Volume 6 Number 2 July – December 2007

ISSN 0972-429X

इण्डियन जर्नल ऑफ साइन्स कम्यूनिकेशन

INDIAN JOURNAL OF SCIENCE COMMUNICATION

Indian Journal of Science Communication

- *Indian Journal of Science Communication* (IJSC) seeks to promote and disseminate knowledge and activities in the area of science and technology communication and provides a forum for addressing issues emanating from concept to research and practice.
- The scope of the journal encompasses all aspects of science communication and science popularisation.
- It excludes pure and applied sciences and anything bracketed as popular science writing.
- The IJSC is a half yearly international journal, issued in January and July.
- The IJSC is brought out and disseminated by Indian Science Communication Society (ISCOS), Lucknow, catalysed and supported by NCSTC/ DST.
- The NCSTC/ ISCOS assume no responsibility for the opinions offered by the contributors.
- IJSC is a peer reviewed semi-technical journal and accepts original papers and other contributions in the form of articles, studies, reviews and reports, etc. Communications in Hindi or English are considered in the original language with an abstract in the other. Refer Instructions to Contributors.
- Communication regarding contributions for publication should be addressed to : The Editor, Indian Journal of Science Communication, Rashtriya Vigyan Evam Prodyogiki Sanchar Parishad (National Council for Science and Technology Communication), Dept. of Science and Technology, Technology Bhawan, New Mehrauli Road, New Delhi - 110 016, India. Phone : +91-11-26537976, Fax : +91-11-26960207, E-mail : mkp@nic.in; editorijsc@gmail.com
- Address for subscription and advertisements : The Coordinator IJSC, Indian Science Communication Society, Chandrika Bhawan, 577-D, Near Dandahiya Masjid, Lucknow – 226 022, India, E-mail : info@iscos.org. Payments may be sent by demand draft/ cheque issued in favour of Indian Science Communication Society, payable at Lucknow.
- Price per copy for Individual :
  Inland : Rs. 100
  Overseas : US $ 5
- Refer subscription form to subscribe IJSC.
- Website : www.iscos.org

Indian Journal of Science Communication
Rashtriya Vigyan Evam Prodyogiki Sanchar Parishad
(National Council for Science and Technology Communication)
Deptt. of Science and Technology, Govt. of India
Technology Bhawan, New Mehrauli Road, New Delhi – 110 016, India
Phone : +91 11 26537976, Fax: 26960207
E-mail : mkp@nic.in; editorijsc@gmail.com

Indian Journal of Science Communication

Volume 6 Number 2 **July – December 2007** **ISSN 0972 - 429X**

CONTENTS

Indian Journal of Science Communication
Vol. 6 (2), July – June 2007

Editorial

Networking Science Communication

It is a welcome situation for the for the world science that more and more agreements for S&T cooperation between nations are coming into existence and this is also an indicator of the cooperation emerging in the area of Public Communication of Science & Technology (PCST). For cooperation in PCST is also an integral part of these agreements. There is activity on the people to people, non governmental front as well. A remarkable networking of cross-national scientists, journalists and science communicators in various PCST activities and programmes across the world has been noted in the recent past. SciDevNet, a UK based science and development web network has started its Regional Gateways (www.scidev.net) incorporating information on science and development, thereby offering stronger science communication networking by integrating regional interests with the global ones.

India's annual National Science Communication Congress and National Children's Science Congress offer forums for participation and exchanging views and experiences of scholars interested in PCST, besides providing great exposure to students by involving them. Efforts are being made to extend the run of India's 'Vigyan Rail' (Science Train: An S&T Exhibition on Wheels) to neighbouring countries as well, after its overwhelming success in India where it travelled to various destinations during 2004-2005 attracting millions of people to the exhibits on developments in science and technology. Such activities could benefit millions of people across the world and hence the case for greater number of viable science communication networks.

More recently a similar venture for propagating science was seen when 'Science Express' – a special train put together by German and Indian scientific agencies on the pattern of world famous Science Tunnel exhibition of the Max Planck Society of Germany, was flagged off in New Delhi by the Prime Minister Manmohan Singh and German Chancellor Angela Merkel.

Networking in science communication in the world is whose cup of tea any way? This networking of organisations and individuals to further the cause of science communication may be at intergovernmental or voluntary level. There are proposals to form an Indo-European Science Communication Forum and / or South Asian Science Communication Forum to foster the science communication activities in the region and have joint programmes involving experts, journalists and scholars from member countries. There is a need for establishing an international institution responsible for multiple objectives of science communication ranging from training, research and academics to publications and also networking of science communication software, hardware and human-ware. National science/environment writers'/ journalists' associations could be a great resource for regional networking of like minded people thereby preparing the setting for convincing and influencing of the governments, media and scientists to take necessary measures for the benefit of mankind and also for the advancement of science and rationality.

International Network on Public Communication of Science & Technology (PCST Network) and World Federation of Science Journalists (WFSJ) are the networks serving the cause of academics and research in science communication and practical aspects of science communication / journalism. The process can be further speeded up by regional and national networking and would help further develop closer and faster interaction, communication and exchange. Web based small / medium / large e-groups can complete the process of this networking to see science communication acquires the place and role that it was always intended to. ■

Manoj Patairiya

Indian Journal of Science Communication
Vol. 6 (2), July – December 2007, pp 3-8

Science Popularisation Activities in Assamese

Dinesh Chandra Goswami
Regional Research Laboratory, Jorhat - 785 006 (Assam)

Abstract

Assamese has a long tradition of science popularisation. The sayings of the Daka Purusa dated back to the fourth or the sixth century clearly depict the picture of an enlightened Assamese society. Evidences of science writing in Assamese also date back to the 15th century. However, a milestone in science writing in Assamese was achieved in 1734, when a colour-illustrated treatise on elephant care was compiled. A 1434 manuscript of Bakul Kayastha was printed in 1845. Since then a number of books were published in Assamese and this has gained momentum in recent times. The first Assamese monthly paper *Arunodoi* published from Sivasagar since 1846, gave a mojor boost to science publishing in Assamese. The culture of coining scientific terms which started in the pages of *Arunodoi* continued with more and more vigour. An explanatory Science Dictionary was also published in 1992.

A three-volume, colour-illustrated science part of a general encyclopedia was published in 2002. Radio and television also played a crucial part in science popularisation. But, popular science magazines, newspapers and general magazines that gave important weightage to science made a good impact. Organisations like the Assam Science Society brought out more than 120 popular science books. Science fiction has also received due importance.

The efforts of various science clubs, including the VIPNET clubs and the National Children's Science Congress movements have enthused the student community. Various other training programmes, workshops, seminars, etc., are also arranged and conducted in Assamese. These efforts have made laudable impact on the masses. This paper attempts to dwell upon some of these aspects.

सारांश

असम में विज्ञान लोकप्रियकरण की लम्बी परंपरा रही है। डाका पुरुष के कथन, जो कि चौथी या छठी शताब्दी के हैं, असमिया समाज के प्रबुद्धता के द्योतक है। असम में विज्ञान लेखन के सूत्र हालांकि पन्द्रहवीं शताब्दी में भी मिलते है, परन्तु हाथी-स्वास्थ्य पर 1734 में लिखा रंगीन सचित्र ग्रंथ मील का पत्थर है। सन् 1434 का बकुल कायस्थ का लेखन 1845 में छपा। तब से असमिया में विज्ञान पुस्तक लेखन का सिलसिला जारी है जो कि हाल के वर्षों में तेज हुआ है। असम का पहला समाचार पत्र *अरुणोदय* सिबसागर से 1846 में प्रकाशित हुआ। धर्म, विज्ञान व बुद्धिमत्ता पर आधारित इस मासिक ने विज्ञान लेखन को गति दी। नए वैज्ञानिक शब्दों का सृजन शुरू हुआ और बढ़ता गया। सन् 1992 में व्याख्यात्मक शब्दकोष का प्रकाशन हुआ।

सन् 2002 में छपे एक सामान्य विश्वकोष में तीन अंकों के रंगीन सचित्र पृष्ठों वाला विज्ञान खंड भी शामिल था। रेडियो व टेलीविज़न ने विज्ञान लोकप्रियकरण में महत्वपूर्ण भूमिका अदा की। लोक विज्ञान की पत्रिकाओं तथा सामान्य पत्रिकाओं एवं समाचार पत्रों ने जो महत्व विज्ञान को दिया उसने समाज में विज्ञान के प्रभाव को स्थापित किया। 'असम साइंस सोसाइटी' जैसी संस्था ने लोक विज्ञान पर 120 से अधिक पुस्तकें प्रकाशित की। निजी प्रकाशकों का भी अच्छाखासा योगदान रहा। विज्ञान कथाओं को भी यथोचित स्थान प्राप्त हुआ।

विभिन्न विज्ञान क्लबों, जिनमें कि विपनेट से संबंधित क्लब भी शामिल हैं; तथा राष्ट्रीय बाल विज्ञान कांग्रेस संबंधी गतिविधियों ने विद्यार्थी समुदाय के आकर्षित किया है। अन्य में प्रशिक्षण कार्यक्रमों, कार्यशालाओं, गोष्ठियों आदि ने असम में अपना-अपना योगदान दिया है। इन प्रयासों से लोगों में विज्ञान के लिए उल्लेखनीय स्थान बना है। यह पत्र इन सब पर चर्चा करता है।

Key words: Science wring, Science popularisation, History of Science publishing, Science literature

Introduction

Assamese has a long and glorious tradition of science popularisation. The Assamese society paid a lot of importance to scientific temper and scientific practices in day to day life. The sayings of Daka Purusha who flourished in Assam during the 4th or the 6th century, very well depict the practice of science and its acceptance by and influence on the society. Daka's sayings cover almost all aspects of the day to day rural life including agriculture, health, hygiene, gynaecology, pediatrics, infant care and food and nutrition. The distant origin and survival of these sayings give enough proof that the Assamese society had a strong affinity for practical scientific things connected with life since long past.

Evidence of science writing in Assamese can be had from the 15th century onwards. Under the patronage

Paper presented at the 'National Seminar on Popularisation of Science and Technology in Indian Languages' organised by the Central Institute of Indian Languages, Mysore, in collaboration with the Vigyan Parishad, Prayag, Allahabad, March 19-20, 2004.

of the great King Naranarayana, in an effort to bring science to the masses, Bakul Kayastha in 1434 translated into Assamese, a book on mathematics titled 'Kitap Manjari'. Bakul Kayastha was thus the first Assamese science writer and his 'Kitap Manjari' written in poetry was the first Assamese popular science book. In a catalogue of books prepared by Sarbeswar Kotoky, the name of one Narayan Das has also been included as a joint translator with Bakul Kayastha, but the authenticity is difficult to ascertain. In 1695, under the patronage of king Rudra Singha, Kaviraj Chakravarty translated Ram Narayana's book from Sanskrit into Assamese with the title 'Bhaswati Shastrar Katha'. Kaviraj Chakravarty also translated one of Kashinatha's books from Sanskrit into Assamese and titled it as 'Ankar Aryya'.

However, a milestone in science writing in Assamese was achieved in 1734. In that year, under the patronage of King Siva Singha and Queen Ambika Devi, a great book on science in Assamese, 'Hastividyarnnava Sar Sangrah' was written by Sukumar Borkath and was profusely illustrated by Dilbor and Dohai. Written on 'sasipat' i.e. barks of Agaru or Sasi tree (*Aquilaria agallocha*), this encyclopedic compilation on care of elephants, their diseases and treatment, and rearing of elephants covers 148 classes of tuskers and 17 classes of female elephants and gives vivid picture of their physical attributes. The book contains 193 folios made from sachi barks of size 58 cm x 16 cm and these are mostly illustrated in colour. The first 163 folios give physical description of elephants. Folios 164 to 193 give descriptions of various diseases of elephants, their prevention and treatment and application of herbal medicines. Even a present day reader or researcher will marvel at the depth of the text and the expertise shown in illustrating the manuscript. Moreover, one also marvels at the fact that the importance of illustrations in a scientific treatise was realised by the compiler so early in the history of science literature in this country.

Another book of the same class was 'Ghoranidan' which vividly describes various classes of horses, their characteristics, diseases, treatment, etc. It is really a matter of pride for the Assamese society to have such invaluable scientific books at such an early time.

It is really noteworthy that the great saint, litterateur, religious reformer and theatre personality of Assam Shri Sankaradeva (1449-1569) was only 5-6 years old, and yet a non starter of school education, when the first modern printing machine — the moving type-face press — was invented and the 42 line Bible composed and printed by Gutenberg in Germany. Sankaradeva and his followers wrote many books and treatises sachi-tree barks. The succeeding writers during the next two centuries wrote books and treatises on sachi-tree barks and subsequently on paper.

The Printed word

The first Gutenberg type modern printing press was established at Sivasagar in Upper Assam in 1836 by Nathan Brown, a Christian missionary, with the help of Oliver T Cutter. The printing press contributed immensely to the creation of Assamese literature and also gave a boost to the Assamese science literature. Multiple copies of high quality print could be produced now in a shorter time and this led to mass distribution and mass readership.

In 1845, Nathan Brown published Bakul Kayastha's 1434 manuscript 'Kitapat Manjari' in two volumes titled 'Padaganit' and 'Lilavati'. In that year itself were published Nathan Brown's book on arithmatic 'Pratham Ganana' and Eliza and Nathan Brown's book on arithmatic 'Dutiya Ganana'. In 1849, Nathan Brown published the first Assamese geography book 'Bhughol Sikshak'. Another popular science book 'Samachar Chandrika' was published in that year. Eliza Brown published her 'Bhugolor Bibaran - Part I' in 1851. In 1855 Nidhiram Keot alias Nidhi Levi Farwell's book 'Padarthabidya Sar' written in the style of 'Natural Science in Familiar Dialogue' adapted by W Clerk was published from Sivasagar. Panindranath Gogoi's 'Lora Siksha' (1893) and Sarada Charan Choudhury's 'Lorar Nija Puthi' (1902) also were two valuable science books. Another noteworthy contribution was Satyanath Bora's 'Akash Rahasya' (1916).

As the culture of science publishing which started in 1845 continued with more and more vigour, the Assamese language also adapted itself to make itself capable to face that challange. In order to do that the language coined a large number of scientific terms.

However, the first major boost to science publishing in Assamese came with the publication of the periodical *Arunodoi Sambad Patra* — 'A monthly paper devoted to Religion, Science and General Intelligence'.

Starting from the first issue which came out in January 1846, every issue of the magazine gave tremendous importance to science news and science articles. Very mature and clear illustrations were also included along with the news and the articles. In fact, it was in the pages of *Arunodoi* that the Assamese

language attained the art of science writing in the real sense of the term. A band of science writers were also created.

Side by side with *Arunodoi*, the culture of science book publishing also continued. In 1874 a second edition of 'Padarthabidya Sar' was published. A book on miscellaneous science articles, 'Bijnanar Baremotora' was also published at the same time. The reintroduction of Assamese in the schools as the medium of instruction in 1873 also necessitated the writing of a large number of science textbooks on subjects ranging from physics to geography.

Articles and news items in *Arunodoi*, and the texts of the textbooks necessitated the Assamese language to adapt itself to express scientific ideas and thoughts and this also lead to the coining of a large number of scientific terms in the language.

Glossary, Dictionary and Encyclopedia

The culture of coining of scientific terms which started in the pages of *Arunodoi* continued with more vigour. Subsequently *Awahon* (1929) a literary-social magazine which created its own trend and made a lasting impact, also serially published a glossary of scientific terms. Efforts of coining scientific terms continued and in 1936 as Birinchi Kumar Baruah, Sarat Chandra Goswami and a few others compiled a large number of such terms. In 1953 Omiyo Kumar Das and Tirthanath Sarma led a team in preparing a compilation of scientific terms. In 1964 the Assam Science Society compiled 8000 scientific terms. In 1969 the State Textbook Production Coordination Committee constituted a committee for preparation of a glossary, and by 1971 about 39,000 scientific terms were compiled. In 1973, the Gauhati University Textbook Production Coordination Committee published the first volume (the only volume till now) of a 'Glossary of Assamese Scientific Terms' (this author was the compiler of the final manuscript). It contained 32,000 terms.

The Assam Science Society, in 1992, published the first volume of the Assamese Explanatory Science Dictionary (this author was its chief editor). The second and final volume came out in 2002.

The glossary of 1973 and the dictionary of 1992 / 2002 immensely contributed to the growth of Assamese popular science literature.

But, a very prominent contribution to science writing in Assamese was made by the publication of the Science Parts of the Assamese Encyclopedia, under the chief editorship of Dinesh Chandra Goswami, in 2002. Published by the Asom Sahitya Sabha in collaboration with the Assam Science Society, this 3 volume, 2400 page colour-illustrated science encyclopedia contained entries on almost all areas of science in a semi popular style and contained more than 300 major articles written by specialist science writers on subjects as varied as space science and cosmology, geography, physics, chemistry, mathmatics, life sciences, anthropology, medical sciences, engineering, public health, museology, numismatics, computer science, nanotechnology, etc. With the publication of the encyclopedia, the language has shown its maturity and power of expression. Moreover, more than 160 authors who contributed the entries, proved their maturity and capability of science writing.

