

The Scientist, Scientific Information and the Library

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One of the manifestations of the rapid growth of science in recent years, has been the vast proliferation of scientific publications. Science and its communication are so intertwined, that scientific research and the dissemination of the results of research go hand in hand. The communication of science is a two-way process. On the one hand, the scientist must make the results of his research known to the scientific community as rapidly as possible, and on the other hand, he must be kept aware of the latest developments in his field of study in the quickest possible time. This two-way communication of information is essential to avoid duplication of work and unnecessary waste of time and money.

It is evident that communication of information in one form or another usually takes up a significant part of the working life of a scientist. The increasing output of scientific literature in all its ramifications is posing problems to the scientist, both to keep himself informed of ongoing research and to find information about a selected topic. It is relevant to note that the results of investigations conducted by S.C. Bradford show that the scatter of scientific literature involves searching papers on a specialized subject in three groups of journals. The first group consisted of a small number of journals containing a large number of relevant papers, the second consisted of an intermediate number of moderately productive journals, and the third group contained very many journals that only contributed a few relevant papers each. In quantitative terms, the ratios of the cumulative number of journals for these three groups were as $1:m:m^2$ (where the data suggested a value for m of about 5).

The traditional tools of communication have been greatly improved and new techniques have been devised to meet the challenge of this literature explosion. These new tools and new methods, which are basic ingredients in the information services of the developed countries have been kept out of the average library in the developing countries due to their high cost, with the result that, not only are the scientists in the developing countries not making use of the new services, but are also unaware of their existence and capabilities.

How do scientists acquire scientific information in Sri Lanka? User surveys have been conducted in many parts of the world and the results have been subjected to intensive analysis, but no such studies have been made in this country. It is therefore better to frame the question in a different way. How should a scientist keep abreast of recent developments and conduct a literature search? Are the available information services in Sri Lanka meeting the users' needs adequately?

Information is used by scientists for two main purposes, firstly, to keep in touch with recent advances, i.e. for current awareness, and secondly to find out about a certain topic selected either for purposes of research or teaching, referred to as a retrospective search. The information is obtained from two sources, namely, formal channels, which are the written sources such as journals, textbooks, abstracting and indexing services, etc., and the informal channels, through personal contact.

The principal formal source of information is the periodical, and most scientists spend some time reading or scanning journals to keep abreast of new developments. The number of periodicals consulted and the time spent on reading them vary considerably from individual to individual. Surveys conducted show that the average number of journals consulted per week ranged from 5 to 15 according to the particular group investigated. The availability of journals will be a determining factor in the number of periodicals consulted by scientists. While periodicals are freely accessible in libraries in the developed countries, the number of titles available in developing countries is greatly restricted by the limited funds.

However, even in the developed countries, where most of the journals are available, the scientists do not find the time to scan all the journals in his own speciality and the peripheral journals where papers relating to his interests may be found. The conventional way out of this dilemma is to resort to consulting abstracting and indexing publications. The vast number of papers that are appearing is making these services larger and the literature included in them selective. Further, the prohibitive costs of these services make it possible for only a few libraries in Sri Lanka to subscribe to them. Due to the limited number of copies of the major abstracting and indexing journals available in Sri Lanka, it is doubtful if they are serving as tools of current awareness. Nevertheless, they are important tools for retrospective searches, which, if not as widely used by the scientists as they should be, are referred to by librarians and information officers to assist the scientists.

Indexes vary in their arrangement. They range from publications such as **Current Contents** which lists the title pages of selected journals, and others such as **Index Medicus**, **Zoological Record** and **Agrindex**, where articles are indexed under subject headings. The **Science Citation Index**, which is probably the most widely used index to scientific literature in the world, uses a relatively new method of organizing the contents of a collection of documents in a way that overcomes many of the shortcomings of the more traditional methods. It enables a literature search to

come 'forward in time' from a given starting point, which is achieved by indexing the citations to earlier work contained in the articles covered. To use these indexes effectively, the scientists should be familiar with them and well versed in the correct techniques of consulting the works.

Abstracting journals serve a more useful purpose than indexes. While the scientist will need to consult the original paper of a citation obtained from an index, he is presented with a synopsis of every item in an abstracting journal, and will need to obtain the original articles only of those that are found important for his work. Although, at first sight the intended use of an abstract journal seems to be to act as a guide to the original literature, many scientists also use abstracts as a substitute for the original literature. Due to the increasing output of literature, the major abstracting and indexing services have to be selective and this creates a drawback in these services to the scientists in the developing countries, as the percentage coverage of literature published in the developing countries included in the major abstracting and indexing services is very low. A recent study made by the World Health Organization on the use of health literature published in the countries of South-East Asia region, revealed that only 10 per cent of the literature published on bio-medical sciences was covered in the **Index Medicus**, and only 35 per cent of the literature when **Biological Abstracts** and **Abstracts of Hygiene** are included. The major abstracting journals are becoming very large and difficult to handle, and the cost is keeping them out of most libraries, though for an effective information service, they are indispensable. **Chemical Abstracts**, the world's largest abstracting service, and **Biological Abstracts** are accessible to the scientists in Sri Lanka, but **Excerpta Medica**, the premier abstracting services in medicine, and the **International Abstracts of Biology** are two examples of abstracting journals not available in Sri Lanka.

