Curiously, K.S.Krishnan, an early associate of Raman at the Indian Association at Calcut-

ta, published only three papers in this journal. He published 99 articles (eighty four in foreign journals and 15 in Indian journals (6 in Current Science and three each in Indian Journal of Physics and Proceedings of the Indian Academy of Sciences) during 1931-1961). Saha published 33 articles (20 in Indian and 13 in foreign journals) during the same period. We see Krishnan's clear *preference* for publishing in *foreign journals*.

The starting of the Indian Science Congress (1914) and the journal Current Science (1932) were two other important events connected with Indian Science during this period. The Indian Science Congress Association was, as it is even today, a forum for the meeting of scientists from different disciplines working all over the country. In the early days (till the Indian Academy and the National Institute were founded), it was the main scientific conference in the country. Bhabha, Bose, Raman and Saha were the General Presidents of the Congress at one time or other. Jawaharlal Nehru was a regular invitee to this congress and he used to participate with interest in the deliberations. Distinguished scientists from different countries representing their national academies were invited for these meetings.

Scientific papers on current work were presented at different sectional meetings. The Proceedings of the Congress was also brought out regularly, in the early days as a part of the Journal of Asiatic Society of Bengal, and later on by the Science Congress Association itself. Unfortunately, today the Annual meetings have become more of a mass gathering (in thousands) of scientists, with very little scientific outcome. It was during one of the meetings of the Association, that the idea of forming a National Academy was discussed.

In 1931, Dr. Forster, the then Director of the Indian Institute of Science sent a questionnaire to various scientists to get their response for starting a Science News Journal on the lines of "Nature". This matter was discussed in the meeting of the Science Congress in 1932. The idea was well received and the journal "Current Science" was started in July 1932. It was managed by a committee and had the patronage of many leading scientists, the Indian Institute of Science and the Madras University. Raman was associated with this journal from its beginning and was the President of the Current Science Association from 1947 till his demise in 1970. Though the journal was intended to be multi disciplinary in nature, it gradually ended up with a bias towards Biological Sciences. Raman published 65

articles in this journal. This journal was hoped to be a *Letter* Journal for all sciences but as mentioned it was biased towards Biological Sciences. It is still being published regularly and as we will see in a later chapter there have been vigorous attempts in recent times (1989) to revive this journal.

As mentioned earlier, the National Institute of Sciences of India also brought out its own publication - "Proceedings" in two sections. Unlike the Proceedings of the Indian Academy, this included not only research articles but also other material like the papers read at its meetings and Annual Report. Saha contributed half a dozen articles to this journal. But there was no contribution from Raman to this journal. The National Institute also published its Transactions.

In 1935 Saha started another journal Science and Culture. This was not a pure research journal. Saha published in this journal nearly 150 articles on various topics including those pertaining to the problems of India. Another periodical published during this period which is still being continued is the Proceedings of the National Academy of Sciences at Allahabad.

Along with Physics, Astronomy also began to take roots in the country, but at a slower pace. An important centre for astronomical observations was the Kodaikanal Observatory in South India. It was started as a result of the shifting of the Madras Observatory and was established under the Meteorological Department in 1900. The observatory was mainly concerned with solar studies. Evershed, who was the director of the observatory in 1911, contributed to a great extent to research in this field. He is well known for his studies on sunspots and in particular, "radial motion in sun spots" which is known as the "Evershed Effect". Cosmic ray measurements were carried out here in 1940. This observatory brought out a bulletin called the Kodaikanal Observatory Bulletin. The first number of this Bulletin was brought out in 1908. Evershed contributed a number of articles (~20) including his work on the" radial motion in sun spots" to this publication. However he published some of those articles in the Monthly Notices of the Royal Astronomical Society also. Apart from the research articles, the Bulletin contained the data of the solar geomagnetic and ionospheric observations carried out at Kodaikanal. In addition to the Bulletin there was also the Memoirs of the Kodaikanal Observatory of which only one volume was published.

Kodaikanal Observatory was the forerunner of the present Indian Institute of Astrophysics. It is interesting to note that for a short while there was an Astronomical Society during 1910–1916. H.G.Tomkins was its first President and Raman was the secretary for some time. The Society published its journal during this period and was closed down in 1916, perhaps due to the World War (Abhayankar, 1982). Both Raman and Saha took keen interest in the development of astronomical research in the country. Knowing the importance of astronomy Raman wrote in an article in Current Science.

> ***"...the organization of scientific research in India must be considered radically defective unless and until adequate provision is made for astronomical study and research of the highest grade in the country"*** **(Raman,*1943).***

Saha was the Chairman of a committee which was set up in the early 1950's to estimate the requirements of Astronomical research in the country (Bhattacharyya, 1985).

Thus we see that by 1940 scientific research activity had taken root in the country and was reasonably well established. Scientists like Bhabha, Bose,Krishnan, Raman and Saha had made a name for themselves and Indian science had gained some recognition

outside the country. This situation is very well reflected in Sommerfeld's impression about India. He writes:

> *" India had a special attraction for me because study shoots of modern physics have sprung up in recent years on this ancient cultural soil and scientific research in India has suddenly begun to compete on equal terms with research in Europe and America. No discovery in Physics during the last year has caused so much excitement and collaboration combined with admiration in the entire world as the spectroscopic effect found by Professor C.V. Raman in Calcutta and developed by him in an exemplary manner; and no discovery in astrophysics has been found to be as fruitful for our understanding of the stellar system as the theory formulated by Saha, at present Professor in Allahabad. The international importance of these two men is borne by the fact that they have been chosen members of the Royal Society in London, that old and venerable Academy of Science"* (Sommerfeld, *1929).*

Though the scenario of scientific activity in the country was encouraging, it was a different story with regard to the scientific journals. They had not the same recognition that Indian science had. This was perhaps due to the fact that leading scientists published their most important work in foreign journals (specially Krishnan, Saha and to some extent even Raman). Table 4 gives a picture of the number of publications of Raman, S.N.Bose, Saha and Krishnan in some of the well known foreign journals. Table 5 gives the number of publications of these scientists in Indian and

TABLE 4

Number of Publications of Raman, Bose, Saha and Krishnan in some leading foreign journals

	Raman 1906–45	S.N. Bose 1918–55	Saha 1917–56	Krishan 1925–61
Nature	83	–	14	47
Proceedings of Royal Society	19	–	1	24
Philosophical Magazine	39	3	15	9
Physical Review	9	–	2	8

TABLE 5

Publication Pattern of Raman, Bose, Saha, Krishnan and Bhabha during different periods

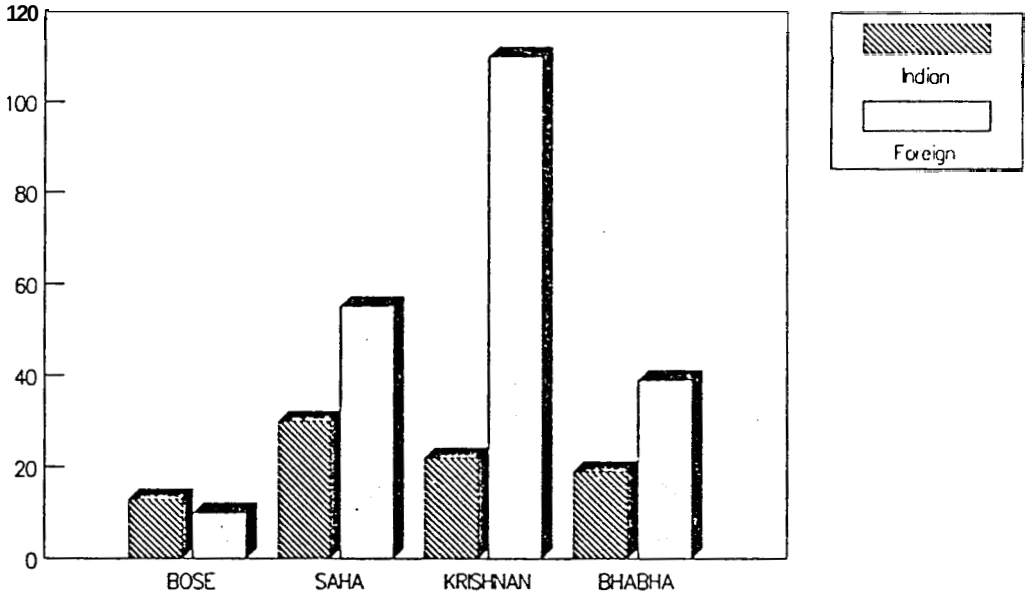
	Foreign	Indian	Total
RAMAN, C.V.			
1906 - 1930	146	21	167
1931 - 1970	18	273	291
TOTAL	**164**	**294**	**458**
BOSE, S.N.			
1918 - 1930	5	2	7
1931 - 1955	5	11	16
TOTAL	**10**	**13**	**23**
SAHA, M.N.			
1917 - 1930	42	10	52
1931 - 1956	13	20	33
TOTAL	**55**	**30**	**85**
KRISHNAN, K.S.			
1925 - 1930	26	7	33
1931 - 1961	84	15	99
TOTAL	110	22	132
BHABHA, H. J.			
1933 - 1954	39	19	58

Source: For Raman: Consolidated list of C.V.Raman's scientific papers published in six volumes by the Indian Academy of Sciences, 1988.

For others: Biographical Memoirs of the Fellows of the Royal Society. V21(1975),V5(1959) and V13(1969)

foreign journals, along with that of Bhabha during different periods. It was only after 1940 that Raman became an exception and published most of his papers in Indian Journals (see Table 5). Till 1940 only 46 articles were published by him in Indian Journals against 162 in foreign journals ! The total number of articles by Bose, Krishnan, Raman and Saha in the Indian Journal of Physics was only 19. The few good articles published in the country had to be shared among the journals of the three Academies and the Indian Journal of Physics ! This is perhaps one of the reasons why most of them could not break ground in the international scene. The Proceedings of the Indian Academy fared better to a certain extent due to the very good articles it published during 1935-1945 especially those by Raman and Nath. Overall, perhaps the starting of so many competing journals worked against the Indian journals getting recognition abroad. In spite of the enlarged scientific community, the journals suffered from lack of continued patronage from leading scientists. What Raman wrote in Current Science before founding the Proceedings, remains true even today, this in spite of now having many journals in India. We can spot a trend set already forty years ago by the eminent scientists of the country with regard to publications in foreign journals (see Table 5 and figure 4).

Publication Pattern of some Eminent Indian Scientists in Journals



Publication Pattern of C.V. Raman in Indian & Foreign Journals

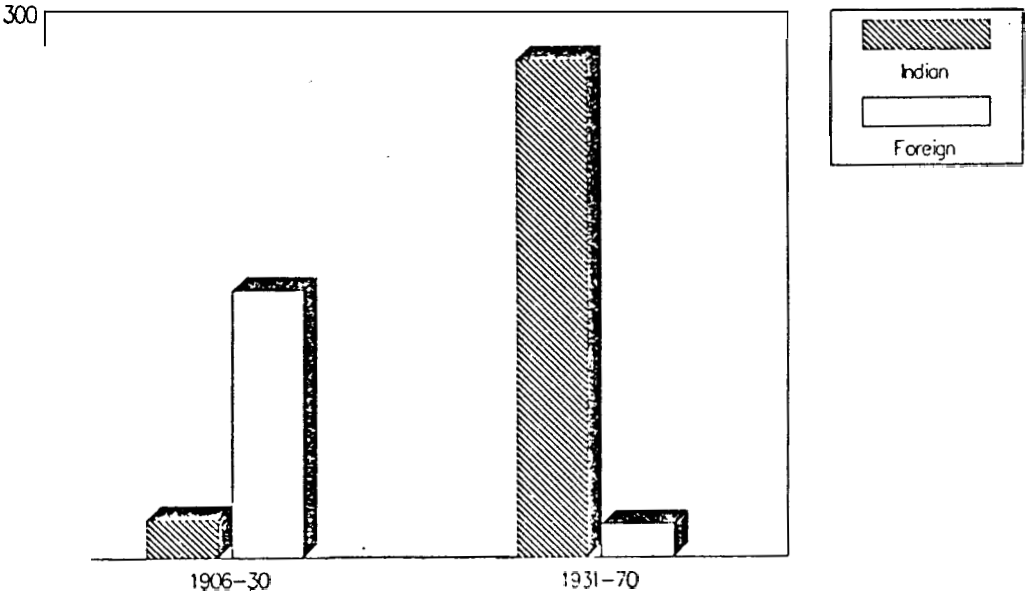


Figure 4

But excepting Krishnan the rest did contribute a reasonable percentage of their papers to Indian Journals. However, as we see in a later chapter the percentage of papers received by Indian journals from well established scientific research centres in the country has dwindled. This is in spite of the serious attempts made by the publishers to improve the standard of the journals.

To summarize, we find that during the period 1900 - 1940, scientific research took roots in the country. A few journals like the Proceedings of the Indian Academy of Sciences and the Indian Journal of Physics published important articles but the majority of the papers from *recognized* Indian scientists (barring to some extent Raman) were published *outside* the country. Not many Indian Journals gained international recognition inspite of the recognition Indian science had received abroad.

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CHAPTER 4

Consolidation and Rapid Growth of Scientific Establishments during 1941 - 1988

We continue our survey of the growth of science in India, focussing now on the period 1941 - 1988. This will then be used to relate the growth to the progress of scientific journals during that period.

If J.C.Bose, Raman, P.C.Ray, S.N.Bose and Saha dominated the Indian science scene till the 1940's, it was scientists like Bhabha, Bhatnagar, Mahalanobis and Vikram Sarabhai who organized Indian science just before and after Independence. The deep interest and concern Jawaharlal Nehru, India's first prime minister had for science was a very important factor. This support of the Government for the development of science and technology in the country was very much continued during the prime ministership of Indira Gandhi also. Senior scientists like Krishnan, Saha, Bhagavantam and Raman continued to contribute in the post-Independent phase in different ways to Indian science.

The academies like the Indian Academy of Sciences pursued their objectives of publication of journals. The Indian National Science Academy (which was known as the National Institute of Sciences of India till 1970) became the official representative of the country in various international organizations.

The dominant feature of the post independence period is the huge expansion of Science and Technology activity through the creation of several departments like the Department of Atomic Energy, Department of Electronics, Department of Energy, Department of Biotechnology, Department of Ocean Development, Department of Nonconventional Energy Sources and the Councils for Scientific and Industrial Research, Medical Research and Agricultural Research. Table 6 gives some data on these organizations. To complement these, research institutions for specific subjects like Astronomy, Atomic and Nuclear Science and their allied fields, Space research and Applied research were established. For higher technical education, Institutions like the five Indian Institutes of Technology were started. The University Grants Commission was set up to support and supervise the various activities of the universities and help the University education. The founding of some of the

TABLE 6

Data on some Science & Technology Organisations

	No. of institutions#/ laboratories	Manpower	Budget
Department of Space	12	10,400	3481 million (1988-89)
Department of Science & Technology	18*	3,500	1989.7million (1988-89)
Department of Electronics	13	23,00,000@	1200 million (1988-89)
Department of Atomic Energy	19		1658 million (1986-87)
D R D O	45	1,82,000	5850 million (1986-87) (Investment)
C S I R	42	24,500	1996.1million Planned Exp. (1985-88)
I C A R	41		2272 million Planned Exp. (1985-88)
I C M R	28		895.1million Planned Exp. (1985-88)

The number of institutions are either directly under the organisation or connected with it in some way or the other.

* Some of these institutions are autonomous bodies but funded by the organisation.

@ This number indicates the total manpower in this field taking into account various small scale industries.

important departments and the Institutions related to the fields of Physics and Astronomy are discussed below.

Department of Atomic Energy:

An important scientific and technical endeavour initiated in the country was the programme relating to Nuclear Power. The main architect of the Nuclear Programme was Homi Bhabha who started **it** way back in **1944.** As a result of his vision, initiative, and drive, the Tata Institute of Fundamental Research was founded in **1945.** The Atomic Energy Commission was established in **1948** and the Department of Atomic Energy in **1954.** The starting of the Atomic Energy Establish-ment at Trombay in **1957** was mainly due to the efforts of Bhabha. This was renamed the Bhabha Atomic Research Centre in **1967** after his death. The Nuclear Power Board (now called the Nuclear Power Corporation of India Ltd.) established under the Department of Atomic Energy, is responsible for construction and operation of the Nuclear power stations in the country. About twenty organizations are administered by this Department. Apart from the Bhabha Atomic Research Centre and its divisions in different parts of the country, a few other important organizations under this department are, Atomic Minerals Division, Nuclear Fuel Complex, Uranium

Corporation of India Ltd., Electronics Corporation of India Ltd., and Indian Rare Earths Ltd.; and research institutions like the Tata Institute of Fundamental Research, Bombay, the Saha Institute of Nuclear Physics, Calcutta, the Institute of Physics, Bhuwaneshwar and the Institute of Mathematical Sciences,Madras. The Science and Technology programme in the field of Atomic Energy is promoted by the Board of Research in Nuclear Sciences which advises the Department of Atomic Energy on the Scientific and Technical activities.

Department of Space:

Soon after the launching of "Sputnik", the first space satellite, by the Russians in 1957 there was widespread interest in space research all over the world. In India, Homi Bhabha was interested in studying Physics related to Space. He suggested to Vikram Sarabhai the initiation of such studies in the country. After some discussions on the matter, a proposal was put up by Bhabha and Sarabhai to the Government for support to Space Science and Technology for possible application to Indian problems. This proposal was readily approved by Nehru, the then Prime Minister (Dhawan, 1985). The

"Space Programme" in the country started formally with the founding of Indian National Committee on Space Research (INCOSPAR) in **1962** under the Department of Atomic Energy, and the establishment of the Thumba Equatorial Rocket Launching Station, the same year. However, studies related to space sciences were already going on at the Physical Research Laboratory started by Vikram Sarabhai at Ahmedabad in **1957.** The Indian Space Research Organization (ISRO) established in the year 1969 (the trained manpower that was formed at laboratories which were involved in the INCOSPAR project became a part of ISRO. **Rajan,** 1988) became the Research and Development Agency of the Department of Space founded in **1972** under the chairmanship of Satish Dhawan. Several organizations specifically related to space technology were started by this Department. Some of them.were, the Space Application Centre at Ahmedabad, Vikram Sarabhai Space Centre at Trivandrum and ISRO satellite Centre at Bangalore. Activities of the National Remote Sensing Agency and the Physical Research Laboratory are supported by the Department of Space. The launching of rockets and satellites by the country during the past decade is an outcome of the research and development programmes of this Department. Apart from the building and launching of rockets and satellites, the space programme opened up new research fields related to

physics and allied subjects. Over ten thousand scientific and technical personnel are working in the various programmes of this department. Its expenditure during 1984-87 was Rs.7,049 million and an outlay of Rs.3,481 million was provided for the year 1988-89. (Publications and Information Directorate, 1988a)

Department of Science and Technology:

To support the activities of the various Scientific and technical institutions in the country, the Department of Science and Technology (D S T) was established in 1971. The main function of this Department is Policy and Guidelines Formulation for Science and Technology, promotion of S & T activities and International S & T Cooperation. It functions through a dozen Divisions, each taking care of a particular aspect of Science & Technology. DST funds not only the activities of several research institutions (about 18 in number) but also specific research projects of science departments in the Universities. This Department's estimated budget for 1988-89 was nearly Rs.1,990 million (Publications and Information Directorate, 1988b).

Department of Electronics:

This Department established in '1970 is the executive wing of the Electronics Commission. It coordinates the research and development activities in the field of Electronics. It is the main body for sponsoring electronics development projects of the various civil and defence research organizations in the country. The Directorate of Standardization, Testing and Qua1ity Control, Centre for Electronics Design and Technology, the Computer Maintenance Corporation, the Semiconductor Complex Ltd., are some of the organizations coming under the purview of this department. Autonomous societies like the National Centre for Software Technology, Centre for Development of Advanced Computing Technology are associated with this department. The Department had an outlay of Rs. 1,200 million for the year 1988-89. Thirteen organizations are either directly under this Department or associated with it in connection with their projects.

Department of Biotechnology:

This Department was established in 1986 to give a boost to biotechnology in the country. The main activities of the department are in the areas of development

of effective vaccines and indigenous production of vaccine; creation of infra-structural facilities in the field of biotechnology, and developing trained manpower for all its programmes. It has established an International Centre for Genetic Engineering and Biotechnology at New Delhi with a unit at Trieste, Italy. The Department conducts short term courses.

Defence Research and Development Organization:

This organization under the Ministry of Defence, was started in 1958 and it oversees the S & T activities related to Defence. With a network of forty five institutions and organizations engaged in research and development activities relating to machines and equipment required by the Armed Forces, this organization serves as the centre for all technical matters pertaining to the defence departments of the country. Its activities encompass fields like aeronautics, electronics, numerical research, combat vehicles, food technology and material science. It also sponsors defence oriented research projects and regular academic courses at Masters level in some universities. It has a man power resource of about 35,000 people, and its budget during 1986-87 was Rs.5,850 million in

1986-87.

In addition to the above departments, the Department of Ocean Development, the Department of Scientific and Industrial Research, the Department of Telecommunication, the Department of Power and the Department of Nonconventional Energy Sources were some of the other establishments created to promote activities related to the concerned fields.

The Council of Scientific and Industrial Research:

The Council of Scientific and Industrial Research, (CSIR) one of the largest scientific organizations in the country today was established in 1941 as a part of the Department of Supplies and Industries for aiding the war effort. It (C S I R) was transferred to the Department of Planning when the latter was set up in 1944. One of the responsibilities assigned to the Council was the collection and the dissemination of scientific information relating to not only research but also industrial matters generally, and publication of scientific papers and a journal of industrial research and development. Since its establishment in 1941, its subject area of activity has very much widened. As of 1988, it had 44 National Laboratories and

institutions under its wing covering the Physical, Earth, Chemical and Biological Sciences besides Industrial Research. In addition to the National Laboratories, the CSIR has 101 Extension Centres and 9 Polytechnology Transfer Centres (Publication and Information directorate, 1988c). Though the scope of CSIR was applied research to start with, it has been concerned with fundamental sciences also. Apart from direct research activities, it is also involved in other science-related activities like information transfer, funding scientific research and maintaining a national register of Scientific and Technical Personnel In the country. There are nearly 24,500 people (out of whom 5,400 are scientists and 10,500 are technical staff) working in the various organizations under its purview. It had an estimated Plan expenditure of Rs.1996.1 millions for 1985-88. C S I R releases the processes developed by its laboratories to entrepreneurs for commercial uti1ization. Its planning division and technology utilization division interact with various other governmental and non-governmental organizations in the country. An important laboratory related to the field of Physics under this Council is the National Physical Laboratory. This was set up in 1948 at New Delhi under the directorship of K.S.Krishnan. The main

objective of this laboratory is to develop, maintain and update the national standards of physical measurements. It is also involved in research in basic and applied physics.

The work of S.S.Bhatnagar in the organization of the CSIR and its various laboratories was very much recognised by Nehru who paid a tribute to him at the Baroda Science Congress in 1955. He said :

> ***" I would like to pay a tribute to Bhatnagar who I think has done, this I say with due respects to others, more than anyone else for scientific development in India. ..... I can truly say that but for Dr. Bhatnagar you could not have seen today the chain of National Laboratories in India "*** (Nehru, 1955).

Indian Council of Agricultural Research:

Established in 1929, this Council's activities have spread to a great extent after Independence. It is concerned with agriculture and animal husbandry research in the country. A large number (41) of research and educational Institutions come under its purview. In addition it has connections with 26 Agriculture universities in the country. It has also started Krishi Vigyan Kendras which provide training to farmers. Its estimated plan expenditure for the period

1985-88 was Rs.227 crores (Publications and Information Directorate, 1988d).

Indian Council of Medical Research:

This is the Apex body in the country for Medical Research. Established in 1911, it promotes research activities of institutions set up by it as well as those departments related to this subject which are under the universities and other non ICMR Institutions. Its programmes include promotion of goal oriented projects, research activity on health problems specific to particular regions and fostering research capabilities in this field in different parts of the country. It has 28 institutions under its wing and had a plan expenditure of Rs.89.5 crores during the period 1985-88. In addition to this, there are 35 other institutions and laboratories doing research in the medical and allied subjects. These are attached to the Ministry of Health and Family Welfare.

Research Institutions:

Research activity was promoted in the country by either establishing or supporting different types of

institutions. Some organizations which were mainly concerned with applied research pursued basic research also. These were organizations like Bhabha Atomic Research Centre, Indira Qandhi Centre for Atomic Research at Kalpakkam, Variable Energy Cyclotron Centre at Calcutta, Space Application Centre at Ahmedabad, Vikram Sarabhai Space Centre at Trivandrum, National Aeronautical Laboratory at Bangalore and the National Physical Laboratory, New Delhi; there were centres which were basically pure research institutes like Saha Institute of Nuclear Physics, Calcutta, Institute for Mathematical Sciences,Madras, Tata Institute of Fundamental Research, Bombay, Institute of Physics, Bhubaneshwar; and Advanced Centres in Universities like that at Madras, Indian Institute of Science, Osmania and Poona universities. Activities of some of these organisations are summarized below:

Tata Institute of Fundamental Research:

At the Tata Institute of Fundamental Research (T ■ F R) 'started under the directorship of Homi Bhabha in 1945, Cosmic Ray studies was one of the early areas of research. Bhabha was involved in this work even while at the Indian Institute of Science, Bangalore. Heeding the advice of Paul Dirac, that a School of Physics could

not grow without a School of Mathematics, Bhabha started a Mathematics school at TIFR (Anderson, 1975). He persuaded a leading mathematician then working in the United States of America to head this group. This school is one of the strongest in the country today. But the interaction between the two schools (i.e. of mathematics and physics) was not very strong (Mukunda, 1990). With Bhabha's close contacts with Nehru, both at the personal level and the official level, the Institute got full support for research. Theoretical Physics, Electronics and Nuclear Physics were pursued, with Bhabha himself taking part in the theoretical physics programmes. After the establishment of the Atomic Energy Establishment at Trombay, the activities of TIFR centred around basic research. It was one of the few institutions which had autonomy (mainly due to the efforts and insistence of Bhabha) and functioned in a different style from most other research schools. The Institute attracted many scientists working abroad to come and work here. New schools in different subjects - Radio Astronomy, Molecular Biology, Chemical Physics, Computer Science were started. These schools set high standards in research, and today form an elite group of scientists in the country. With the number of subjects increasing, there was a growth in the organization.

The Radio Astronomy Group built a Radio Telescope at Ooty and is involved in research in that subject. It is presently in the process of building one of the largest Radio Telescopes in the world (Giant Metre Wave Radio' Telescope) near Poona. TIFR has a mathematics centre at Bangalore and field stations at Kolar Gold Fields and Gauribidanur near Bangalore.

Bhabha Atomic Research Centre:

The Atomic Energy Commission established in 1948 by. the Government of India started the Atomic Energy Establishment at Trombay (AEET) in 1954 with the objective of providing research and development facility needed to fulfill the nuclear power programme. Homi Bhabha was instrumental in starting this centre. Scientists already working at TIFR in related fields became a part of this organization. In 1967 AEET was renamed as Bhabha Atomic Research Centre (BARC). The activities of this centre, though mainly related to nuclear science, have been multi-disciplinary in nature. Planning and building reactors, production and research programmes in radio isotopes, material science, nuclear and radio chemistry, biochemistry, biology, food irradiation and processing, electronics and instrumentation, robotics and basic research in some frontier areas of nuclear and

condensed matter physics are all being pursued. It has set up reactors at different parts of the country and research wings at some centres like Calcutta, Indore and Kalpakkam. One of the important activities of this centre is its training programme. A training school was started in 1957 to train scientists and engineers in different disciplines related to the nuclear programme. The trainees coming out of this Institute formed the back bone of the S & T groups of this organisation.