In spite of the glorious past, science writing in Assamese has been a very slow and feeble endeavour. In a collection of 77 Sanskrit and 156 Assamese books and manuscripts by Hemchandra Goswami in 1912, there were only 4 books on mathematics and 2 on herbal medicine.

In a catalogue prepared by Kosheswar Sarma in 1927, out of the 564 Assamese books, 39 were on various disciplines of science like health, medicine, agriculture, sericulture, and mathematics.

In a catalogue published in 1972 by the Asom Sahitya Sabha and compiled by Lila Gogoi and Keshabananda Deva Goswami, out of the 1964 books published in Assamese during 1956-1971, 48 were shown as science books.

According to a paper read by Santanu Tamuly in 1980 at a conference organised by the Assam Science Society at Duliajan, 384 Assamese science books were published till 1980. According to Tamuly 500 more science books were added till 1997.

A conservative figure about Assamese science books published till date will be 1050.

Radio and Television

Apart from the printed word, radio also played a crucial role in the science popularisation efforts in Assam. The Guwahati and Dibrugarh centres and the small FM centres of AIR regularly broadcast news, reports, talks, discussions, interviews, and features on science. Assamese was one of the first few languages in the country to broadcast science features in the style of dramas. As back as in 1974, a multi instalment serial on 'Imaginary interview with scientists' authored by

Dinesh Chandra Goswami was also broadcast from AIR Guwahati. These centres even broadcast science fiction shortstories and dramas. Since radio is still a mass media in the real sense, these programmes have made noteworthy contribution to science popularisation. A band of experienced science writers have been making dedicated efforts to deliver science to the mass in an effective way by targeting the various sections of the society.

Television, particularly Doordarshan, has come to play a dominant role in the science popularisation movement. The coverage of this medium has been gradually increasing and through its various programmes it has been driving science home to the various sections of the society. The rural population and the student community have been highly benefited.

Popular magazines

The trend of science publishing in the literary and social magazines continued with more and more vigour and magazines like *Assam Bandhu* (1885), *Mou (1885), Jonaki* (1889) and *Alochani (1908), Assam Bandhab (1909), Banhi* (1909), *Chetona (1919), Milon, Awahon* (1929) and *Ramdhenu* (1950) devoted a good percentage of space to science. Even children's magazines like *Pakhila, Parijat* and *Akon*, and subsequently *Dipak* allotted a good share to science.

The Assam Science Society started publishing a popular science magazine, *Bijnan Jeuti*, in 1961 and the magazine has completed 37 years now. *Bijnan Jeuti* has made noteworthy contribution to science popularisation and has immensely benefited the society in general and the student readership in particular. The Dibrugarh District Committee of the Assam Science Society gave a much needed fillip to the science popularisation effort by its two-monthly newspaper *Janabijnan* (1982). Dinesh Chandra Goswami also brought out a single-topic science bimonthly *Dristi* from 1984. As a single-topic science magazine, every issue of which dwelved into one topic of science, *Dristi* was claimed to be a unique magazine in this country. Santanu Tamuly has been publishing a popular science children's monthly magazine named *Nutan Abiskar* since 1988.

The *Arunodoi* culture has been kept alive by all the magazines and newspapers in Assam by devoting considerable portions of their space to science popularisation. In a study carried out by Dinesh Chandra Goswami and Pramod Chandra Neog in 1988 *(Prantik,* 1 March 1988*)*, it was seen that Assamese magazines gave almost equal amount of space to science in comparison with Bengali and English magazines (*Prantik* 7.21%, *India Today* 8.20%, *Desh* 7.75%). Assamese newspaper also were not lagging behind their English counterparts (e.g. *Dainik Janambhumi* 2.49%, *The Telegraph* 1.19%). The picture has even improved gradually afterwards with more competition among similar publications which has led to bringing out of full page supplements on science, environment, agriculture and health on weekly and fortnightly basis.

The Assam Science Society has been rendering yeoman service to science popularisation in Assam. Starting with Harendra Nath Kalita's 'Akasor Katha' in 1964, the Society has till now published more than 140 books on various subjects. The 90 odd branches of the Society scattered all over the state of Assam, have also been publishing popular science books and periodicals and have, thus, created a band of science writers. Organisations like the Asom Sahitya Sabha; the publication Board, Assam; and the Assam Children's Literary Trust have also published a number of popular science books. Many reputed private publishers have also made noteworthy contribution in this area.

Training workshops

The number of training workshops on science writing and journalism organised by various organisations like the Asom Sahitya Sabha, the Assam Science Society and the Assam Science Writers Association (ASWA) have also contributed in a very effective way in generating an interest in science reading and writing and in creating a band of science writers. The ASWA has decentralised the science writing concept by taking these workshops to even the rural areas of the state and by training a large number of young science writers.

Science fiction

With the history of about seven decades to its credit, science fiction has earned its due reputation in Assamese literature.

In 1937 Hariprasad Baruah, an engineer, published a shortstory which had all the characteristics of science fiction stories, in the pages of the *Awahan.* The story which had the title 'Birachatiyar Desh', traces the antecedent of a member of the society to the planet Jupiter. Nagendra Narayan Choudhury's 'Rasayan', published in the *Awahon* in 1938, narrated an attempt by a scientist to recapture the lost youth of a subject

by some chemicals and the consequent ill effects. Kumudeswar Borthakur in 1946 published a book titled 'Atom Bom' in his then famous 'Golai Series' and this may be taken as the first attempt to write a science fiction short story book. The story described an attempt by a sponsorer to compel a doctor-scientist to make an atom bomb in a cave near Guwahati and the plan to explode it in the hilly regions of Meghalaya. However, Saurabh Kumar Chaliha's 'Mini Noise' written in 1950 and published in 1966 in the *Asom Batori* can be called the first Assamese science fiction shortstory with all the attributes of science fiction. The story depicts the ill effects of sound pollution brought about by the mechanised world with the help of an equipment developed by a sound engineer. Some success was achieved in absorbing 60 per cent of the unwanted noise, but the process had its own ill effects.

The established SF and science writer Bijoy Krishna Deva Sarma has been writing SF stories, novels etc. from the sixties. His first SF story was 'Year 2466, 1st April' (*Amar Pratinidhi*, 1963). His 'Chandralokot Pratham Manuh' (1969) can be claimed to be the first Assamese SF novelette. Dr Sarma's other SF books are 'Suryyar Sonali Aapel' (1976), 'Bignan Bhittik Galpaguchcha' (1991) and 'Tulasi Talat Mriga Pahu Chare' (1994).

The noted Science and SF writer Dinesh Chandra Goswami has been making valuable contribution for the last four decades to Assamese literature by publishing and broadcasting the largest number of SF stories, novels, dramas, etc. Goswami, made his debut into the SF world by writing his first SF shortstory 'Kankal' in 1970. He has published four collections of his SF shortstories — 'Bhadrata Mapak Yantra' (1985), 'Portable Smell Absorber' (1986), 'Ek Tarangar Dare' (1993) and 'Abhinna Hriday' (2004). Goswami's SF shortstory collection 'Dinesh Chandra Goswamir Swanirvachita Galpa' was subsequently published by NBT in 2005. He has also published three of his SF novels — 'Ejak Jonakir Jilikani' (1992), 'Sabda, Nirantar Sabda' (1992) and 'Usma Prabah' (1993). Goswami, who has been regularly writing SF shortstories in various magazines and newspapers, wrote about forty SF stories in *Abikol*, a popular monthly. His novels 'Ati Bisista Samaj' (1999) and 'Mananiya Sampraday' (2000) were published in the Bihu special issues of *Sadin* and *Asom Bani*. Goswami's only SF children's drama is 'Tritonor Abhijan' (1985). By broadcasting a large number of SF drama, including a 13 episode serial drama broadcast from the AIR, Goswami has made valuable impact in the society.

In 1982 a poet Nabakanta Baruah published a beautiful SF novels 'Apadartha'. Amulya Kumar Hazarika has also published two SF novels 'Akraman' (1983) and 'Sandhan' (1992). He has been contributing other SF novelettes since then.

The popular literary magazine *Bismoi* has been continually contributing to the Assamese SF scene. Many of the present day SF writers started their SF career in *Bismoi*. Bandita Phukan's 'Priyatoma' (*Bismoi*, 1987) was her first SF shortstory. She published a shortstory collection 'Dwitiya Byakti' in 1991. She has been regularly contributing SF shortstories through various publications. Another SF shortstory writer Santanu Tamuly wrote his first SF shortstory 'He Chandra Biday' *(Asom Bani)* in 1964. He has published a shortstory collection 'Mayamriga' in 1998. A prolific writer Ranju Hazarika has also written an SF novel 'Suryya Sandhan' in 1996.

The other SF writers of repute are Saqueel Zamal, Rathindranath Goswami, Mihir Kumar Goswami, Ajanta Das, AK Ziauddin Ahmed, Prabhat Goswami, Manabendra Kumar Baruah, Parag Rajkhowa, etc. But many other new and upcoming SF writers have made infrequent but valuable contributions.

Translations of SF books

Many notable SF translation also have enriched the Assamese SF literature. The first SF work to be translated into Assamese was H G Wells' 'Invisible Man' by Hemabala Das ('Adrishya Manav', 1956). The same book was translated in abridged form in 1995 by M A Mazid Khan. Recently Abhijit Sarma Baruah has also translated it with the title 'Adrishya Manuhjon' in 2001 under the 'Kalajayee Sahitya' series edited by Dinesh Chandra Goswami.

Sada Saikia translated Tolstoy's Russian science fiction 'Aielita' in 1957. Kshiren Roy brought out an abridged translation of SF works of authors like Jules Verne, H G Wells and R L Stevenson in 1973. In 1988, Dinesh Chandra Goswami translated Jules Verne's 'Twenty Thousnad Leagues under the Sea' with the title 'Sagaror Taliyedi Kurihazar League'. Goswami also translated Arthur C Clarke's '2001 — A Space Odyssey' in 1996. He has translated for NBT its collection of Indian SF stories 'It Happend Tomorrow'. Goswami's latest translations have been 'Astronaut' (1999) - where he included two long Russian SF

shortstories, and Jules Verne's 'A Journey to the Centre of the Earth' (2001). The last book was earlier translated in 1982 and in 1988 by two other translators also. Anil Kumar Sarma translated Jules Verne's 'Round the Moon' in 1965. Raihan Shah translated Arthur Conan Doyle's 'The Lost World' in 1990. In 1993, Ranju Hazarika brought out a collection of worlds' best SF stories in Assamese. Sayed Azizul Hussain translated 'The War of the Worlds' by H G Wells in 1993. Under the 'Kalajayee Sahitya' series edited by Dinesh Chandra Goswami, Saurabh Kumar Chaliha translated R L Stevenson's 'Dr Jekyll and Mr Hyde' in 1991. A number of children's SF stories and novelettes were also translated into Assamese by various authors.

In the last four decades a large number of SF short stories and novels have been published in Assamese. The festival publications at the time of the Bihu and the Durga Puja also give a lot importance to science fiction. However, in comparison to the 50 odd science fiction stories published in Marathi every year, an average of ten science fiction stories are published in Assamese every year. In spite of that, Assamese can really boast of the originality and the high quality of its science fiction short stories, novels and dramas, and particularly the science fiction radio dramas. The All India Radio, Dibrugarh, has even serially broadcast a thirteen episode SF radio drama written by Dinesh Chandra Goswami. It is notable that many of the SF stories, novels and dramas in Assamese have been labelled as some of the best stories, novels and dramas in Assamese literature.

Miscellaneous science popularisation activities

Science plays and science street dramas : Various adults', women's and children's groups have now actively taken up science plays and science street plays particularly in lower and middle Assam, thanks mainly to the painstaking efforts of Professor Shyama Prasad Sarma, a veteran in the drama movement of Assam. These seem to have received very good audience response and and to have notable impact on the society. Sarma has deliberately kept the science content low and the language simple so that the message is well absorbed in the society.

VIPNET Clubs and NCSC : The large number of VIPNET Clubs formed at various corners of the state with the guidance of Vigyan Prasar and the National Children's Science Congress (NCSC) have generated overwhelming response in the state and have immensely contributed to generation of scientific temper and scientific literacy.

Science motivation programmes : The Regional Research Laboratory (RRL), Jorhat, has been conducting, for two decades now, a novel science motivation programme for the students and teachers of NER. The programme for the Assam students are conducted in Assamese. The selected students participate in five-day residential and one day non residential programmes where they are shown round RRL, and various other scientific and industrial institutions. They also participate in science elocution competitions, 'Face-to-face' interactive programmes with scientists, debates, experiments, etc., where the medium is Assamese. The programmes have earned high reputation as science popularisation and science motivational programme in vernacular language.

Open houses : Open houses have been taking place at various places in Assam like Guwahati, Mangaldai, Biswanath Chariali, Jorhat, etc. on scientific temper and related subjects. Conducted in Assamese, these open houses, where up to a thousand participants gathered, and where anybody from eight to eighty years of age could participate, have generated a lot of enthusiam, and have been termed as very efficient step towards science popularisation.

It can, therefore, be said, that a lot of sincere efforts have been going on on science popularisation in Assamese and these have greatly contributed towards inculcating scientific temper in the Assamese society.

The future of the science popularisation movement in Assam seems to be very promising. ■

Indian Journal of Science Communication
Vol. 6 (2), July – December 2007, pp 9-15

Infrastructure of Scientific and Technological Knowledge Flows in Society : Polish Experiences

Andrzej H Jasinski
School of Management, Warsaw University, Warsaw, Poland
E-mail : ahj@onet.pl

Abstract

In 1990, fundamental politico-economic transformations started in Poland with a primary purpose to introduce the free market economy into the country. As a legacy after the previous system, there existed – among other things – two separate 'worlds' in the Polish economy i.e. science and production (in the broad meaning). In the field of science and technology, we inherited : bad communication between science and society, low level of public understanding of science (PUS), weak co-operation between the science sphere and the production sphere, small scale of science commercialisation, practically nonexistent infrastructure of scientific and technological knowledge flows in society.

At present, the market reforms are far advanced. So now, the main direction is to build the knowledge based economy / society. Here, 'knowledge' is obviously understood as a scientific and technological (S&T) one. Achieving this purpose requires a significant intensification of the knowledge flows. There exist two basic sources of this knowledge : (1) a domestic science and technology sector / system and (2) inflows of S&T knowledge from abroad. Both sources are equally important, however, this paper deals mainly with (1) This study covers year span 1989-2004.

सारांश

पोलैंड में सन 1990 से मुक्त-बाजार प्रणाली के शुरूआत के कारण मौलिक राजनैतिक-आर्थिक बदलाव शुरू हुए। पूर्ववर्ती प्रणाली के प्रभाव-स्वरूप, अन्य विशेषताओं के अलावा, पोलैंड की आर्थिक व्यवस्था में दो प्रणालियां मौजूद थीं। इनमें एक थी विज्ञान, व दूसरी उत्पादन (वृहत अर्थों में)। विज्ञान एवं प्रौद्योगिकी के क्षेत्र में, पोलैंड को समाज व विज्ञान के मध्य खराब स्तर का संवाद, विज्ञान की समाज में न्यून समझ, विज्ञान के व्यापारीकरण का अभाव, विज्ञान के लोकप्रियकरण तंत्र की गैर मौजूदगी जैसी स्थितियों विरासत में मौजूद थीं।

आज के वर्षों में बाजार का उदारीकरण बहुत आगे पहुंच गया है। विज्ञान व प्रौद्योगिकी के ज्ञान आधारित अर्थव्यवस्था आज की नई दिशा है। इसके लिए सघन ज्ञान प्रवाह की आवश्यकता है। इस ज्ञान के विकास के दो मुख्य स्रोत है (1) घरेलू विज्ञान व प्रौद्योगिकी आधारित क्षेत्र व (2) विप्रौद्योगिकी ज्ञान का अन्य देशों से प्रवाह। दोनों महत्वपूर्ण हैं। यह पत्र मुख्यत: पहले पर आधारित है।

Key words: Science-production linkage, Public understanding of science (PUS), science and society, Institutional intermediaries

Introduction

A broadly developed, well organised and functioning infrastructure of scientific and technological knowledge flows is a basis for the knowledge based economy or society. However, in the Polish conditions, due to historical occurrences, science-production (S-P) linkages have a crucial role to play in the desired intensification of scientific and technological knowledge flows. Therefore, a special attention must be paid to institutional intermediaries between science and production. In this paper they are called as 'uttis' (units making up technology transfer infrastructure).

As in several other countries, there exist three main types of institutional science-production links :

1. Science parks, innovation incubators, technology centres,
2. Bridging institutions and
3. Spin off firms.

A big progress has been achieved in this field during the Polish transformations. Nowadays, we have twelve science parks, three of them in the course of organisation; a quite well developed network of bridging institutions, nevertheless, not all of them working properly; and a certain, but not too big, number of spin offs.

Of course, not only uttis participate in scientific and technological knowledge flows in the Polish society. Also, the other elements of the infrastructure are engaged in such events organised in the country every

year as, for example, science festivals, scientific picnics, a national day of science, scientific and technological exhibitions and fairs, etc.

Post transformation scenario

In 1990, fundamental politico post transformation scenario, economic transformations started in Poland with a primary purpose to introduce the free market economy into the country. As a legacy after the previous system, there existed – among other things – two separate 'worlds' in the Polish economy : i.e. science and production (in the broad meaning). In the field of science and technology, we inherited :

- bad communication between science and society
- low level of public understanding of science (PUS)
- weak co-operation between the science sphere and the production sphere
- small scale of science commercialisation
- practically non existent infrastructure of scientific and technological knowledge flows in society

At present, the market reforms are far advanced. So now, the main direction is to build the knowledge based economy / society. Here, 'knowledge' is obviously understood as a scientific and technological (S&T) one. Achieving this purpose requires a significant intensification of the knowledge flows. There exist two basic sources of this knowledge :

1. A domestic science and technology sector / system and
2. Inflows of S&T knowledge from abroad

Both sources are equally important, however, this paper discusses mainly with the first one

A broadly developed, well organised and functioning infrastructure of scientific and technological knowledge flows (ISTKF) is a basis for the knowledge based economy / society. The infrastructure contains mainly :

- Universities and other higher education institutions (HEIs)
- R&D institutions
- Science-production intermediaries
- Mass media

Of course, telecommunications and similar networks are necessary, too. They make up a technical infrastructure for the knowledge flows.

Table 1: Major elements of infrastructure of scientific and technological knowledge flows in Poland, 1989 and 2004

	1989	2004
Universities and other public HEIs	80	128
Private higher education institutions	None	over 200
Polish Academyof Sciences' research institutes	81	78
Industrial R&D institutions (public and private)	297	197
Science-production intermediaries	None	155

Source: GUS (2005), SOOIPP (2004)

The development of the above institutions in Poland - as a country in transition – between 1989 and 2004, is shown in the below Table 1. The Polish R&D sector consists in three sub sectors : (a) universities and other HEIs, (b) Polish Academy of Sciences' (PAS) research institutes and (c) industrial R&D institutions.

As can be seen, in 1989-2004 :

- a number of universities and other higher education institutions increased, mainly because about 30 public HEIs at the bachelor level were established;
- many private HEIs appeared, non existent in the past;
- the number of PAS's research institutes remained stable;
- the number of industrial R&D institutions decreased because many of small such units merged with each other or just were dissolved, which is a positive phenomenon in the Polish conditions;
- numerous science-production intermediaries were established, practically non existent before 1990.

Additionally, which is not shown in the table, a sector of mass media (both traditional and electronic) is now developed very broadly. Also, we have made a big progress in the development of telecommunications and similar networks, especially Internet. For instance, in 2005, about 30% of house holds and 87% of enterprises had an access to Internet. (GUS, 2005).

In result, one can say that infrastructure of scientific and technological knowledge flows in Poland is now quite well developed.

Institutional science-production linkage

In the Polish conditions, due to historical occurrences, science-production (S-P) linkages have a crucial role to play in the desired intensification of scientific and technological knowledge flows. Therefore, a special attention must be paid to institutional intermediaries between science and production. I call them 'uttis' (units making up technology transfer infrastructure). So, uttis are a key component of ISTKF. Their place on the innovation scene is shown in the figure.

If we treat the innovation scene like a theatre stage, then we will be able to distinguish 'actors' who are in the foreground (science, production and government) and those in the background (uttis). As known, the latter sometimes play a very important role on the stage. Also, here uttis have a significant role to play in the processes of S&T knowledge flows in society*.

However, the previous political authorities did not 'love' any intermediaries, including science-production go-betweens. Thus, this area of the national economy was underdeveloped and S-P linkages - very poor. In result, flows of S&T knowledge used to be weak in the past.

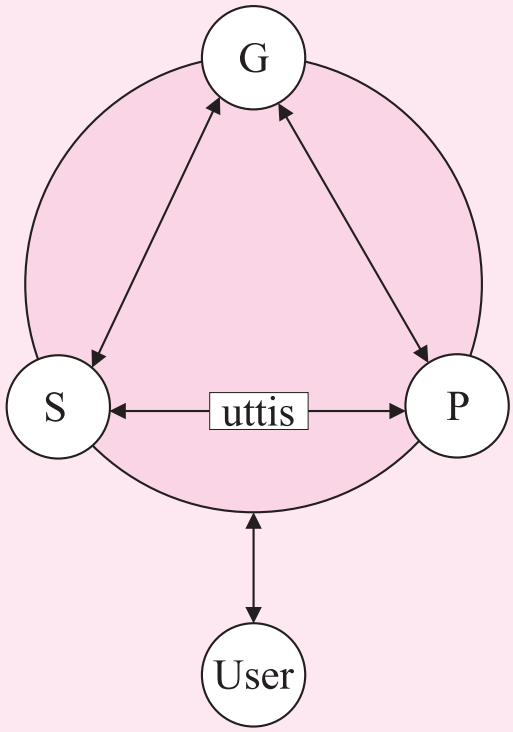
Institutional science-production links can be divided into three main groups :

1. science parks, innovation incubators, technology centres
2. bridging institutions and
3. spin-off firms

At the end of 2004, in Poland there were (Jasinski, 2006) :

1. 91 institutions belonging to the first group, including :
   a) 12 science parks, three of which in the course of organisation
   b) 53 innovation incubators
   c) 26 advanced technologies centres
2. 64 institutions creating the second group, including :
   a) 29 technology transfer and information centres
   b) 35 Polish Engineers Association's network of innovation centres

* More information on a model of the innovation scene in: Jasinski and Okon-Horodynska (2002). The general inspiration has here been a concept of a Triple Helix (Etzkowitz and Leysedorff, 1995).



G – government / the state,
S – science / the R&D sector,
P – production / industry,
uttis – units making up technology transfer infrastructure,
user – usually a consumer.

Figure : A model of the innovation scene as a triangle inscribed into a circle

Source : Jasinski (1999)

3. 600 to 700 spin offs (an estimate; the precise number is unknown)

The tally for institutions in first and second groups sums upto 155.

Below, following this classification, several case studies will be analysed within each of the groups.

Analysied studies of the linkage groups

(1) Science parks

A first such institution in Poland was established in 1995. The Poznan Science and Technology Park has been formally established as a department of the Adam Mickiewicz University Foundation in Poznan. It is located in the outskirts of the city on a 3.1 ha area which was granted to the Foundation by a local gas-works. After the necessary conversion and maintenance work had been completed, the gas pumping facility was turned into a chemical technology hall. Thus, the post industrial facilities became the site of the Park's Chemical Synthesis Experimental Station; a section of it was leased to the University's Chemistry Department to house its technological centre. Owing to the renovation, a new unit – New Technologies Incubator – has been established in the premises of the technological hall. The modern facility of the office building provided space for more Park institutions : the Archaeological Research Centre, the Unimarket Company, and the Innovation Promotion Centre. At present, the Park has 3,000 sq m of high class office space; 1,700 sq m of warehouse space; a 750 sq m technological hall; a multipurpose hall occupying an area of 680 sq m; some auxiliary buildings; and an old residential facility. The site is the location of the Park's several organisational units, including scientific institutions, and eight tenants, mainly small and medium sized enterprises with a total staff of 160 people.

(2) Bridging institutions

As far as bridging institutions are concerned, at least five initiatives can be mentioned here.

(i) In 1996, the Foundation for Polish Science (FNP), a semi governmental institution, launched an INCOME programme financed by PHARE Sci-Tech. The long term objective of INCOME was to convince Polish research workers that their achievements can be applied within various branches of the national economy, and to encourage financial institutions to accept the challenge of investing in new high technology products / processes. Support can be provided for initiatives connected with carrying out advanced technological projects.

Within that programme, some Technology Transfer Centres (CTTs) accredited to the Foundation, have been established. The first units approved by the Foundation in 1996 were : CTT affiliated to the Incubator Foundation in Lodz and the Enterprise Development Centre (EDC) at Warsaw University of Technology. (EDC lost the accreditation a year later). In 1997-2000, several new CTTs were established. Their main aim was to seek promising scientific achievements / projects to be assessed, selected by a CTT and then, if approved, implemented using INCOME's financial support. A positive example of such projects, i.e. Biostar Plus, is given below. However, the biggest problem with INCOME has been the lack of sufficient supply of promising market oriented technological projects. Since financing of INCOME finished in 2000, Technology Transfer Centres must now fully rely on themselves.

(ii) In 1997, a small governmental Technology Agency (TA) was established reporting to the Minister of Economy. The main areas of the Agency's activity were :

- support for the implementation of innovations oriented towards manufacturing companies, especially SMEs
- transfer of technology from R&D institutions to industrial applications and
- organisation of a competition 'Polish Product of the Future' in two categories : the best product and the best process to be used in practice

For implementation of innovative projects the Agency used to offer relatively cheap loans, guarantees for bank credits and additional payments for interest and credits. TA, acting as a bridging institution, also maintained databases of :

a) innovation projects ready for implementation

b) innovation oriented entrepreneurs and

c) capital investors interested in investing innovative production

Huge expectations preceded the establishment of the Technology Agency. The Agency worked for a relatively short period of time : due to the big deficit in the state budget, TA was, unfortunately, liquidated in April 2002. However, while it operated some reservations emerged, which resulted in TA, continually seeking its

own place on the innovation scene in Poland. These shortcomings were as follows :

- a very limited Agency budget, which originated almost exclusively from the state budget
- the small scale of operations, resulting from the above and
- certain competition from the Foundation for Polish Science

(iii) In 1998, an OTI (**I**nnovation **T**ransfer **C**entre) consortium was established as a joint initiative of eleven institutions acting on the scene. As a virtual organisation / network, OTI belongs to a European network named FEMIRC – Fellow Members of Innovation Relay Centres. OTI helps local enterprises to define their needs as well as to identify and establish contacts between partners implementing new technologies. OTI provides access to specialised databases on innovative projects and emerging technologies. It publishes a journal 'Innowacje' (*Innovations*). Some of units belonging to groups (1) and (2) are members of the consortium as well.

(iv) Since 1998/1999, university centres for the transfer of technology have begun to appear. One of them is the University Technology Transfer Centre (UOTT) at Warsaw University, which began to operate in 1999. The Centre's specific scope of activities includes, in particular :

1. identification of results of the R&D work within the University which could become the subject of transfer and commercialisation of innovative technologies
2. implementation of new technologies and patents created in the University
3. support for academic entrepreneurship offered through the university incubator
4. courses on commercialisation of R&D results and consultations for scientists and students
5. support for regional development by strengthening partnerships with SMEs interested in research, training and other forms of co operation provided by the Centre.

So, the idea of UOTT is similar to the concept of EDC at WUT. The first actions undertaken by UOTT appear very interesting, namely :

- The Centre has prepared Warsaw University's 'technological offer,' which included over 30 innovative projects and laboratory services; some of those achievements were granted the TA's Polish Product/Process of the Future award in 2000
- UOTT has established co operation with 43 companies within USAID's Fabrykat2000 programme,
- There has been one successful transaction with a Venture Capital Fund to create an Internet firm within the university incubator.

(3) Spin off firms

A first project approved and launched within the INCOME programme has been carried out by BioStar Plus, a limited liability company, registered in January 1997 in Zgierz near Lodz. Shareholders in this firm were the Foundation for Polish Science and the Polish Development Bank, each one holding 24% of shares; the remaining 52% were held by the BioStar partnership set up by faculty members of Lodz Technical University. September 1997 saw the launching of production of an agent known as a 'lyophilised backing starter culture' used in making bread, and indispensable for ensuring its high nutrition value.

The story of this case begins in 1991 when Doctor, presently Professor Emeritus Magdalena Wlodarczyk started this research project within her department in Lodz Technical University. The inspiration came from inside : having observed the bread market in Poland, she realised that something had to be done to radically improve the poor quality of Polish bread. A new baking agent was the practical result intended from the very beginning.

The project lasted six years and was financed mainly from funds received directly and indirectly from the State Committee for Scientific Research and partly from the University's own funds. In the final phase of research, Dr Wlodarczyk was assisted by several collaborators from her department. At the beginning of 1997, the unique backing vaccine (four strains in one) was patented.

The Technology Transfer Centre in Lodz, learned of the project and has played a key role in it. The CTT has analysed and evaluated this achievement, and assisted the researchers in preparing a business plan. Afterwards, an application, recommended by the Centre, was sent to the Foundation for Polish Science which began to arrange funds for

implementation. BioStar partnership has brought in the patent as its initial share and so a new firm was established.

Thus, there have been four partners in this successful project :

1. State Committee for Scientific Research contributed the basic funds for research.
2. Lodz Technical University was the location where the research was conducted. Moreover, a group of researchers who established BioStar Plus were affiliated with that university.
3. Technology Transfer Centre in Lodz organised the entire process leading to implementation.
4. Foundation for Polish Science arranged the funds for implementation.

In this case, the first partner represents government, the second one – science, while the third one is a bridging institution. The fourth partner is a kind of semi governmental agency. Finally, the spin off firm belongs, of course, to industry.

Concluding, a big progress has been achieved in this field during the Polish transformations.

Survey of technology transfer infrastructure

Let us now present selected results of my Internet questionnaire research conducted in 2005 (Jasinski, 2006). The questionnaire was sent to fifteen uttis being elements of infrastructure of scientific and technological knowledge flows in Poland. All of them answered. Among them there were :

- Two science parks
- Seven university technology transfer offices
- Five independent technology transfer or innovation centres
- One advanced technologies centre

The surveyed institutions are rather young; seven of them work less then five years; the oldest was established in 1994; the youngest – in 2004. They are rather small; eight of them employs up to 5 employees; six – between 6 and 15, and only one – over 15. In ten institutions, i.e., two thirds, public sources of finance predominate while in the other – private funds.

The main, general conclusions are as follows :

1. As far as the nature of their activities is concerned, most of the institutions deal mainly with research and training / teaching activities, and with actions which are expected to support entrepreneurship among small and medium sized enterprises (SMEs).
2. The surveyed institutions in principle don't deal with actions for PUS via better communication between science and society.
3. Those units which work within universities may be called 'technology transfer bureaus', however, they don't function like typical liaison offices in highly developed countries (HDCs) :
   - firstly, in their answers, the respondents practically don't mention a commercialisation as a field of their activities and
   - secondly, non of the respondents mention – among their institution's tasks – issues concerning intellectual property rights (IPRs) protection.
4. The other institutions surveyed don't mention the protection of IPRs among their tasks either. And only few of them operate as professional bridging institutions like typical science-production intermediaries in HDCs.

So, activities of the surveyed uttis on the innovation scene in Poland leave a lot to be desired. They should play a much bigger then now, role in the flows of scientific and technological knowledge between science and industry or society, broadly speaking. Nevertheless, to become a catalyst of the flows, Polish uttis must improve their internal efficiency. They face a big challenge: how to reconcile their social mission (facilitating S&T knowledge flows) with the commercial purpose (gaining incomes).

Of course, not only uttis participate in scientific and technological knowledge flows in the Polish society. Also, the other elements of the infrastructure are engaged in such events organised in the country every year as, for example, science festivals, scientific picnics, a national day of science, scientific and technological exhibitions and fairs, etc.

Conclusions

1. Many different types of elements of infrastructure of scientific and technological knowledge flows, non existent in the past, appeared in Poland after 1989.
2. In result, the infrastructure is now quite well developed and diversified.

3. Due to historical occurrences, science-production linkages have a crucial role to play in the desired intensification of the flows.

4. A big progress has been achieved in this field of transformations in Poland.

5. Activities of uttis, being elements of infrastructure of S&T knowledge flows, still leave a lot to be desired. They should concentrate, fist of all, on :

   - a commercialisation of results of the R&D work
   - intellectual property rights protection
   - reconciling their social mission with commercial purpose of their activities

6. And finally, each of the actors on the innovation scene has an important role to play to facilitate flows of scientific and technological knowledge in society. However, a key role must be played by actors in the background, i.e. uttis (units making up technology transfer infrastructure).

References

1 Etzkowitz H and Leydesdorff L, The triple helix : University-industry-government relations, *EASST Review,* No. 1, 1995.

2 GUS, Nauka i technika w 2004 roku, Central Statistical Office, Warsaw, 2005.

3 Jasinski A H, S&T policy and science promotion in Poland : Old practices and new challenges, in Transition economies in the European Research and Innovation Area : New challenges for their science and technology (A H Jasinski, ed), The Warsaw University Press, Warsaw, 2004.

4 Jasinski A H, Innowacje i transfer techniki w procesie transformacji, Difin, Warszawa, 2006.

5 Jasinski A H and Okon Horodynska E, Innovation in transition : The case of Poland, The Warsaw University Press, Warsaw, 2002.