Saha Institute of Nuclear Physics:

In 1945, Saha made a move to establish an Institute of Nuclear Physics at Calcutta. Saha felt nuclear physics and nuclear sciences would dominate in the post war years, and he did not want India to lag behind. He succeeded in starting the institute of his dreams by getting grants from different sources including the Atomic Energy Commission whose establishment he had initially opposed. Saha was the Honorary Director of this Institute established in 1950. Research work related to building a Cyclotron was one of the initial activities at the Institute. Later on work in Biophysics was started. Its present activities include research in particle physics, nuclear science, atomic and

molecular physics, condensed matter physics, plasma physics and biosciences.

Raman Research Institute:

After his retirement from the Indian Institute of Science, **Raman** started his own Institute at Bangalore in 1948. Unlike at the Indian Institute of Science, here he had only a small group of students. As could be expected, physics was the main branch of study in the initial period. But after the **1950's,** he worked all by himself, on other topics like physiology of vision and perception of colours. After his demise in 1970, the Institute was **reorganised** with a number of scientists (physicists and astronomers) joining **it.** Today, its research activities are centred around liquid crystals, theoretical astrophysics and radio astronomy. A ten metre radio telescope working at millimetre wave length has been fabricated here and is being used for astronomical observations. In a joint programme with the Indian Institute of Astrophysics, **it,** has built a decametre wave length telescope at Gauribidanur.

Indian Institute of Astrophysics:

This Institute was established as a separate organ-

ization in 1971. Earlier it was functioning at the Kodaikanal Observatory under the Department of Meteorology. Vainu Bappu was the architect of this Institute and was instrumental in starting the construction of an Optical Telescope (93 inches) at Kavalur which is now a national facility. As already mentioned it has joint programmes with the Raman Research Institute at Gauribidanur.

Prior to the establishment of the Indian Institute of Astrophysics, as a follow up of the recommendations of a committee headed by Saha in early 1950's, the Astronomical Observatory at Kodaikanal was improved in 1957. A new observatory was also built at Naini Tal in 1953 under the leadership of Bappu. Very recent1y (1987) an Inter University Centre for Astronomy and Astrophysics was started at Poona. This is a collaborative effort of the Poona University and the University Grants Commission. It is planned that this centre will act as an apex body for astronomy research in the Universities, and also as an advanced centre for research in this field, similar to the International Centre for Theoretical Physics at Trieste, Italy. In another collaborative activity, a Joint Astronomy Programme has been started at the Indian Institute of

Science in which five astronomical institutes are participating along with the Indian Institute of Science in teaching and training students for a career in Astronomy. This subject is also being taught in some universities.

The Universities:

Along with the growth of specialized institutions like the ones mentioned above, a large number of universities were started in the country during this period. Where there were four universities in the previous century, there were 148 universities in the country in 1988. In addition to this, there were 22 Institutions deemed as universities (UGC, 1988). Figure 5 shows the growth of the Institutions deemed to be universities during the period 1979–1988. To oversee university education and to support the activities of the various university centres, the University Grants Commission (UGC) was established in 1953. In addition to the various universities run by the state governments there are 13 centres in different parts of the country designated as Central Universities. These are administered by the U.G.C. A few other centres have been identified as Centres for Advanced Studies in different subjects. One such Centre is for

Growth of Institutions deemed to be Universities (1979-80 to 1987-88)

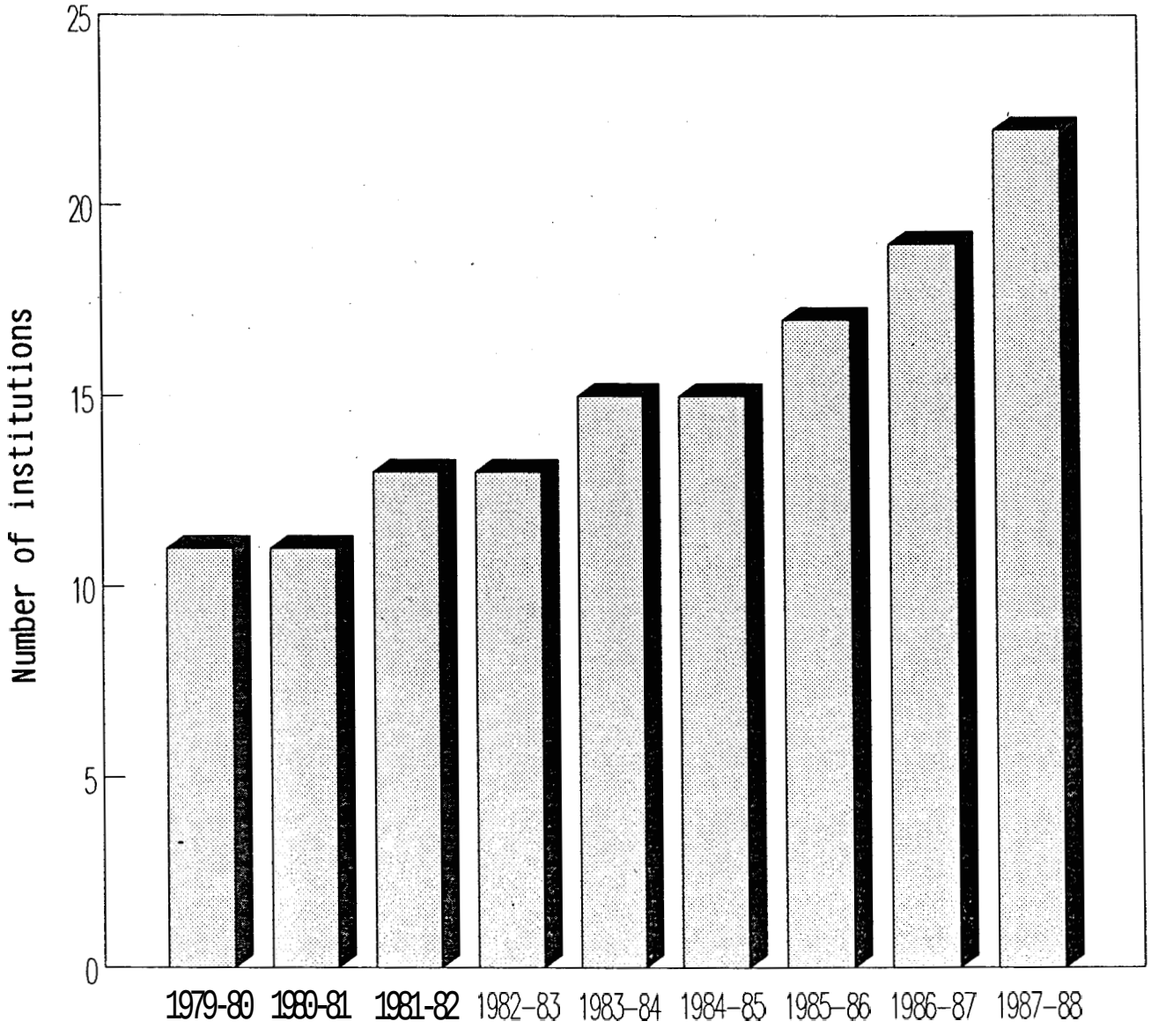

Figure 5

Astronomy at the Osmania University, Hyderabad. Faculty members working in universities/colleges and teachers who have retired receive funds from UGC for projects approved by it. UGC also offers fellowships (both Junior and Senior) for research work. It has also established a National Science Information Centre at Bangalore to help scientists working in universities and research institutions to have access to nascent information in their fields.

The Indian Institutes of Technology:

Apart from the technical colleges established by various state governments and private organisations, five Institutes of Technology were established after 1950's for higher education in Engineering. At some of these institutes, in addition to engineering subjects, Physics is also pursued as a discipline.

Academies and Societies:

It is observed that when a subject grows sufficiently, it is normally followed by the starting of a society in that discipline. Such a thing happened in the country in physics and astronomy. With the growth

in the number of research organisations in these fields (as seen earlier) the number of people involved in research activities also increased. Consequently new societies were started. The Indian Physics Association was founded in 1970 to promote active interaction among those interested in achieving advancement, dissemination and application of the knowledge of Physics. (Physics News, 1988). It has nearly 3,200 members (but only 300 to 400 are active members (RAO, 1990) and has chapters in different cities. There are also societies like the Vacuum Society of India, Acoustical Society of India for sub specialities. The Astronomical Society of India started in 1973 has objectives similar to the Indian Physics Association, viz. to promote Astronomy in the country. Both these organisations bring out their publications, Physics News and the Bulletin of the Astronomical Society of India.

As scientific conferences are extremely important for the exchange of nascent developments in a field, a number of national and international conferences are organized in different parts of the country. Various agencies have been supporting the running of summer/winter schools in different disciplines. The TIFR Schools in Panchagani (Particle physics), the Solid State Symposia of BARC and the Astronomy summer

schools are fairly regular features. Recently the Department of Science and Technology has initiated a scheme called the Theoretical Physics Seminar Circuit wherein it supports individuals who have done important work in India to lecture at certain centres for short periods. Physics research in the country has not stopped just at the study of the physical phenomena but has had impact on derived fields like biophysics, chemistry, geophysics, meteorology, engineering and electronics. Similarly, astronomy research is not confined merely to observations using an optical or radio telescope, but has become more refined and has led to the use of computers, CCD Cameras, infrared and x-ray detectors, all of which demand high precision work.

Apart from the research activities at the various Scientific and Research establishments funded partly or fully by the Government, the Research and Development activities in the private sector also increased to a great extent. Though we are yet to have something like the Be11 Labs of USA, the industries are slowly waking up. There were about 75 Private In House R & D Centres which incurred Rs.7.5 millions expenditure on R & D activities during 1987-88. The expenditure of these centres on R & D raised steadily from Rs. 1.50

million in 1958 - 59 to Rs.3817.30 million in 1987-88 !(Publications and Information Directorate 1988e)

Thus it is seen that around and after the 1970's, not only did the Science and Technology activity in the country greatly increase but it was also spread over a number of disciplines. These coupled with the national facilities created like the Cyclotron, Large Telescope and Reactors resulted in an increased number of scientific and technical personnel pursuing research careers. Table 7 gives a general idea about the magnitude of the S & T activities in the country. (The figures shown are all indicative and not exact) It becomes clear from the developments seen during the last two decades that pursuit of scientific research took firm roots during this time. To quote Venkataraman :

> *" Within a few fleeting years, science became a vast, nationally organized activity and there were people working on all sorts of subjects ranging from astrophysics to antibiotics, from computers to catalysts, from mesons to the monsoon, from number theory to nuclear physics, from pulsars to polymers, from quarks to earthquakes, from reactors to remote sensing, from semiconductors to sewage treatment, from turbulence to tuberculosis ,....."* (Venkataraman, 1988).

If awards and recognitions from outside the country mean anything, there were quite a few of them for Indian Scientists. Several Indians have been elected to

TABLE 7

Data relating to Science & Technology activities in the country (1986-87)

Research institutions including specialized laboratories		1300
Private research associations/ institutions/foundations/centres		530
In-house R & D units (public and private sector)		1015
Universities		160
Learned societies/academies	>	73
Total estimated Science & Technology personnel	(in million)	0.24
Research papers published per year	>	22,000
Patents filed (1985 - 86)		359

From : Status Report on Science & Technology in India, New Delhi, 1988 : Publication and Information Directorate, Page 138

important international bodies like the International Astronomical Union, International Union of Pure and Applied Physics, International Union of Pure and Applied Chemistry, the Royal Society, London. It has often been pointed out that India has the third highest Scientific manpower. If one goes by degrees awarded, this may be correct. But if one takes into account how many of these people are pursuing a career in science, this picture does not hold good. Nevertheless, even after making allowance for this, there is still a sufficiently large number working in the scientific and technical fields. One should therefore expect a sizable scientific output and therefore also a healthy impact on our journals. The actual state of affairs is discussed in later chapters.

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CHAPTER 5

The Indian Journals : A Focus On The Present Scene

The widespread growth of science and technology in India reviewed in the previous chapter has resulted in the increase in number of scientific researchers, as also the proliferation of scientific journals in the country. The Directory of Indian Scientific Periodicals brought out by the Indian National Scientific Documentation Centre (INSDOC) in 1964 listed 725 current periodicals. The second edition brought out in 1968 listed 996 current periodicals, out of which 828 were mentioned as periodicals in the accepted sense of the term (INSDOC, 1968). By 1985 the total number had crossed two thousand mark but only about 600 can be regarded as journals in the real sense. (Sen, 1989).

The National Union Catalogue of Scientific Periodicals which is a catalogue of the "holdings" of the scientific journals in the libraries in India and brought out by INSDOC in 1988 listed nearly 2300 titles of Indian origin. This is about 12.6% of the total coverage in the catalogue of approximately 18,300 entries from all over the world! It listed 838 Physics

titles and 1,346 Mathematics & Astronomy titles indicating the approximate numbers of journals published in these fields from a11 over the world. But we should take into account the fact that this list included even those journals which have ceased publication. Physics Abstracts lists 190 titles pertaining to physics published from a11 over the world, in the list of journals scanned for INSPEC services (Physics Abstracts. 1989). Astronomy and Astrophysics Abstracts lists 115 titles from all over the world that it covers fully. (Astronomy Astrophysics Abstracts, 1989).

The growth of Indian Scientific periodicals is shown in figure 6 and the subject-wise breakdown is given in Table 8 (Krishnan and Manorama,1989). These numbers refer to only those publications (564) which Krishnan & Manorama considered as being of research interest. But our examination indicates that the numbers given for different subjects, (at least for Physics journals) appear to be much higher than what is prevailing. ***Physics Abstracts*** for ***1989 covered only 69 of these Indian Journals.***

The main publishers of scientific journals in India are the Academies/Societies and agencies 1ike the C.S.I.R., the I.C.M.R., and the I.C.A.R., besides

Growth of Indian Scientific Periodicals

(1964 to 1988)

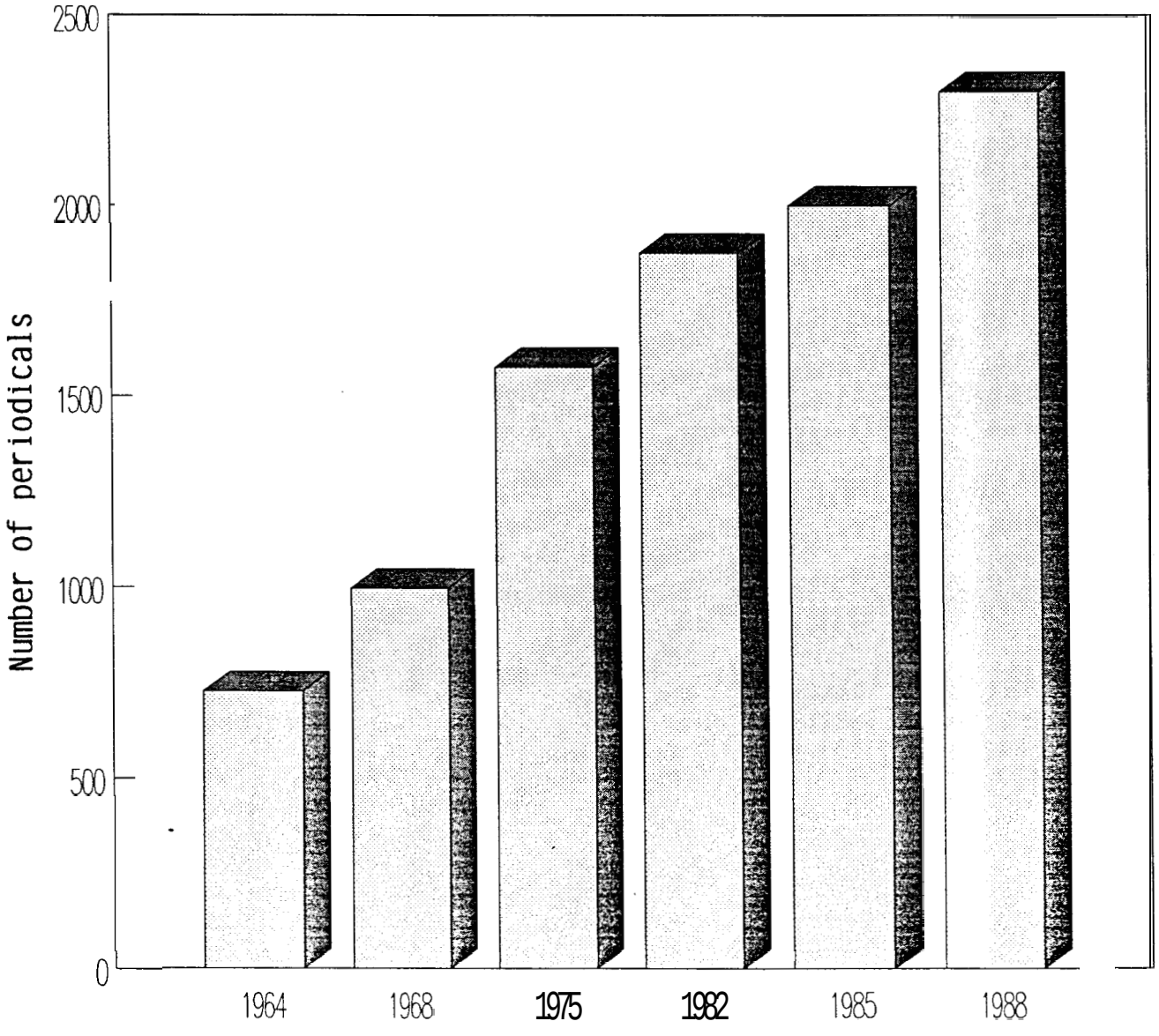

Figure 6

TABLE 8

Subjectwise Breakup of Indian Scientific and and Technical Journals as on 1988

1.	Medicine (including Veterinary Medicine & Pharmacology)	105
2.	General Sciences	74
3.	Engineering	61
4.	Agriculture	54
5.	Physics	37
6.	Botany	32
7.	Chemical Sciences	29
8.	Zoology	23
9.	Ecology/Environment	23
10.	Animal Sciences	18
11.	Records	18
12.	Geology/Earth Sciences	17
13.	Mathematical Sciences	13
14.	Biosciences	11
15.	Reviews	8
16.	Marine Sciences	6
17.	Genetics	6
18.	News Letters	6
19.	Social Sciences	5
20.	Minerology	4
21.	Entomology	4
22.	Anthropology	4
23.	Management	3
24.	Digests	3
	T O T A L	564

(Source : From Krishnan and Manorama, 1989)

some laboratories of the C.S.I.R. Unlike in the Western countries there are no "commercial publishers" of science journals in India excepting for the recent attempt in the Medical field (National Medical Journal of India published by the All Indian Institute of Medical Sciences, Journal of Applied Medicine published by the Living Media, India Ltd.), and the reprinting of Indian editions of the Scientific American, the British Medical Journal and the English edition of the French journal La Recherche. However, there is one popular science journal in English (2001/Science) published by Bennett Coleman & Co. This situation must be due to the fact that it is not commercially viable (as of now) for a commercial publisher to venture publishing research science journals in India.

The Council of Scientific & Industrial Research (CSIR) is one of the two organizations in the country publishing a large number of scientific journals, the other being the Indian Academy of Sciences (each of them publish nearly a dozen journals). Many of the important periodicals published in the country originate from these two organizations. C S I R is a Government sponsored body and the Indian Academy receives substantial financial aid from the Government for its publication activity.

The present study has shown a general absence in the country of certain types of journals like Review Journals or Letter Journals catering to a specific subject. The Journal of Scientific and Industrial Research (published by the Publications and Information Directorate about which more will be said shortly) is the only Review journal and Current Science (published by the Current Science Association and the Indian Academy) and National Academy of Science Letters are the only letter journals. There is one Abstracting periodical for all sciences namely the Indian Science Abstracts and a few for special subjects (such as the Medicinal and Aromatic Plants Abstracts published by the PID, the Metal Cutting Abstracts published by the Central Machine Tools Industries, Bangalore and Food Science Abstracts published by the Central Food Technological Research Institute, Mysore).

Letter Journals and Review Journals play a very important role in the dissemination of work done in a field. If one wants to follow the development of a particular sub field in a subject over a period of time, a Review Journal is very useful. If one wants to announce the results of an important piece of research

without losing much time, a Letter Journal comes in very handy. Whenever speed of publication matters, Letter Journals are used. So it is essential to have journals of different kinds to cater to the different needs of the scientists. This is presently missing in the Indian context. The reason for not having a review journal in physics could be due to the fact that Indian physicists do not write enough review articles to sustain such a journal.

5.2.1 Publications of the CSIR

The Council of Scientific and Industrial Research set up a separate Directorate, Publications & Information Directorate (PID) in 1951 for its publication activity by merging two of its existing units, one concerned with the" Wealth of India Project" and the other with the Journal of Scientific & Industrial Research (JSIR). Though CSIR was publishing a journal from 1942 (Journal of Scientific & Industrial Research), with the establishment of the PID, its journal publication activity increased many-fold. It started new sections of JSIR and eventually from 1963 onwards, began publishing subject periodicals, a trend seen all over the world. We discuss this aspect shortly.

PID publishes nine primary journals (in collaboration with the Indian National Science Academy), one review journal and an abstracting periodical. It also publishes three popular science journals (one in English and two in Indian languages). All the research journals published by the PID have editorial boards and full-time editorial staff, with the majority of the editors having at least a Master's degree in a science subject. If a large number of papers are received for publication, then having a full-time editor would be helpful. Most of the important journals which can be called 'successful' and have a large quantum of publication (like the Physical Review, Physical Review Letters, Journal of Physics, Science, Nature, to name a few) have full time editors. But if the community is small and the flow of articles to the journal is not high, then scientists who can devote some part of their time regularly (as in the case of Pramana) could effectively run the journal with sound editorial assistants. The journals published by PID cover:

Physical Sciences:

Indian Journal of Pure and Applied Physics.
Indian Journal of Radio and Space Physics.

Chemical Sciences:

Indian Journal of Chemistry (in two sections)

Biological Sciences:

Indian Journal of Experimental Biology.
Indian Journal of Biochemistry and Biophysics.
Indian Journal of Marine Sciences.

Engineering and Technology:

Indian Journal of Technology.
Indian Journal of Textile Research.

The papers published in these journals are all refereed. These journals are covered by the relevant and major abstracting services like the Chemical Abstracts, Physics Abstracts and Biosis. Physical, Chemical and Earth Sciences edition of Current Contents published by the Institute of Scientific Information (ISI), USA, covers 5 of these journals. The Science Citation Index, also brought out by ISI, covers 3 of these journals in 1990.

The infra-structural facilities of this organization are quite good. There is a modern printing press (with photo composition facility), an Art & Graphic section to process art work, a we11 equipped library, a Sales promotion/Distribution section and adequate manpower. In 1987 there were 212 editorial/technical staff and 113 administrative staff. However., this number includes not only those who are

involved in research journals publication activity but also those working on other projects of PID, like the Wealth of India, Scientific & Technical Information Services, Popular Science Magazines and other publications. (PID, 1987). All these factors are important and go a long way in making a journal successful. But one of the lacunae is not having good communication facilities - there is no telefax or electronic mail service (however, it is learnt very recently (1990 June) that there is some change in this direction and e-mail facility is available to all the CSIR organizations through the Indian National Scientific Documentation Centre).

In 1988, the PID published 7,254 pages in its journals (PID, 1988). Its journals bring out special numbers to commemorate special events (Special issues were brought out by Indian Journal of Pure and Applied Physics to mark Raman's birth centenary and by the Indian Journal of Radio and Space Physics to honour S.K.Mitra the eminent Radio Physicist; and Indian Journal f Technology brought out a special issue in honour of K.G.S.Doss, the well-known electrochemist and special issues on fluid mechanics, catalysis and materials science. Two physics related journals, Indian Journal of Pure and Applied Physics (IJPAP) and Indian

Journal of Radio and Space Physics (IJRSP) are also published by the PID. Table 9 gives the number of articles and pages published by PID in its journals during the years 1987 and 1988.

5.2.1 Indian Journal of Pure and Applied Physics

In 1963, section B of the Journal of Scientific and Industrial Research (JSIR) published by the PID was split into two journals namely Indian Journal of Pure and Applied Physics(IJPAP) and Indian Journal of Chemistry. IJPAP publishes articles in all areas of Physics except space physics and is brought out as a monthly.

5.2.2 Indian Journal of Radio and Space Physics (IJRSP)

This journal was started by the PID in 1972 as a quarterly and is now brought out as a bi-monthly. This was done to facilitate speedier pub1ication of the papers submitted to it. This journal publishes articles in all branches of radio and space physics, ionosphere, radio and radar astronomy and meteorology. Very recently (in August 1990) the journal announced that it has widened its scope to include all areas covered by the various commissions of the International Union

TABLE 9

Number of Articles and Pages published in Publications & Information Directorate, (CSIR, New Delhi) journals during the years 1987 and 1988

		Number of Articles published		Number of Pages published	
		1987	1988	1987	1988
1.	Journal of Scientific & Industrial Research	50	61	588	770
2.	Indian Journal of Chemistry "A" (Inorganic Physical, Theoretical and Analytical)	284	318	988	1150
3.	Indian Journal of Chemistry "B" (Organic Chemistry including Medicinal Chemistry)	355	387	1110	1220
4.	Indian Journal of Pure Applied Physics	132	163	514	736
5.	Indian Journal of Technology	137	114	660	624
6.	Indian Journal of Experimental Biology	209	254	804	1038
7.	Indian Journal of Biochemistry & Biophysics	92	134	460	718
8.	Indian Journal of Radio & Space Physics	58	49	410	314
9.	Indian Journal of Marine Sciences	64	74	280	354
10.	Indian Journal of Textile Research	44	45	222	320

Titles 1-6 are monthlies; 7 & 8 are bi-monthlies and 9 & 10 are quarterlies

of radio Sciences, the commissions being, Electromagnetic Metrology, Fields and Waves, Signals and Systems, Electronic and Optical Devices and Applications, Electromagnetic Noise and Interference, Wave Propagation and Remote Sensing, Ionospheric Radio Wave Propagation, Waves in Plasmas and Radio Astronomy. Table 11 gives the number of articles published by IJRSP during different years. Various other factors relating to these two journals are discussed later on in this chapter.

Apart from PID a few other organizations belonging to CSIR also publish journals. Insdoc publishes the only abstracting periodical in the country covering all science disciplines. Thus CSIR has emerged as a major publisher of science journals in the country.

5.3. PUBLICATIONS OF THE INDIAN ACADEMY OF SCIENCES

The Indian Academy of Sciences (herein after called I.A.Sc.) which had started its publications activity in 1934 continued to publish its Proceedings in two sections till Raman's demise. As mentioned earlier, Raman published most of his work after 1945 in the Proceedings of the Academy and Current Science. His works on Crystal Physics and Physiology of Vision were published mostly in the Proceedings. After Raman's

demise in 1970, the Academy took stock of its publication activity. Perhaps noticing the rapid changes in the pattern of scientific research, and emergence of more and more specialized subjects and with it also that of specialized journals devoted to a single subject, the Academy felt the need to reorganize its journals and appointed a professional as Executive Editor. The time had come when one single journal could no longer meet the requirements and demands of specialists even within a particular subject, let alone in different subjects.