6 SOOIPP, Osrodki innowacji i przedsiebiorczosci w Polsce : Raport roczny, Lodz / Poznan, 2004.

Scientific and Societal Context of Structuring in Amar Kosh, Roget's Thesaurus and Samantar Kosh

Arvind Kumar
Block 3, Villa 1, Eros Garden, Charmwood Village, Faridabad (Haryana)
Email : samantarkosh@yahoo.com

Abstract

The paper begins with very brief mention of the Sanskrit language thesauruses in ancient India before focusing on Amar Kosh. Word groups in Amar Kosh show how its structure was dictated by the world view of Amar Singh and the needs of his society. Roget remarks on the jumbled nature of many word groups in it, especially those having anything to do with 'mental operations'. Focus on the Roget's thesaurus reveals that due to the 'protean' ambiguities of language it becomes necessary to deviate from a purely scientific line. Examples of some word groups from some English and Sanskrit thesauruses and the Hindi thesaurus are taken to find out how they deal with the problems of following a structure. The concluding comment in this sub section is: 'Everyone tries to be as logical as possible in a field which can only be partly logical.' Samantar Kosh evolved a non classificatory but associative approach in placing its word groups. Special mention have been made of the problem of thesaurus making in languages like Hindi which have, as compared to English, many more words or synonyms for a single concept including 'natural objects'. How Samantar Kosh has dealt with it. A thesaurus ultimately is a mirror of its society and follows the mental perceptions of its audience.

सारांश

संस्कृत भाषा के प्राचीन भारतीय समांतर कोषों से अध्ययन शुरू करके यह पत्र आगे अमर कोष का अध्ययन करता है इनमें शब्द–समूहों के अध्ययन से यह स्पष्ट होता है कि किस प्रकार अमर सिंह के विश्व परिदृश्य का और तत्कालीन समाज की शाब्दिक आवश्यकताओं का शब्दकोष की संरचना पर असर पड़ा है। रोजेट की इस पर टिप्पणी थी कि इसमें शब्द समूहों, विशेषकर मानसिक क्रियाओं वाले शब्द समूहों का योजना क्रम अस्पष्ट है। उधर रोजेट के विश्वकोष में भी अस्पष्टता मौजूद है जो विशुद्ध वैज्ञानिकता पर खरी नहीं बैठती है। शब्द समूहों के आयोजन को लेकर कुछ संस्कृत के व अंग्रेजी के शब्दाकोषों के उदाहरणों से उनके शब्द समूहों के आयोजन की संरचना विधि को इंगित किया गया है। इन सबका निष्कर्ष यही, कि कितना भी प्रयास करें, पूर्ण तार्किकता से यह काम करना सदैव मुश्किल है। 'समांतर कोष' में शब्द समूहों की परस्पर स्थिति हेतु गैर–वर्गीकरण, सहचारी विधि का विकास किया गया है। हिन्दी भाषा की अंग्रेजी के मुकाबले एक विशेषता यह है कि हिन्दी में प्राकृतिक चीजों समेत शब्द या सिद्धान्त के अनेकों समानार्थी हैं। कोई भी समांतर शब्दकोष अंततः उस समय के समाज और उसकी समझ का दर्पण है और उसी के अनुसार उसकी संरचना होती है।

Key Words: Sanskrit tradition of glossaries and thesauruses, Structure in thesaurus, Lexicon of contemporary English, Plan of organisation and classification

The rich Sanskrit tradition

The tradition of glossaries, thesauruses and dictionaries in India goes back to the Vedic age, estimated to be anywhere from 5,000 BC to 1,500 BC. The pride of being the world's first known thesaurus may go to *Nighantu.* It was compiled by sage Kashyapa, and was a glossary of Vedic words, arranged subject wise. Sage Yask wrote a treatise on it, called *Nirukt*. Every Vedic scholar was made to memorise and master *Nirukt,* because a proper and precise understanding of words and their context was considered of utmost importance in carrying the Vedas, literally *knowledge,* from person to person and generation to generation.

Over the centuries, the tradition led to compilation of many famous Sanskrit dictionaries. The *Shabdakalpadrum,* a Sanskrit dictionary, lists 29 such earlier works.[1] Most of these too were arranged subject wise and were thesauruses in a very broad sense.

Amar Kosh is at the apex of all the Sanskrit thesauruses. Its author Amar Singh gave his work the title of *Namalinganushashan, i.e.,* the Discipline of Names and Genders. It was also called *Trikand* — after its three cantos. However, popularly it is known only as *Amar Kosh*,[2] to commemorate the great achievement of its author, just as the English thesaurus is better known as 'Roget's Thesaurus', in all its editions and variations.

The exact time of the writing of *Amar Kosh* is not known. It may have been written anytime between the sixth and the tenth century AD. This vagueness is

because the ancient Indians never cared to keep an exact record of dates. Like Roget's Thesaurus, *Amar Kosh* was an instant hit. Ever since, it has been the subject of many treatises. Its Hindi commentator Pandit Haragovida Sastri lists 41 of them.[3] Its fame crossed the trans Himalayan borders of India and spread far and wide. It is said that one Pandit Gunaraj translated it into the Chinese, language some time in the 6th century.[4] The Persian Khalikbari was directly inspired by it.

It has also been translated into many European languages. From one such translation Peter Mark Roget was well acquainted with *Amar Kosh*. In a footnote to the Introduction of his first edition, he writes:

"The following are the only publications that have come to my knowledge in which any attempt has been made to construct a systematic arrangement of ideas with a view to their expression. The earliest of these, supposed to be at least nine hundred years old, is Amera Cosha, or Vocabulary of the Sanskrit Language, by Amera Sinha, of which an English translation, by late Henry T. Colebrooke, was printed at Serampore, in the year 1808."[5]

Roget goes on to comment : "The classification of words is there, as might be expected, exceedingly imperfect and confused, especially in all that relates to abstract ideas or mental operations. This will be apparent from the very title of the first section, which comprehends Heaven, Gods, Demons, Fire, Air, Velocity, Eternity, Much; while Sun, Virtue, Happiness, Destiny, Cause, Nature, Intellect, Reasoning, Knowledge, Senses, Tastes, Odours, Colours, are all included and jumbled together in the fourth section (of the first canto)."

Roget also expresses some satisfaction with Amar Kosh. He goes on to say : "A more logical order, however, pervades the sections (in the second canto) relating to natural objects, such as Seas, Earth, Towns, Plants, and Animals, which form separate classes; exhibiting a remarkable effort at so remote a period of Indian literature". [6]

It is a remark coming from a dispassionate scientist-philosopher who liked everything to be properly categorised and ordered. However, the point Roget missed was that if it has to have any relevance to its users, the categorisation in a work of associative contexts the structure has to differ from society to society and time to time.

Society of the time and the logic of lexicons

Amar Singh lived in an ancient oriental society. This society had a social pattern that was unique to India. Outsiders have come to know a lot about it but find it difficult to follow its 'mental operations'. This society was compartmentalised in a rigid system of four well defined *Varnas* or castes or classes of people, namely, the *Brahmins*, the *Kshatriyas*, the *Vaishyas* and the *Shudras*. In this society, everybody had a given vocation and social status. These were decided by the *Varna* in which a person was born and bred.

Above all, in this society, everybody's desires and motivations, thoughts and actions, were guided by a plethora of religions most of which taught that attainment of *moksha* or *nirvana* was the only goal worthy of a human being. All human activity, including pursuit of wealth, was a means to that end. Human destiny was guided by the supreme beings who inhabited the heavens.

This society guided not only Amar Singh's personal world view but that of his audience too.

In the light of above, let us look into Amar Kosh and its structure and see how it was very much relevant to its contemporary audience, though Roget, belonging to a different society and period, found it rather inadequate. This will also help us in getting a better idea of the problems of a thesaurus's structure in general.

The Amar Kosh Structure

The Sanskrit language has a vast repertory of words, but Amar Kosh lists only about 8,000, most of them nouns or names as many Sanskrit grammarians referred to them. These are versified in 1,502 *shlokas*, organised in three cantos and divided into 25 headings. One subject leads to the next associated with it or to its opposite. The poetic form at times forces the author of 'Amar Kosh' to deviate from the strict path of orderliness. At times, we find him taking short detours from the main line. The following Table-1 gives a broad idea of how 'Amar Kosh' is organised.

It is appropriate that Amar Singh starts his work with the canto called The Heavens Group and the first heading in this canto too is Heaven. Heaven and Gods occupied the top place in that society and guided not only destiny but also all social activity.

Canto 1	Canto 2	Canto 3
1. Heaven	1. Earth	1. Adjectives
2. Sky	2. Towns	2. Words with narrow meanings
3. Directions	3. Mountains	3. Words with many meanings
4. Time	4. Plants	4. Non-changing words — *avyayas*
5. Intellect	5. Animals	5. Words as per gender
6. Words	6. Man	
7. Dramatic Arts	7. Brahmins or priests	
8. The Nether World	8. Kshatriyas or warriors	
9. Hell	9. Vaishyas or traders and farmers	
10. Water	10. Shudras or menials	

Table 1: Organisation of word groups in Amar Kosh

Let us have a closer look at the contents of some of the word groups under the first heading Heaven :

1. Heaven

Gods as such
Adityas — the main Gods, sons of Aditi
Types of Gods — enumerates 11 types of Gods
Asuras or demons — they too were considered Gods in the beginning, but like Satan fell from their position later (their placement here may also be taken as the opposites of the previous)
Buddha — (because he places Buddha before Brahma and others, Amar Sinha is supposed to be a Buddhist by religion)
Brahma
Vishnu
Kamadeva or Cupid
Lakshmi — the consort of Vishnu
Belongings of Vishnu — like his conch, *chakra*, *gada*, sword, jewel, the sign on his body, his horses, his charioteer, his minister, and finally the eagle whom he rides in the skies

In a similar manner, Amar Singh goes on to give names and synonyms of various Gods and the things associated with each of them.

Sun, Fire and Air too are Gods in Indian mythology. It was appropriate for these to get their place here. Various aspects of it follow each one. For example, Fire is followed by flame, spark, heat, ash... and Air by various type of storms, various types of air that reside in the body, and Pran the breath. Since in the Indian mind air was associated with speed, it finds its place here, and so does continuity and quickness.

The fact remains that many of the Hindu Gods represent human sensibilities and various aspects of nature on which the humans subsisted. Intellect was considered a heavenly attribute, and mind and the senses were supposed to be its aspects. Word or language, dramatics, etc., again relate to intellectual activity. Dramatics (including performing arts) especially was part of religious activity and a gift of the gods.

Roget found the placement of these under the heading Heaven 'jumbled together'. However, it was quite logical to Amar Singh's time and society.

We saw earlier that the first five headings of the Second Canto, generally known as The Earth Group, got some approval from Roget. These are the ones that deal with 'natural objects', namely Earth, Towns, Mountains, Plants, Animals. (Later on, in our discussion, we will see that even these groups have not been treated by the thesaurus makers of the past or present times in a very scientific or methodical manner.)

However, the last five headings in the Second Canto are of greater interest to us. It is in them that we discover how society dictates the classification and placement of word groups in a thesaurus. Let us take a look :

The first one of these, i.e., No. 6 is devoted to Human Beings. In this Amar Singh tells us about things he thought pertained to humanity as such, e.g., man, male, female, types of women... young girl, young woman... relatives like son, brother, sister... weakling, strongman, fat man, disease... We will not go into more detail of these and other word groups included in this heading here.

From the heading 7 Brahmins onwards, Amar Singh enters the realm of social organisation. As pointed out earlier, Indian society in the Brahminical ages was organised on the basis of four well known Varnas. One has to keep in mind that to an Indian living in that age the only valid point of reference to any social activity was based on this system. All artefacts and products were every how identified with these Varnas. It may be beneficial if we go into some details of any one of these. Well... let us go to the Kshatriyas then. The following represents only a few of the first word groups under this heading :

8. **Kshatriyas.** They were the rulers and warriors. Naturally, this heading contains words pertaining to them, their activities like ruling and war, mental attributes like bravery and cowardice, and objects and things like horses and arms associated with them

King
Types of kings
Ministers
Purohit or the priest of King
Judges and justice
Doorkeeper
Bodyguards
Headmen — like the village headman, the head of the mint, the keeper of the harem, the eunuch
Subordinates, servants
Other kings — Enemy king, friend king, non-aligned king, king who defends and takes care of the fort when a king is out on a conquest
Friend
Request — requests can be made only to a friend...
Spy
Confidante

It may be interesting to note that death is included under this heading. Obviously so. Kshatriyas fought wars, war meant death. War also meant prisoners of war, and the heading concludes with them.

I will now give just a very fleeting glimpse of the Third Canto. It is titled Words in General. Here the subject matter and the author's approach are very different from what we have seen so far. It is divided into five sub headings. (see Table above)

The first of these contains adjectives. The word groups are put together either by association or juxtaposition. To give a few examples — tolerant, angry, very angry, awake, swaying with sleep, one who sleeps, asleep, facing the other way, facing down, one who worships gods, one who worships everything... We see the same approach through to the fourth heading.

The fifth and the last heading in this canto is called Words as per genders. In this the word groups are organised by the last letters, much like any other dictionary of its time.

To summarise : the structure of Amar Kosh is partly based on classification and partly on social or linguistic associations. The social and linguistic association is mostly reflected in word groups connected with human activity. Its third canto is partly glossary and partly thesaurus.

The structure of thesauruses in general

Various terms like hierarchical, classificational, domain specific and associative have been used to describe the manner of collection of words in groups according to their subject or topic and the placement of these groups in the context of other groups. One may call this the structure, framework, organisation or arrangement of a thesaurus.

Talking of Roget's arrangement of word groups, Susan M. Lloyd, who prepared the Longman's 1982 edition, writes Preface to the 1982 edition :

"Roget arranged his...material into a comprehensive framework with a clearly visible structure, in which each topic, or concept, had its own logical place. In this, he was following in the steps of the seventeenth century philosophers such as Leibnitz, who had attempted the classification of concepts as a preliminary to inventing a Universal Language... "[7]

However, this approach does not take one very far in a thesaurus. Roget had to deviate from it more often than not. Under the subheading 'The originality of the Thesaurus', of the above Preface, Susan M. Lloyd has this to say, in Roget's defence :

"While Roget approved of Wilkins's aims, and expressed his wish that his own classification might be instrumental in preparing the way for further investigations into a Universal Language, his primary intention in compiling the Thesaurus was more practical : to offer the reader a choice of expressions from which he or she could choose the most suitable or the most effective in a given context. His task, then, was two fold. First, like the philosophers, he had to create a

hierarchy of concepts, which would provide the framework for his book; then he had to discover and classify the language, which could express these concepts. While the philosophers sought to simplify, in order to discover what they hoped were the limited number of concepts basic to any language, Roget had to recognise and come to grips with the protean ambiguity of the language itself, with all its interrelationships and its infinite capacity for expressing shades of meaning."[8]

One need not elaborate further, since Lloyd has very succinctly put her finger on the crux of the problem of creating and following a structure in a Thesaurus.

Categorisation of 'natural objects' like species and placing them in a scientific manner at first might seem a very easy task. It does not turn out to be so in a thesaurus. Let us take a look.

How do we place various animals and living beings with reference to others? One may choose to place *lion* either alphabetically within a broad group called animals or under a true hierarchical and zoological categorisation. Nobody has done this.

Susan Lloyd's edition places *lion* under heading 365 *Animals/cats*. Roget's International Thesaurus (fourth Edition, revised by Robert L. Chapman), Harper & Row, 1997, puts lion under heading 414 *Animal*/27 (*wild cats*) and lists it also under subheading 58 *Mammals*. Another edition, Roget's International Thesaurus, Third Edition, Collins, London and Glasgow, reprinted 1974, lists *lion* under heading 413 *Animals*/4 (*wild animals*). However, and quite mysteriously, the same edition puts *lioness* much later under heading 420 *Feminity*/10 (*female animals*).

All these editions are published under the selling brand name of Roget, and broadly follow the original structure devised by Roget. None of these placements is very scientific or methodical, if one may say so. All of them derive inspiration from a societal context.

Mr. Tom MacArthur breaks new ground in his Lexicon of Contemporary English (Longman 1981) by devising a totally different structure. In this work, A50 *Animals/Mammals* is an independent heading having various subheadings. *Lion* is included (with illustration) under subhead A53: *the cat and similar animals*. He gives words for a female and a young lion at the same place. However, this work is not a thesaurus in the sense that it does not offer synonyms. Its purpose is to place words of a similar nature for a user to understand and appreciate subtle semantic distinctions.

To a poet a lion may remind of the deer that the lion hunts, as it certainly would a Sanskrit poet in whose imagery the two are linked through the sport of hunting. Thus, in Amar Kosh, we find *lion* as the first subcategory in the Second Canto's heading 5 *Lions* etc. He starts with lion considered to be the king of animals and puts many other wild animals just after it and concludes the subsection with cat, iguana and porcupine. The wild animals lead him to *deer* that the *lion* hunts. From the *deer*, he goes on to enumerate legendary beings that in his times were counted among animals.