Stephen P.Lock the Editor of the well-known medical journal British Medical Journal explains this phenomenon very aptly :

> *" Disciplines tend to split every ten years or so, and the new sub disciplines do not necessarily correspond with the organizational and professional structures. These are much more rigid and slower to change than the way in which the pattern of new knowledge changes. These structures will include journals, and thus there is constantly a real need for new journals which will reflect the needs of the new sub disciplines. In this way, a specialist journal will be formed to take some of the work which has become too complex for the general journal - and the general journal may truly have been under tremendous pressure for space and unable to publish even all the first- rate material submitted to it"* (Lock, *1989).*

Also, a specialized article published in a general

journal may be missed by other specialists in the field. Nearer home, such changes i.e., splitting have been done by the PID. The Proceedings of the Indian Academy (which had International standing in the 1930's and 1940's) faced a similar situation. As a remedial measure to the diminishing status of the Proceedings, the Academy reorganized its Journals publication in 1973 with the starting of a new journal "Pramana - a Journal of Physics" which was published in collaboration with the Indian National Science Academy and the Indian Physics Association. In 1978 it split the Proceedings into theme journals calling them :

.....

Footnote: Leading publishers elsewhere in the world had taken cognizance of this and had split single journals into different parts - Physical Review (we discuss this journal in detail in a later chapter) which was split into two parts in 1964 was further split into two more parts in 1970 resulting in 4 sections - A, B, C and D. Similarly Journal of Physics (Published by the Institute of Physics, London) was split into 5 sections A,B,C,D,and E. In 1971 one more section F was added and very recently (1988) yet another section, G was started. In 1971, the journal Nature published by Macmillan & Co., London, was split into three sections (Nature-Physical Science, Nature-New Biology and Nature) to cater to the needs of specialists as well as those readers with general interest. All the sections were brought out weekly on different days of the week, Monday , Wednesday and Friday. But this lasted for only three years and in 1974, the three sections were once again merged into a single section. Journals which were multi disciplinary or general in scope slowly receded into background - the one time favorite publications like the Proceedings of the Royal Society (London) or the Proceedings of the National Academy of Sciences (USA) no longer commanded the same attention as in the past.

Proceedings - Chemical Sciences

Proceedings - Mathematical Sciences

Proceedings - Animal Sciences

Proceedings - Plant Sciences

Proceedings - Experimental Biology

Proceedings - Engineering Sciences

Proceedings - Earth and Planetary Sciences

In 1979 the section of the proceedings devoted to Experimental Biology was discontinued and in its place a new journal, Journal of Biosciences was started. In the same year another new journal, Bulletin of Material Sciences was also started. During 1980, Journal of Astrophysics and Astronomy" (JAA) was started to cater to the needs of the astronomical community. Till JAA was started the astronomy articles were being published in Pramana. In 1981, the Academy started associating itself with the Current Science Association in publishing the journal Current Science. The Journal of Genetics founded earlier by Bateson was taken over by the Academy in 1984. Thus, the reorganisation of the Proceedings into various thematic journals and starting of new journals put the Academy in a more favourable position as one of the leading publishers of science journals in India. In addition to these journals, the Academy

brings out special publications to honour eminent scientists of the country. During its Golden Jubilee in 1984, the Academy brought out special numbers of all its journals.

All the journals of the Academy have editorial boards and three of them, Proceedings - Earth and Planetary Sciences, Journal of Astrophysics and Astronomy and Journal of Genetics have international boards of Editors. The infrastructural facilities of the Academy are not at the same level as those of the PID. Though it publishes as many journals as the PID, its man power is less when compared to that of PID (only 7 persons on the editorial staff). This is partly explained by the fact that the composition and printing is carried out by outside agencies. Table 10 gives the number of articles published by the various journals of the Academy during the years 1988 - 1989. We discuss below the starting of the journals Pramana-a Journal of Physics and the Journal of Astrophysics and Astronomy.

5.2.1 PRAMANA - A JOURNAL OF PHYSICS

In the early 1970's the physics community in the country felt a need for a good physics journal published

TABLE 10

Number of Articles and Pages published in the Indian Academy of Sciences Journals during the years 1988 and 1989

	Number of Articles published		Number of Pages published	
	1988	1989	1988	1989
PROCEEDINGS :				
Chemical Sciences	59	67	570	560
Mathematical Sciences	17	28	223	279
Earth and Platenary Sciences	17	31	197	378
Plant Sciences	51	70	533	606
Animal Sciences	62	53	587	459
Engineering Sciences (Sadhana)	34	9	696	221
Pramana	137	140	1133	1563
Journal of Biosciences	49	42	438	410
Bulletin of Material Sciences	90	48	846	515
Journal of Astro-physics & Astronomy	26	31	248	443
Journal of Genetics	18	16	188	211
Current Science	562	598	1358	1410

from India. Since the number of people working in the field had been rapidly increasing and a number of physicists had returned to India from abroad, a need was felt for a national journal of international standards. Daniel from T.I.F.R wrote:

> *" The need for a high qua1ity research journa7 in physics of internationa1 standard, published from India and commanding the wide support of the specialists, has been fully recognized by the physicists in the country; this is evident when one reads through the proceedings of a conference on Physics Education and Research held at Srinagar in June 1970"* (Daniel, **1970).**

There were discussions among the members of the Indian Physics Association, the Fellows of the Indian Academy of Sciences and the Indian National Science Academy which resulted in the starting of **Pramana** - a Journal of Physics" in **1973** by the Indian Academy of Sciences in cooperation with the Indian Physics Association and the Indian National Science Academy. Ramaseshan wrote in the first editorial in the journal:

> *"The publication in foreign journals of the major part of the work done in India today is having a deleterious effect on Indian science. Relegating the refereeing of our best scientific work leads to loss of judgement and se1f-confidence. This process has sapped the inner resources of Indian scientists and, among other things, has 7ed them to follow b7indly fashions set elsewhere in choosing fields of work. A71 this has caused much unrest among active scientists in India and 7ed quite recently to an united attempt to*

> *find a solution. Pramana (which in Sanskrit means a source of valid knowledge, a standard etc.) is the outcome of a nationwide effort by Indian physicists to create a vehicle for their best efforts in Physics. The pub7ication in it of good papers received from abroad can only add to its strength, and is most heartily welcomed"* (Ramaseshan, *1973).*

Thus Pramana was started by a community which felt the need for it. It started with an editorial board, a panel of referees and an editor who also happened to be a leading physicist in the country. It also had a well-experienced executive editor who had research as we11 as editing experience. The journal did well in its early years when it received contributions from leading institutions in the country. Raja Gopal, a past editor of this journal and Rajaraman its present editor write:

> *" Even the early issues contained some very significant papers. The discovery of the pressure-induced liquid crystallinity by S. Chandrasekhar, S. Ramaseshan, R. Shashidhar and others was pub7ished first in Pramana. So was the observations suggesting a breakdown of the particle-hole symmetry in fluids, as observed through a deviation of the so called rectilinear diameter behaviour in Critical Phenomena. A new topic of quarternary nuclear fission was reported by Kataria and BARC group. The first results of a large carefully planned experiment in the Kolar Gold Fields on the possibility of proton decay by M. G. K. Menon, Ḃ. V. Sreekantan, V. S. Narasimham and colleagues were discussed in a recent issue of Pramana. Whatever be the verdict of the future on some of these papers, there is no denial of the fact that they have acted as cata7ytic stimulants for discussions and*

progress in physics ..... Since the advent of Pramana, there has been a sharp increase in the number of research papers published by the Academy in theoretical physics in genera7 and particle and nuclear physics in particular. The seventies and early eighties have seen many papers of good qua1ity, by the highest internationa7 standards, pub1ished in Pramana" (Raja Gopal and Rajaraman, **1984).**

Thus a new vehicle for communication was made available to the physicists in the country by the Academy. The journal was well received not only in India but also outside. Soon after its founding it was covered by current awareness services like the Current Contents and a little later by the Science Citation Index. Apart from regular research articles, it publishes research articles which require immediate publication as "Rapid communications". It also publishes comments on earlier papers published in the journal. In recent times **(1990) it** has started paying an honorarlum for the authors writing Review Articles in the journal. Till the Journal of Astrophysics & Astronomy was started in **1980 it** also used to publish articles in Astronomy and Astrophysics.

The usage of Pramana is discussed in detail in the next chapter but it may be mentioned here that due to the gradual decline in the number of good articles received, the journal does not receive at the moment,

the same attention it used to about a decade ago. Taking note of this, the Academy has been making serious attempts to improve the situation.

In spite of Pramana's present somewhat low profile, the physicists in the country continue to fee1 that Pramana is our best physics journal. This aspect has been discussed further in a later chapter which deals with the "opinions of the users".

5.3.2 JOURNAL OF ASTROPHYSICS AND ASTRONOMY

Consequent to the growth in astronomical research in the country during the 1970's and the absence of a research journal in the country for this subject, the Indian Academy started the Journal of Astrophysics and Astronomy (J A A) in 1980. From the beginning, this journal aimed to be an international journal of a high standing. Or. Bappu, the Chairman of the first editorial board, as well as its editor, wrote:

> *"Progress in astrophysics and astronomy in the last few decades has been phenomenal and there is therefore litt7e need for justification when a new international journal makes its debut as a rapid means of dissemination of scientific results..... .....It is our hope that the new journal wi11 provide the additional facility needed for quick publication of the results of research from members of an expanding fraternity.....It is our wish to*

aim at a high quality of scientific content and thereby contribute to the promotion of astronomical research" (Bappu, 1980).

Journal of Astrophysics and Astronomy publishes both observational and theoretical papers in all branches of astronomy. This journal has been acclaimed as one of the good journals in the field by the astronomical community both in the country and abroad. We discuss the usage of this journal in the next chapter.

5.4 THE CURRENT SCIENCE ASSOCIATION

As mentioned in an earlier chapter, the Current Science Association had started publishing the Journal Current Science in 1932 as a monthly. Since that time till today it is being published regularly. In 1947, C.V.Raman was elected the President of Current Science Association and he held this office ti17 his demise in 1970. The journal became a fortnightly in 1964. The Indian Academy of Sciences started collaborating with the current Science Association from 1981 in publishing this journal and has now taken the managerial responsibility for this journal. Current Science which earlier had a major emphasis on life sciences, has recently been publishing occasional articles in the fields of

astronomy and physics. This journal was reorganized in 1989 and is now publishing not only research articles and communications but also articles and reports on science-related topics (example: reprinting in India Science Journals published abroad, funding by the Department of Science & Technology). It is also publishing special numbers devoted to proceedings of conferences (for example one on Waves and Symmetry) special topics (like issues on Astronomy, cholera, Science and Public Accountability) and to honour renowned scientists (for example G.N.Ramachandran, S.N.De).

5.5 SCIENCE JOURNALS FROM CALCUTTA AND OTHER CENTRES

Calcutta was a leading centre for the publication of science journals till about the middle of the century. As we saw earlier, the Indian Association for the Cultivation of Science started an important journal of physics (Indian Journal of Physics); the first science journal in the country, the Journal of the Asiatic Society of Bengal was from Calcutta. Two of the good journals of the country, "Sankya" - the journal of statistics and the Journal of Indian Chemical Society are also published from Calcutta. But unfortunately one cannot see any appreciable changes for better in

these journals especially when one sees the changes taking place elsewhere in the country. There have not been any new journals which have made a mark from either the Indian Association or any other organization from this region. We find a similar situation with the journals published by Indian National Science Academy and the National Academy of Sciences, Allahabad. Proceedings of both these organizations (though published in two sections) are too general in nature and receive very little attention from researchers working in leading institutions. The University Grants Commission has sponsored four quarterly Science journals in the fields of Biology, Chemistry, Mathematics and Physics. These are meant mostly for college and university teachers and students and are not really research journals. We discuss below the "Indian Journal of Physics".

5.5.1 INDIAN JOURNAL OF PHYSICS

The starting of the Indian Journal of Physics by Raman at the Indian Association for Cultivation of Science, has been discussed in an earlier chapter. Over the years, with the increase in the number of papers received for publication, this journal was split into two parts (in 1977) - Part A covering Condensed

Matter, Nuclear Physics and Particle Physics and Part B covering Atmospheric & Space Physics, Atomic & Molecular Physics, General Physics, Optics and Spectroscopy, Plasma Physics and Relativity and Cosmology. Six issues each of the two parts are published annually.

The journal publishes full-length research papers, short notes, rapid communications and review articles. The journal pays an honorarium for those writing review articles. It lists titles of articles to be published in the forthcoming issues. Later in this chapter we discuss the other aspects pertaining to this journal. The usage of this journal and opinions of some of the scientists about this journal are covered in chapters 6 and 8.

Proceedings of the Indian Association for the Cultivation of Science continued to be published at irregular intervals as a section of IJP. This section is devoted to matters pertaining to the Association including publication of endowment lectures delivered at the Association.

5.6 A COMPARATIVE STUDY OF FIVE JOURNALS

Presented below is a study of four physics journals and an astronomy journal with respect to their editorial policy (Editorial Boards, Editorial Staff, Refereeing system), Circulation, Coverage in Abstracting Services, Current Awareness Services and the Science Citation Index, Impact factor, Rate of Rejection of papers, time lag in publication and volume of publication. The Editors/Associate Editors of these journals were interviewed to get an insight into the various aspects of these journals. The journals that are being compared are:

Indian Journal of Physics
Indian Journal of Pure and Applied Physics
Indian Journal of Radio and Space Physics
Pramana
Journal of Astrophysics and Astronomy

5.6.1 EDITORIAL POLICY

i) Editorial Boards

Editorial Boards of journals normally comprise of distinguished scientists in the field who will be

able to guide the journal in the right direction and support the editors in maintaining the quality of the journal. Having scientists of standing from outside the country as members of the editorial board gives the journal certain advantage like getting better visibility outside the country and acceptance by the Scientific community both within and outside the country. But some journals which are well established and have international visibility and acceptance do not follow this policy. For example, members of editorial boards of well known journals like the Physical Review and the Astrophysical Journal published from the USA, are from that country only. However, having at least a few members from outside the country on the editorial board is important for those journals published from the developing countries, specially in the initial stages.

All the five Indian journals being examined have Editorial Boards. But only two of them, Indian Journal of Radio and Space Physics (3 foreigners out of 14) and Journal of Astrophysics and Astronomy (8 out of 15 - one each from Australia, France, Japan, the Nether1ands and the United Kingdom and three from the United States of America) have foreigners on their editorial board.

While some members of the boards of Indian Journal of Radio and Space Physics (IJRSP), Pramana and Journal of Astrophysics and Astronomy (JAA) publish occasionally in their journals, those of the Indian Journal of Physics (IJP) and Indian Journal of Pure and Applied Physics (IJPAP) seldom seem to publish in their journals (Sen Gupta,1990 ; Mahadevan 1990). However, some members of the board of IJP contribute to the journal by soliciting review articles, reviewing books and refereeing papers received for pub1ication (Sen Gupta, 1990). There is hardly any active interaction of the members of the board of IJPAP with the editors/editorial staff of the journal and the board is only *ornamental* (Hahadevan, 1990). Excepting for IJP, the Members of the editorial boards of the other four journals meet normally once a year. Those editorial members of IJP residing at Calcutta meet once in 2 to 3 months and others at longer intervals.

ii) Editors and Editorial Staff

Editors and editorial staff play an important role in implementing policy with respect to the various features of the journal. Editors are the intermediary personnel between the authors and users of a

journal. The editor has to be alert to recent progress in the field and should be able to assess the changing needs of the scientificcommunity. His right choice of the referees plays a crucial role in publishing good articles from among those received by the journal for publication. Timely editorials on matters pertaining to maintaining the quality of the journals like, for example, those by Goudsmit in Physical Review Letters would greatly help in preserving/raising the standard of a journal. An editor's job demands a lot of time and energy. It would be advantageous to have a full-time editor who can devote him-self exclusively to the activities of the journal. An editor who is also an accomplished scientist commands from the scientific community better attention than an unknown editor. Eugene Garfield wrote in one of his editorials in Current Contents:

> ***" Editors of scientific journals are in a different way important gate keepers. They disseminate in their journals the kinds of artic7es they think their particular readership desires and needs"*** (Garfield, 1976a).

An important job done among others by the editorial staff is copy editing of an article. It involves careful reading of a finished article accepted for publication and making sure that it is according to the

general framework and policy of the journal with regard to style and format and making suitable corrections whenever required.

Both IJPAP and IJRSP have full-time paid editors. IJP, Pramana and JAA have honorary editors who have a doctorate degree in the subject and are practicing physicists and astronomers. Editors of these three journals (IJP, Pramana and JAA) do not spend their full-time on the journal. IJP has a full-time paid Associate Editor who is a Ph.D. Pramana and JAA have Associate Editors who have a Ph.D. They are involved with the journal work in addition to their research work. Excepting IJPAP all the other journals have just one more person on the editorial staff to carry out the various jobs related in bringing out a journal. IJPAP has four members on the staff all of them at the same level as the editor.

iii) Refereeing and Panel of Referees

The " Refereeing System" is a well-established practice followed by most of the scientific journals for the articles received for publication. One of the main reasons for following this system is to gain the confidence of the scientific community with regard to the

quality of the articles published in the journal. To quote D.A.Kronick, professor of Medical Bibliography at the University of Texas at San Antonio :

> *"Members of these and other scholarly societies sponsoring official or semi official publication began to realize that if scholars were to have confidence in the content of these journals, then material submitted for publication had to be critically evaluated before it was published"* (Kronick, 1978).

Eugene Garfield writes:

> *" Soundly refereed journals do set standards in scientific publications that journals without referees should and do try to observe"* (Garfield, 1976b).

Journals normally have scientists from different sub fields as referees on their panel.The panel of referees of many journals comprise scientists from different parts of the world and it will not be confined only to those within the country. If there is a large enough scientific community in the country comprising scientists from different sub fields who can pass valid judgement on the scientific content of a paper, then international refereeing for all the papers received by the journal will not be necessary. But in some newly emerging areas where the number of people working is small and some times hardly a few, it would be definitely necessary to have specialists from outside to act as

referees. It is unlikely that any country, especially a developing country, can claim to have many competent persons in all the sub fields of a subject. If one wants to communicate the science done in the country to an international audience through a national journal, then having an international panel of referees would certainly help in this task and it also will help the journal establish its credibility and gain the confidence of the scientific community all over the world. It is well known that referees act not only as filters keeping back bad papers from being published, but also as helpful guides to the authors, and thus share the responsibility of the editor in publishing quality papers. As Peter Amiry, former editor of the Journal of Operational Research says:

> ***" referees are an editor's insurance policy providing a reservoir of knowledge that few editors could hope to match"*** (Amiry, ***1980).***

A much-debated point about the refereeing system is whether it should be open or anonymous. For various reasons, the majority of the journals follow the anonymous refereeing system.

All the five journals examined in this study are refereed journals and follow anonymous refereeing.

These journals give the referees guidelines for assessing the articles. Editors keep a watch over the performance of the referees. All the journals provide the authors referee's comments keeping the identity of the referee confidential (unless the referee mentions that his name may be disclosed). Three of the five journals, Pramana, IJRSP and JAA use foreign referees, the first two to a limited extent and the other to a larger extent. Pramana has about 600 scientists on its panel of referees (mostly from India) while IJRSP has about 100 . JAA has a larger number of foreigners (335) than Indians (45) on its panel of referees, 80% of whom do critical refereeing, 10% over critical refereeing and the remaining 10% luke warm refereeing (Prabhu,1990). IJP and IJPAP both of which have only Indians on their panel, have 100 and 300 referees, respectively. In 1985 JAA published the panel of referees who assisted the journal during 1980-1984. The journals are by and large satisfied with the performance of the referees. As is the normal practice, excepting for IJP and Pramana which use only a single referee for a paper, others use, at least as of now (1990), two referees.

THE REJECTION RATE: The rate of rejection of articles in a journal generally indicates how rigid the referees

are and the standards set by the editors. The rate of rejection in the five journals varies from 20 to 30%. IJRSP, JAA and Pramana have a rejection rate of about 30%, while IJPAP's rejection rate is 28%. The rejection rate in IJP is between 20 and 25% and its rejection rate for articles received from abroad is 30%. For comparison, the rejection rate of Physical Review (all sections taken together) during the year 1988 was 22% and in 1989, 21% and that of Physical Review Letters 66% in 1988 and 60% in 1989. It can be seen that though the rejection rate in Physical Review is lower than in the five journals under discussion, it certainly is not in any way inferior to these five journals. On the other hand, the majority of the articles that appear in the Physical Review are of above average standard. The reason for this could perhaps be due to the presence of a selection effect by the authors themselves for the articles submitted by them to Physical Review. Physicists must be general1y submitting to Physical Review, their better papers and hence the rejection rate in this journal may be lower when compared to those in the five Indian journals under study. It is understood that a similar situation prevails with the Biology journals published by the Indian Academy. Though the rejection rate in the

Biology journals are 50-60%, they are considered to be inferior to Pramana(Srinivasan,1990). However it has been very recently (late 1990) learnt that the rejection rate in Pramana which was earlier 30% has gone up to nearly 50%.

TIME LAG IN PUBLICATION: The time lag between the date of receipt of an article at the editorial office of a journal and its publication in the journal is important, especially when the article reports a new research finding. Journals like Nature, Physical Review Letters, Physics Letters are fast in publishing (approximately 4 to 6 months on an average and sometimes as fast as one month). But there are also internationally recognised journals whose time lag in publication is much more - some times as long as a year or a year and a half (example, Physical Review and Astrophysical Journal).

The time lag in publication in the five journals during the year 1989 ranged from 8 to 12 months and these journals are generally faster compared to those published from abroad. JAA and IJRSP had a time lag of 8 months each, and IJPAP 9 to 12 months. However we should note that JAA is a quarterly and IJRSP is a bi-monthly and hence the time lag is not a true representa-

tion. We have to give certain margin for those articles which have just missed an issue and because of the nature of periodicity of these two journals (quarterly and bi-monthly respectively) are further delayed in getting published. Pramana has an edge over IJP. While Pramana has a time lag of 8 to 10 months that of IJP is 11 to 12 months (we understand that the time lag in Pramana has reduced in mid 1990 to six months). Presently, among the physics journals published in India, Pramana has the minimum delay in publishing.

The date of receipt of the article which is an important factor for establishing priorities in research finding, is mentioned by all the journals, though we should point out that Pramana lapsed on this count on a few occasions. In addition to this date, **IJPAP, IJP** and Pramana give the date of acceptance also. IJRSP gives only date of receipt and if there is revision, that information. **JAA** gives the date of revision (if there are major revisions) and date of acceptance in addition to the date of receipt. Though it would be advantageous if the time lag is reduced, this short- coming can be overcome sometimes by circulation of Preprints. Unfortunate1y the Preprint culture is more prevalent in Astronomy and certain

special fields of Physics like High Energy Physics and Condensed Matter Physics. Also, the non availability of sufficient funds in the Universities in India restricts production and mailing of preprints in large numbers to physicists in other parts of the world. In view of this, reducing the existing time lag in publication in Indian Journals is important.

CIRCULATION: Circulation figures and more specifically subscription figures of a journal are good indicators of its popularity and visibility. In these times of inflation and budgetary constraints, a large subscription figure of a journal reflects its wide usage and also its quality. Rightly or wrongly, majority of the scientists prefer to publish their research findings in a journal having a wide circulation, preferably abroad (in the Indian context).

The subscription figures of the five journals for 1989 are rather on the low side. JAA has the highest figure of 245 foreign subscriptions and next comes **IJP** with 158 foreign subscriptions. **IJPAP** and **Pramana** have 100 and 90 foreign subscriptions respectively. **IJRSP** has a meagre 12 foreign subscriptions. This number does not correlate with its Impact factor (we will be discussing Impact factor a little later) which is near

about that of Pramana and JAA. Pramana has 280 Indian subscriptions as compared to 172 of IJP and 112 of IJRSP. JAA has 165 Indian subscriptions. (the exact numbers for Indian subscriptions to IJPAP was not available). We may mention here (just to give a feel for the subscription figures for an internationally well known physics journal) that during 1988 the non member subscriptions for one section of **Physical Review**- Section "A" was 2,137 and the total subscriptions for all the four sections was 11,634 and in 1989 11,675; and that of **Physical Review Letters** for 1989 was 2,728. The number of subscriptions to Indian journals, especially foreign subscriptions, indicate the poor visibility of Indian Physics journals abroad. One of the important points we should consider is the marketing of Indian journals. Even if a journal is good, unless there is an aggressive marketing strategy, the journals from developing countries will not catch the attention, specially that of the international scientific community. Excepting IJPAP and IJRSP, the publishers of other journals do not have a separate marketing division in their set up.

COVERAGE IN SECONDARY SOURCES: Secondary sources or secondary periodicals are those which give information

about what is published in the primary periodicals. Abstracting periodicals, Indexing Periodicals, Current Awareness periodicals are all examples of this category of publication. Coverage of a journal in an abstracting/indexing periodical or a current-awareness periodical will help the journal to achieve better visibility. Articles published in a journal covered by an abstracting periodical will come to the notice of a scientist even if he is not aware of the existence of that journal itself or if that journal is not available in that geographical area. It is particularly so when someone is searching for an article on a particular sub subject.

"Physics Abstracts': Physics Abstracts published fortnightly by the Institute of Physics (United Kingdom) is a leading abstracting journal. It includes not only Physics journals but also selected Astronomy journals. All the five journals examined here are covered by the Physics Abstracts.

"Astronomy and Astrophysics Abstracts": This Abstract published twice a year by the Springer Verlag is the only comprehensive abstracting journal covering the field of Astronomy. IJPAP, IJRSP and JAA are covered by this abstract.

"Current Contents": Current Contents is published weekly by the Institute for Scientific Information, Philadelphia, and this gives the contents pages of journals and covers in 7 different sections, all branches of science and technology and Social Science. Excepting for IJP, the other four periodicals are covered by Current Contents in its Physical, Chemical & Earth Sciences edition. It may be pointed out here that this edition covers only 12 Indian Journals which is rather a low number compared to the very large number of journals published in the country. This is due to the fact that most of the Indian journals that are not covered do not confirm to the standards laid down by the Current Contents.

"Science Citation Index (SCI)": This is an indexing system in which all the papers that cite a particular paper, say paper A, during a particular period of time, are listed under paper A. The merits and demerits of this system of indexing will not be discussed here. However, it is pertinent to mention that inclusion of journals in this publication is considered by the publishers of scientific journals as an important factor. It is found that the coverage of Indian journals in this publication is very limited. Presently (1990)

only 11 Indian Journals are covered in it. Of these, six are published by the Indian Academy of Sciences, one by the Current Science Association in collaboration with the Indian Academy, three by the Publications and Information Directorate and one by the Indian Council of Medical Research. Among the five journals examined here, only JAA and Pramana are presently covered by this publication.

"The Impact Factor": This is a concept increasingly coming into vogue in recent years. As defined in the Journal Citation Reports, a section of Science Citation Index (SCI), the Impact Factor of a journal is a measure of how often articles published in the journal get quoted on an average in a given time span. This concept is very much debated, as getting cited or not depends on various factors and it is only indicative and not definitive about the quality of any research work. However, in the absence of any other acceptable measure, we cannot totally discard this concept but have to take it with a certain caution.