What is remarkable is that Amar Singh does not list all the animals here. One finds cattle like *cow*, *sheep*, under the *Vaishyas*, because animal husbandry was their profession. *Elephants*, *horses*, etc. are under the *Kshatriyas*. It was they who used them in warfare. Similarly, in Susan's Longman edition the main entry for horses is under heading 273 *Carrier*.

This brings to another and perhaps more important aspect of the subject. How to arrange, in a thesaurus, various headings with reference to others. Let us for the time being remain with the *lion* and the *deer* and consider where may the word groups connected with hunting be placed. Under *sport*? To the kings in historical times, it was a sport. To many it **is** a sport even now. Under *jungle*? Why not? *Jungle* may remind one of *hunting*? Under *bravery*? Under *adventure*? Under professions? To a hunter who lives on his earnings from it, it is a *profession*. In such a scheme, it might be placed near *butcher*. Under *violence*? To a Vaishnavite Hindu or a Jain, who believes in non violence, it represents nothing but abhorable violence.

Susan M. Lloyd's edition puts *hunting* under heading 619 *Pursuit*. In Roget's International Thesaurus (third edition) Collins 1963, the headword is *Pursuit*, but the heading number is 653. In Roget's International Thesaurus (fourth edition) revised by Robert L. Chapman, Harper and Row, 1977 the heading number is 655.

The concept *Pursuit* forms a minor part of this heading. It gets two paragraphs pursuit and pursuer as nouns, later followed by one paragraph as verbs, one as adjectives and another as adverbs. The rest of the word groups under Pursuit are : *hunting, fishing, hunter, fisher, quarry,* (to) *hunt, fish,* and the interjections *hunting cries*.

At times one wonders that the topic of pursuit did not remind Roget of a policeman in pursuit of a thief. Or why did he not create an independent

heading hunting which could have found its due place elsewhere? Maybe the idea of pursuit could remain where it is with more word groups like following, coming after. But following reminded Roget of followers and courtiers—the concepts that could be accommodated elsewhere.

As far as the question of placement of the heading *Pursuit* is concerned, in all the Roget editions, it comes under the general class *Volition*. Susan's edition puts it under 2 *Prospective volition/conceptional* with the following plan :

617 Intention	618 Nondesign
619 Pursuit	620 Avoidance
	621 Relinquishment

In Roget's International Thesaurus (fourth edition) by Chapman (Harper & Row) it is under *Volition/ Purpose* with this plan:

653 Intention
654 Plan
655 Pursuit
656 Business, Occupation

Roget's International Thesaurus (third edition), (Collins) follows the above plan with no divergence.

Tony MacArthur, in his Lexicon, again breaks new ground. He puts hunting in the broad category M *Movement, Location, Travel, and Transport/Moving, Coming,* and *Going*, where under M34 are found *following, chasing, hunting*. This is preceded by M33 *hurrying and rushing*, and followed by M35 *escaping, etc.*

In the same work hunting also features in the broad category N *General and Abstract Terms/Showing, Hiding, Finding, Saving, and similar words* where under N359 *seeking and searching*, one finds hunt as one of the keywords. In the same subcategory *hunt* features as a keyword in N361 *finding, discovering, etc*. However, *fishing* has been delinked from *hunting* and features under *K Entertainment, Sports, and Games/K 190 Outdoor Games*.

One can understand this rather easily. Hunting is no longer a sport in western society, while fishing continues to be. Still one feels some sort of a link could be provided between *hunting* and *fishing*.

Even though *hunting* was a kingly sport in Amar Singh's time, in Amar Kosh, it features as a profession, and is placed under heading 10 *Shudras*.

Another important point to be noted here is that while the dramatics was a heavenly activity and was listed along with Gods, professional dramatists, along with *musicians* feature under *Shudras*. It may be shocking to many today, but was quite natural at that time!

All this goes to show that any placement of words or word groups in a thesaurus is at best arbitrary. Everyone tries to be as logical as possible in a field that can only be partly logical. At this point one may say in the passing that the study of language may be a science, but development of languages is generally associational which is mostly unscientific in the sense that it defies the rules of scientific taxonomy.

The Samantar Kosh

When the author (and his wife Kusum) started work on Samantar Kosh, we thought our job would be rather easy. Did we not have the excellent model of Roget to follow. As a first step, we assigned numbers to all the concepts as per our model. We thought that now all we had to do was to add Hindi words to them. Very soon we discovered that it would not work. Indian sensibility did not lead the reader as per Roget.

To give an example, Roget saw *hereafter* and *doomsday* in the context of *Future*. An Indian would be more comfortable if *hereafter* led him to *life after death, rebirth, incarnation, this incarnation, past incarnation, moksha*. To an Indian's way of looking at things, doomsday may have more to do with the end of the world juxtaposed to creation. A God fearing Muslim or Christian would think of *doomsday* linked to *heavenly justice and retribution.*

When Roget failed us, we thought of pursuing Amar Kosh. However, we found that Amar Singh was too much out of tune with expansion of knowledge and language. Also, Indian society has changed radically since Amar Singh's day. No longer is an Indian reminded of *war* or arms with reference to a *Kshatriya*. Nor would he think of *lion* in the context of a *Kshatriya* or of *cow* in that of a *Vaishya*. The *Shudras* are no longer menials or servants.

The sombre realisation was that we had no model to follow. We decided to develop our own system as we progressed with the work. The most important question was : What order, sequence, and pattern to give to our word groups so that a reader

could make the best use of it? Do we divide our headings in broad classes as Amar Singh and Roget had done?

We know Amar Singh divided the whole language in three broad Cantos : 1. Heaven 2. Earth 3. Words in General. Roget compartmentalised the whole language into eight classes : 1. Abstract Relations 2. Space 3. Physics 4. Matter 5. Sensation 6. Intellect 7. Volition 8. Affections

While organising our data of some 4,00,000+ expressions* arranged in 1,100 headings and 23,759 subheadings, we forgot all about Amar Singh and also decided to do away with the Rogetian classification. We kept ourselves to the basic line that our word groups should be collected under specific headings. Some of these headings could be clubbed together on the basis of commonness, but it would not be necessary for them to follow any strict hierarchical order. The only guiding principal in their mutual placement should be that one idea should lead to the next by association or juxtaposition. We would jump to an unrelated topic only when it became unavoidable.

If you look at the list of 1,100 headings in our Kosh, given at the beginning of the book, you will find that there is just no attempt to have any sort of classification. Only the names of some headings have been printed in bold letters. This does not indicate any logical change from one class to another. It only draws a user's attention to the nature of subjects which one may find in its vicinity. We start with

The Universe
Sky
Stellar Body

Movement of Stellar Bodies
Rotation of Earth
Eclipse

Solar System (all the non-earth planets)
Sun and Moon
Earth
Geography

Plains and Deserts
Jungles and Gardens
Garden and Urban Trees
Garden Flowers
Pits and Caves

Mountains and Valleys
Indian Mountains (list and synonyms of important mountains like the Himalayas — we give only 30 out of many)

Ponds and Lakes

Water Supply (types of wells for drinking and irrigation, water carriers, water taps)

Rivers
Indian Rivers (Ganges has 37 synonyms here, Yamuna 20)

River : From its source to the end (source of a river, waterfall, flow of water, confluence, delta, submergence in the sea, etc.)

Flood
Flood Control (dams, etc.)
Draining Out (*canals, drains, sewers, etc.*)

Seas and Bays

As in the popular mind a body of water is associated with its banks and landmass, we go to :

Landmass (coast, ground recovered from water, marsh, etc.)

Islands and Continents
Asia and Countries of South Asia
India and the States of India

Now, let me tell you briefly how we have treated the living beings. After various headings devoted to *matter* and *energy*, 'SAmantar Kosh' *Samantar Kosh* goes to *animate mater*. We start with 111 *Vegetation*, its aspects like 112 *seed, root,* 114 *branches,* 115 *leaves...* to 121 *living beings...*122 *Worms* and *Insects,* 123 *Reptiles*, 124 *Water Animals*, 125 *Fish*, 126 *Birds*, 127 *Animals*. While individual *fish* and *birds* are placed alphabetically, the *Animals* section starts with types of animals like *wild animals, pets... dairy cattle...animals used for riding and as carriers,* to *deer, lion,...cats, rats...dogs...monkeys* and concludes with *primates* to lead up to the next heading 128 *Man*.

Once again to revert to the placement of *hunting,* in 'Samantar Kosh', under heading 252 *Hunting,* one finds most of the concepts related to hunting, including fishing, bird catching, big game,

* Out of this data we included only 1,60,850 expressions to be included in the Samantar Kosh (published 1996) from National Book Trust, New Delhi. It has two parts : 1. The main thesaurus. 2. The index (we kept the index in a separate volume to help the reader. If the index is a separate volume, it can be kept open for ready reference

machan or concealed platform built for hunting, covered pit to catch elephants... *Hunting* follows heading 251 *Killing*.

Synonyms Galore

It will be very much in place if, before ending this section of our discussion, I mention another major difference between the English language and many eastern languages. In English, most of things have only one word. *Lion* is *lion*, at the most also *Leo*. *Mango* is *mango*. In Hindi, they have many synonyms. In our main data bank of 5,40,000 records *lion has 129 synonyms, cheetah 29, deer 55, elephant 165, wheat 30, mango 46, grape 34....* Among gods, we collected 2,317 names for *Shiva!* It may not be necessary to include all the synonyms in a thesaurus designed for day-to-day use. Yet, very many of them have to be included and special methods have to be devised to contain them. Let us look at the problem in some detail.

The fact that many concepts do not have a large number of synonyms allows the makers of English thesauruses to include alphabetical lists for groups of things (to change to subject from animals) like *minerals, ores, elementary metals, alloys*. In these, *iron* features in *elementary metals* (here the thesaurus maker gives two more words [*Ferro-* or *ferri-sider(o)-*], also as *iron pyrites* in minerals, *steel* is listed under *alloys*. One may comment here that, in the reader's mind, *iron* is linked to *steel*. The flow of thought in this list fails to take a user from *iron* directly to *steel*. He has to remember that steel is an alloy of iron with carbon and various other metals like nickel, chromium, manganese. Only then will he be able to locate the word steel in the next list *Alloys*.

This device of providing simple lists just does not work in Hindi. To give an example, the first edition of our work contains 20 synonyms for *iron* (out of 57 from our data). Similarly, the device of lists does not allow the inclusion of other related things like *raw iron, cast iron, iron dust* — for all of which the Hindi language has many words. Besides these, our work under heading 93 *Metals* goes on to *steel, alloy steel, stainless steel,* steels which were used in India earlier, *e.g., armour steel.*

Thesaurus : a mirror of society

Thus we see that the very scope and design of a lexicographic work and its success depends on the clear understanding of the target audience on part of its makers. On this depend the criteria for the basic format, framework or structure of a work. For example, a dictionary made for poets has to be arranged by the last letters of words, to be of help in rhyming. Thus, a large number of earlier dictionaries in many oriental languages follow this pattern. And we today have many rhyming dictionaries. On the other hand, dictionaries in the modern age of the printed book are made for writers of prose. We find them following the alphabetical order so familiar to all of us.

Similarly, it is the users who dictate the placing and inter relations in which various word groups in a thesaurus are to be arranged in proximity of others. If a thesaurus has to lead its users from one word group to another, it will have to follow the scientific cultural and mental perceptions of its society to be of any practical use to it.

It is a cliché, but bears repetition. Like a piece of art, a lexicographic work, too, be it a dictionary, glossary, vocabulary or a true thesaurus in the modern sense, has to be addressed to its own society at any given point of time. It has to take care of the understanding levels, mental perceptions and thought patterns of its target audience.

Footnote

1 Amarasimha, Amarkosa (Namalinganushasana) Bhoomika (Preface) to the First Edition (1947, edited with Notes) and The 'Maniprabha', Hindi commentary by Pandit Haragovinda Sastri, Published by Chowkhamba Sanskrit Series Office, Varanasi, pp 9, Second edition, 1978.

2 Ibid, pp 13.

3 Ibid, pp 13 to 16.

4 Ibid, A footnote quotes Pandit Girija Prasad Dviwedi on Prof. Maxmueller, pp 7.

5 Footnote to Introduction to the original edition as reproduced in Roget's Thesaurus of English words and phrases, New edition prepared by Susan M. Lloyd, Longman, Group Limited, 1982.

6 Ibid, The above footnote continued.

7 Ibid, Preface to the 1982 edition, Last Paragraph, pp vii, 1982.

8 Ibid, Preface to the 1982 edition by Susan M. Lloyd, pp vii, 1982.

Article

An Overview of the State of Science Journalism in India

Dr. Y. Bala Murali Krishna
Bureau Chief & Special Correspondent, United News of India (UNI)
D-5-B, Govt. Flats, St. Inez, Panaji, Goa - 403 001
Email : ybalamuralikrishna@gmail.com; ybalu@operamail.com

Introduction

Science journalism started taking off these days with the media, both print and electronic, giving prominence to different events. Trained and experienced science journalists and communicators are in demand with the opening up of more career opportunities for them. These opportunities are plenty both in India and abroad with the information technology combined with convergence benefits becoming a handy tool for instant communication across the globe.

The trained communicator at the sametime should be equipped not only with the appropriate writing techniques but also conversant with media laws and ethics without observing which one could be miserable as a media professional.

The science communicator could further shine if he chooses journalism as a mission, not simply as a profession or a career where he is devoid of commitment to the cause of either science or journalism. Indian writers require a missionary zeal as witnessed during the pre and immediate post independence era to promote scientific temper among the masses through journalistic profession.

Background

With India making rapid strides in science and technology, the need for experienced science communicator has become imperative. Though the number of science journals and magazines constitute an insignificant number compared to over 5000 dailies and 50,000 periodicals in the country, the media, both print and electronic have started giving good coverage of scientific events and developments, though not at the desired level considering country's large scientific establishment.

India's science establishment consists of 38 prestigious research laboratories under the Council of Scientific and Industrial Research (CSIR), spread across length and breadth of the country. This is apart from various other organisations such as the Bhabha Atomic Research Centre (BARC) and the Indian Space Research Organisation (ISRO), besides a slew of research laboratories under the Defence Research Development Organisation (DRDO).

To top it all, Dr. A.P.J. Abdul Kalam, considered father of the Indian Missiles Technology has been chosen as the President of India even as the country witnessed rapid progress under his stewardship particularly as the chief scientific advisor, cabinet rank, to the Prime Minister earlier.

At the sametime, the country has several prestigious research institutions in the private sector and joint sectors such as the Tata Energy Research Institute (TERI), Tata Institute of Fundamental Research (TIFR) and the Centre for Science and Environment (CSE) which provided the scientists with a role model for investigative science journalism by breaking the story of pesticide residues in bottled water and soft drinks questioning the very credibility of the multi-national companies in the field.

While the Goa-based National Institute of Oceanography (NIO) had become a pioneer in ocean sciences research with many patents registered to its credit besides commercialising its technologies, the National Centre for Antarctic and Ocean Research (NCAOR) is credited with replicating the Antarctic sub-zero temperature in a state-of-the-art laboratory at its Vasco-da-Gama headquarter to undertake micro-paleo-climatic studies using ice-core the scientists brought from Antarctica that is bound to revolutionise climate studies.

The CSIR laboratories brought laurels to the country by securing many patents and commercialising technologies benefiting the humankind. Their spin-off technologies started yielding results in myriad fields of applications including medicine and defence such as stents to deal with heart patients and warming up the soldiers on icy heights of Himalayas without suffering the frost bites.

Other achievements included perfecting satellite technologies using cryogenic engines for launching geo-synchronous satellite launch vehicles and efforts now underway to send unmanned mission to the moon (Chandrayan) under the pioneering leadership of ISRO.

Many more were such achievements in the field of agriculture, oceanography, environment, medicine and biotechnology. Efforts to tap the vast resources of gas hydrates entrapped in the seabed as ice crystals were also underway apart from claiming ownership of expanded EEZ for which a marathon multi centric oceanographic survey was made recently.

The rapid strides in the S&T should not narrow the development of human face. Efforts to induct scientific temper among the masses to help their awakening towards a better society are also underway simultaneously, both through the media and the government wings such as the National Council for Science and Technology Communication (NCSTC), Indian Science Writers Association (ISWA) and the Indian National Science Academy (INSA), leave alone several NGOs and dedicated individuals and scientists.

The million dollar question before us now is whether science journalism has grown on par with the development in S&T in the country to bridge the gap between the scientists and the masses.

The answer is certainly no but there has been a radical change for the better in this regard during the last one decade if we closely watch the media coverage of scientific events.

Media Priorities : Politics, Crime & Cricket, Not Science

According to a recent study, science coverage in India is about 3 per cent which should be increased to at least 15 per cent for proper projection, as desired by the Indian Science Writers Association (ISWA), the only professional body comprising both scientists and journalists writing for science and technology promotion in the country.

With politics and crime taking precedence propelled by commercial outlook instead of missionary zeal, the coverage of science in the media continued to be poor and science stories make front pages only occasionally. Dismal was number of scientific journals in the country while some had been closed down for want of support.