According to the Journal Citation Reports of ISI, among the five journals under study, in 1988 JAA had the highest impact factor of 0.58 (incidentally this is the highest for any Indian Journal) with Pramana following

it closely with **0.51.** Till JAA came into the picture Pramana had the highest impact factor among all the Indian journals. In **1983** Arunachalam wrote:

> ***" Pramana, the physics journal of the Indian Academy of Sciences, Bangalore has the highest impact factor among Indian Journals. Also since 1975, it has been recording the highest impact factor among Indian journals every year"*** (Arunachalam, **1983).**

IJRSP and IJPAP had **0.47** and **0.11** respectively. Indian Journal of Physics was not included in the data base. To give a feel for these numbers, during the same period Nature had an impact factor of **15.75,** Physical Review Letters **8.31,** Astrophysical Journal **3.544** and Astronomy and Astrophysics **1.96.** It was also found that the impact factor of JAA has come down from **1.31** in **1986** but that of Pramana has gone up from **0.428** in **1986** to the present **0.51.** Neither 'IJPAP nor IJRSP were covered in SCI during **1986.** The reason for the fall in the impact factor of JAA could be due to the fact that the special number brought out during the Golden Jubilee of the Indian Academy (in **1984)** contained a number of invited articles from well-known astronomers from both within and outside the country and these articles must have drawn the attention of astronomers all over the world and hence the higher figure during **1986** as compared to the **1988** figure of **0.58.** The rise

in the impact factor of Pramana during 1988 could be due to the better articles received by the journal during that period, specially those on High T_c superconductivity

The Volume of Publication: It is found that there is only a marginal difference between the Indian Journal of Physics and Pramana (both monthlies) with regard to the number of articles and number of pages published. The number of articles published in both these journals during the last few years has been quite steady. The number of articles published in IJPAP which is also a monthly is less than the number published in IJP and Pramana. This could be due to the fact that IJPAP is a specialist journal. Even after taking into consideration that IJRSP is a bi-monthly publication, the number of articles published by it during the year is on the lower side. Table 11 gives the quantum of publication in the five journals over the last few years and Tables 12 and 13 give other statistics pertaining to these journals.

Special Numbers: IJP, IJPAP, IJRSP and Pramana publish special numbers from time to time. These are brought out either to honour an eminent scientist or to highlight a particular theme or sometimes to publish pro-

TABLE 11

Number of Articles and Pages published by *IJPAP, IJRSP, IJP, Pramana & JAA* during 1985-1989

Journal	1985		1986		1987		1988		1989	
	Articles	Pages	Articles	Pages	Articles	Pages	Articles	Pages	Articles	Pages
Indian Journal of Pune & Applied Sciences (IJPAP)	166	638	162	614	132	514	163	736	140	736
Indian Journal of Radio & Space Physics (IJRSP)	40	174	48	432	58	410	49	314	59	314
Indian Journal of Physics (IJP)	115	1084	121	1076	142	1130	172	1574	154	1375
Pramana	173	1670	136	1400	148	1344	137	1133	140	1563
Journal of Astro-physics & Astronomy (JAA)	26	277	28	316	38	395	26	248	31	443

TABLE 12

Some Statistical information pertaining to the five Indian journals, *IJP, IJPAP, IJRSP, Pramana & JAA*

Journal	Periodicity	Editorial Board Members		Panel of Referees		Editorial staff*	Number of subscriptions	
		Ind.	For.	Ind.	For.		Ind.	For.
Indian Journal of Physics (IJP)	Monthly	30	-	100	-	3	172	158
Indian Journal of Pure & Applied Physics (IJPAP)	Monthly	11	-	300	-	5		100
Indian Journal of Radio & Space Physics (IJRSP)	Bimonthly	14	3	100	-	3	112	12
Pramana	Monthly	14	-	600	5	3	280	90
Journal of Astrophysics & Astronomy (JAA)	Quarterly	7	8	45	5	3	165	245

* includes Editor and Associate Editor

TABLE 13

Information regarding rate of rejection, time lag and coverage in secondary periodicals of the the five Indian journals, *IJP, IJPAP, IJRSP, Pramana and JAA*

Journal	Rate of rejection (%)	Time lag (in months)	Coverage			
			Physics Abstracts	Astronomy & Astrophysics Abstracts	Currents Contents	Science Citation Index
Indian Journal of Physics (IJP)	20 - 25	11 - 12	Yes	No	No	No
Indian Journal of Pure & Applied Physics (IJPAP)	28	8 - *2	Yes	Yes	Yes	Yes
Indian Journal of Radio & Space Physics (IJRSP)	30	8	Yes	Yes	Yes	Yes
Pramana	30	8 - 10$	Yes	Yes	Yes	Yes
Journal of Astrophysics & Astronomy (JAA)	30	9	Yes	Yes	Yes	Yes

* Time lag is between date of receipt and publication of the articles

$ It is understood that the time lag in Pramana has been reduced to 4 - 6 months in the recent months (end of 1990).

ceedings of a conference. Some of the special issues brought out by these journals are: IJP brought out a special issue dedicated to the Memory of Prof.K.R.K.Asundi and a special issue in honour of Prof.S.N.Biswas. It also published as special issues, about half a dozen Proceedings of National Seminars (on Scattering theory and application, Crystal Growth, Physics & Technology of Particle accelerators, Physics and Applications of New Materials). Pramana published theme issues on Nuclear structure and Nuclear Fission and to mark the Diamond Jubilee of Bose Statistics, it published the Proceedings of an International Symposium on Theoretical Physics. It also brought out a felicitation volume in honour of Dr.Raja Ramanna. IJPAP published a special number to mark the Raman Effect Diamond Jubilee and brought out a special number covering the selected papers presented at the Fourth National Workshop on Atomic & Molecular Physics. IJRSP published special numbers on the Indian Middle Atmosphere Programme, selected papers presented at the National Science Symposium and symposium on Current status and future perspectives in solar terrestrial physics research. JAA does not bring out any special number (excepting for the special number published during the Golden Jubilee of the Indian Academy). It is understood that the Council of the Indian Academy has recent-

ly (1990) resolved that special issues of the journals will not be brought out in honour of scientists as a matter of routine (Srinivasan, 1990).

Infra-structural Facilities: We have earlier discussed this point with respect to PID (publishers of IJPAP and IJRSP) and the Indian Academy of Sciences (publishers of Pramana, JAA and in collaboration with the Current Science Association, Current Science). With regard to IJP, the editorial offices of this journal has telephone and telex facilities but does not have its own printing facility. It does not have E-Mail facility either.

5.7 OTHER PHYSICS AND ASTRONOMY PUBLICATIONS:

In addition to the journals discussed above, there are a few other publications in the country which deal with physics and astronomy but which are not research journals in the true sense. Physics News published by the Indian Physics Association and Physics Education (sponsored by the U.G.C) are two such journals. Physics News is an official organ of the Indian Physics Association. This is a quarterly publication and carries news items of interest to the physics community and a few general articles in the field of phys-

ics. Though not at the same level, it is rather like Physics Today published by the American Institute of Physics. Physics Education is oriented towards a younger audience in schools, colleges and universities.

In astronomy there is Bulletin of the Astronomical Society of India" which is the official organ of the Astronomical Society of India. Started by the Astronomical Society in 1973, this publication which is a quarterly, publishes research articles., reports from Observatories, Society news, and book reviews. Though it includes research articles it is not in the same genre as JAA. However, this publication is covered by both Physics Abstracts and Astronomy and Astrophysics Abstracts. Bulletin of the Kodaikanal Observatory which was discussed in an earlier chapter, is being brought out by the Indian Institute of Astrophysics at irregular intervals. Earlier each issue of the Bulletin was individually numbered and starting from 1976 onwards volume numbers were given to the issues. So far 10 volumes have been brought out in the new series. It published the proceedings of the colloquium held in 1984 (On Magnetic field - Plasma interaction) in commemoration of the 75th anniversary of the discovery of the Evershed Effect. It has also brought out special issues covering the proceedings of the Second National

Workshop on Solar Physics held at Kodaikanal in 1987 and the National Workshop on Supernova 1987A held at Bangalore in 1988. But it no longer enjoys the same status that it did during the first half of this century.

5.8 FUNDING FOR THE PUBLICATION OF JOURNALS

Science Journals publication activity in India has been largely supported by the Government. As has been mentioned earlier, the Council of Scientific and Industrial Research is a major publisher of journals and it gets its funds from the Government. The Department of Science and Technology has been increasingly funding the journals publication activity in the country and during 1988-89 it funded thirty nine organisations including the Indian Academy of Sciences for publishing journals (Department of Science and Technology, 1989). Councils like I C M R and I C A R also fund the publication of journals in their respective fields, once again drawing funds primarily from the Government. Thus we see a major thrust from the various funding agencies in supporting the publication of scientific journals in the country; however, one way or the other all funds are derived from the Government.

As the motivation for publishing these journals is not earning revenue, the monetary returns from these journals should not be questioned. Commercial publishing houses abroad like North Holland and Gordon & Breach, for example, attach importance to financial returns. (In the last two years there has been severe competition among publishers abroad and unfortunately things have gone to such lengths as one publisher taking the other to court for alleged unethical practices. Ratnakar, 1990). However, one should examine the usefulness of these journals to the scientific community in the country and whether they are effectively used. Our present focus is on physics and astronomy, and we should keep in mind the fact that there is now a sizable number of physicists and astronomers in the country (there are at least 400 practising research physicists among the 3,000 and odd members of the Indian Physics Association and there are 188 astronomers from India as members of the International Astronomical Union). One should also examine if *Indian journals devoted to these areas reflect the research work done (in these areas) in the country.* We discuss in the next chapter these issues and the usage of Indian journals especially the Physics and Astronomy journals discussed in this chapter.

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CHAPTER 6

UTILIZATION OF INDIAN JOURNALS

A study has been carried out to find out the extent to which the Physics and Astronomy community in India and researchers outside India utilized the five Indian journals, Indian Journal of Physics, Indian Journal of Pure and Applied Physics, Indian Journal of Radio and Space Physics, Journal of Astrophysics and Astronomy and Pramana) to publish their research findings during the period 1985 to 1989 and to determine the organisations which extended support by way of publishing papers. These journals were chosen because of their nature of publication (the journal being a research periodical was the main criterion, uninterrupted publication over the years, and coverage in secondary periodicals.

Much of the research activity in India, both fundamental and applied research, is by and large confined to research institutions. Barring a few university departments and the Indian Institutes of Technology, research activity is minimal in most of 'the universities. Hence seven research institutions in the country where active research is going on in physics, or in

astronomy or in both were chosen and their publication pattern was analysed to find out the journal preferences of researchers in these institutions for publishing their research findings. The institutions were chosen on the basis of their visibility in the scientific world, their past record and their achievements. However, the study had to be restricted to a limited number of institutions as one obviously cannot include all the research centres of repute in a country. Thus the notable exclusions in our list are the Bhabha Atomic Research Centre, Bombay, Institute of Physics, Bhubaneswar, National Physical Laboratory, New Delhi, Jawaharlal Nehru University New Delhi and the central universities. Nevertheless, their contributions to the five Indian journals studied, have not been totally ignored and to a limited extent their contributions as well as those from the universities etc. are reflected in the analysis of CURRENT CONTENTS to be discussed later. The institutions chosen for detailed study were, the Indian Association for the Cultivation of Science, Calcutta, Indian Institute of Astrophysics, Bangalore, Indian Institute of Science, Bangalore, Physical Research Laboratory, Ahmedabad, Raman Research Institute, Bangalore, Saha Institute of Nuclear Physics, Calcutta and the Tata Institute of Fundamental Research, Bombay.

To first get an approximate idea of the quantum of research articles in physical sciences contributed during 1989 from all over India to journals published abroad, 15 issues of CURRENT CONTENTS (Physical, Chemical and Earth Sciences edition) spread over the year 1989, were analysed. The author indices were scanned for names with Indian addresses. Apart from this, data were also collected about contributions from India in 1989 in the leading astronomy journals such as the Astrophysical Journal and its supplements, Astronomy and Astrophysics and its supplements and the Monthly Notices of the Royal Astronomical Society. The data obtained this way has been compared and presented later in the chapter.

6.1 AN ANALYSIS OF ARTICLES PUBLISHED IN THE FIVE JOURNALS

An analysis was made to find out the extent to which different institutions within and outside the country were making use of the five journals (under study) to report their research findings. For this, articles published in these journals during the preceding five year period, 1985 to 1989, were examined.

The analysis has shown that majority of the articles published in Indian Journal of Physics(IJP) (53.4%) and

Indian Journal of Pure and Applied Physics (IJPAP) (66%) were received from the universities /colleges and those in Indian Journal of Radio and Space Physics (IJRSP) (56%), Pramana (50.4%) and the Journal of Astrophysics and Astronomy (JAA) (47%) were contributed from research institutions. While JAA published substantial contributions from abroad (41.6%), it was much less in the other four journals (IJP 16.3%, IJPAP 12%, IJRSP 11% and Pramana 8.4%). We discuss below the quantum of contributions of articles by different groups (universities/colleges, research institutions, and foreign institutions) in the five Indian journals analysed. To give a proper quantitative credit to joint authors in a paper, whenever an article had joint authors (say two) belonging to two different institutions, equal credit of (0.5) was given to each institution. When an article was co-authored by three persons belonging to three-different institutions, a credit of 0.33 was given to each institution. When an article had two authors from one institution and one author from another, a credit of 0.66 was given to the institution with two authors and 0.33 to the other institution with a single

author.

6.1.1 INDIAN JOURNAL OF PHYSICS (IJP)

Contributions from Universities/Colleges

IJP published 704 articles/notes during the period 1985-1989. The major contribution (53.4%) to this journal came from universities/colleges. Andhra University, Waltair (16 articles), Anna University, Madras (20), Banaras Hindu University, Varanasi (17), Karnatak University, Dharwad, (11) Mysore University, Mysore, and Delhi University (10 articles each), Shivaji University (12) and University of Gorakhpur (11 articles) were the main contributors.

Contributions from Research Institutions

Around 25% of the total articles published by this journal were from research institutions. The leading contributors among the research institutions were Bhabha Atomic Research Centre (51 articles), Indian Association for the Cultivation of Science, Calcutta (46), Indian Institutes of Technology (27) and Saha Institute of Nuclear Physics, Calcutta (15 articles). There were

just four articles from the Indian Institute of Science, 9 from the Tata Institute of Fundamental Research and none from the Raman Research Institute. A large number of articles from BARC and IACS were contributed to the special issues of the journal brought out during that period. In general, the special issues of the journal increased the number of articles published by the research institutions in this journal.

Contributions from Abroad

About 115 articles (16.3%), were received from twenty countries from abroad, with Egypt contributing 46 articles and the USA 24 articles. Bangladesh contributed 9 articles. It may be mentioned here that in this journal,the rejection rate for articles received from abroad (30.7%) is higher than its over a11 rejection rate (20%).

6.1.2 INDIAN JOURNAL OF PURE AND APPLIED PHYSICS

Contributions from Universities/Colleges

As in the case of the Indian Journal of Physics, the majority (66%) of the 763 articles published during 1985-89 in this journal was contributed by the universi-

ties and colleges. As can be seen, the percentage of contribution is higher than in the case of IJP (53.4%). Eleven universities - Allahabad, Andhra, Banaras, Gurunanak Dev, Jadavpur, Karnatak, Kumaun, Lucknow, Nagarjuna, Rajasthan and Shivaji Universities, contributed more than ten articles with Gurunanak Dev (18), Karnatak (17) and Bangalore (16) topping the list.

Contributions from Research Institutions

About 21.6% of the articles published were contributed from the research institutions, Out of this a little more than half was contributed by seven institutions with Bhabha Atomic Research Centre and National Physical Laboratory (21 each), Indian Institutes of Technology (25) and the Tata Institute of Fundamental Research(15) leading this group. Again, as in the case of the IJP, special issues brought out by the journal received a good number (perhaps invited) of articles from these organisations.

Contributions from Abroad

Of the 763 articles published in the journal during the period under consideration, 12% were contributed

from 24 countries abroad. As in IJP, Egypt contributed the highest number of articles (35) to this journal with Nigeria (12 articles) and Italy and the USA. (with 8 articles each) being the other notable contributors. It is observed that 73% of the contributions from abroad were from universities in those countries.

6.1.3 INDIAN JOURNAL OF RADIO AND SPACE PHYSICS

This journal being a bi-monthly, fewer articles were published by it as compared to other three physics journals. In all it published 254 articles during the period 1985-1989.

Contributions from Universities/Colleges

Unlike in IJP and IJPAP, contributions from universities/ colleges were less compared to contributions from research institutions. Thirty nine universities and colleges contributed 32% of the articles published by the journal. University of Roorkee (11 articles), Banaras Hindu University (9), University of Delhi and University of Kerala (6 each) were the main contributors to this journal.

Contributions from Research Institutions

Research institutions contributed 56% of the articles published in this journal, a large number (55) articles corning from the National Physical Laboratory, New Delhi. Other major contributors were the organisations connected with Space Research (1ike Indian Space Research Organisation, Space Application Centre, Vikram Sarabhai Space Centre and Indian Scientific Satellite Project) which together contributed 20 articles and the Physical Research Laboratory and the Indian Institute of Geomagenetism contributed 14 articles each. The patronage pattern observed is understandable as these organisations are involved in research in ionosphere and space physics, subjects which are rarely pursued in universities and colleges. Perhaps one of the reasons for a large number of contributions from the National Physical Laboratory could be due to the fact that this organisation, apart from being involved in ionosphere work, was at that time headed by the person who was instrumental in starting this journal.

Contributions from Abroad

The journal published 28 articles (11% of total number of articles published) contributed from outside the country. These articles were received from a dozen countries. Federal Republic of Germany (5 articles), Ghana (4) and Australia (3) were the main contributors from outside the country. There was only one article from the USSR and two each from USA and UK.

6.1.4 PRAMANA

As mentioned earlier, 50% of the articles published in Pramana were contributed by research institutions, 41% by the universities/colleges and 8% by institutions abroad.

Contributions from Universities/Colleges

Out of the total 734 articles published during the period 1985-89 in this journal, 302 articles (41%) were contributed by 120 universities and colleges. The major contributors were, Banaras Hindu University (21), Cochin University (20), University of Delhi (15) and University of Madras (16 articles). It is found that these four universities accounted for 23% of the arti-

cles contributed by this group. Contributions from the rest of the universities, though collectively a good number, were individually not significant.

Contributions from Research Institutions

Research Institutions in India contributed 50.4% of the 734 articles published in Pramana, these contributions coming from 38 organisations. A large number of articles (280), were contributed by six Institutions of repute - Bhabha Atomic Research Centre (at Bombay and its centre at Calcutta) and Indira Gandhi Centre for Atomic Research, Kalpakkam) 108 articles, the five Indian Institutes of Technology (56 articles), Indian Institute of Science (40), National Physical Laboratory (18), Physical Research Laboratory (13) and the Tata Institute of Fundamental Research (45 articles). But it is important to note that at least 25% of the articles published by the Bhabha Atomic Research Centre were in the special issues of the journal (conference proceedings and commemoration volumes). It is also important to note that premier institutions like the Tata Institute of Fundamental Research and the Indian Institute of Science contributed only about 6% each (of the

total number of articles published by the journal). And only 9 articles (~11% of its total publication) were published (during the period 1985-89) by the well established Liquid Crystals Group of the Raman Research Institute !

Contributions from Abroad

Pramana published only 62 articles (8.4% of the total pub1ication) from abroad. This is less compared to the number of articles from abroad published in the other three physics journals discussed earlier. Though the journal published articles from 23 countries, 75% of these articles were contributed from four countries - U.S.A (19), USSR (17), Germany (7) and Italy (4). This is in contrast to the other three journals where contributions from developing countries was more (specially from middle eastern countries). Perhaps this has a bearing on the standard of the journal.

6.1.5. JOURNAL OF ASTROPHYSICS AND ASTRONOMY

As this is a quarterly, the number of articles published in this journal is low compared to those in the other journals. Majority (88%) of the articles

published in this journal during the period 1985-89 were contributed by research institutions and from abroad with universities and colleges publishing little in this journal.

Contributions from Universities/Colleges

Unlike in the other four journals discussed above, the contributions from universities and colleges was only 10% of the total number of articles (149) published during 1985-1989. Out of this, three articles were published by the Centre for Advanced Studies in Astronomy (CASA) at Osmania University, Hyderabad. This low percentage indicates that Astronomy is not being pursued much in the universities in the country or the research work done by the universities is reported in journals published outside the country. As we see a little later in this chapter, the second possibility can be eliminated.

Contributions from Research Institutions

Research Institutions contributed 47% of the arti-

cles published by JAA during 1985-89. These contributions were received from about a dozen organisations in the country, with the three centres of Tata Institute of Fundamental Research (at Bombay, Bangalore and Ooty) and the Indian Institute of Astrophysics contributing 30 and 25 articles respectively. Though these numbers look impressive, the contributions from these institutions to foreign journals far exceed those to JAA, as will be seen later. Raman Research Institute published 9 articles in JAA. Although this number is small it represents a large percentage of papers published from this institute.

Contributions from Abroad

Of the 149 articles published, 41% (62 articles) were contributed by 17 countries from abroad. However 10 articles are the papers presented at the IAU Commission 29 meeting on Nucleosynthesis, held during the XIX General Assembly of the International Astronomical Union, at New Delhi in 1985. Out of the 62 articles contri'buted from abroad, 12 were from the United Kingdom, 8 from the USA and 6 each from France and Greece. It is interesting to note that of the 12 articles from the United Kingdom, 11 were from a single Institute (The Observatory, Cambridge) and were contributed by a member

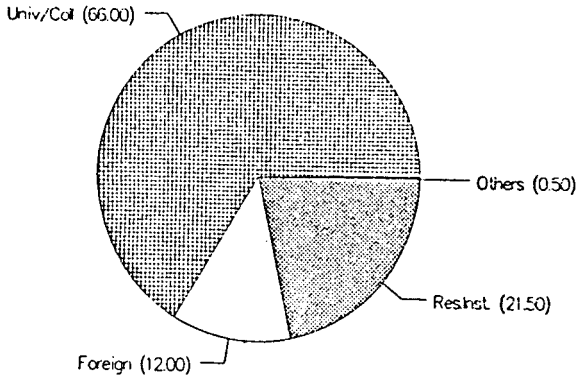
of the editorial board of the journal.

6.2 SOME REMARKS

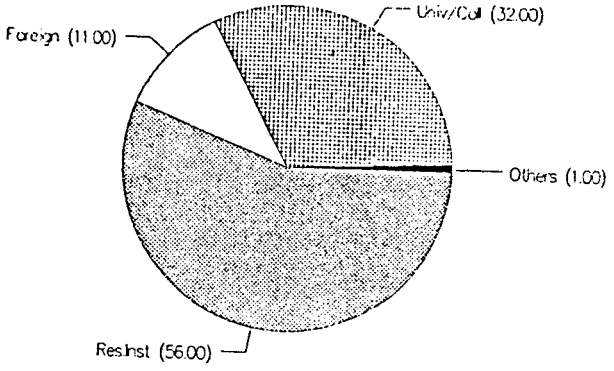
The analysis of the publications pattern in the five journals studied indicates that the journals, Indian Journal of Physics and Indian Journal of Pure and Applied Physics are used more by the universities/colleges and Indian Journal of Radio and Space Physics and Pramana are utilized more by the research institutions. If the contributions in the special issues are not considered, the four physics journals do not receive contributions from the developed countries and are utilized to a small extent by the leading research centres in the country. To a lesser extent this is true in the case of Journal of Astrophysics and Astronomy also. The pie diagram (see figure 7) depicts the data presented above for the five journals.

6.3 PUBLICATION PATTERN OF SEVEN RESEARCH INSTITUTIONS IN INDIA

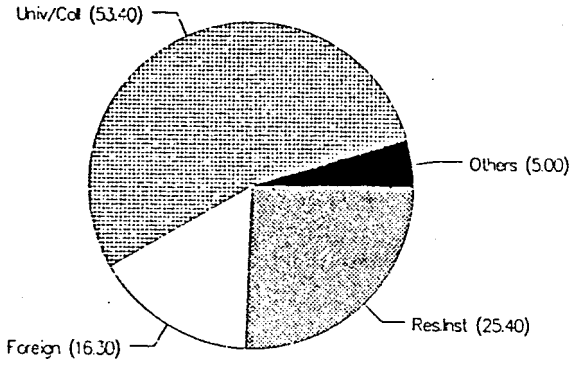
Having got a feel for the contributions of the different groups (like the universities/colleges, research institutions and institutions from abroad) to the



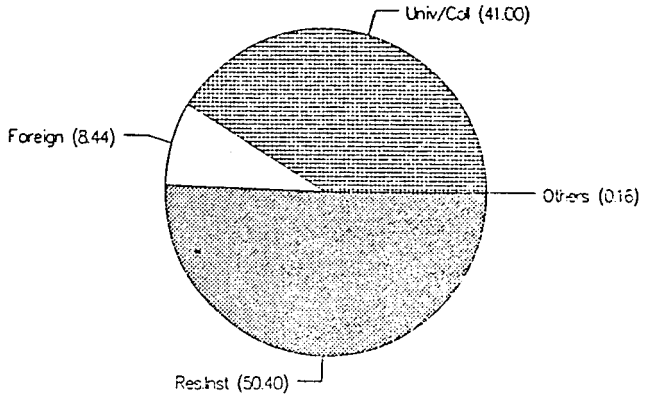
Indian J. Pure & Applied Physics



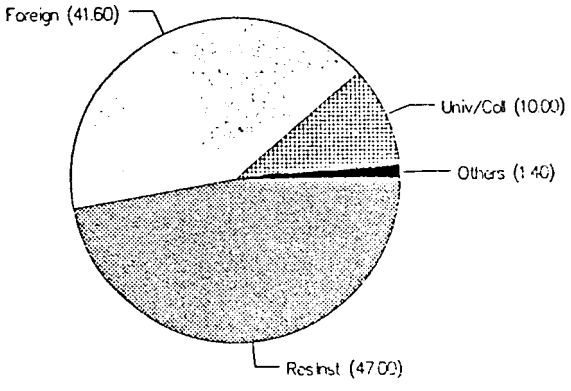
Indian J. Radio & Space Physics



Indian Journal Of Physics



Pramana



Journal of Astronomy & Astrophysics

Figure 7

Percentage of contribution of articles by different groups

five Indian journals, a study was made of the publications output in *journals* (of the research findings in Physics and Astronomy) of the seven research institutions mentioned earlier for the period **1983-84** to **1988-89.** These institutions were chosen as they are well established centres in their fields and cover Physics or Astronomy, the two subjects whose journals are the topic of this study. The study was carried out to find out the extent to which the research findings of these institutions were reported in ***Indian Journa7s*** and in ***Foreign Journals.*** For this purpose, only the research articles published in journals were taken into consideration. The papers published in Conference Proceedings (which did not form a part of a journal), books, monographs and Technical Notes have been excluded. It may be added that, as this study is mainly concerned with physics and astronomy, generally articles pertaining to these fields have been considered. However, articles on space physics, cosmogeophysics and material science have also been included in the study. The articles published either as a single authored or as joint authored paper by the researchers of these institutions when they were abroad (reporting results of work carried out there) have been excluded. The data was derived from the Annual Reports of the concerned institutions and in one case the list of publications made available

by the concerned department. It should once again be stressed that the study pertains only to articles appearing in journals and hence the entire publication output is not reflected in this study.. Presented below is the analysis of the publication pattern of the seven institutions.

6.3.1 Indian Association for the Cultivation of Science, Calcutta

Research publications of this organisation in journals pertaining to Physics during 1983-84 to 1987-88 (five year period) was analysed. It was found that during this period 426 articles were published by this centre. Of these, 80% (340 articles) were published in foreign journals and 86 articles (20%) in Indian journals. It is interesting to note that a similar situation prevailed during 1933-1942 when K.S.Krishnan and his associates published from this organisation 52 papers out of which only 11 (21%) were in Indian journals. The situation changed to certain extent during the period 1943-47, when physicists working in this organisation published 50 articles out of which 31 (62%) were in Indian journals. The situation has once again changed during 1983 to 1989. We should recall here

that it was at this organisation Raman founded the Indian Journal of Physics in the 1920's and it is still being published by this Association. It is found that during the five year period 1985-1989, this organisation published only 46 articles in the Indian Journal of Physics, 6 articles in Pramana and 9 articles in the Indian Journal of Pure and Applied Physics. However, during the period 1985-88, 34 articles were published in Physical Review, 29 articles in Journal of Physics (UK), and 12 articles in Physica Status Solidi, all the three journals being published from abroad. This clearly indicates that the researchers of this organisation prefer to publish more in foreign *journals* than in Indian journals (see figure 8).

6.3.2 SAHA INSTITUTE OF NUCLEAR PHYSICS, CALCUTTA

Though the name of this Institute (founded by M.N.Saha in 1948) suggests that this Institute is concerned with Nuclear Physics, research work is also going on in other areas of physics such as mathematical, quantum and statistical physics, plasma physics, condensed matter physics and high energy physics. Apart from physics, other fields of research at this Institute are biophysics, radiochemistry and radiation/photochemistry and to a small extent astrophysics. The analysis

I. A. C. S. Publications (Physics)

in Indian & Foreign Journals

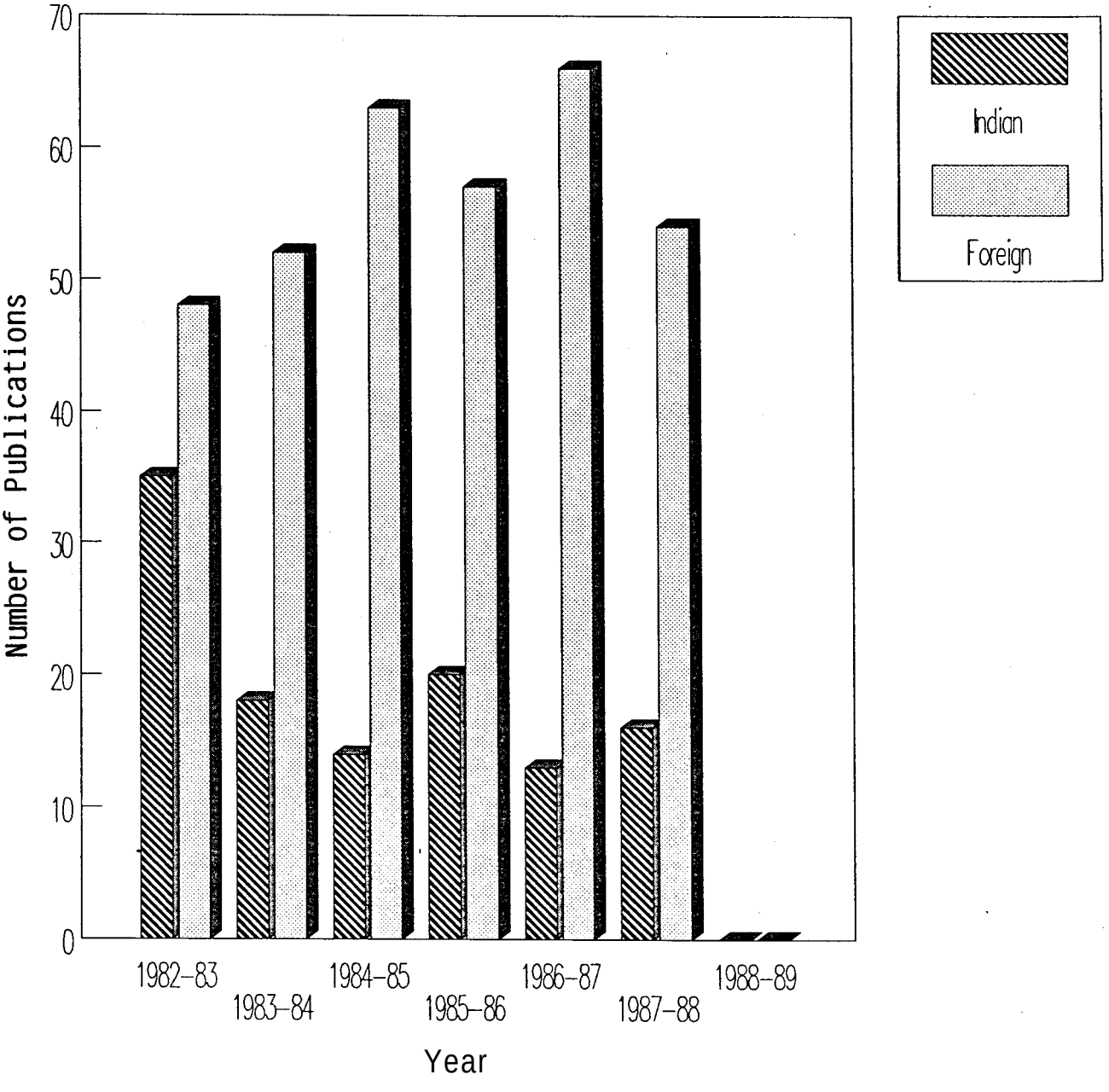


Figure **8**

of the physics publications of this 'Institute during April 1983 to March 89 (six year period) shows that 412 articles were published in journals during this period. Out of this 89% (368 articles) appeared in journals published abroad and 11% (44 articles) in Indian journals. It is found that during the period 1985-89, 13 articles were published in Pramana and 15 in Indian Journal of Physics. It is pertinent to point out that just during *one* year period, April 1988 to March 1989, the physicists of this Institute published 13 articles in Physical Review, 13 articles in Journal of Physics (UK), 11 articles in Nuclear Physics and 11 articles in Zeitschrift fur Physik.

The above analysis brings out clearly the preferences of the physicists of this Institute to publish their research findings in large numbers in ***Foreign Journals*** (see fig ***9***).

6.3.3 INDIAN INSTITUTE OF SCIENCE, BANGALORE

As mentioned in an earlier chapter, the physics group at this premier Institute was established by C.V.Raman during the early 1930s. A number of well-known physicists of the country have worked at this centre at one time or the other and there has always

Saha Institute Publications (Physics)

in Indian & Foreign Journals

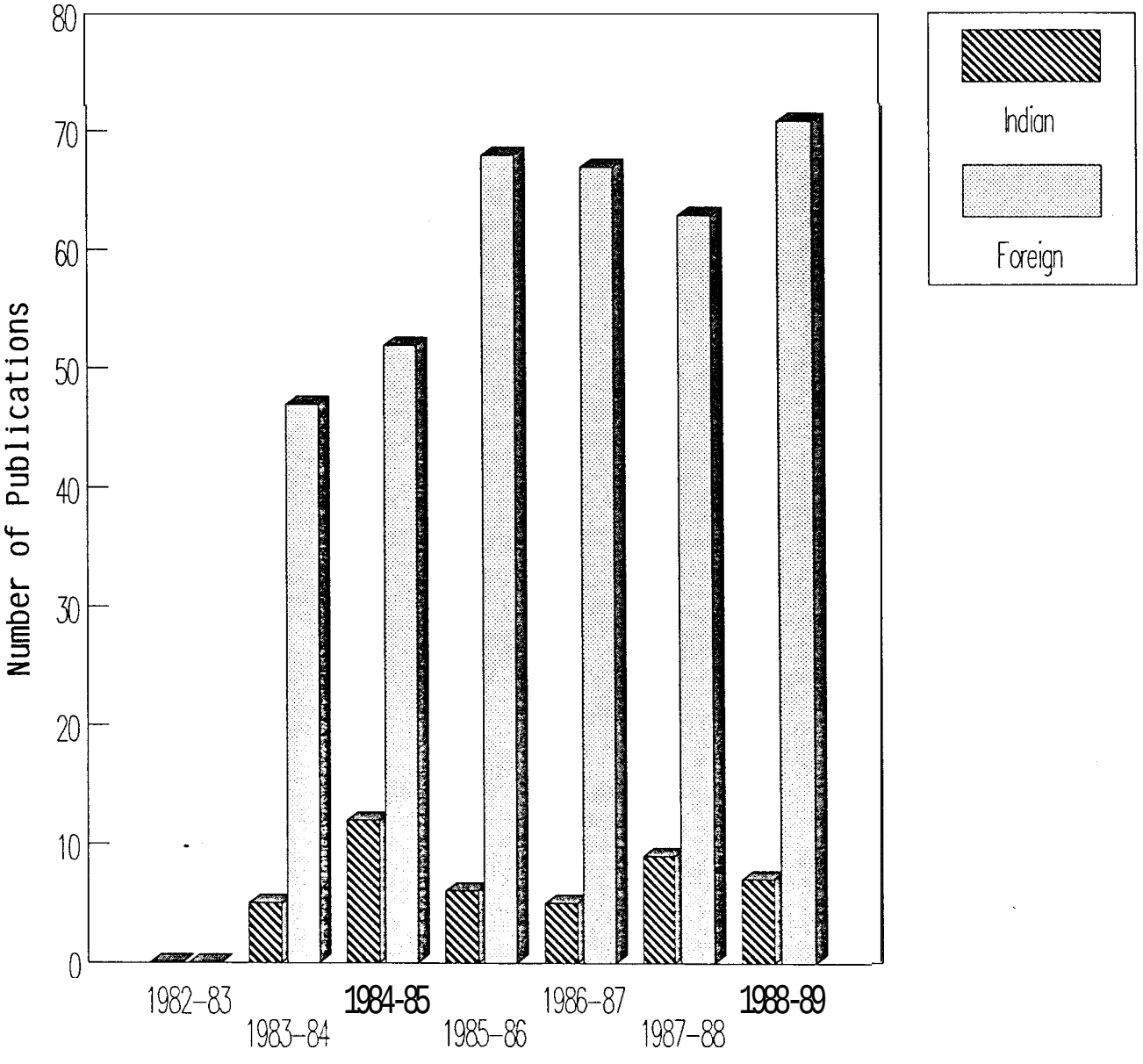


Figure 9

been a strong physics group at this institute. This group has been attracting the attention of leading physicists in the country and is today one of the well-known centres in the country for physics research with a blend of experienced and young physicists working here.

During the period 1983 to the end of March 1989, physicists from this Institute published 302 articles in journals. Out of them 79% (238 articles) were in journals published abroad and 21% (64 articles) in Indian journals. Forty articles in Pramana and 4 articles in the Indian Journal of Physics were published during the years 1985 to 1989. The analysis shows further that during the period 1988 April to March 1989, 85 articles (which is more than what was published in Indian Journals during the *six year period* 1983-89) were published by this group in foreign journals (see fig 10). Out of these, 18 articles appeared in Physical Review, 11 in **Acta** Crystallographica, 5 each in Journal of Physics and Solid State **Communications** and 4 each in Physical Review Letters and Physics Letters.

Thus, it is clearly seen that *Foreign Journals* are the choice of the physicists of this Institute for

publishing their research findings and their contributions in Indian journals are very limited (see figure 10) However, it may be mentioned here that the scientists of this Institute did utilize Pramana to publish their work on high-temperature superconductivity. But this was more an exception than the rule.

6.3.4 PHYSICAL RESEARCH LABORATORY, AHMEDABAD

Established over 40 years ago, the research fields of this institute include, apart from space physics and astrophysics/astronomy, geocosmo physics, atomic and molecular physics, classical and quantum mechanics, particle physics, nuclear and sub nuclear physics, meteorology and climate studies, archaeology and hydrology. The research work of this Institute has been published not only in journals devoted to astronomy and physics, but also in geology, geophysics and mechanics journals.

Publications of the Physics Groue

During the period April 1983 to March 89, 203 articles were published by this group in physics. Out

I. I. Sc. Publications (physics)

in Indian & Foreign Journals

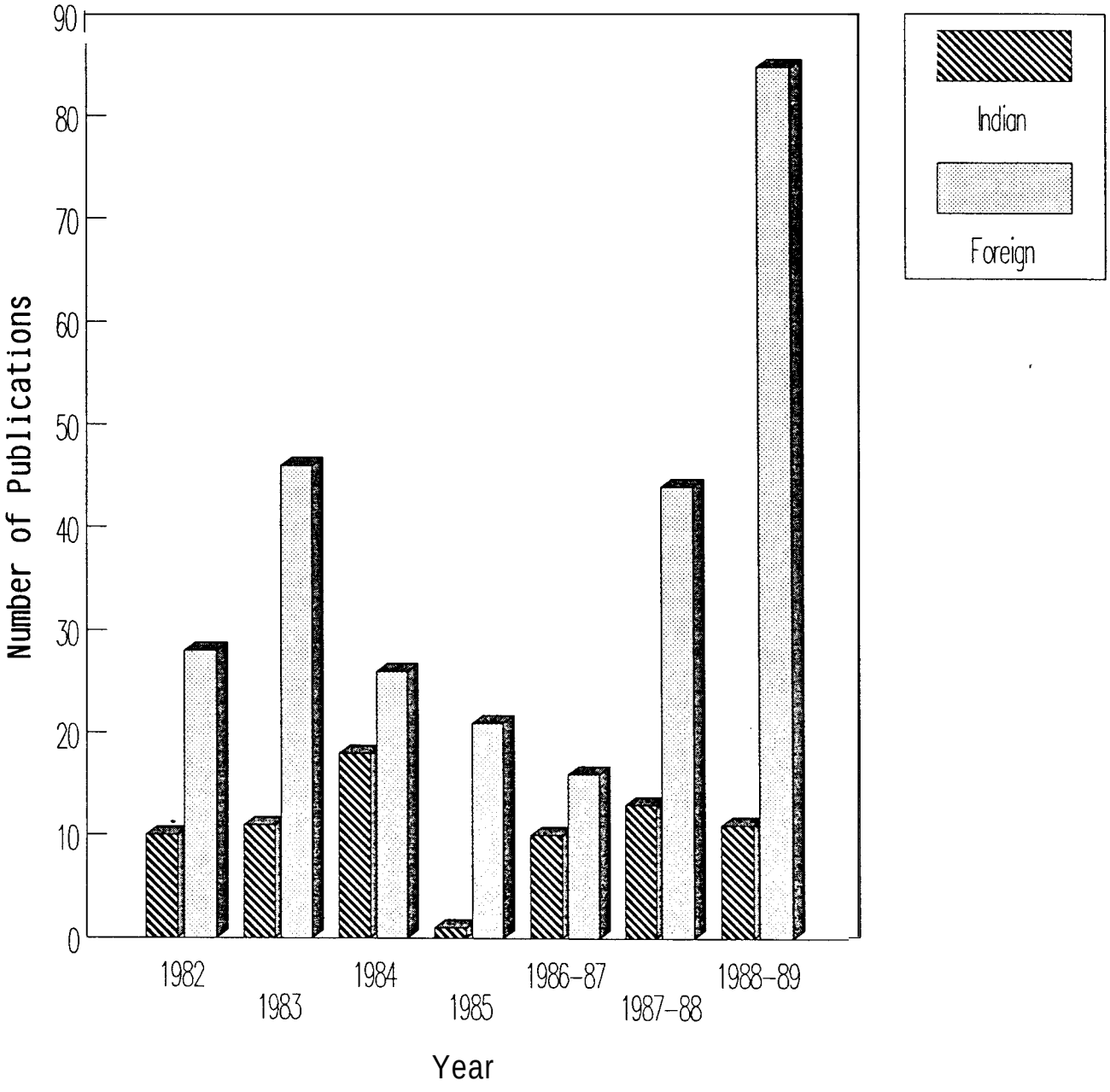


Figure 10

of this 79% (160 articles) were in journals published abroad and 21% in Indian Journals. During the five year period 1985-89, 13 articles were published in Pramana and 5 articles in the Indian Journal of Pure and Applied Physics and one article in Indian Journal of Physics. In 1988-89 (April to March), 5 articles were published in the Physical Review (it was the same number in IJPAP but published over a period of five years), 2 articles in Annals of Physics and one article each in Physics Letters and Zeitschrift fur Physik.

Publications of the Astronomy Group

In astronomy/astrophysics (space physics included), 168 articles were published during the same period (1983 April to March 89). Out of this 74% (124 articles) were in *foreign journals* and 26% (44 articles) in *Indian journals*. It is found that only 14 articles were published by the astronomers/astrophysicists of this Institute in the Indian Journal of Radio and Space Physics and two articles in the Journal of Astrophysics and Astronomy during the five year period 1985-89.

This analysis shows that both physicists and astronomers of this organization prefer to publish their

research findings more in *Foreign Journals* than in *Indian Journa7s* (see figures 11 & 12).

6.3.5 TATA INSTITUTE OF FUNDAMENTAL RESEARCH

The publications of the physics and astronomy groups of this Institute during the period 1983-84 to 1988-89, were analysed separately to find out the preferences of these groups for publishing their research findings. As mentioned in a previous chapter, this centre's research in astronomy is carried out not only at Bombay but also at Ooty (where the radio telescope is located) and Bangalore. Recently (in 1990), the astronomy group at Bangalore and a good portion of the group from Ooty have moved to Poona where a new project GMRT (Giant Metre wave Radio Telescope) is under way.

Publications of the Physics Group

It is found that 89% of the 678 articles published by the physics group during the period (1983 April to March 89) was in *foreign journa7s* and only 11% in *Indian journals.*

P. R. L. Publications (Physics)

in Indian & Foreign Journals

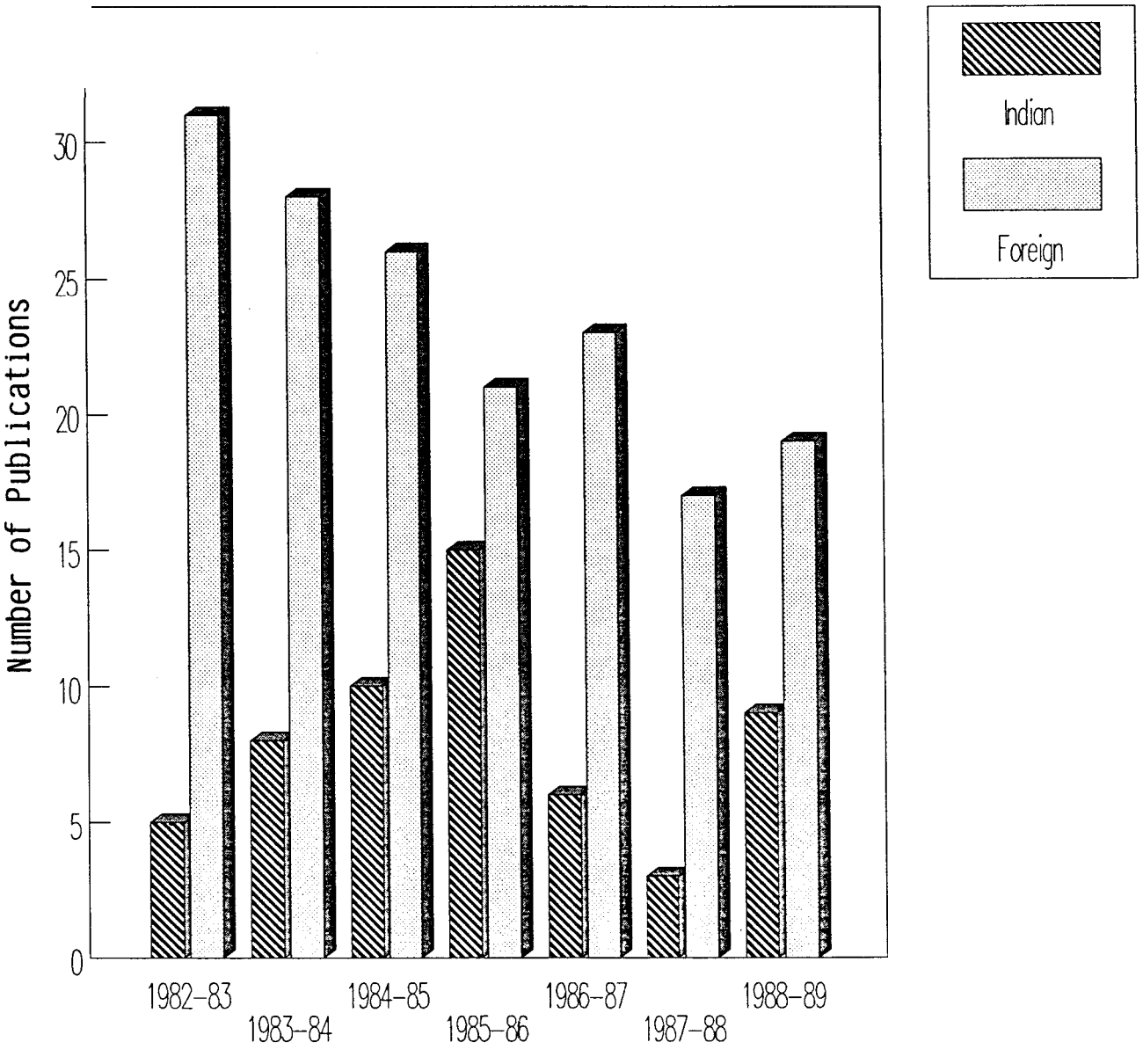


Figure 11

P. R. L. Publications (Astronomy)

in Indian & Foreign Journals

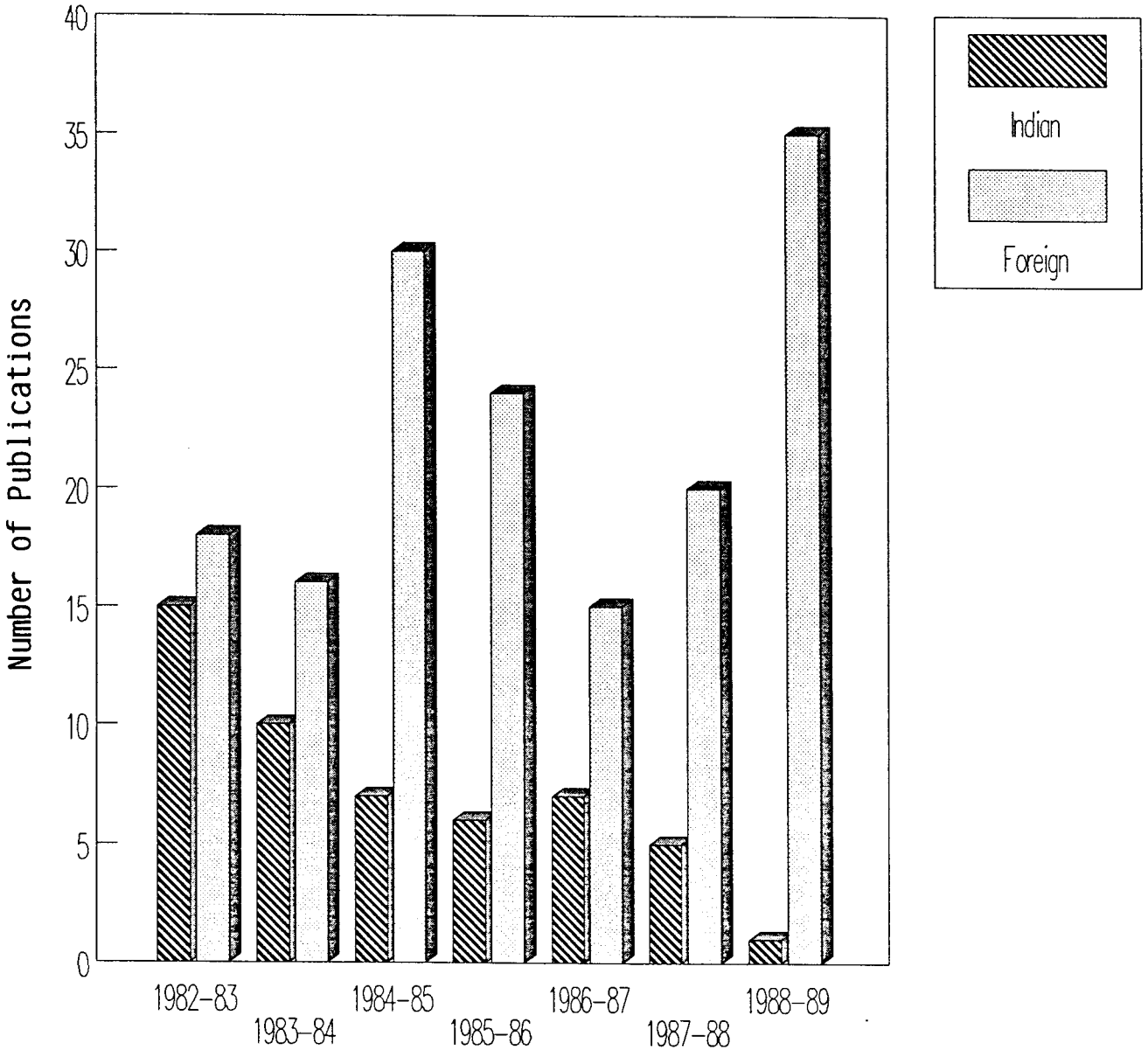


Figure 12

The contributions from this Institute during 1985-89 to the four Indian physics journals considered in this study were, 45 articles in Pramana, 15 in Indian Journal of Pure and Applied Physics, and 10 in Indian Journal of Physics. About 20% of these articles were contributed to the special issues brought out by these journals. The research findings of the physicists appeared in a number of foreign journals during the period 1985-1989, and some of the important journals in which they appeared were Physics Letters (65 articles), Physical Review (45), Physical Review Letters (20), Journal of Physics (46), Nuclear Physics (20) and Zeitschrift fur Physik (40 articles).

Publications of the Astronomy Group

This Institute which has well established Radio Astronomy and Astrophysics groups published 427 articles during the period 1983 to 1989. Out of these, 361 articles (84.5%) were published in *foreign journals* and 66 articles (15%) were published in *Indian journals*. This group contributed 30 articles to the Journal of Astrophysics and Astronomy during the years 1985 to 1989. An analysis of the articles published by this group in 1989 alone showed that 14 articles were pub-

lished in Astrophysical Journal and its supplement series, 6 articles in Monthly Notices of the Royal Astronomical Society and two articles in Astronomy and Astrophysics. It should be mentioned here that these three journals are important core journals in the field well known among the astronomers all over the world. During the same year(1989), six articles were published by this group in Journal of Astrophysics and Astronomy (out of which two articles were joint papers published in collaboration with astronomers outside the country).

The analysis of the publications of the scientists of this institute over the last six to seven years, indicates that *Foreign Journals* are used much more than *Indian Journals* for publishing their research findings (see figures 13 & 14). This practice has been steadily increasing over the years with both physicists and astronomers of this Institute.