Regrettably, leading science magazines like *Science Today, Science Age, Bulletin of Sciences, Research and Industry* and Indian editions of foreign science magazines, like *Vigyan (Scientific American), World Scientist (La Recherche*) could not survive for various reasons. Recently, Indian edition of *Popular Science*, however, started its publication from New Delhi.

Unscientific and occult information continues to take precedence in the media as against the scientific information that promotes logical thinking and scientific temper among the masses, particularly rural folk and the student community.

It is only recently that the electronic media started broadcasting special programmes to promote science and technology and environment and holding competitions to popularise science. In fact, the country with over one billion people and a majority of them illiterate needs an exclusive channel for promoting science among masses on the lines of sports and entertainment.

Translation-transliteration

Yet another major hurdle for not so encouraging coverage of science and technology events is lack of professional translators into and from regional languages. The phrases ‘in vitro’ and ‘in vivo’ are misunderstood as some terminologies by the translators and the sub-editors use the same words in the translated copy as was witnessed by the author in some popular and highly circulated Telugu newspapers.

In one of the national news agency copies, an experienced senior deskman considered ‘lab to land’ as a technology and tampered with the copy. The science stories were given to inexperienced sub editors with no scientific background for editing with no suitable hands available in the desk. We can thus imagine the fate of the science story.

Some egoistic sub editors try to hold or kill the interesting science story as they fail to get their doubts clarified from the author of the story as they feel beneath their dignity and self respect and that they are masters of the subject.

Held up was one such story related to wild bees finding massive structures of the Narora Atomic Power Plant in Uttar Pradesh as their favourite rendezvous for building innumerable colonies of honeycombs.

The sub-editor has the strong notion that the bees cannot survive at the atomic power plant even as the scribe produced photos and different versions of the authorities of the atomic power plant. The story was later released with the intervention of the news editor after getting more information on several such huge honeycomb colonies at the astronomical centre near Pune and the Bees Research Centre in Pune. Informatively, Narora Atomic Power Plant was the first in the country to have secured the coveted ISO-14001 certification for maintaining international environmental standards in and around the plant.

This makes it amply clear that the sub editors as also the reporters need exposure to science and technology related issues and training through capsule courses so that the former were in a better position to polish the copy to make it more catchy and the latter gained expertise to file the science story in simple language with more punch to make it more effective and educative to the common reader.

Of course, writing a science story in the common man's language in simple terms is very difficult unless the writer understood the essence of the entire story and its implications and put it in his own language avoiding the scientific jargon. This could be done only when the journalist takes strain and homework before and after getting the story, through a press conference or an interview to his satisfaction.

Cultivation of sources : Embargos - imbroglios

Another difficulty these days is handout journalism. The scientist in charge often does not maintain rapport with the scribes. He comes in the open through a handout only when there is a newsbreak. Even during the new briefing, he tries to explain the development in his own jargon and gives out a handout that contains more jargon and acronyms.

This could be eliminated once the science writer is conversant with the jargon and translates the story in simple language avoiding the jargon to the maximum extent. While writing a story, the journalist should keep in mind the audience / reader he is about to inform and educate, setting aside his professional standards and profile, if at all he wants to become a popular science writer.

This could not be achieved overnight. The journalist should cultivate the sources and vice versa for the common objective of informing and educating the target reader / audience. It applies to all media - the print, radio, TV and the Internet alike. There is no compromise in it.

At the sametime, the journalist should protect the source by all means; even if attracts imprisonment after a court trial. One should bear in mind that "source is sacred and protect it".

If one scientist confides with you some development and asks you not to report till sometime, you should abide by it. The embargo of a story, set by the scientist or an institution should be kept, not broken at all. Otherwise, you will be in trouble in due course, as no source would trust you. You would thus be at a disadvantage.

Plagiarism - Press Notes

Successful is the science journalist who tries to probe to get more details of a scientific event or a development at a press conference or an interview instead of depending on a press note.

No doubt, press notes are mostly pithy and vague full of jargon, particularly released by scientific institutions. It could be in shape if a professional public relations officer with expertise in science writing issues the handout after whetted by the scientist incharge concerned.

Many are the newspapers in the country that simply release the handout as it is without bothering to explain or elaborate the content and acronyms. The case is different in case of crime stories and politics and sports, as they tend to reel out volumes of backgrounds and anecdotes related to these subjects.

Hence, the need for specialised science correspondents who know the importance of the story or an event and file it suitably with background wherever it is necessary and do justice to the science story. They also know whether a specific story should be followed up or not and when to do it.

Training facilities in newspapers and other media establishments in science journalism are very few and limited. Mostly, the establishments in the capital city of Delhi have the system of appointing science correspondents to take care of the S&T, Environment and Health ministries, etc.

They had been sent out to cover the major events such as the annual sessions of the Indian Science Congress with the ministry sponsoring the trips besides boarding and lodging. Very few are the organisations that send their staffers to cover the scientific sessions on their own without depending on the government assistance. Unfortunately, the special correspondent on job gets no assistance from other reporters as covering S&T is nothing but Greek and Latin for them with no genuine efforts made to cover the events.

Regrettably, the coverage of the respective science congresses was not so encouraging. The newspapers often publish the inaugural session and the concluding session wherein the Prime Minister and S&T minister were present. At the most, they publish one or two stories of the sessions and nothing else.

It would be a wonder if a local newspaper brings out a supplement exclusively covering the science congress sessions, as it does not involve any advertisement galore like other social events such as industrial exhibitions.

Prejudices and jealousies

Professional jealousies and ditching are common in this field also. Rare are the occasions when colleagues in the beat congratulate a journalist for filing a good story. Instead, they try to make insinuations and pass unsavory comments against the good work done by the colleague in science journalist fraternity.

Some even try to project an opinion that they are monopoly in the trade by virtue of their long standing in the field of science journalism and do not allow others to grow.

This tendency goes to such an extent that they question the scientist who passed on the information to his rival responsible for filing the exclusive science story. They think it is their exclusive prerogative and domain and that the scientific institutions should first report to them and later others.

Hence, the novice in science journalism needs self respect and caution requiring him / her to rise above these narrow domestic walls and establish his own contacts through sheer dint of hard work and homework to make a mark in the profession. This required dedication to the profession with missionary zeal.

Often, the science journalist will be facing an awkward situation wherein the boss of a scientific institution is not willing to communicate with the media on the pretext of getting permission from his higher ups. They do not even part with information related to patents obtained following the good work done by the fellow scientists.

The use of Internet websites comes handy in this kind of situation. One could access the US patents websites and secure the information related to the patents secured by the particular institution in India and elsewhere. You can even access the official websites of concerned Indian scientific institutions and analyse the information for a follow up story.

If you do not know the Uniform Resource Locator (URL) of the particular website, try to make use of the search engine facility which opens up all vistas to assist you. But beware, try to learn to what extent the content of a website should be relied upon. Proficiency in information technology tools would be of immense help to the modern science journalist.

The science websites such as the *www.eure kalert.org, www.newswise.com, www.aaas.org, www.scidev.net, www.sciencedaily.org www.cseindia.org and www.nature.com* are quite useful as they send alerts related to embargoed stories and science news breaks which you can depend on for widening your knowledge base and contacts in S&T in India and abroad. Noted foreign institutions like the, NASA, Scrips and Woods Hole Institute of Oceanography.

Many websites based in the USA and the UK provide you with information related to scholarship for promoting science journalism abroad. It would be a wonderful opportunity. Other websites besides noted newspapers like the Christian Science Monitor would invite you to send commissioned science stories and write ups and offer good remuneration.

The scope for growth is plenty in science journalism. Tapping the potential requires talent and hard work imbued with writing skills. Vast resources are at your doorstep in this globalised village in the Information Technology era.

"Science writers, like all other journalists, must have an insatiable appetite for reading, and the best are endowed with a memory like a filing cabinet," says late Anthony Tucker, former science editor of the British newspaper *The Guardian*.

Inquisitiveness combined with probity, perseverance and skills of communication makes you a successful science journalist worthy of pride. The talent could

develop in science writing provided different institutions also instituted scholarships, awards for best science reports and organised training courses for journalists.

Facilitating inter-institutional visits of journalists to reputed scientific laboratories for interacting with the scientists besides providing them backgrounders would go a long way in promoting science journalism. An exclusive website to facilitate networking of all science journalists on a regular basis would further boost science journalism in this information technology era.

The NCSTC, in collaboration with different institutions should come out with publications for free circulation among science journalists besides organising more training courses to encourage science communication across the country. Universities should include science journalism in the JMC depts.

Interacting with the local farmers / people and identifying their problems that could be related to science for projecting them in the media would also go a long way in the task apart from popularisation of science and technology and promoting scientific temper among the masses. It could help bring out scientific facts through analysis of traditional knowledge and practices in vogue.

The S&T ministry should try to impress upon the scientific institutions on the need for transparency in their functioning so that the journalists would have easy access to information through their websites as also heads of the institutions, besides facilitating regular interaction with the regional media units. ■

To Our Readers

Indian Journal of Science Communication invites readers' views and critical comments on any of the aspects of the journal. Suggestions for further improvement in presentation of the journal and its contents are also welcome. Selected letters would be considered for publication under the column *'Letters to the Editor'*.

उल्लेखनीय विज्ञान कथाएं

पुस्तक : 325 साल का आदमी (विज्ञान कथा संग्रह)

लेखक : मनीष मोहन गोरे

प्रकाशक : भारतीय विज्ञान कथा लेखक समिति, फैजाबाद (उत्तर प्रदेश)।

प्रकाशन वर्ष : 2006

पृष्ठ संख्या : 88

मूल्य : 120/- रु. मात्र

इक्कीसवीं सदी का पहला दशक मानो हिन्दी विज्ञान कथा की एक नई सुबह लेकर आया है। इस दशक में युवा विज्ञान कथाकारों की उम्दा विज्ञान कथाएं चर्चा में हैं। जाकिर अली रजनीश, कल्पना कुलश्रेष्ठ, अमित कुमार के कथा संग्रहों के बाद अब युवा विज्ञान कथाकार मनीष मोहन गोरे का यह पहला विज्ञान कथा संग्रह निश्चय ही हिन्दी विज्ञान कथा साहित्य के लिए एक शुभ संकेत है।

समीक्ष्य कथा संग्रह में ग्यारह विज्ञान कथाएं सम्मिलित हैं। संग्रह की पहली कहानी 'पृथ्वीपुत्र' सुदूर भविष्य के मंगलवासियों की पृथ्वी के लोगों से पहले तो शत्रुता और फिर मैत्री प्रस्ताव की एक सुखान्त कथा है। संग्रह की अगली कथा 'स्वर्ग रथ' ब्रह्माण्ड के निस्सीम दिक्काल में जीवन के खोज की एक मुहिम का जीवन्त वर्णन करती है। डॉ. कौस्तुभ जहां अंतरिक्ष यान में 'तरल नाइट्रोजन' के कैप्सूल के अपने 'विलम्बित जीवन' के सहारे कई सदियों तक ब्रह्माण्ड में विचरण करते रहते हैं, वहीं धरती पर उनके इस अद्भुत अभियान के अनुश्रवण में वैज्ञानिकों की कई पीढ़ियां गुजर जाती हैं। तीसरी कथा 'नाभिकीय बम और कागज के सारस' में विज्ञान की संहारक क्षमता के खौफनाक मंजर पर मानवीय जिजीविषा की जीत का संदेश है जो मुख्य कथा पात्र जनमेजय के अनोखे से एकल शांति प्रयास - एक हजार कागज के सारसों को बनाने के प्रण से प्रेरित है। अगली कहानी 'विनाश का इतिहास' एक मार्मिक कथा है जिसमें मुख्य पात्र डॉ. निरंजन समस्याओं से ग्रस्त धरती से भविष्य गमन कर अनजाने ही चन्द्रमा पर जा पहुंचते हैं जहां पहले से ही एक विकसित सभ्यता अस्तित्व में है।

संग्रह की अगली कथाओं में 'एडीसन की छायाप्रति' में लेखक ने 'क्लोनिंग' विधि द्वारा प्रसिद्ध वैज्ञानिक थामस अल्वा एडीसन को जीवित करने की कल्पना किया है। 'उड़नतश्तरी' परग्रही लोगों से धरतीवासियों की एक दोस्तान मुलाकात की दास्तान है तो 'हादसा' क्लोनिंग कथा की ही पुनरावृत्ति है। 'जीवन की तलाश' कहानी अधिक प्रभावशाली बन पड़ी है जो पृथ्वी से इतर प्रॉंकुर ग्रह पर 'मानवी' सभ्यता की तलाश करती नजर आती है।

भविष्य की नारी' मानवीय संवेदनाओं को उकेरती हुई उस असहज स्थिति का पूर्वावलोकन कराती है, जब नर-नारी के आदर्श मूलक एकनिष्ठ संबंधों का वजूद मिट चुका रहता है। नारी महज बच्चा पैदा करने की मशीन न होकर एक स्वच्छन्द और सर्वथा उन्मुक्त जीवन की हिमायती होती है। 'निराहारी मानव' प्रकाश संश्लेषण के गुण धर्म से युक्त मनुष्यों के कल्पित अस्तित्व पर आधारित विज्ञान कथा है। संग्रह की शीर्षक कथा '325 साल का आदमी' डायरी विधा की कहानी है जिसमें 1680 में जन्में विलियम फ्रैंक नाम का शख्स आत्मकथात्मक शैली में 04 जुलाई 1775 से प्रारम्भ कर अपने जीवन का वर्णन करता है, यानि कुल 325 वर्ष का जीवन वृतान्त! है न हैरतअंगेज बात...? पर विज्ञान का यह चमत्कार संभव कैसे हुआ, इसकी मुकम्मल जानकारी पाठकों को संग्रह की यह कथा पढ़ने से ही हो पाएगी।

समीक्ष्य पुस्तक में हिन्दी की उल्लेखनीय विज्ञान कथाएं समाहित हैं जो भावी विज्ञान कथाकारों के लिए अनुकरणीय होंगी।

डॉ. अरविन्द मिश्र
16, कॉटन मिल कॉलोनी
चौका घाट, वाराणसी, उत्तर प्रदेश
Email : dr_arvind3@rediffmail.com

Science Communication in India : Status and Challenges

Ashish Baldi
Department of Biochemical Engineering & Biotechnology
Indian Institute of Technology Delhi, Hauz Khas, New Delhi - 110016
Email : ashishbaldi_iitd@hotmail.com

Introduction

Scientific information is becoming an essential and integral part of people's daily lives. Science communication efforts have great potential in shaping the lives of the people and making their decisions more informative and rational. India has an impressive scientific heritage. At present, India has undertaken a large number of science communication initiatives. There also exist challenges like ineffective utility of various modes of communication, dry and boring scientific writing, lack of new methodologies and absence of a properly defined national policy to monitor scientific communication activities still persist. Present article will address current status and possible solutions of problems involved in order to bridge the gap between science, scoemce writers and common man.

Modern science has really bun making inroads into human domain in this part of the world with the development of a strong scientific culture in India and other countries of Asia-Pacific region. Although India has an impressive scientific heritage in form of ancient literature in almost every facet of science mainly mathematics, medicine, geography, astronomy, etc., it is only in the last 20 years or so that India has experienced a widespread penetration of science communication activities in the daily life of common man. These efforts are making their decisions more logical, informative and rational. Both government and non-government organisations are making best efforts in spreading scientific knowledge in public. Science is truly a collective endeavor and enhancing the understanding of common man is directly related to scientific thinking of the nation and also leads to development of a knowledge based socio-cultural diversity, which is the unique quality of India.

Progress made till date

India's well developed and rich scientific knowledge based past was not transcribed in to the next generations due to unawareness of common man and woman, lack of proper scientific communication and loss of ancient literature. After independence, the concept of modern 'scientific temper' was introduced by Pandit Jawaharlal Nehru, which means an enquiring attitude and analytical approach that leads to rational thinking and the pursuit of truth without prejudice. Accordingly, the constitution of India has a special provision 'to develop the scientific temper, humanism and spirit of enquiry'.

Then a number of government agencies and non-governmental organisations (NGOs) made serious efforts to popularise science by improving science communication at various levels. There are two levels of scientific communication, one is among the institutions and another is among the population. The developments made in this field since 19th century along with representative activities are given in Table-1.

Modes of scientific communication

Science communicators of India have used various modes of communication to reach out to the masses as huge socio cultural and economical diversity exist in the country. As a result, nowadays a lot of infrastructure, software and human resources are available in the country with their own importance and utility.

Following are different medium that are used in India to improve science communication :

1. Print media

- Mainly includes science journals and science based articles in daily newspapers.

2. Audio visual media

- More popular mode based on television serials and science based shows on radio.