6.3.6 RAMAN RESEARCH INSTITUTE, BANGALORE

This Institute, as mentioned in an earlier chapter was founded by C.V.Raman around 1948 and was reorganized during 1971-72. The main areas of research at this Institute are, Astrophysics/Radio Astronomy, Theoretical

T. I. F. R. Publications (Astronomy)

in Indian & Foreign Journals

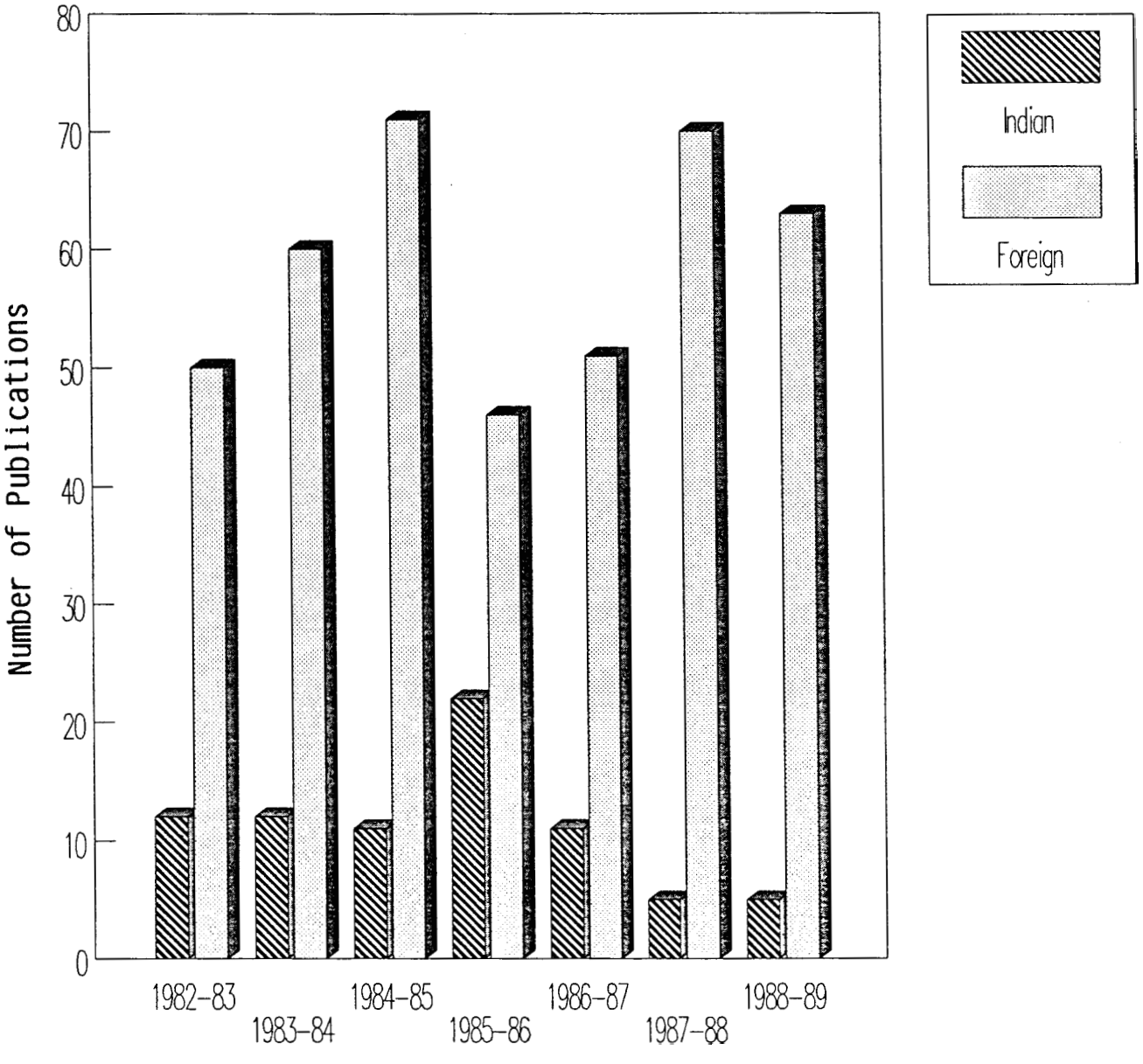


Figure 13

T. I. F. R. Publications (Physics)

in Indian & Foreign Journals

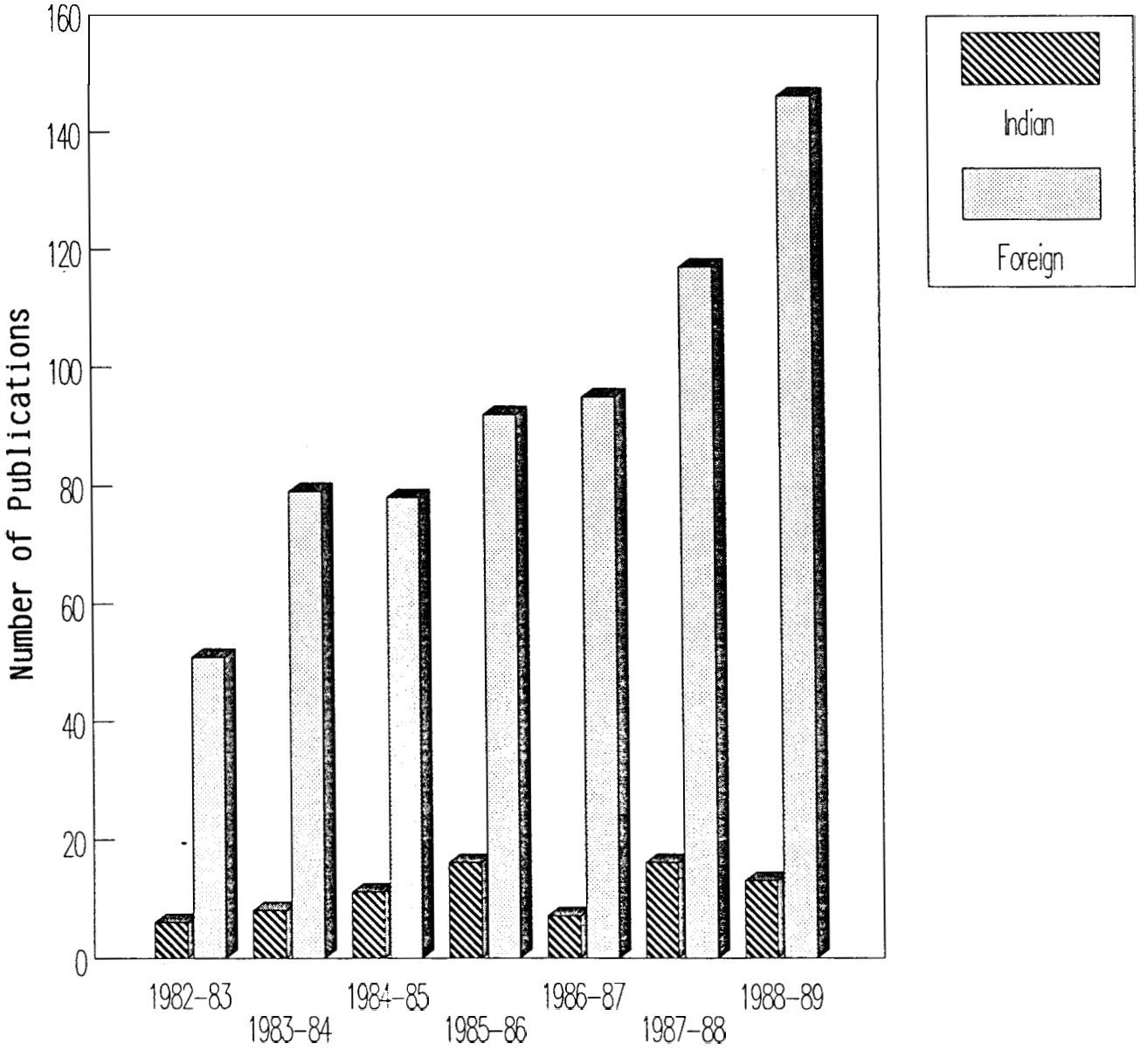


Figure 14

Physics and Liquid Crystals with the Liquid Crystal group being one of the well known groups in the field. It has a field station at Gauribidanur (a joint project with the Indian Institute of Astrophysics) where a radio telescope has been functioning and has recently (1989) taken up another new project at Mauritius to build a low frequency radio telescope.

Publications of the Theoretical Physics and Liauid Crystals Groups

Publications of the research work of these groups have been largely in journals published *abroad.* Out of the 163 articles published in journals during the period 1983 April to March 1989, 86% (143 articles) were in *foreign journals* and *14%* in Indian *journals.* During 1985-89, this group published only ten articles in Pramana and none in the Indian Journal of Physics. However, in 1976, the liquid crystals group published one of the important discoveries in liquid crystals (and perhaps the most important work of this group) relating to *'discotic liquid crysta7s'* in Pramana. This paper was well received and is highly quoted. But even this factor has not sufficiently induced this group to *publish more papers* in Pramana or any other Indian journal.

Publications of the Astronomy/Astrophysics group

In contrast to the liquid crystals and theoretical physics groups, the astrophysics and radio astronomy group of this Institute contributed to Indian and foreign journals *equal* number of papers during the period Apri1 1983 to March 89. However, the total number of papers (44) published by this group during this period is less compared to that of the liquid crystals and theoretical physics groups. Out of the 44 papers published in journals, 22 were published in Indian journals and 22 in foreign journals. This group published six papers in Journal of Astrophysics and Astronomy and 5 papers in Current Science during 1985-89. In 1989, it did not publish any paper either in Astrophysical Journal or in Astronomy and Astrophysics and published one paper in Monthly Notices of the Royal Astronomical Society.

Thus, this study shows that the physicists of this institute, as seen in the case of physicists at other institutions discussed earlier, pub1ish their research findings *more* in journals published *outside* the country than in journals published within the country (see figures 15 & 16). The astronomers working at this insti-

R.R.I Publications (Physies)

in Indian & Foreign Journals

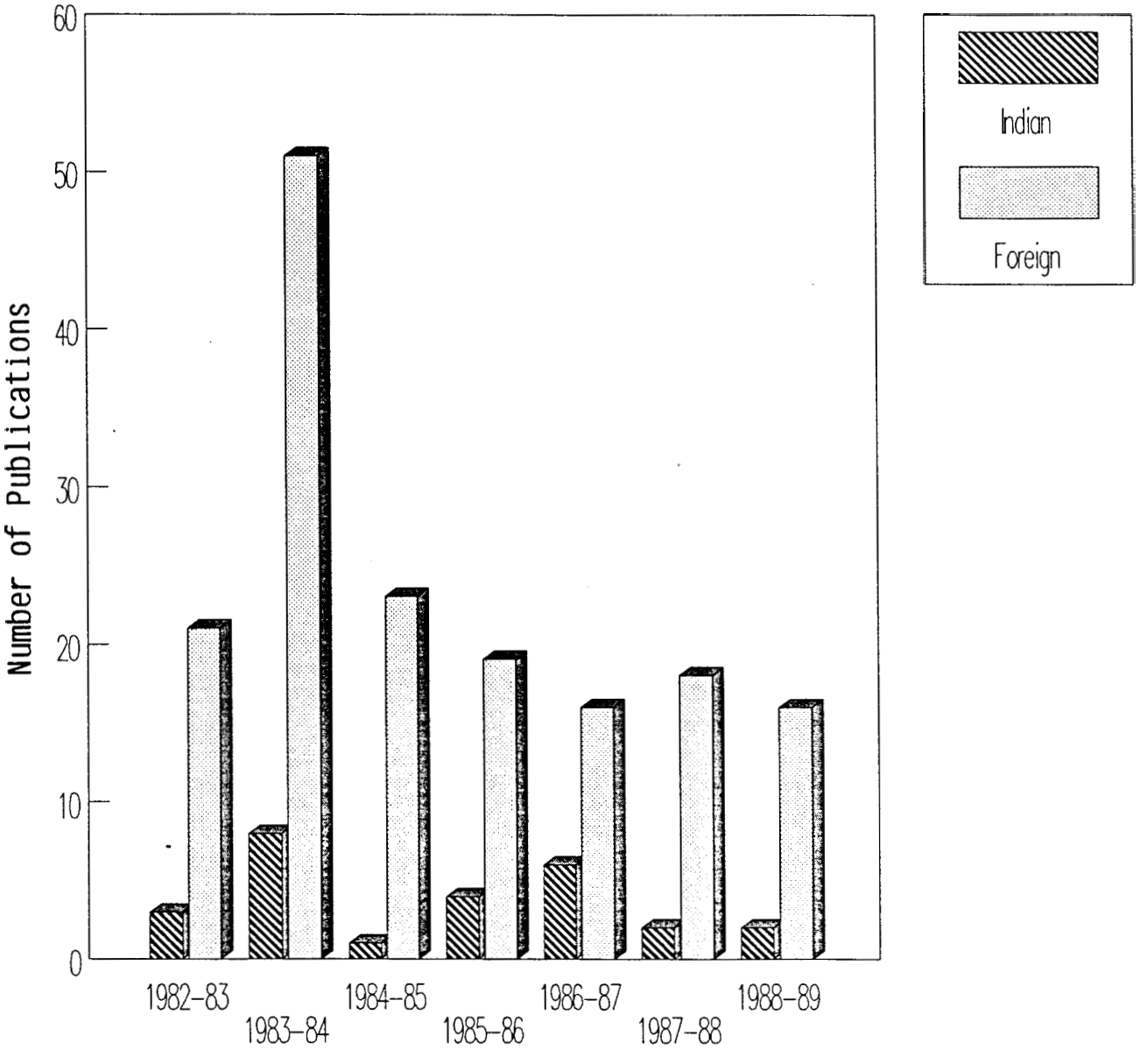


Figure 15

R. R. I. Publications (Astronomy)

in Indian & Foreign Journals

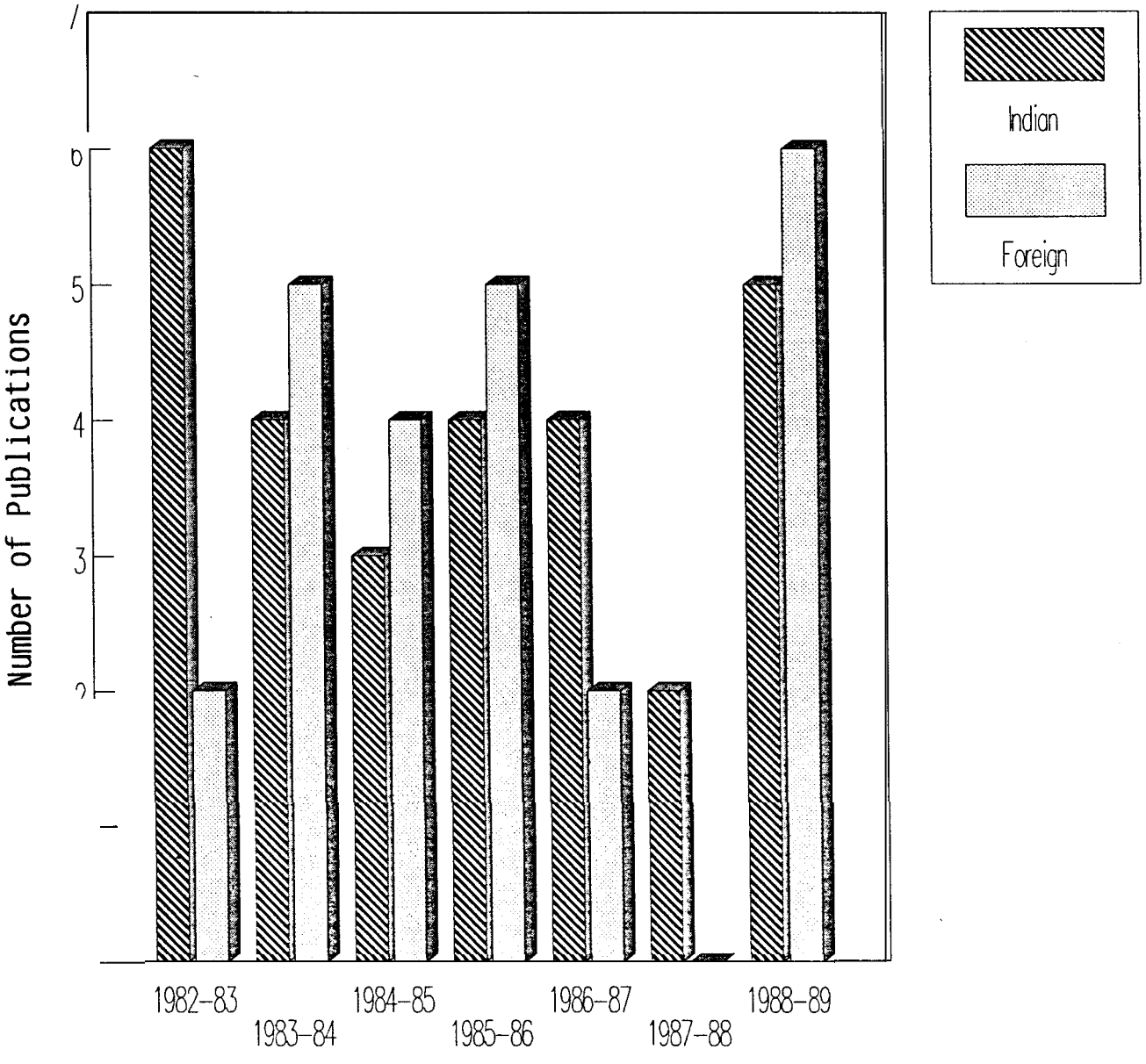


Figure 16

tute are found to pub1ish at least an equa7 number of papers in journals published within the country and outside the country and is the only group among the Institutions considered in this study to do so.

6.3.7 INDIAN INSTITUTE OF ASTROPHYSICS, BANGALORE

The main area of research at this institute is astronomy and astrophysics with both theoretical and observational work going on. Apart from its main centre at Bangalore, it has three field stations, at Gauribidanur (a joint project with the Raman Research Institute), at Kavalur (where it has its new optical telescope) and at Kodaikanal (where the Institute was located before it moved to Bangalore).

During the year 1983 April to March 89, the research work of this Institute was reported in 350 articles. Of these, 219 articles (63%) appeared in *foreign journals* and 131 articles (37%) appeared in *Indian journals*. The researchers of this Institute published 25 articles in Journal of Astrophysics and Astronomy during the period 1985-89. In 1989, they published 5 papers in the Monthly Notices of the Royal Astronomical Society, 4 papers in Astronomy and Astrophysics and one paper in Astronomy and Astrophysics Supplement Series

and one joint authored paper in Astrophysical Journal and 8 articles in Journal of Astrophysics and Astronomy. We should mention here that the articles published in the three foreign journals mentioned above are not the **total** number of papers published in foreign journals (see figure 17). We have taken into consideration only articles published in the top astronomy journals.

Analysis of the publications of this institute has shown that the researchers of this Institute published their work slightly ***more in foreign journals,*** but their contributions to Indian journals was not ***insignificant.*** (However we must mention here that not all articles published in Indian journals were in journals internationally refereed).

Contributions from the seven institutes :

Total contributions of the seven research institutes whose publications were studied, to physics and astronomy articles in the Indian and foreign journals are given in table 14.

I. I. A. Publications

in Indian & Foreign Journals

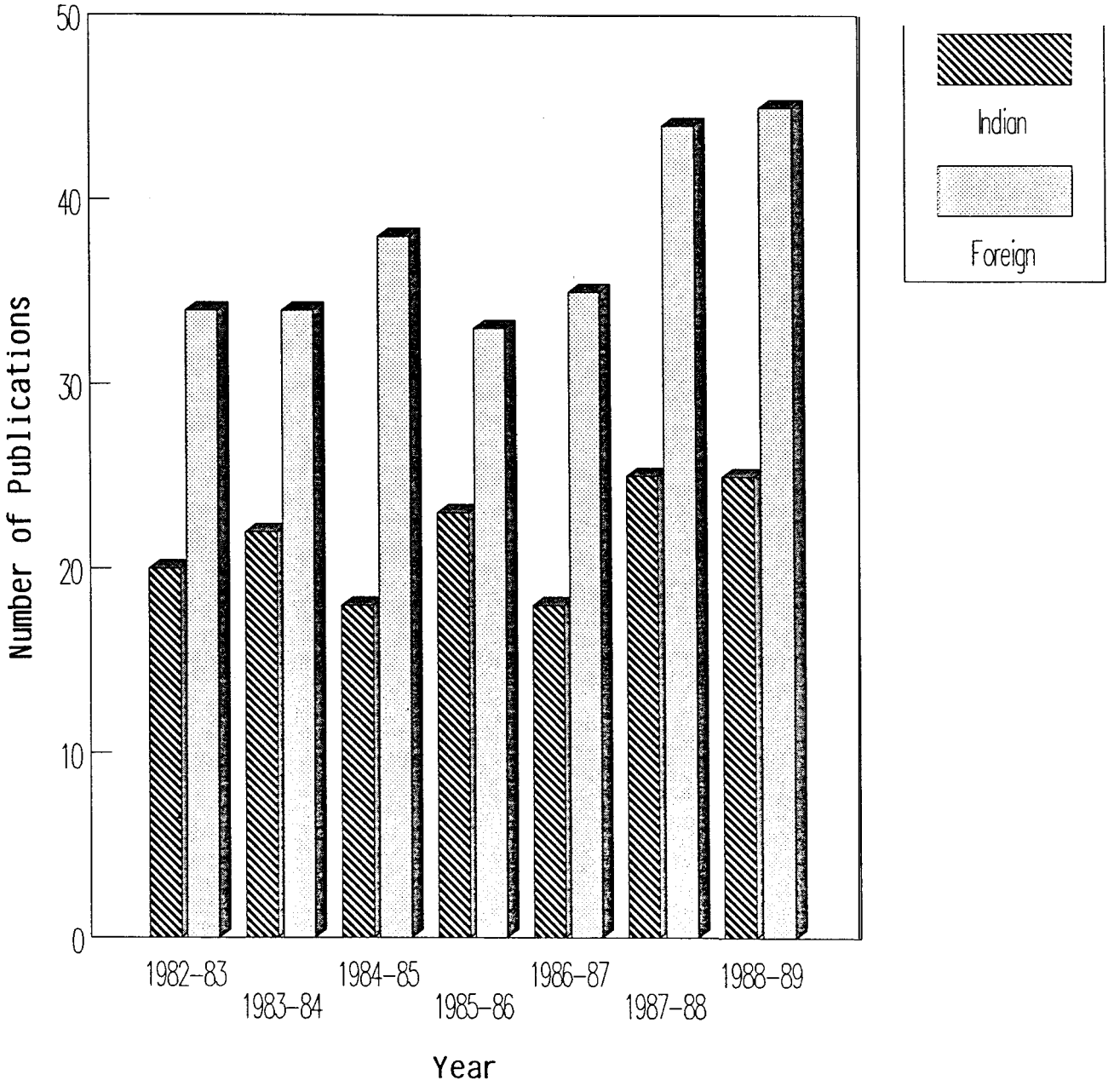


Figure 17

TABLE 14

Number of articles **published** in **Physics &** Astronomy in ***Indian*** and ***Foreign*** journals by seven research institutions during 1982–83 to 1988–89

	1982-83		1983-84		1984-85		1985-86		1986-87.		1987-88		1988-89		TOTAL	
	Ind.	For.	Ind.	For.	Ind.	For.	Ind.	For.	Ind.	For.	Ind.	For.	Ind.	For.	Ind.	For.
Indian Association for Cultivation of Science (Physics)	35	49	18	52	14	63	20	57	13	66	16	54	N/A	N/A	116	340
Raman Research Institute (Physics)	3	21	8	51	1	23	4	19	6	16	2	18	2	16	26	164
Raman Research Institute (Astronomy)	6	2	4	5	3	4	4	5	4	2	2	-	5	6	28	24
Physical Research Laboratory(Astronomy)	15	18	10	16	7	30	6	24	7	16	5	20	1	3 5	51	158
Physical Research Laboratory (Physics)	5	31	8	28	10	26	15	31	6	23	3	17	9	19	56	175
Tata Institute of Fundamental Research (Physics)	6	51	8	79	11	78	16	92	7	95	16	117	13	146	77	658
Tata Institute of Fundamental Research (Astronomy)	12	50	12	60	11	71	22	46	11	51	5	70	5	63	78	411
Saha Institute (Physics)	N/A	N/A	5	47	12	52	6	68	5	67	9	63	7	71	44	368
Indian Institute of Astrophysics	20	34	22	34	18	38	23	33	18	35	25	44	25	45	151	263
	1982		1983		1984		1985									
Indian Institute of Science	10	28	11	46	18	26	1	21	10	16	13	44	11	95	74	266

N/A : Data Not Available

6.4 ANALYSIS OF CURRENT CONTENTS

The analysis of data from 15 out of 52 issues of Current Contents of 1989 (the issues were spread over the whole year) showed that a good number of articles were published in foreign journals from India in Physical Sciences, Chemical Sciences and Geosciences in 1989 (the fifteen issues listed 1,055 articles and this number will be much higher when all the 52 issues of Current Contents for 1989 are examined). Articles in Physics were published by physicists working not only in the seven institutions whose publications were analysed but also those at other research centres and universities. Similarly articles were published by astronomers in journals other than the three foreign journals analysed. A large number (22) of articles were published in the journal Astrophysics and Space Sciences whose standing is not in the same level as either Astrophysical Journal, Astronomy & Astrophysics or the Monthly Notices of the Royal Astronomical Society (however, contributions from the universities to astronomy journals published abroad was negligible). Articles in physics and astronomy were published both in journals of good standing and otherwise. Some of the physics articles published were in journals such as the differ-

ent sections of The Physical Review(57 articles), Physical Review Letters(8 articles), different sections of Journal of Physics (34 articles), Nuclear Physics(7), Nature (7) and Zeitschrift fur Physik(10). Ten physicists who were asked to rate these journals for their quality, felt that these journals were among the top physics journals in the world.

6.5 FINDINGS OF EARLIER STUDIES

There have been a number of bibliometric and citation studies on different aspects of Indian science publications. We mention below a few of those which have some relevance to the present study.

Mehrotra and Lancaster (1984) used the Science Citation Index to analyse the literature covered by it pertaining to the period 1979 to June 1981. Their study covered the entire field of science. They analysed 3,378 articles (picked from the Science Citation Index as random samples) and found that 42% of the papers analysed were published from India and almost 50% of this was in national journals. Out of this 67.6% were published by Institutions of higher education (Universities, Indian Institute of Science, and the five I.I.T's

included), 22.6% by the Government agencies (like the C.S.I.R laboratories, Department of Atomic Energy, the various Councils like the Agriculture, Medical etc.) .

Arunachalam and Hirannaiah (1978) studied ten issues of Current Contents (Physical and Chemical Sciences edition) for the period March 1977–May 1978. In this sample they found 1,009 articles from India, more than 50% of them were in foreign journals. They concluded that *highly rated Indian Institutes of Technology, Bhabha Atomic Research Centre and the Tata Institute of Fundamental Research appear to publish more in foreign journals and Physical research Laboratory and Indian Institute of Science divide their papers between Indian and foreign journals.* However, the present study pertaining to a more recent period *does not show this to be the case* and indicates a change in the trend.

In a different type of study, Ratnakar (1984) found that the *members of the editorial board of Pramana published (during the period 1978-81) only 16 articles in that journal while they published 151 articles in other journals during the same period indicating their preference of other journals to Pramana* for publishing their research findings.

Krishnan and Viswanathan (1987) found that *the majority of the fellows of the Indian National Science Academy preferred to publish more in foreign journals.*

6.6 SIGNIFICANT POINTS EMERGING FROM THE ANALYSIS

The analysis of the contributions in the five Indian journals (during the period 1985 to 1989) by the different groups in the country and from abroad, and the publications of the physicists and astronomers of the seven research institutions in the country (for the period 1983 April to March 89) taken together, leads us to the following important conclusion:

1. *Contributions to the Indian Physics journals by the well established research Institutions in the country is minimal.*

2. *A good portion of the articles received from abroad by the Indian physics journals studied were from middle eastern countries. Interestingly as mentioned in the previous chapter (chapter 5) the rejection rate in IJP for the articles received from abroad is higher than for those received from within the country.*

3. *Physicists of the Institutions whose publications during 1983-89 were analysed, published 85% of their research papers in foreign journals and only 15% in Indian journals indicating clearly that their choice of journals for publishing the results of their research work to be foreign journals.*

4. Astronomers in the country published during the same period (1983-89) 73% of their research papers in journals published abroad and 27% in Indian Journals. In 1989, 44 articles were published in three leading astronomy journals published outside the country while only 31 papers were published in the Journal of Astrophysics and Astronomy

5. The choice of the journals of the astronomers in the country for publishing their research findings is, as in the case of physicists, Foreign Journals

6. The analysis of Current Contents indicates that a good quantity of research work done in India in Physics and Astronomy gets published outside the country and that there are very few contributions from the universities to either Indian or foreign astronomy journals.