Table 1: Chronological development of scientific communication efforts in India

Year	Development	Activities
Early 19th century	Translation of English books in local languages by elite upper class.	Bengali journal *Sangbad Koumudi*, edited by Raja Ram Mohan Roy in 1820's.
Early 20th century	Books published in languages like Hindi and Bengali.	*Vigyan* (Science), a monthly popular science magazine in Hindi, has been published by 'Vigyan Parishad' (a learned society of scientists and academics) since 1915. *Visyaparichay*, published in 1937 by Noble laureate Rabindra Nath Tagore.
1950-1980's	Post independence era, publication of journals and formation of scientific societies.	The National Institute of Science Communication (NISCOM) began publishing of the Hindi popular science journal *Vigyan Pragati* (Progress in Science) in 1952. The *Science Reporter* (an English monthly) and *Science Ki Dunia* (an Urdu quarterly) followed soon. 'Kerala Sastra Sahitya Parishad (KSSP)' established. The National Council of Science Museums (NCSM) was established.
1980's	Involvement of public and non-government organisations along with print and audio-visual media.	People's Science Movement (PSM) formed, later changed its name to the All India People's Science Network (AIPSN). National Council for Science and Technology Communication (NCSTC) was established in 1982 with a mandate to integrate, coordinate, catalyse and support science communication and popularisation, at the micro as well as macro level. Several NGO's like The Indian Science Writers' Association (ISWA, in 1985) were founded. Vigyan Jatha, village to village march of scientific communicators that could be considered the biggest science communication experiment anywhere in the world, were held in 1987 and 1992. Vigyan Prasar, an autonomous organisation of the Department of Science and Technology set up in 1989, coordinates efforts among various scientific organisations for the effective exchange and dissemination of scientific information. A 13-part film serial on the history of science and technology in the Indian sub-continent and its impact on the world, entitled 'Bharat Ki Chhaap', was produced by NCSTC and broadcast on the state-run Doordarshan channel in 1989.
Early 1990's	Strong involvement of media and establishment of professional bodies with specific goal to improve science communication in India.	144-part radio serial 'Manav Ka Vikas' (Human Evolution) was jointly produced by NCSTC and All India Radio in 18 Indian languages. The annual Children's Science Congress was started in 1993. Indian Science Communication Society (ISCOS), a non governmental association of professional science communicators set up in 1994 and publishes *Indian Journal of Science Communication.*'Scientific Explanation of Miracles'. Programme which used trained science activists to demonstrate and explain so called miracles.
1995-2005	Involvement of Digital media, including internet and CD-ROMs and software development.	VIPNET, the VIgyan Prasar NETwork, established in 1998, groups together over 2,000 clubs and associations dotted all around India and dedicated to the diffusion of science. The National Centre for Science Communicators (NCSC), founded in 1997, is responsible for creating the National Directory of Science-Communicating Organisations, Governmental Organizations (GOs) and non-Governmental Organisations (NGOs). Start of NCSTC's training programmes in science and technology communication, software development, research, field-based projects and creation of information networks and databases.NISCOM also brings out 11 professional scientific journals and publishes various popular science books. Declaration of Science and Technology Policy in 2003.

3. Folk media

- Uses traditional means of communication in local languages.
- Includes street plays, puppet shows, folk songs and dances, stage shows etc.
- More successful and cost effective mode.

4. Interactive media

- Science exhibitions, science fairs, demonstrations, seminars, workshops, lectures, scientific tours, conferences and digital softwares.

Challenges Ahead and Future Perspectives

Scientific research in India is making huge progress as there are currently more than 100 research institutes and over 150 university centres throughout India and the number of private centres dedicated to research and development is also on the rise. Although India features so much interest and offers so many initiatives and activities dedicated to science communication, there is still an urgent need to make these activities more effective qualitatively and quantitatively. Prof. Yash Pal, one of the most important scientists continuously striving to diffuse science, says : "it is true that a lot is done to promote scientific knowledge in our country, but it is not enough. The 'scientific awareness' spreading process must take place first and foremost by contextualising the data and knowledge into the needs of everyday life. We have to make our communication more interesting and interactive". Current status of scientific communication efforts in India, basic problems and possible solutions to narrow the gap between science writers and common man are as follows :

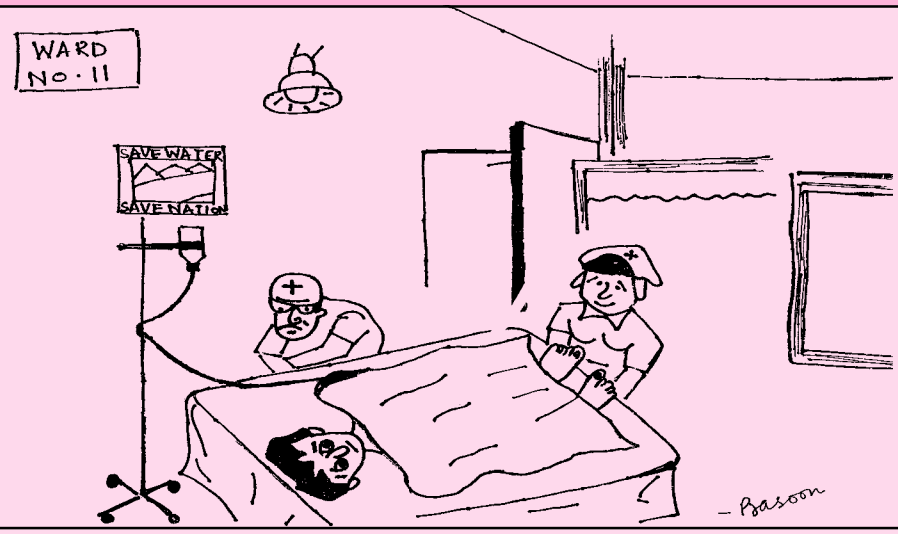
Population related problems and socio cultural diversity

More than one billion population of India has resulted in so many problems related to fulfillment of their basic needs like shortage of resources, environmental deterioration and illiteracy. Unawareness and widespread superstitious beliefs in rural areas of country has also aggravated the problem. Communication is a cultural process and existing cultural differences amongst population is also major area of concern. People in India speak more than 1600 different languages and this resulted in universal ineffectiveness of means used to improve scientific communication in different regions.

Although literacy level is increasing these days, scientific literacy is very low. Efforts can be made for mass science education of common man by paying more attention to local languages and with the help of trained scientific communicators. A need is also there to wipe out the superstitions that prevailed mainly in rural areas. Development of need based specialised programmes according to the needs and problems of each individual region and use of folk

(Contd. on page 33....)

SCIENTOON



Poor chap! He was highly influenced by the slogan "SAVE WATER-SAVE NATION..." He stopped drinking water and then dehydrated. He has now agreed to take intravenus injection of glucose.

(Contd. from page 32....)

forms can also be possible means for effective communication.

Poor reading habits and complexicity involved

Literature is said to be mirror of the society but unfortunately Indians are very poor readers and adding to the problem is poor communication skills of scientists. About 82% of Indian science communication has never surfaces. The present academic system emphasises only on the contents of a scientific subject, but ignores its language. Good literature reading habits and command on language of scientists from developed nations give them an advantage and thus they dominate the international scientific publications.

Development of good reading habits along with study of language and literature is essential to be a good communicator. Mere production of voluminous literature is not enough; it should arouse the interest of the reader on the subject and be conveyed in a simple and lucid manner to make it understandable.

Unattractive forms of communication

The general public is still largely ignorant about common scientific principles as science is not succeeding in attracting mass media interest. Science writing still tends to be dry and boring, resulted in lost interest of print media also. On average, science only accounts for around three per cent of coverage by India's mass media. Additionally diminishing interest in printed matter, greater demand for audio visual presentations, lack of proper format and specific forms of communication for target public are the reasons for the major discrepancies between supply and demand of scientific communication. Well educated and trained science communicators and voluntary organisations are alarmingly low in numbers and hardly sufficient to cater to the large and diverse population of country.

Modes of presentation of scientific information in media should go under a complete makeover with a new generation of the science writers and journalists presenting useful science in an interesting and innovative manner. For example, a common platform should be established to allow writers and journalists to exchange information on scientific research and developments.

Lack of funds due to basic needs

Being a developing country, shortage of funds specifically for scientific activities also put countries like India on a back foot in comparison to other countries in the world. The country only allocates approximately 1% of its gross domestic product to research and development (R&D), to reach 2% in the next two years.

Government policies

Communication continues till the receiver is engrossed with the content. It is the duty of the source to deliver the message in simplest and understandable manner. Makers of the National Science Policy should take note of these aspects. The challenge will therefore also to co-ordinate all the institutions and associations engaged in scientific research. Most importantly, science communication activities must be conducted and governed in a well planned manner, according to a properly defined national policy under one umbrella organisation. Infusion of creative ideas and innovative approaches along with development of a strong and effective network with the help of digital media to work in synergistic manner are also vital for proper communication.

Establishment of NCSTC Network in 1991 with the goal to popularise science activities in all parts of the country is one of the major steps in this direction. Presently it has around 100 members, including NGOs and government organisations. NCSTC has also started a countrywide project to compile information on science communication software, hardware, 'humanware' and agencies to facilitate further networking.

Conclusions

There is no doubt that scientific information is becoming an essential and integral part of people's daily lives. Present and future science communication efforts have great potential in shaping the lives of the people and making their decisions more informative and rational. In an ideal world, science communication activities would be widespread right down to the village level. Furthermore the need of scientific information will also increase with technological advances. India has undertaken a large number of science communication initiatives, and has sometimes led the way in innovative approaches. But still the problem of ineffective scientific communication persists because of large population and ignorance of common man to scientific research. The present scenario can be changed by application of new ideas, methodologies and strategies. Mass education, trained scientific communicators, better utilisation of existing facilities and effective networking with properly defined policies are the possible solutions to carry scientific messages to the people impressively. ■

Data Mining on Plant Sciences

M. Praveen[1], P. Mukesh[2], K. Subhash[2], and N. Rama Swamy[2],
1. Department of Biotechnology, Dravidian University, Kuppam – 517425 (A.P.)
2. Department of Botany, Kakatiya University – 506 009 (A.P.)

The success of any research group depends upon the up-to-the-minute data available with the group generated in the labs located all around the world. A researcher should be able to know the basic strategies for accessing the literature which has undergone rapid transformation after the integration of internet into every lab. Now each researcher is required to know what, where and how to search for the information. The present paper communicates use of internet for a botanist to retrieve the required data from different sources.

The world wide web (WEB, WWW or W3) was conceived and developed at CERN, the European laboratory for particle physics, to allow information sharing between internationally dispersed groups in the high energy community. The concept of information sharing between remote locations and the ramification for rapid data dissemination and communication found immediate application in numerous other areas. As result the web spread quickly and is making a profound impact in the filed of modern science (Baxevanis and Ouellette, 1998). Hence now-a-days internet is popularly referred as the 'information superhighway' as it has achieved a very pervasive influence in everyday life (Sagjoy etal., 2001).

Internet is a network of computers located all round the world with the ability to access end exchange information with lightening speed. The scientific data generated by educational, governmental and business organisations can be obtained by a simple click. Internet basically provides various services such as e-mail, newsgroups (group of people sharing latest information of their area of interest on day to day basis), FTP (file transfer protocols), Tenet etc., (Sanjoy etal., 2001). In order to work effectively, the networks share a communication protocol, called transmission control protocol - internet protocol better known as TCP-IP. It has shown a pervasive influence in everyone's life with massive expanding body of information. The latest information published in journals or proceedings of particular conferences can be now reach the hands of researcher within no time, whereas the classical approach is equal to 'searching a small fish in an ocean at the time of heavy storm'.

The beauty of internet lies with its capability to join two or more different web pages (data written in html format that contains texts, images, links, etc.) together at a particular site and the whole information can be searched by using search engines (Table 1). A web search engine is an interactive tool to help people locate information available via WWW. Web search engines are actual database that contain references to thousands of resources. Users interact with the database, submitting questions that 'ask' the database if it contains resources that match a specific criteria.

Table 1: Popular search engines

Search Engine	Hyperlink
Yahoo	http://www.yahoo.com
Google	http://www.google.com
Excite	http://www.excite.com
Info	http://www.info.com
Altavista	http://www.altavista.com
Big hub	http://www.thebighub.com
Hot Bot	http://www.hotbot.com
Lycos	http://www.lycos.com
Looksmart	http://www.lookstnart.com
Elite	http://www.elite.com
Dog pile	http://www.dogpile.com
Mega sources	http://www.acr.ryerson.ca/joumal/megasource.html
Profusion	http://www.profusion.com
123india	http://www.123india.com
khoj	http://www.khoj.com

Table 2: Websites useful for searching information in online plant science journals

Online Journals	Hyperlink
Abstracta Botanica	http://ramet.elte.hu/podani/abscont.htm
Acta Botanica Croatica	http://hirc.botanic.hr/actabot/actahome.htm
Acta Horticulturae	http://www.actahort.org/
Acta Paleobotanica	http://botan.ib-pan.krakow.pl/acta/default.htm
African Journal of Biotechnology	http://www.academicjournals.org/AJB/
American Journal of Botany	http://www.amjbot.org/
American Potato Journal	http://potato.tamu.edu/assobuis.htm
American Scientist	http://www.sigmaxi.org/amsci/amsci.html
Annual Review of Cell and Developmental Biology	http://celIbio.annualreviews.org/
Annual Review of Genetics	http://genet.annualreviews.org/
Annual Review of Plant Physiology & Plant Molecular Biology	Physiology http://plant.annualreviews.org/
Annual Review of Phytopathology	http://phyto.annualreviews.org/
Aquatic Botany	http://www.elsevier.com/locate/aquabot/
Archives of Phytopathology and Plant Protection	http://www.tandf.co.uk/joumals/titles/03235408.html
Arctoa: A Journal of Bryology	http://herba.msu.ru/journals/arctoa/
Asian Journal of Plant Sciences	http://www.pjbs.org/ansinet/ajps/tjps.htm
Australian Journal of Botany	http://www.publish.csiro.au/journals/ajb/
Australian Journal of Plant Physiology	http://www.publish.csiro.au/iournals/fpb/
Australian Systematic Botany	http://www.pub]ish.csiro.au/journals/asb/
Australasian Plant Pathology	http://www.publish.csiro.au/joumals/app/
Biodiversity and Conservation	http://www.kluweronline.com/issn/0960-3115
Biodiversity Newsletter	http://www.unibas.ch/mco/newsletter.htm
Biologia Plantarum	http://www.kluweronline.com/issn/0006-3134
BioScience	http://www.aibs.org/bioscience.html
Biotechniques	http://www.biotechniques.com/
Biotechnology Advances	http://www.elsevier.com/locate/biotechadv/
Biotechnology Letters	http://www.kluweronline.com/issn/0l41-5492
BMC Plant Biology	http://www.biomedcentral.com/1471-2229/
Botanical Electronic News	http://www.ou.edu/cas/botany-micro/ben/
Botanical Review	http://www.nybg.org/bsci/spub/botr/frontpge.html
Brazilian Journal of Plant Physiology	http://www.cpa.unicamp.br/bjpp/
Bryological Times	http://www.unomaha.edu/-abls/bryotimes.html
Canadian Journal of Botany	http://www.nrc.ca/cgi-bin/cisti/journals/rp/rp2-desc-e?cjb
Canadian Journal of Plant Pathology	http://www.cps-scp.ca/cjppeng.htm
Canadian Journal of Plant Science	littp://www.nrc.ca/aic-joumals/cjps.html
Crop Protection	http://www.elsevier.com/locate/cropro/
Current Advances in Plant Science	http://www.elsevier.com/locate/caplant/
Current Opinion in Plant Biology	http://journals.bmn.com/journals/list/browse?jcode=jpbl
Development	http://www.biologists.com/Development/
Differentiation	http://link.springer.de/link/service/journals/00258/index.htm
DNA Research	http://www.dna-res.kazusa.or.jp/
Ecology	http://www.esajournals.org/esaonline/'?request=get-current-issue
Ecological Bulletins	http://www.oikos.ekol.lu.se/EB.jrnl.html

Methods in Cell Science	http://www.kluweronline.com/issn/1381-5741
Journal of Wood Science	http://wwwsoc.nii.ac.jp/jwrs/editor/index-e.html
Molecular Phylogenetics and Evolution	http://www.idealibrary.com/egi-bin/Iinks/toc/fy
Molecular Plant-Microbe Interactions	http://www.apsnet.org/mpmi/
Mutagenesis	http://mutage.oupjournals.org/
Mutation Research	http://www.elsevier.com/locate/inca/600799
Nature	http://www.nature.com/nature/
Nucleic Acids Research	http://nar.oupjoumals.org/
Photosynthesis	http://www. kluweron I i ne.com/i ssn/0166-8595
Photosynthetica	http://www.kluweronline.com/issn/0300-3604
Phycological Research	http://www.blackwellpublishing.com/journal.asp? ref'=1322-0829
Phycologia	http://seaweed.ucg.ie/phycologia/
Physiologia Plantarum	http://www.blackwellpublishing.com/jotinal.asp?ref=0031-9317
Physiological and Molecular Plant Pathology	http://www.idealibrary.com/cgi-bin/links/toc/pp
Phytopathology	http://www.apsnet.org/phyto/
Plant and Soil	http://www.ktuweronline.com/issn/0032-079X
Plant Biology	http://www.thieme.com/SID2040873192129/journals/pubid-891620121.html
Plant Journal	http://www.blackwellpublishing.com/joumal.asp?ref=0960-7412
Plant Molecular Biology	http://www.kluweronline.com/issn/0167-4412
Plant Molecular Biology Reporter	http://pubs.nrc-cnrc.gc.ca/ispmb/reporter.html
Plant Pathology	http://www.blackwellpublishing.com/journal.asp?ref=0032-0862
Plant Physiology	http://www.plantphysiol.org
Plant Physiology and Biochemistry	http://www.elsevier.com/locate/plaphy
Plant Production Science	http://www.jssst.or.jp/cssj/pps/index.html
Plant Science	http://www.elsevier.com/locate/plantsci/
Plant Science Bulletin	http://www.botany.org/bsa/psb/
Planta	http://link.springer.de/link/service/journals/00425/index.html
Planta Medica	http://www.thieme.com/SID2040873192129/journals/pubid-1019644585. html
Plants	http://www.plants-magazine.com/
Proceedings of the National Academy of Sciences	http://www.pnas.org/
Review of Aromatic and Medicinal Plants	http://hort.cabweb.org/Aromatic/rampome.htm
Review of Palaeobotany and Palynology	http://www.elsevier.com/locate/revpalbo/
Review of Plant Pathology	http://pest.cabweb.org/Journals/Abstract/roppmain.htm
Scientia Horticulturae	http://www.elsevier.com/locate/scihorti/
Scientific American	http://www.the-scientist.com
Seed Science Research	http://hort.cabweb.org/SeedSci/ssr-home.htm
Systematic Biology	http://www.utexas.edu/ftp/depts/systbiol
Systematic Botany	littp://www.sysbot.org/asptsbl.htm
Theoretical and Applied Genetics	http://link.springer.de/link/service/journals/00122/index.htm
Transgenic Research	http://www.kluweronline.com/issn/0962-8819
Tree Physiology	http://heronpublishing.com/tphome.html
Trees: Structure and Function	http://link.springer.de/link/service/journals/00468/index.htm
Trends in Plant Science	http://journals.bmn.com/journals/lis/browse7jcode=plants
Plant Ecology	http://www.kluweronline.com/issn/1385-0237
Plant Molecular Biology Reporter	http://pubs.nrc-enrc.gc.ca/ispmb/reporter.html

Economic Botany	http://www.econbot.org/journal/economic-botany.html
Edinburgh Journal of Botany	http://uk.cambridge.org/journals/ejb
Electronic Green Journal	http://egj.lib.uidaho.edu/index.html
Electronic Journal of Biotechnology	http://www.ejbiotechnology.info/
EMBO Journal	http://emboj.oupjoumals.org/
Ethnobotanical Leaflets	http://www.siu.edu/~ebl/
Euphytica	http://www.kluweronline.com/issn/0014-2336
European Journal of Botany	http://uk.cambridge.org/journals/ejb/
European Journal of Plant Pathology	http://www.kluweronline.com/issn/0929-1873
Fitoterapia	http://www.elsevier.nl/locate/fitote/
Forest Science	http://www.safnet.org/pubs/periodicals.html
Functional Plant Biology	http://www.publish.csiro.au/journals/fpb/
Genetics	http://www.genetics.org/
Genome Research	http://www.genome.org/
Horticultural Abstracts	http://hort.cabweb.org/HortAbs/ha_home.htm
Hort Science	http://www.ashs.org/scrialpubs/hortscience/hortscience.html
Indian Horticulture	http://icar.org.in/dipa/journal/Hort/JM01/content.htm
Indian Journal of Agricultural Sciences	http://icar.org.in/dipa/journal/agri/feb0l/content.htm
Indian Journal of Experimental Biology	http://www.bioline.org.br/ie
Industrial Crops and Products	http://www.elsevier.com/locate/indcrop/
International Journal of Algae	http://herba.msu.ru/journals/ija/
International Journal of Plant Sciences	http://www.journal.uchicago.edu/IJPS/
International Journal of Mycology and Lichenology	http://www.borntraeger-cramer.de/j/international-journal-of-mycology-and-lichenology/
International Journal of Phytoremediation	http://www.crcpress.com/us/jour/jourinfo/15126514.asp?mscssid
International Rice Research Notes	
In Vitro Cellular and Developmental Biology - Plant	http://www.irri.org/irm.htm
Journal of Agricultural Genomics	http://www.ncgr.org/jag/index.html
Journal of Applied Botany	http://www.blackwellpublishing.com/journal.asp?ref=0949-5460
Journal of Applied Horticulture	http://www.rajans.com/journalhorticulture.htm
Journal of Applied Phycology	http://www.kluweronline.com/issn/0921-8971
Journal of Bryology	http://www.maney.co.uk/bryology.html
Journal of Ecology	http://blackwellpublishing.com/journal.asp?ref=0022-0477
Journal of Ecosystems and Management	http://www.siferp.org/jem
Journal of Ethnopharmacology	http://www.elsevier.com/cdweb/journals/03788741/viewer.htt
Journal of Evolutionary Biology	http://www.blackwellpublishing.com/journal.asp?ref=1010-061 X
Journal of Experimental Biology	http://www.biologists.com/JEB/
Journal of Experimental Botany	http://jxb.oupjournals.org/
Journal of Forest Research	http://link.springer.de/link/service/journals/10310/
Journal of Forestry	http://www.safnet.org/pubs/jof/index.html
Journal of General Plant Pathology	http://link.springer.de/link/service/journals/10327/
Journal of Molecular Biology	http://www.idealibrary.com/cgi-bin/links/toc/mb
Journal of Photochemistry and Photobiology	http://www.elsevier.com/locate/jphotobiol
Journal of Plant Biology	http://bric.postech.ac.kr/bsk/journal.html
Journal of Plant Physiology	http://www.urbanfischer.de/journals/frame-template.htm?/journals/jpp/p_physio.htm
Journal of Spices and Aromatic Crops	http://www.iisr.org/iss/Josac.htm

Table 3 : World wide web address of specific topic from public domain

Specific topics	Hyperlink
Biodiversity Data Management System.	http://dspace.dial.pipex.com/alice/
BIOSIS	http://www.biosis.org/html s/reviews/tn. html
Digital Taxonomy	http://www.geocities.com/RainFores/V ines/8695/
Inquire Plant Species Phylogenetic analysis	http://members.ao1com/rwpsys/
Phylogcnies	http://evolution.uoregon.edu/-COMPARE/
Pollen analysis	http://evolution.genctics.washington.edu/phylip.html
Rarity and endemism restriction mapping	http://www.nhn.ac.uk/science/projects/worldmap http://www.ccsi.com/firstmarket/firstmarketcutter/
Species identification sequence repetition	http://www.aldcx.co.uk/ http://life.anu.edu.au/molecular/software/simpie.html
Taxonomy identification	http://www.euronet.nl/users/mbleeker/prog/soflis-e.html
Taxonomic descriptions	http://www.biodiversity.uno.edu/delta/

Table 4 : Link to botany related databases

Literature Databases	Hyperlink
AGRICOLA	http://www.nal.usda.gov/general-info/agricola/agricola.html
autecological literature	http://www.atkinsonm.demon.co.uk/autecol/
BIOSI S	http://www.biosis.org/
CATAL PA	http://1ibrisc.nybg.org/
Biological Conservation	gopher://nmnhgoph.si.edu/11/.botany/.biocon
IRRO	http://www.bdt.org.br/bdt/irro/irrodir
Phylogenetic Database	http://www.vims.edu/~mes/hennig/education.htmi

Table 5 : Hyperlinks for advanced plant sciences

Molecular biology related sites	Hyperlink
Restricton enzymes protocols	http://www.atcg.com/
Genome structure	http://www.biosupplynet.com/cfdocs/btk/btk.cfm
Online Guide for general cell	http://www.tiac.net/users/pmgannon/
gene & genetic marker technology	http://www.scri.sari.ac.uk/cmg/cmg. htm
Genetic Transformation	http://agriculture.tusk.edu/AgHe%20Website/biotech%20 Website/biotech.html
Trouble shooting protocols	http://www.pk.uni-bonn.de/ppigb/Inot.fhtm#5
Database entry points	http://www.expasy.ch/
FABI	http://www.up.ac.za/academic/genetics/fmbcweb.htm
Engineering Resistance	http://www.ars-grin.gov/ars/PacWest/Corvallis/hcrl/frrm-genetic.htm
Genomes & Databases	http://www.horizonpress.com/gateway/molbiol.html
Disease Resistance	http://plantbiology.stanford.edu/shauna/shauna.htm
Plant-Pathogen Interactions	http://ibmp.u-strasbg.fr/dep4/equ2/dequ2res9195.html
Fungal pathogen	http://www.jic.bbsrc.ac.uk/sainsbury-lab/paul-schulze-lefert/pslhome.htm
Molecular Plant Pathology	http://www.crc.dk/phys/index.htm
PCR Jump Station,	http://www.horizonpress.com/gateway/pcr.litml
PCR Primer Design Programs	ftp://ftp.res.bbsrc.ac.uk/pub/per/
RAPD	gopher://life.anu.edu.au/11/RAPDistancc

There are many search engines which provide an interface between the user and the desired database. The interface presents the user with a place to type in search string, which may be word or phrase and a way to submit the request. The web search engine search the string against the database and returns a list of resources that mach the criteria and display the results for the users. Some of the most popular search engines are listed in Table 1.

There are some search engines, which are better designed to carry out search for a particular branch of scientific knowledge and prove to more effective than most of others. Hence it is quite useful to make use of information available with experts as to what search engine to put to task for a particular search subject.

References

Baxevanis A D and Ouelllette B F F, Internet basics for biologist, In : *Current Protocols in Human Genetics* (Dracopoli N C Haines J L, Korf B R, Moir D T, Morton C C, Seidman J G, Smith D R, eds.), John Wiley & Sons Inc., New York, pp. 10-11, 1998.

Lev Yadun and Sederoff R, Pines as model gymnosperms to study evolution, wood formation and perennial growth, J. *Plant Growth Regul*, vol. 19, pp. 290-305, 2000.

Lorenz W W and Dean J F D, SAGE Profiling and demonstration of differential gene expression along the axial developmental gradient of lignifying xylem in loblolly pine *(Pinus toeda), Tree Physiol*, vol. 22, pp. 301-310, 2002.

Sanjoy K P etal., Internet : A major resource for toxicologists, *Indian Journal of Experimental Biology*, vol. 39, pp. 1207-1213, 2001.

Sederoff R, Building better trees with antisense, *Nat.Biotechnol*, vol. 17, pp. 750-751, 1999.

Tips for Radio Writing

A radio script is different from say, a magazine article, because :

1. It engage the ear and not the eye.
2. It is meant to be spoken, not to be read.

Radio is, in one way, an extension of our oral tradition, passing information by word of mouth.

Points to remember

1. **It is sound only :** You must catch the attention of your listener by imaginative use of your voice. Modulation of the voice comes with proper training. If you have an unattractive voice, you cannot be in this business. The words should help the listener to build his own mental pictures. They have to be simple and convey the meaning effectively. The eye has no role except perhaps to distract attention while listening.
2. **It is you to him / her :** Although Radio has been a mass media, the broadcaster is actually speaking to a person or two. It is intimate and at a personal level. The beauty lies in the fact that every individual feels so. There is no scope for lecturing, sermonising or talking down to just anyone. That would be disastrous.
3. **It is spoken language :** The language used is in the style of spoken language. There is no need to have perfect and complete sentences. A conversation indeed. It is important to communicate and not be bothered about complexities of grammar, complex and ornamental expressions.

Radio talks

Radio talks have to be short and crisp. It is known that the attention span of listeners is very short. Therefore the need for short duration talks only.

Recent trend is for very short duration of three to five minutes. Guard against crowding the talk with too many messages, ideas, facts and figures. Never say one million two. This figure will never register. Say, Just over a million and that should suffice.

Avoid tongue twisters, alliteration and repetition. They can trip you and embarrass you. Sibilants are best avoided. Example : “The six sisters are serious students of systems analysis.”

Is there an ideal reading speed on radio? No, there is no standard speed of delivery. Some languages are spoken fast. Usually reading is intelligible between 120 and 160 words per minute.

Pauses are important. They can give a dramatic effect. The listener needs these pauses as much as the broadcaster.

Above all, the radio talk has a serious disadvantage. It is heard only once. The magazine reader can read and re-read the piece and fill up the gaps in his understanding. The radio listener has no such advantage. What is lost is lost forever. Radio talk has therefore to be simple, capable of being understood the very first time.

Broadcasters have learnt a well tried trick from the clergy. It is :

> “Tell them what you are going to tell them. Then tell them
>
> Then tell them what you’ve told them.”

In other words, it is repetition with variation.

Next how do you get started on radio writing. Here is a tip. Pick up an idea, just one. Speak it out as if you are chatting with someone and then write it down in the same conversational style. Now read it aloud to someone who cares. If he shows interest in what you said, you have won. If he becomes impatient, I’m afraid you have to rewrite and start all over again. ■

Indian Journal of Science Communication

Instructions to Contributors

Indian Journal of Science Communication accepts original papers in the area of science communication for publication. Besides, articles on related issues; write-ups on science communication skills, innovative ideas to communicate science, cartoons (scientoons) are also published.

Books, monographs, copies of TV and radio programmes are accepted for review. News, views, opinions, letters to the editor and suggestions on various aspects of communicating science are welcome for inclusion.

All above communications can be either in Hindi or in English language. Manuscript preparation is described below :

General : Manuscripts should be submitted in hard copy as well as electronic form. Good quality printouts (two copies) with a font size of 12 pt. are required. The pages should be numbered. Print outs must be double spaced with margin on one side of the white paper. The corresponding author should be identified by an asterix (include Email address). Electronic form of the manuscript should be submitted in a floppy (3.5 inches, 1.44 MB). Text should be entered using word processing softwares such as MS Word (IBM compatible). For illustrations, Corel Draw, Harward Graphics or any compatible format software (BMP, GIF, JPG, PCX, TIF) may be used. Label the floppy disk with the author(s) name(s), the word processing package used, software for illustrations and the type of computer. In case of any discrepancy between the electronic form, and hard copy, the latter will be taken as the authentic version.

Order of Text : The matter should be arranged in the following order : Title, Name(s) of author(s), Affiliation, Abstract (in English and in Hindi), Keywords, Main text, Acknowledgements, Appendics, and then References. The abstract, tables, figures and captions for figures should be typed on a separate page. In electronic form, figures or tables may not be imported into your text.

Units : The use of SI units in papers is mandatory. Commonly used units may also be given in parentheses following SI units.

Abstracts : Should not usually exceed 200 words in each language.

Key words : Five or six in alphabetical order should be provided.

Acknowledgements : Include only special nature of assistance. No routine 'permissions' to be mentioned.

References : References for literature cited in the text should be given at the end of text, numbered consecutively. In the text, the reference should be indicated by a number placed above the line (superscript). If done so, the reference should be listed in that order. References should be given in the following form :

> Vilanilam J V, Science Communication and Development, Sage Publications, New Delhi, 1993.
>
> Kotler Philip and Zaltman Gerald, Social Marketing - An approach to planned social changes, *Journal of Marketing*, 35 (4), pp 3-12, 1971.

Even if a reference contains more than two authors, the names of all the authors should be given.

Unpublished papers and personal communications should not be listed in the references but should be indicated in the text, e.g. (Vijayan C K, Unpublished work), (Das Anamika, Personal Communication).

Tables : Each table should be typed on a separate sheet of paper not containing any text. Tables should be numbered consecutively and given suitable captions.

Illustrations : All illustrations should preferably be provided in camera ready form on white drawing paper suitable for reproduction without retouching and about twice the printed size to facilitate reduction.

All photographs charts and diagrams to be referred as figures(s), should be properly numbered and the captions should be provided on a separate sheet. The figure numbers should be marked on the back of the illustration along with the author's name.

In case of photographs, only originals should be provided, photocopies are not acceptable.

Manuscripts sent for publication should necessarily conform to the above guidelines.

Address : All contributions may be sent to :

The Editor
Indian Journal of Science Communication
National Council for Science and Technology Communication (NCSTC),
Deptt. of Science and Technology, Technology Bhawan,
New Mehrauli Road, New Delhi - 110 016, India.
Phone : +91 11 26537976, Fax : 26960207, E-mail : mkp@nic.in; editorijsc@gmail.com

National Council for Science and Technology Communication

The National Council for Science and Technology Communication (NCSTC) is an apex body of the Government of India for promotion, coordination and orchestration of science and technology communication and popularisation programmes in the country, with two major objectives of popularisation of science and technology and stimulation of scientific and technological temper among people. It has seven major work elements :

- Training in Science and Technology Communication
- S & T Software Development/ Production/ Dissemination
- Information Networks/ Databases
- Incentive Schemes
- Field Based Projects
- Research in Science and Technology Communication
- International Collaboration

Published and printed by Dr. Manoj Patairiya on behalf of
NCSTC/DST, Technology Bhawan, New Delhi-110016 (India).
Printed at Systems Vision, A 199 Okhla-I, N.Delhi. Tel: 26811195