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CHAPTER 7

THE PARADIGM OF A SUCCESSFUL JOURNAL: A CASE STUDY OF TWO LEADING PHYSICS JOURNALS

To get a feeling for the reasons behind the success of a journal, a case study was made of two leading journals in physics: The Physical Review and The Physical Review Letters. Their history, growth, factors contributing to their success and present status were studied. For this purpose not only the information available from the journals themselves but also material related to the journals that was available at the Niels Bohr Library of the American Institute of Physics, New York was also examined and analysed.

Till about the 1890's there was no journal in the USA devoted exclusively to physics. Scientific articles were published in journals like the American Journal of Science, Journal of the Franklin Institute, Science, Scientific American, Popular Science and Connecticut Academy of Arts and Science Transactions etc. According to Merritt one of the early editors of Physical review:

> *"....there was at that time in the United States a small group of physicists who believed in the importance of their science and were anxious to see it progress and they were able to make up by their energy and enthusiasm their lack of numbers; this group was responsible for three major landmarks in American physics - American Physical Society, the National Bureau of Standards and the Physical Review"* (Merritt, *1934).*

Physical Review was started in 1893 by Edward L.Nichols and Ernest Merritt at Cornell University, USA. They were supported by Cornell University in this endeavour. Starting with one volume (consisting of four numbers) of around 320 pages per year, it has grown *astronomically* in size. *In* 1989 Physical Review which had by then four different parts (A, B, C and D) published 7,339 articles (including Brief Reports, Comments and Rapid Communications) *comprising* 52,822 *pages* (Bulletin of the American Physical Society, June 1990).

Study of the early volumes of the journal shows that the journal published not only research articles but also extensive book reviews, reports of meetings, and occasionally papers presented at meetings. The editor sometimes used to translate into English articles of interest published in German Periodicals. The journal also published what were called Minor contributions.

Though the journal today commands international readership and receives contributions from all over the world, it went through difficult periods and faced at least for the first thirty five years all the problems Indian journals are facing today. It had very few contributions from outside the USA till 1930 (that is almost for 40 years). In fact, in the earlier years most of the articles were from the Cornell University staff itself. The main reason for ,this was the fact that the *playing fields* of Physics at that time were else where in Europe, specially in Germany, the United Kingdom and France. Hence the journal was not widely read outside the USA. John Cockroft the British Physicist, says in an interview:

> *"...well, up ti77 1932, we would go to Zeitschrift fur Physik and Journal de Physique in France as major journals in the field of nuclear physics outside our own journa7s and we would hardly ever read the Physical Review. As far as I was concerned it was not until people like Lawrence and Truve started publishing in about 1932 or perhaps two years before that, that we started to read the Physical Review..... and from that time onwards it became re7atively more important than the German Journals"* (Cockroft, *1967*).

The American Physicist I. I. Rabi found to his surprise and dismay that the Hamburg University Library was not receiving The Physical Review as and when it was published but in bulk at the end of the year. He

learnt that this was to save some money as it was not thought important to receive this journal immediately after its publication (Rigden, 1987).

The return of young physicists like Oppenheimer and I.I. Rabi to their country (USA) after their studies in Europe (where they had gone to learn the new physics), their determination to put their science through their journals on a firm footing, the growth of physics not only internationally but in particular in the USA and with it the increase in research activity, all led to the Physical Review receiving a large number of good articles. This was a turning point for the Physical Review and by 1933 it had gained importance in Europe too. It also became by then the most cited of all physics journals (Hooker, 1935). The quality of papers appearing was so good that the French physicist Louis de Broglie said in 1935:

> *" Today scientific publications from the United States are awaited with an impatience and curiosity inspired by those from no other country"* (Kevles, 1978).

What a transformation in the impact of the journal on the physics community!

The arrival of physicists like Hans Bethe, Enrico Fermi, Samuel Goudsmit (who later became one of the most influential editors of the Physical Review, and the Physical Review Letters), Von Neumann and Wigner from Europe, enriched American Physics and Physical Review certainly benefited from this. Thus, about forty years after its founding, Physical Review attained a high stature. Though it had a lean period during the Second World War, (only 350 pages were published in 1945) it promptly regained its importance among the physics journals in the world in the post-war period and today, it is one of the top *journals in physics..*

Six years after the starting of Physical Review, the American Physical Society was established. Merritt, one of the early editors of this journal says:

> *" In the years 1893-1899, the Physical Review undoubtedly contributed in no small degree to the increased activity in physics which later resulted in the establishment of the American Physical Society"* (Merritt,1934).

This is in contrast to the development of physics journals in India. Indian Journal of Physics was started by the Indian Association for the Cultivation of Science almost forty years after the founding of the Association. However, there is similarity in one

aspect - Scientists in India during that period had some nationalistic feelings similar to what was seen among the physicists in the USA. They wanted to publish their scientific work in Indian Journals. But this spirit was limited to only a few people and lasted only for a short while.

From its inception, the American Physical Society strongly supported the Physical Review. In 1913, the publication responsibility of the journal was handed over by the Cornell University to the American Physical Society. When the American Institute of Physics was founded in 1931, it took over the publication activity of the American Physical Society and started publishing the Physical Review (on behalf of the Society) from 1932.

In 1930, the concept of page charges was introduced for the first time and the Physical Review started levying page charges for articles published in it. An amount of $2 per page was charged to start with. This amount has steadily increased and today it stands around $100 per page. Page charges were levied to make the journal *self sustaining* without seeking continuous support from outside (especially Government agencies). Page charges have helped considerably to counter the

rising cost of journal production without raising steeply the subscription rates. It may be pointed out here that the subscription rates of the journals produced by the societies have been reported to be much lower than those journals published by commercial publishers (Barschall, 1986). As pointed out in an earlier chapter, Indian Journals do not levy any page charges as most of the science journals are published by academies/institutions which receive funds from the Government towards this activity or by a Government funded agency (like the Pub1ications and Information Directorate of CSIR).

The American Physical Society had started the journal Reviews of Modern Physics in 1930 and the American Institute of Physics started Journal of Chemical Physics (1933) and continued the journal Physics as a new journal with the title Journal of Applied Physics (1938 onwards). These journals took a part of the load off Physical Review. Articles which had some significance to physics but not suitable for The Physical Review were published in these journals. The Physical Review had a section called ***"Letters to the Editor"*** for a long time.

A new journal titled Physical Review Letters (PRL) was started by the American Physical Society in 1958. It comprised of the letters to editor section contained in the Physical Review and the abstracts of the articles to be published in the future issues of the Review. The publication delay was three weeks. Sam Goudsmit who was the first editor of this journal and connected intimately with the Physical Review for a long time, set standards for the new journal. He wrote in his first editorial :

> *" Since there is little time or none at all for refereeing, most of the decisions for acceptance and for minor attentions will have to be made in the Editor's office. We shall do our best to make as few mistakes as possible but for this we require the cooperation of authors and an understanding on their part of the many problems facing a journal of this type. To maintain the high speed and high standards, only Letters which really deserve rapid publications should be submitted" (Goudsmit, 1958).*

After five years, when the articles received did not meet this requirement, he made an appeal to the scientists for cooperation in maintaining the standards. In an editorial he appealed:

> *" Physical Review Letters still has an alarming rejection rate. We are disappointed by observing that so many authors still send us letters which are unsuitable for this journal. We admit, as we have stated on previous occasions, that the difficult decision of what deserves speed is sometimes the*

result of a rather subjective judgement, which may appear to be arbitrary. But it is most essential to keep the number of Letters limited if we want the journal to fulfill its function of speed and readabi7ity. Our principal complaints are sti77 about the authors who pub7ish their research in a series of Letters instead of performing the more useful service of writing a good definitive article..... Physical Review Letters can maintain and improve its high standards only if the editors have the ful7 cooperation of a77 contributors". (Goudsmit,1962).

G.L.Trigg was the first Assistant Editor and later became the Editor. He edited this journal steadfastly for 30 years till 1988. Physical Review Letters is now the most sought after journal by the physics community for publication of their research findings. This journal which started as a fortnightly became a weekly in 1964.

With the increase in the number of papers received, Physical Review was issued in two parts from 1956 onwards. By 1970 the journal grew to such a size that it was split into four parts - A, B, C and D. Each part is issued twice a month and as mentioned earlier, in 1989 a total number of 52,822 pages were published by a11 the parts put together. A separate publication, Physical Review Abstracts is being brought out to announce the articles to appear in the forth coming issues of the various parts of the Physical

Review. This is done due to the increased number of articles received for publication by the various parts of this journal.

It is however to be noted that with this proliferation in publication, there has been an increase in deiay in publication. The reasons for this delay have been ascribed to the large number of articles received in recent years (Passell,1988). In 1931 when the letters were a part of the Review the delay was about 21 days; by 1980 it was 138 days and in 1989 it is about 4 to 6 months. Though it has a very wide circulation, physicists no longer read the letters from cover-to-cover. Mermin of Cornell University has raised similar doubts and also points out that Physical Review Letters has reached a stage in volume whichThe Physical Review had reached during 1956 (Mermin, 1988). Undoubtedly as can be seen from the number of pages published, there is some truth in it. However, the rate of rejection of articles in Physical Review Letters is quite high. In 1988 it was 66%. Because a large-number of above average articles are published in it, Physical Review Letters receives a large number of citations and has a high impact factor. In 1988 its Impact Factor was 8.312.

It can be seen from the various papers published in the Physical Review from 1900's onwards that most of the physicists who were acclaimed as leaders, achievers and belonging to the top group of physicists of their times, published in this journal some time or the other and this trend is continuing even today. Notable early contributors from India were S.N.Bose, K.S.Krishnan, Raman and Saha. The journal had Editors of high standing who were not only good physicists but also had a commitment to the journal. They contributed significantly to the high standards attained by the journal. This is made very clear in an editorial in 1988 at the time of retirement of George Trigg. Adair, Krumhansal and Sandweiss wrote:

> *" Sam (Goudsmit) was the architect of this first letter journal, a journal that was to change the form of pub7ications in physics and much of science. George (Trigg) was the builder-aye, the Master Builder.....Sam and George set up the initial editorial policies, recognizable forerunner of the policies in place today. With the goal of quick pub7ication precluding the review of proofs by authors, George and Sam recognized that the editing must be meticulous and it was George Trigg who set the standards of care and detail in editing that have marked the journal through its history"* (Adair et al 1988).

It is also noticed that active physicists take up full time editorial jobs of these two journals for a few years at a stretch and then go back to their re-

search work. This must be certainly helping both the journal as well as the physics community including those who work for the journals.

The Physical Review and Physical Review Letters have panels of referees drawn from all over the world. In 1989, the Letters had on its panel 14,000 physicists (American Physical Society, 1989). However, their editorial boards consist of only physicists in the USA. This must be for practical reasons. Besides, the journal can afford to do this now, as it has the needed visibility and recognition in the international community. The members of the editorial board interact with the editors by assisting them in selecting the referees and participating actively in the formal appeal process. The Physical Review and Physical Review Letters receive world wide attention not only in terms of readership as indicated by the large subscription figures (during 1989, The Physical Review had, totalling for all the four parts, a non member subscription of 11,675 and Physical Review Letters had 2,728), but also for publishing research findings. In 1989 these two journals together received articles from 64 countries accounting for approximately 52% of the total contributions they received (13,534 articles). Out of this number 55% were

from six countries - West Germany, Japan, France, Canada, India and China (Bulletin of the American Physical Society, 1990). Table 15 gives the number of articles and number of pages published in The Physical Review and Physical Review Letters during the years 1985 to 1989. The Physical Review and the Letters allow the authors to suggest names of physicists who in their (authors) opinion are suitable to referee their papers. However, the journals are not bound to use the list. The authors are also permitted to indicate if they do not want the paper to be refereed by any particular physicist. If the authors do not want their names to be made known to the referees, they can request for "Blind Refereeing".

The Physical Review and Physical Review Letters have good infra-structural facilities. Authors communicate with the editorial offices of these journals not only by postal mail but also through Electronic Mail and Facsimile Transmission. Communication between Editors and referees through electronic Mail has also been r-apidly increasing.

TABLE 15

Number of Articles/Pages published by *The Physical Review* and *Physical Review Letters* during 1985 - 1989

YEAR	PHYSICAL REVIEW				PHYSICAL REVIEW LETTERS			
	No. of Articles / B.C.R.* published			No. of pages published	No. of Letters / Comments published			No. of pages published
	Articles	B.C.R.	Total		Letters	Comments	Total	
1985	3566	1554	5120	35513	1440	164	1604	5697
1986	3932	1693	5625	39536	1525	198	1723	6186
1987	4211	1890	6101	43181	1442	191	1633	5841
1988	4776	1994	6770	48775	1391	232	1623	5784
1989	5210	2129	7339	52822	1449	230	1679	5957

* B.C.R. : Brief Reports, Comments, Rapid Communications

Source : Bulletin of the American Physical Society, June 1985, June 1987, June 1988 July / August 1989 and June 1990

During 1989 nearly 9300 reports (36%) were received by the editorial office thorough BITNET. The journal also received articles prepared in TEX and submitted via BITNET. In 1989, the four parts of the The Physical Review (A,B,C and D) together had a man power of 34, comprising of one Editor-in- Chief, one Deputy Editor-in-Chief, 7 Editors, 10 Associate Editors, 3 Assistant Editors, 3 Assistants to the Editors, 8 Editorial Assistants and 1 Editorial Services Assistant.

The Physical Review and the Physical Review Letters carry from time to time Editorials seeking the suggestions of the readers for improving the journal, explaining the policy of the journal and the basis for any changes made or contemplated. The Editors constantly feel the pulse of the users. During 1984-85, the Physical Review Letters noticed a fall in submission of papers from the field of particle physics. The problem appeared to be with the refereeing of the papers in that field. The Editors took note of this and immediately took remedial action. In an editorial George H Vineyard and George Trigg wrote:

> *" Unfortunately, many particle theorists no longer regard Physical* ***Review Letters as*** *the journal of choice for publication of short communications of their best work. People*

> *have various opinions as to why this is so, but almost surely the special difficulties of securing satisfactory refereeing of papers in this field have contributed. The editors have been concerned with this situation for some time. We have had extensive discussions with particle theorists, with officers of the Division of Particles and Fields, and most recently with the Publication Committee and the Council of the American Physical Society. As a result, a new refereeing system for particleand field-theory manuscripts submitted to Physical Review Letters has been approved.. ..... With everyone's help we can make Physical Review Letters the preferred place to publish particle theory letters"* (Vineyard and Trigg, 1985).

In a similar spirit, David Lazarus, Editor in Chief, American Physical Society wrote in an editorial in the Physical Review Letters :

> *" My job can only reflect your concerns if I know them. I want to know when you have troubles with your papers, when you think that the system is working poorly (or even well!), when you think that there is something that we should be doing that we are not, or any other thoughts you may have that could make the next five years of APS journals better than last. If I hear very little, I may conclude that everything is now perfect and we both know better than that! If I hear a lot from a lot of you, that too, will carry a strong signal. We may not be able actually to effect all the changes suggested (or needed), but atleast we can see the directions where we should be heading"* (Lazarus,1985).

The editorials are quoted here to drive home the point that there was a constant attempt by the editors to be in touch with the users and to solicit their cooperation in keeping the standard of the journal high.

Unfortunately, this aspect is ***very rare*** among the Editors of the ***Indian Journals.***

In 1987, when High Temperature Super Conductivity hit the headlines, Editors of The Physical Review and Physical Review Letters were quick to gauge the importance of the subject and with it the need for quick publication of papers submitted on this topic. To achieve this, they appointed several distinguished scientists to an anonymous review panel to examine the large number of papers which were expected to be generated. This was to accelerate the process involved in refereeing and to keep the reviews and judgments as consistent as possible. Both Physical Review Letters and Physical Review "B" published a large number of articles on this topic and the Letters listed from time to time, the papers published on this subject in the two journals. This sort of fast decisions and speedy actions by the editors must have gained the confidence of the physicists all over the world. We should mention here that the topic of High ***Temperature Superconductivity*** was quite well covered by Indian Journals like Pramana and many Indian physicists published their findings in ***Indian journals.***

The Physical Review introduced in 1981 (in a11 the four parts A,B,C and D) a section called "Rapid Communications". Rapid Communications were short reports of important new work of interest. These were given priority in processing. This section was perhaps introduced to accommodate the specialized articles of interest to only certain groups and which were not suitable for Physical Review Letters where the subject matter was of interest to a wider audience. With the increase in the number of articles received even by the individual parts, The Physical Review had to split these parts into further sub parts like The Physical Review A1 and A15. Such changes have been made for Sections B and D. and in 1987 Section A was split into A1 and A15. As the Physical Review Letters has been growing steadily over the years (it has almost doubled in the last ten years), American Physical Society has appointed in early 1990, a review panel to study the working of this journal and to recommend possible improvements in the journal.

We thus see constant changes in these two journals to keep up standards and to meet the demands of the user community. The efforts of the Editors in maintaining high standards of the journal, the involvement of active physicists with the journal either as

Editors or members of editorial boards or as referees, or as contributors of articles, stand out. In 1993, The Physical Review will be celebrating its centenary, a proud land mark for any journal.

From this study it is concluded that some of the important factors contributing to the growth, visibility and importance of The Physical Review and Physical Review Letters are:

1) High standard of research in the country

2) Commitment in the early days of physicists in the USA to publish most of their good work in these journals, a tradition which is still being continued.

3) High standards maintained by the journal with regard to refereeing, editing and printing

4) Punctuality in publication

5) Good infra-structure (sufficient editorial staff, international panel of referees, modern communication facilities like the E-Mail and Fax at the editorial offices, sufficient funds for quality printing)

6) Commitment of the Editors to the journal.

7) Active scientists spending a few years with the journal as editors

8) Editors constantly feeling the pulse of its users making necessary changes in the journal as and when required.

9) Active involvement of the editorial board members with the editors and the journal.

10) Commitment of both the physicists in the USA

and the American Physical Society to have their own journal of a high standard and

11) The journal receiving good papers from physicists from a11 over the world.

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CHAPTER 8

OPINIONS OF SOME SCIENTISTS ABOUT INDIAN JOURNALS

After studying the starting, growth and usage of the Indian journals (specially those pertaining to the fields of Physics and Astronomy) through different periods in this century and getting a picture of the present status of the journals in the country, it was necessary to find out what the users (the scientists) of these journals felt about them. It was also important to find out from those involved in bringing out these journals (specially the editors) the problems faced by them in bringing out the journals and their assessment of the journals.

We present in this chapter the opinions expressed by a cross section of scientists in the country about Indian scientific journals. This presentation consists of three sections. Several physicists and astronomers from abroad (three of them Indians settled abroad) and a few science administrators in the country were interviewed to find out their opinions about the journals in India. The first section gives a summary of the views expressed during the interviews; the second covers the

views expressed in publications by practicing scientists and others; and the third gives the opinions expressed by scientists and editors at conferences and seminars.

8.1 Opinions expressed in interviews

Opinions were got by interviewing a cross section of scientists, editors of the five journals studied by the author and a few administrators. A small sample of physicists and astronomers belonging to twelve leading research institutions in the country, six universities and one University Centre for Astronomy were interviewed and their opinions sought. The physicists/ astronomers were from the Bhabha Atomic Research Centre, Bombay, Indian Association for the Cultivation of Science, Calcutta, Bose Science Centre, Calcutta, Bose Research Institute, Calcutta, Indian Institute of Astrophysics, Bangalore, Indian Institute of Science, Bangalore, Indian Institute of Technology, Madras, Institute of Mathematical Sciences, Madras, National Physical Laboratory, New Delhi, Raman Research Institute, Bangalore, Saha Institute of Nuclear Physics, Calcutta and the Tata Institute of Fundamental Research, Bombay. Among the universities at which scientists were interviewed were Bangalore University, Bombay University,

Calcutta University, Delhi University and Jawaharlal Nehru University, New Delhi, Karnataka University, Dharwad and the Inter University Centre for Astronomy, Pune. The interviews were limited to a small number since the sampling of opinions held by the scientific community is only a minor part of the present study. About 65 physicists (45 from Research institutions and 20 from universities) and 16 astronomers (12 from Research institutions and 4 from universities) were interviewed.

Some of the important aspects of journals on which their opinion was sought were :

1. Their perception of the important journals in their field

2. Whether journals were the main channel of information?

3. Whether they pub1ished in Indian journals and if so in which journals ?

4. If they didn't publish in Indian journals reasons for not doing so.

5. Their impression about the refereeing system in Indian journals.

6. Their assessment specifically of the following journals - IJP, IJRSP, Pramana, IJPAP, JAA, Current Science, Proceedings of the National Academy of Sciences, Proceedings of the' Indian National Science Academy, and the Bulletin of the Astronomical Society of India.

7. Whether India should have national journals ?

8. Whether scientists should be compelled to publish in Indian journals ?

9. Whether the quality of science done in the country has gone up and whether the scientific journals in the country reflect the science done in the country?

10. What they felt could be done for the improvement of Indian journals.

We summarize below the opinions expressed on each of the above points. Whenever required, opinions of astronomers and physicists are given separately.

1. Important journals:

The majority of the physicists and astronomers categorically stated that the journals published from abroad were of importance to them. Over 90% selected Physical Review Letters, Physics Letters, Physical Review, Journal of Physics, Reviews of Modern Physics, Astrophysical Journal, Astronomy and Astrophysics,

Monthly Notices of the Royal Astronomical Society as being the leading journals. Only two Indian journals namely Pramana and Journal of Astrophysics and Astronomy were mentioned as of interest, that too marginally. Concerning IJP, IJRSP and IJPAP, these three journals were mentioned as important only by a few working at the universities. Those working in research institutions had very little to say about them. A list of journals mentioned as important by the scientists has been given in Appendix 1.

2. Main channel for information:

Scientists working in certain areas like Particle Physics, Condensed Matter Physics, Astronomy, observed that they depended more on informal channels like pre-prints, discussion with fellow scientists and attending conferences. They depended on journals only about 20% of the time. But this was not the practice among physicists in some of the universities. They did not receive any pre-prints and depended more on journals. In other fields, however, it appears that journals still remain a major channel for information.

3. Publications in Indian journals:

More than 80% of the scientists working in research institutions preferred to publish the majority of their papers in foreign journals. Some of them hardly ever published in Indian journals. This agrees with our data presented in the chapter 6 on Journals utilization. By contrast, those working in universities had no hesitation in publishing in Indian journals.

4. Reasons for not publishing in Indian journals and for publishing in foreign journals:

Ninety percent of those not publishing in Indian journals gave the following reasons for preferring foreign journals:

a) The poor *"visibility"* of Indian journals in the international scientific community

b) Articles published in Indian journals not getting due credit nor cited (perhaps, because of its poor visibility)

c) Not getting a good or a critical feedback from the referees of Indian journals.

d) uneven standard of refereeing, even in journals like Pramana

e) Good articles getting buried among mediocre (or even worse !) articles

f) Indian journalsoften being too general and diffuse and non-specialist or non thematic in character.

g) Earlier papers and related papers being published in foreign journals.

h) Active groups working in a certain area publish in certain journals. So, others also publish in them to get noticed.

i) Articles published in foreign journals tend not to be ignored easily.

j) There 'are "theme" journals among the foreign journals, and it would be useful to publish in these.

Approximately fifty percent of the scientists interviewed belonged to the age group 25 - 35 years, and they expressed a few additional strong reasons for not publishing in Indian journals. These were :

a) A higher weightage was given to articles published in foreign journals while assessing a candidate for a position. This was the case not only at the international level, but more so at the national level.

b) Most of the " senior" scientists had published and continue to publish most of their output in foreign journals and therefore, to expect the young scientists to publish in Indian journals was considered *"unfair."*

c) To a large extent, foreign journals not having the deficiencies mentioned earlier that were found among Indian journals.

5. Refereeing:

Seventy five per cent of the physicists felt that refereeing in Indian journals was fair. About 20% of physicists working in research institutions felt that Pramana, whose record was much better than that of any other Indian journal, had uneven refereeing and that papers sometimes did not go to proper referees. It was also felt that there were not many physicists in the country in certain newly emerging sub-fields of Particle Physics and that unless Pramana has an international refereeing policy, it would not be helpful either to the scientists or even to the journal. About 50% of the scientists interviewed were refereeing papers. The majority of those scientists who were refereeing, observed that they adopted the same standards while refereeing a paper received from Pramana as they would for a paper received from Physical Review or Physics Letters. About twenty five percent adopted a slightly different standard for Indian journals, specially IJP or IJPAP. If they felt that the paper did not have any serious scientific errors, then they accepted it even if the work was of a routine nature. They took the view that one had to consider the environment/facilities, background of the author before totally rejecting the papers. At least 50% of the physicists interviewed felt

that there was certainly an unseen bias in refereeing. The byline of the article played an important role with the referees. The place from where the article was submitted appeared to carry some weightage. This was more so in the case of periodicals published from abroad. One scientist remarked that when something new or controversial is reported, the paper gets into problems with referees.

6. Assessment of Indian journals:

The physicists working in the universities felt that both IJRSP and IJPAP were "average" journals, IJP was "good" and Pramana our "best journal." Nearly 90% of the physicists in the research institutes felt that IJRSP and IJPAP were definitely not in the same class as either IJP or Pramana. A physicist who referees papers for IJPAP felt that this journal received only very low quality papers. Another physicist who was a member of the editorial board of IJPAP mentioned that the senior members of the editorial board do not take the board meetings seriously. Not withstanding the twenty five percent of the physicists who felt that Pramana was too general and refereeing in it uneven, other physicists working in research institutes felt that Pramana was our

best journal, but that it could still improve. A referee of Pramana felt that the articles received by it does not give it enough scope to become a viable journal of international standard. A few physicists (~5%) felt that Pramana had not kept up the early promise it showed.

The astronomers (both working at the research institutions and universities) felt that JAA was a very good journal but had poor visibility outside the country and because of that they did not wish to publish their work in it. It was also felt by many (about 50%) that its level is slowly coming down over the years. A leading Radio Astronomer observed that very important papers from his group published earlier in JAA were totally ignored by outsiders and did not get the due acknowledgement. Hence, they were forced to publish in foreign journals. Contrary to the opinion of the associate editor, about 75% of the astronomers considered the Bulletin of the Astronomical Society of India as just an official organ of the Society and did not give it the status of a research journal. They equated it, at best, with Mercury the official organ of the Astronomical Society of the Pacific.

About 40% of the physicists and astronomers in the research institutes considered Current Science as a journal covering predominantly Biological Science and of little interest to physicists or astronomers. 10% felt that though it claimed to be a refereed journal, the refereeing was very poor and in fact highly questionable.

The other 50% felt that of late (1990 onwards) this journal had been' improving dramatically and coming up with interesting numbers covering important themes and issues relating to science and technology in the country, along with research articles in physics and astronomy. The efforts of the editor in his present attempt to change the status of the journal were commended by most of the scientists.

Eighty percent of the physicists said that they did not look at the Proceedings of Indian National Science Academy or National Academy of Sciences and considered them to be of no consequence.

7. Whether there should be National Journals in India:

About 90% of both physicists and astronomers expressed the need for national journals. But it was felt

by them that there were too many journals in the country and we should consolidate our efforts and bring out only a few good journals. The other 10% felt that our national journals served no purpose and we may as well scrap them.

8. Whether Indian scientists should be compelled to publish in Indian journals :

A question frequently debated is whether Indian journals could ever improve unless there is offical pressure and compulsion on Indian scientists working in India to publish their results in Indian journals. Over 80% felt that there should not be such compulsion and compulsions will not bring in the required results. On the other hand, if Indian journals were improved and brought to near about international standards, then the scientists will automatically start publishing in them of their own accord.

However, 20% strongly expressed the view that there must be such legislation and since the Government was funding almost the entire scientific research in the country, there was nothing wrong in its compel1ing the

scientists to publish in national journals which were again funded by the same Government. Examples were quoted of the articles from CERN (Geneva) being published in European journals, work from the European Southern Observatory (ESO) published in the journal Astronomy and Astrophysics and the majority of Russian and Japanese work being published in their national journals (though the scene is changing in Russia). A few (5%) among this lot felt that the restriction could be for a period of five years during which time all out efforts should be made to improve the other aspects of the journal like refereeing, editorial boards and distribution of the journal for a wider audience.

9. Quality of science done in the country and whether it is reflected in Indian Science journals:

Nearly 80% of the physicists and astronomers felt that the standard of Indian scientific work has certainly gone up in the last few decades, but that this applied to only the top research institutions in the country. There were many small pockets of excellence but if one took the national average of the country as a whole, it indicated a low quality of work, though the number of articles published were large. Fifteen percent of the scientists felt that the science done in

the country though of good quality, could not be classified as original scientific work and that it was only a poor imitation of western science with hardly any new result contributed to the existing knowledge. The remaining 5% felt that there was hardly any change in the scientific work done in the country over the last five decades excepting for the large number of below average articles published and the absence of the scientists of the calibre of Raman, Saha, Bose, Krishnan and Bhabha.

Majority of the scientists (85%) expressed the view that *one does not get a true picture of the science done in India by looking at the Indian journals (in Physics and Astronomy). The Indian journals they opined, publish by and large, the low quality of work that they receive for publication as most of the good work done in the country, especially at the leading research institutions, is reported in foreign journals.* Unlike in the journals of Britain, USA, USSR and Japan where one does get a picture of the science done in those countries, Indian journals do not reflect the scientific work of the country in the true sense.

Opinions of Editors

Editors/Associate Editors of the four Physics journals and the Astronomy journal studied were interviewed to find out the opinions about their own journals and the problems faced by them as editors.

The problems seem to be common to all the journals, a11 the editors complained about the difficulty of ***getting sufficient number of good papers from the leading institutions.*** The editors felt that contribution both in terms of articles for publication and suggestions for imnproving the journal) from the editorial board members was minimal, specially that of IJRSP and IJPAP where, they were just ornamental. IJPAP editors drew attention to the difficulty experienced by their not having independent typing facility or artists facility and that they had to depend on a common pool. They (IJPAP editors) also felt handicapped by the inadequacy of telecommunication facilities. This was the case with the editors of IJRSP also. Editorial offices of IJP, Pramana and JAA had these facilities. Editors of IJP mentioned that they take extra trouble to encourage papers from new centres. Editors of Pramana mentioned the efforts they were making to review their referees list. Though they had a large panel of referees, only

200 were active. It was also mentioned that in most fields good and conscientious referees were few. Editors are all the time campaigning to get good articles from leading centres of physics research in the country and are also constantly trying to reduce the delay in publication. The editors of Pramana mentioned that they were requesting referees to give more objective reports and were not accepting one-line referee reports.

It was mentioned by the Associate Editor of JAA that the number of papers they received was rather small and that not many send their best papers to this journal. It was also felt by him that *generally articles* from *universities were* not *good* and were lacking in professionalism.

The Editor of publications of the Indian Academy observed. that it had been resolved by the Council of the Academy, not to publish commemoration issues of journals to honour scientists on a routine basis. He also mentioned about the efforts being made by the Academy to revamp the editorial boards and panel of referees with active scientists.

The general impression given by almost all the

editors is that the ***Indian scientific community does not contribute its best papers to Indian journals generally, and that there is a lack of commitment from everyone concerned.*** However, the editors seem to be making efforts to improve the situation.

10. Miscellaneous Comments:

Various other general opinions were expressed about Indian journals and these have been summarized below. These opinions have not been quantified, only the significant ones, having some direct relation to the topic of study, are being mentioned.

a) It was felt that a mixture of publications of Indian articles in Indian and foreign journals would be good for disseminating Indian Science and that ***total weightage should not be given for Indian publications in foreign journals.***

b) The articles going to foreign journals were not really harming Indian Science. However, they should give references to publications in Indian journals.

c) Most Indian scientists (majority of them) who publish their research work send their best work to foreign journals and poor work to Indian journals. One should not publish in any journal as a charity.

d) Circulation of reprints/pre-prints will not make up for the poor visibility of the journal. It is not just the attention of the scientists known to authors that one would like to receive but also that of scientist not known to the author.

e) Indian journals serve more to help the scientist to increase the number of publications (most of the time, poor quality papers) to meet the necessary stipulations laid down by the employers to get promotions etc.

f) Elder scientists in the country have set a trend of pub1ishing in foreign journals.

g) As of today, Indian Science is a removable appendix of Western Science and hence we don't need science journals in the country.

h) Journals published by CSIR are not of any use to mainstream science done either in India or outside.

i) If a journal is not able to get good papers, it should be closed down.

j) Majority of the editors of Indian journals are not serious about the standards of the journal and the integrity (of referees and editors) is low in Indian journals. Most Indian journals are associated in the public eye with particular groups which is not congenial for the journal.

k) A lot of effort is required from those running the journal to make a journal successful.

1) A number of younger physicists in the leading research institutions mentioned that they (their group) were planning to publish hereafter regularly at least a few articles in Prarnana .

11. Some Suggestions for improving Indian journals:

The representative sample of the Indian scientists interviewed made a number of suggestions for improving the Physics and Astronomy journals published

from India. Significant among them are:

a) It would help to reduce the number of journals as there are too many at present.

b) Channelize articles of certain type to a particular journal, for example, publish a11 review articles in IJP, articles on Applied Research in IJPAP and the rest in Pramana. This way, there would be consolidation of these three journals, each of them getting good articles of a particular variety.

c) Indian scientists should publish the longer version of the work in Indian journals with a short account going to the foreign journals. There should be cross referencing to these articles.

d) Editors of the journals should be chosen carefully and they should campaign for good articles from their colleagues.

e) Journals should try to gain the confidence of the scientific community, especially the quality-conscious segment, by adopting rigorous refereeing standards and not compromising on the quality of the articles published.

f) Leaders should come forward and publish their good work in Indian journals.

g) Authors in rapidly developing and newly emerging areas must be consulted to obtain a panel of names for referees. The number of international referees should be increased and it should not be a closed circle.

h) Good review articles should be published.

i) There should be a campaign directed at those in charge of recruitment, not to underrate the arti-

cles published in Indian journals.

k) Special efforts must be mounted to improve sales and subscription for Indian journals.

8.3 "Opinions of Science Administrators":

Five scientists who had turned part administrators (like Directors of research institutions) but who were still involved in research and a scientist who is a full time administrator in one of the important wings of the Government, were interviewed to get their reactions about the Indian journals. The general opinion of this group was that we should certainly have good journals in the country and that Pramana was fairly good. They were of the opinion that it was not totally true that no weightage was given to publications in Indian journals while assessing a scientist. Whatever the situation might have been in earlier days, of late the people who were recruiting did give the deserved weightage for every journal, be it Indian or foreign. No journal was discriminated against just because it was Indian. It was a1-so expressed that it would be unfair to expect the same weightage to be given to all the Indian journals specially knowing the standard of many of the Indian journals presently. It was also felt that the- scien- tists could not be expected to publish all their work in

Indian journals. They were not for any sort of legislation. But one of them expressed the view that project leaders of specific projects funded by the Government could be requested to publish the results of that project in an Indian journal. However, all of them emphasized the need for improving the standard of our journals first by following rigorous refereeing standards, publications coming out on time and adopting generally accepted international norms in publication of journals. When a suggestion was made by this author to the administrator from the funding agency to support the practice of circulating sufficient number of reprints of articles published in Indian journals (among scientists whose opinion mattered and who were mostly working abroad), the suggestion was readily accepted. However, it was mentioned that such a thing could be done only for a few selected journals, to start with. One important factor that emerged out of talking to this group was that the science administrators knew very well the importance of having good journals in the country and they were prepared to support this activity fully. (This is not surprising as all of them were themselves researchers and had published some time or the other).

Opinion of some foreign scientists:

About ten physicists and astronomers from abroad were interviewed to get their opinions about Indian journals. These scientists were from Australia, Britain, United States and the USSR. Three of them were Indians settled abroad.

Most of the astronomers (seven of them) and the physicists felt that there was a need for national journals in every country and that India should certainly have its national journals. However, it was emphasized by all of them that the scientists of the country should feel the need for a journal and they should be prepared to publish their work in it. A few of the astronomers felt that in case it was not possible to get sufficient good papers, one could think of a regional journal for a geographic area (like European astronomy journals coming together to start the journal Astronomy and Astrophysics).

One of the astronomers felt that it was not a question of National Journal one should be thinking about. He felt that if a journal had to be made good, then one should try to make it of the highest standard with papers from all over the world. If it caters only

to a national group, naturally its usage and circulation will be limited. To achieve acceptance in the international community, one has to build up a good reputation and be backed up by individuals/institutions well known for their work. And it takes time for such a thing to happen. Another astronomer felt that one should not publish all their articles in their own national journal but should publish a certain percentage outside also. At the same time, national journals should attract and publish good articles from outside the country.

The physicists were aware of Pramana and felt that there was scope for making it to international level with a little more effort. One of them expressed the view that good papers do not come to journals just like that. It depended on the reputation of the journal, the editor's powers of persuasion for good articles, relations with active scientists and his group of associate editors reaching out for papers from different active centres.

Another physicist felt that there must be Indian journals for various reasons. But all the articles of Indian scientists need not be published in them and that Indian journals should try to get some good articles

from abroad from time to time in newly emerging fields.

One of the leading astrophysicists in the world expressed that Journal of Astrophysics and Astronomy was as good as any other leading astronomy journal in the world. He felt that the Radio Astronomy work done in India and especially at the Tata Institute of Fundamental Research was quite good and that it would certainly be read even if published in JAA. He mentioned that it would be good to have full time editors with subject background but was aware of the difficulties of getting committed scientists to edit journals. He was also of the opinion that a journal could be made good by keeping a high standard and gaining the confidence of the people for integrity. Even though the other astronomers had known JAA, none of them read this journal as their reading of journals was limited to just a few journals. They read pre-prints/reprints received from known quarters much more than the journals. In fact, their channel of communication was personal communication (pre-prints/discussions/ electronic mail messages) and information gathered during conferences (most of the time outside the conference rooms in informal discussions). One of the astronomers had refereed papers for JAA and felt that the standard of papers he had received was good.

To summarize, though the physicists and astronomers (from abroad) interviewed were aware of **Pramana** and JAA, these journals were not used by them. They were not aware of any other physics journal from India.

Opinions from others:

A number of opinions have been expressed in publications by scientists, editors and publishers about Indian journals. We mention below a few of them which are relevant for this study.

Rajagopal (1988), the then Editor of Pramana wrote an article in Physics News in which he raised doubts whether Pramana should be continued to be published. He drew attention in this article to the prevailing practices of the leading Indian scientists underrating Indian journals and publishing their best works in journals published outside the country. He also came forward with a few suggestions to improve the situation but expressed his doubts as to whether the community would accept them.

Arunachalam (1979) reviewing the scientific journals in India wrote :

> *" from the point of view of impact factor, immediacy index and interconnections with the overall scientific literature of the world, most articles published in Indian journals have very little cognitive connection with international science".*

In an article on the Journal of Astrophysics and Astronomy, Arunachalam (1985) concluded that JAA was truly international and that it stood a good chance of becoming a core journal in the field. Reviewing this journal in Nature, John Barrow (198.2) wrote that the success of this journal would depend on it receiving articles from foreigners and expatriate Indians.

Mathai Joseph (1979) felt that Indian journals could only reflect Indian science at best and even in that 'it could not succeed as very little of quality material was submitted to it.

Ramaseshan, a leading Physicist of the country who edited the journals of the Indian Academy of Sciences and was the first editor of Pramana, discussed the problems of journals in India in the key note address to a seminar on Primary Communication of Science and Tech-

nology(Ramaseshan,1978). To quote him, on a few points, he says :

> *" While it is true that the quality of our science is by no means of the highest order, our journals are much worse than the science we produce".*

Referring to the early Indian journals, he says :

> *" The qua1ity of the work and the references made in foreign journals to Indian ones gave to the latter a standing and reputation so good that most scientific laboratories in the world subscribed to journals like the Indian Journal of Physics, Proceedings of the Indian Academy of Sciences, Current Science and Sankhya".* (Ramaseshan - *1978).*

Touching on the aspect of improving the journals, he says :

> *"The only method of improving the qua1ity of scientific papers in a journal is by insisting on the highest standards of refereeing. In fact, a good journal disciplines a scientific community by demanding an impartia1 assessment system based only on quality - not dependent on any hierarchal system".* - (Ramaseshan - **1978).**

In another talk, Ramaseshan explained why **Pramana** was started. He says that it was an attempt for starting a cohesive community in the country that could take care of peer group assessment without any reservations. He emphasized that the attempts to strengthen the jour-

nals should be seen as a part of building "an endogenous and indigenous scientific community" (Ramaseshan - 1989).

Venkataraman (1989) lamented in a note to the same conference (perhaps pessimistically) about our journals. He felt that the neglect of our journals was only a manifestation of general neglect and indifference prevailing in the country.

Rao, the then Editor of the publications of the Indian Academy of Sciences was forced by the prevailing situation to appeal to the Fellows of the Academy to send at least one or two of their good papers every year to the journals of the Academy. He wrote to the Fellows:

> *The publication record of our Fellows in our Academy journals is miserably poor. A sample survey shows only about 50 papers (which is a little less than 10% of the total publications) are published by the Fellows in our journals. Furthermore, only a few Fellows publish these papers."* (Rao, 1988).

Recently the issue of Indian science journals has been taken up by a number of scientists in Current Science. Padmanabhan (1990) discussed the issue of journals compromising on their standards on the grounds of helping or showing some concession to those scien-

tists working under difficult conditions with very little facilities. He argued that journals should not have such an attitude and that "the pride of a scientist cannot be compromised with attempts to publish poor quality papers based on mistaken justifications." Bala Ravi (1990) dealt with the aspect of professionalism in producing the journals in the country. He observed that it is only through peer review and sound editorial policy that one could enforce quality in publishing science journals. Kochhar (1990) analyzing the problems of Indian journals felt that peer pressure was essential as the strength of the journal was in it and that its set of authors should be identical with the set of referees. He was of the opinion that any honour to scientists from within the country should be made conditional to his services to Indian science and if a scientist felt that the Indian learned societies were good enough to be members of, then they should accept that the journals of those bodies also to be good enough to publish their research papers in.

Opinions expressed in conferences:

There have been a few conferences in the country devoted to Indian scientific journals. There was a

seminar on Primary Communication in India in 1978 at Bangalore. At this seminar, editors of journals and librarians and teachers in Library and Information profession in the country discussed the various aspects of Indian journals. A number of papers on bibliometric studies were presented. The papers presented indicated that the level of'Indian journals (excepting a handful) was very low. There was no in depth discussion as to why it was so.

In 1989, there was an interesting meeting at Madras where perhaps for the first time scientists, editors of journals, representatives of funding agencies and librarians met in what was termed a "Brain Storming Session on Indian Science & Technology Journals". Each of the groups expressed their opinions about the state of Indian journals and the reasons for why they are so. Most of the points that emerged were similar to what has already been mentioned in connection with the opinions expressed by scientists in interviews. An attempt was made to get a collective pledge from the scientists that they would publish most of their good papers in Indian journals. But the scientists were not prepared to take such a pledge and one scientist went to the extent of saying that he would rather leave the country than be forced to accept such a regulation (self-imposed or

otherwise).

A Summary of the opinions:

To summarize the opinions expressed in different forums, the scientists are not happy about most of the Indian publications and have their own reservations about publishing their work in Indian journals. Editors feel that they cannot do much unless they receive good articles. However, efforts are going on from both sides to improve the situation and hopefully things would improve in course of time.

The author's comments on the remarks summarized here are deferred to the next chapter.

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CHAPTER 9

CONCLUSIONS

From the findings reported in the earlier chapters of this study, we draw the following conclusions:

The amount of research work done in the country in all the disciplines and in particular in physics and astronomy/astrophysics has increased manyfold. This is as a result of increased number of research workers (contributed by the increased funding which in turn has resulted in the starting of more research centres). Though outstanding work may be rare, a lot of good work is being done in the country. But only a small percentage of this good work finds its way into journals published in India. As the Indian journals are not receiving the entire output of the scientific results of the country, especially from the active research centres, one is not in a position to grade the level of the subjects by merely examining these journals. To make the situation worse, even the few articles that are received from leading institutions are usually not their better papers. Good work done at-not-so-well-recognised centres also go to "Foreign Journals". *It is only when immediate priority has to be established (for*

example, in highly competitive and fast moving fields like in the case of High Temperature superconductivity) that the leading scientists in India turn to Indian journals. Hence the Indian journals examined indicate the quality of the work of those who contribute to these journals and thus the journals published from India in the field of Physics and Astronomy "do not" reflect the true quality of research done in those subjects in the country.

By and large the scientists do not have enough confidence in Indian journals. As a result, much of the good work done in the country goes to foreign journals. Many of the scientists subscribe to the view that Indian journals must improve and achieve visibility before they could contribute to them. Unfortunately they appear to forget that this cannot happen unless they (the scientists) get involved with the journal in various ways. The situation prevailing is reminiscent of the proverbial problem of "Chicken and egg" - Unless the journals improve their quality, scientists are not willing to contribute their better papers to Indian journals and Indian journals cannot improve unless they receive a sufficient quantity of good research papers and scientists get involved with the journal.

The trend seen among the scientists to publish in foreign journals is not just today's phenomenon. Raman complained as far back in 1932 about Indian papers going to foreign journals. This investigation confirms that such a practice did prevail even among the renowned scientists of the country during the 1930's. Only after recognition and fame had been achieved for their work, did some scientists publish in Indian journals. But unfortunately, even that does not happen now. Only when there are repeated requests/pressure from Editors personally known to scientists, or when there is a special issue in connection with a special occasion or when there is urgency for establishing priority, articles limp their way to Indian journals.

There is no inner commitment from the scientific community to build up national journal(s). This is because of the existing socio-scientific conditions in the country where peer recognition, awards, rewards depend on the visibility of an individual or his work. So the scientist is pushed into seeking avenues which would help him reach his goal. In their present levels, most of the Indian journals do not provide such channels. Hence, the physicists and astronomers in the country use foreign journals to be visible in their

circles.

To an extent some of the complaints of the scientists regarding the Indian journals appear to be true. Indian journals do not enforce strict norms in terms of refereeing and even in better journals like Prarnana, standards are highly variable. This is because of the philosophy of different editors/referees who, though may be reluctantly, allow papers to be published even if they are not up to the mark as they (editors/referees) do not wish to harm the career of a scientist. This has led to many mediocre articles being published in the journals resulting in "a few good articles published getting buried in a large number of below average or just average articles."

The lack of "theme journals" in the country is a deterrent for the scientist working in frontier areas to publish in Indian journals. However, without a critical number of articles in a particular sub-field being generated in the country, and contributed to the Indian journals, such specialized journals cannot sustain/succeed. Presently this number is sub-critical.

The preprint exchange practice does not exist in

all branches of Physics but is limited to certain branches like Particle Physics and to an extent in Condensed Matter Physics. Physicists working in other fields still depend on the journal for new information.

One of the complaints heard against Indian journals is its delay in publication. But this study has shown that it is not altogether valid. The average time lag in publication of an article from the date of its submission to the date of publication in Indian journals is relatively short and in fact articles in Indian journals get published much faster than those pub1ished in prestigious journals from abroad. This is one of the good points of most of the journals investigated in this study.

Some suggestions for possible improvement in the present situation :

The following suggestions are made based on the findings of this investigation and the conclusions drawn by the author. It is hoped that on implementation of these suggestions, the prevailing conditions will improve and make the Indian science journals stronger so that they come closer to international standards.

1. One should consider the important factors which made The Physical Review succeed and try to incorporate the relevant points.

2. The most important step to be taken is for the scientific community to decide to support the Indian journals to a much greater extent than what is being done presently.

3. The standard of the Indian journals to be raised to the level where scientists would voluntarily submit majority of their good papers to the Indian journal

4. To devise methods which would enable a scientist to make his work more visible in the community of his choice.

5. Not to discriminate against the work pub-lished in Indian journals because of a pre-conceived notion that work published in Indian journals are bad.

We elaborate on each of the above points. Before that, it is very important to note that as each of the above factors are interrelated, they should be taken up for consideration and implementation simultaneously and not at different times.

1. Factors which helped The Physical Review succeed:

As mentioned in a previous chapter, the factors that helped Physical Review succeed are:

a. scientific community in the country wholehearted1y supporting the journal

b. active scientists willing to take a few years off to assist the journal in various editorial activities.

c. editors and members of editorial board being alert and following the developments in the field

d. gaining the confidence of the scientific community by making suitable changes in the working of the journal to meet the sudden demands brought upon by a particular situation (like in the case of the High Temperature Superconductivity when The Physical Review had to appoint special refereeing panels etc,)

e. having an International panel of referees and

f. ensuring that the publication comes out on time.

2. Support of the Scientific community:

As mentioned a little earlier, journals cannot continue to maintain a high standard without the active support of the scientists doing quality research. Mere lip sympathy of the scientists belonging to such groups or an occasional contribution for a "Special Issue" will not help the journals to sustain. If the scientists who are publishing in foreign journals send at least 50% of the articles they publish in foreign journals to Indian journals, it would make quite a difference to Indian journals. It is understandable that scientists have to publish some times in foreign journals for unavoidable reasons. Barring such occasions, if a sufficient number

of articles are sent to Indian journals (without separating the good articles for foreign journals and the others to Indian journals), it would help both the scientist and the journal. Following the earlier method of Raman of sending a short version to a foreign journal and the detailed account to an Indian journal with each article referring to the other will certainly make Indian work more visible. It is found in this investigation that 85% of the articles from the seven research institutions studied go to foreign journals. If even half of this large quantity comes to Indian journals, to start with, it would raise the number of good articles published in Indian journals and displace the articles of the average or below average qua1ity presently published. This would automatically raise the standard of the journal. But this decision of the scientists should not come as a charity but as a necessary step to make Indian journals sound.

3. Raising the standard of the journals:

The first step in this direction is for the journals to gain the confidence of the scientists. This can be achieved only by setting rigorous standards for each of the components in publication of journals. These

include :

(a) having an active editorial board whose members contribute to the journal in different ways (by way of submission of articles, giving inputs to the editor in selection of referees, being a watchdog for any possible slip occurring in the publication). Presently the editorial boards of the Indian journals are not as active as one would expect them to be.

(b) having active scientists as editors will certainly enhance the image of the journal. It is no doubt difficult to persuade an active scientist to get involved full time with a journal as Editor. But the community should take the journal publication as a part of the scientific activity and scientists at different levels could work as Editors for a few years at a stretch and resume their research again. Such a practice is seen, as mentioned in an earlier chapter with successful journals like the Physical Review and Physical Review letters.

(c) The panel of referees of the journals should be drawn from among the scientists both within and outside the country. This is very essential to get a fair assessment for the articles submitted especially in the newly emerging areas. In areas where there are not many specialists, editors should not hesitate to have referees from abroad in the panel of referees. Present1y physics journals in India have none or a very few referees from outside the country. However JAA, the astronomy journal has a very large number of foreigners on its panel of referees.

(d) If one wants to have atleast one or two good journals of international calibre in the country, then the refereeing policy should be quite rigid. Articles should not be accepted for publication unless they meet the standards laid down by the journal. Considerations like the limited facility available for a scientist at a particular place, the environment in which he is working etc. should have no place. The only criterion

should be the scientific content of the article. Such compassion does not help the journal to maintain a high standard. Some of the Indian referees and journals, do tend to consider points other than scientific content of a paper before rejecting it. This practice should be discontinued atleast in the journals (like Pramana and JAA) which are striving to raise their standards.

(e) Wide visibility of a journal is very important to induce scientists to submit their papers to any particular journal. Visibility can be achieved only by making the standard of articles published in a journal to be on par with those published in journals well received by the community all over the world. If journals consistently publish a fair number of good articles in each issue and have a good marketing system, the visibility will follow over a period of time. Till that happens, a very large number of reprints should be distributed all over the world to make the work known among the community abroad. To do this, financial support should be extended to the scientists.

(f) The editorial offices of the journals should have sound infra-structure. Modern telecommunication facilities would greatly help in speeding up the matters. Though e-Mai1 and Facsimile transmission may appear to be extravagant and out of place in our country presently, in reality it does help the scientists, editors of the journals and referees to communicate with each other more efficiently.

The above mentioned factors, if adopted would help to a great extent to raise the standard of the Indian journals.

4. Facility to distribute the reprints and increase the visibility of the journal:

It is understandable that scientists would like visibility for their work and for international peer recognition. How can this be ensured if publication is done in Indian journal? One suggestion would be that ti11 such time as the journal gets good visibility in the International community, efforts are made to make

the work published in Indian journals reach a wide section of the community outside the country, by circulating in large numbers, articles published in Indian journals among scientists working elsewhere in the world. Since this would involve additional expenditure which Institutions may not be able to provide, some other funding agency like the Department of Science and Technology (DST) should provide funds for this. To start with one or two important journals could be identified for this purpose (like journals which already have a certain standing in the community). Authors of the accepted papers could be asked to suggest a list of scientists who in their (authors) opinion should receive a copy of the reprint. Authors may also be asked to name a few scientists to whom specimen copies of the journal should be sent. The publishers of the journal could then mail the reprint/specimen copy direct to those scientists and DST could meet this expenditure (cost of the reprints and the postage). If this is done, the present problem of poor visibility will be solved to a certain extent. Scientists may feel encouraged to publish in Indian journals when this is done.

5. Discrimination against the work published in Indian Journals:

Efforts should be made to make it known to those in charge of recruiting scientists that an article published in an Indian journal should not be looked down upon just because of its publication in an Indian journal. When questions are asked either in the application forms or at interviews, weightage should be given to the quality of the article and not just the title of the journal. It is not suggested that all Indian journals be given the same weightage. They should be graded and then proper weightage given to the articles published in them.

Indian science today is in a much better position and state of health than earlier. Unfortunately, it is the journals which are suffering. Though Indian scientists look forward to getting elected to the national academies/societies and receiving national honours, they seem to ignore Indian journals. However, Indian scientists have learnt to appreciate from the experience of high temperature superconductivity, that Indian journals do have a value. It is only a question of recognising that this value has a larger domain.

A conscientious effort on all the fronts mentioned above will very likely improve the present situation of Indian journals in physics and astronomy not receiving good portion of the better work done in the country resulting in their not truly reflecting the research done in these subjects in the country. Such an effort is already seen in Pramana and it has improved in many respects during the last few months (after July 1990). If these improvements sustain in the coming years and other journals also take similar steps towards improvement, *there* is hope *for the future.*

It is conceivable that some of the conclusions arrived at, and suggestions made in this study are "obvious". Since present findings are based on very recent data and on a systematic study and analysis of the state of the Indian journals in physics and astronomy from many angles, one should take these conclusions seriously, even if they are "self evident".