The increasing size of indexing and abstracting journals are making manual searches rather difficult. Further, in order to economise on the size of the publications, articles are being indexed only under the more important subject headings. Since the mid — sixties, these services have been computerized, which is affording better and speedier utilization of the databases. While the production of the abstracting and indexing journals continue to be one of the major products of these databases, they are now being used more and more for current awareness services and retrospective searches. Most of the computerized services simply mechanise the procedure of searching abstracting and indexing journals in the case of retrospective searches, or of current journals in the case of current awareness services. Many of the major services not only provide standard current awareness services, but also provide individually tailored alerting services.

For instance, BIOSIS (Bio-Sciences Information Science) which produces **Biological Abstracts** and **Bioresearch Index** provide a Standard Profile Service which is a current awareness service operating on set profiles in subjects of general interest giving 12 monthly computer printouts of references, costing \$50 per profile a year, and also a Current Literature Alerting Service (CLAS) which is an individually tailored current awareness service giving 26 fortnightly batches of references on 5 x 8 in cards at \$120 per profile per year. Similarly, MEDLARS (Medical Literature Analysis and Retrieval System) is the computer database of **Index Medicus**, SCISEARCH operates as the **Science Citation Index** source tapes, and **Chemical Abstracts** database provide the United Kingdom Chemical Information Service (UKCIS). Most of the databases are now ON-LINE, providing immediate search capabilities. Probably the only database that has been utilized by scientists in Sri Lanka is MEDLARS, through the courtesy of the WHO who provide a free service to developing countries. It must be emphasized that these computerized information services could be utilized by anyone anywhere in the world. Unfortunately the costs are prohibitive to scientists in developing countries, but nevertheless, in some instances, the utilization of computerized information services may be justifiable.

A widely adopted method of doing a literature search by scientists is by following up citations in relevant papers. The papers cited will have more relevant citations, which will ultimately give access to most of the literature on the subject. The citations are particularly useful as indexes and abstracts are not comprehensive in coverage due to their selective policy.

The sources considered above are those that lead to the primary literature. The secondary literature, or the literature in digested form such as review articles and textbooks, also form an important source for acquiring information. The digested material, being about 2 to 3 years later than the appearance of the primary literature in the form of articles in journals, is more useful to the scientist as background introductory information on a research topic, rather than for recent developments. Reviews and textbooks are particularly important to the teacher who must convey to the student, in a concise form, the subject treated.

Information through personal contact is an important vehicle of communication. Private correspondence, the oldest form of scientific communication, is still widely used, but is not as important as other forms of information transfer. Most surveys indicate that discussions with colleagues rank with journal articles as the major source of research information. Informal group meetings where research topics are discussed, is a widely practised method of information transfer. The formal meetings, seminars, conferences, etc., also assist in the process of scientific communication

to a great extent. Most surveys show that conferences represent a highly efficient means of transferring information within a limited span of time.

Although great strides have been made in **informatics** during the last two decades, and the library has offered a much improved service to scientists in the transfer of information, the scientists have not taken full advantage of recent developments in information services. As a group, scientists tend neither to use all the bibliographical aids available nor to consult with professional librarians about their information needs.... Following on from this first phobia comes yet another — the general dislike scientists have of expending any great effort on the acquisition of information from the literature. One of the firmest conclusions of information usage surveys seems to be, indeed, that the intrinsic value of an information channel has little or no bearing on the frequency with which it is used. The important factor is always its accessibility.

This indifference of the scientist in regard to his informational needs can be remedied to a large extent, if he is made aware of the existing information services and their potential use. The scientist in Sri Lanka, and in most developing countries, has yet not begun to appreciate the assistance that could be obtained from the library, as, until recently there were only a few qualified persons in information work. With the development of programmes for the education for librarianship and the recognition of the importance of libraries in Sri Lanka, there is a positive move towards the provision of better information services for scientists.

The lack of a wide range of scientific literature has been due to the low financial allocations, non-availability for sufficient foreign exchange, absence of organised inter-library cooperation and the lack of suitable means of the duplication of scientific literature. Steps are now being taken by the Working Committee on Scientific and Technical Information, and the Sri Lanka Scientific and Technical Information Centre of the National Science Council to remedy those shortcomings. It is envisaged that in the not too distant future, there will be a coordinated library service with a more rational utilization of available funds for the acquisition of scientific literature, and an improvement in the back-up services, such as the provision of photocopies, inter-library loans, bibliographical services, etc., which will meet more adequately the users' needs.

While it is essential for there to be an informed library staff to deal with the dissemination of scientific information, it is equally important for the scientists to be aware of the availability and capabilities of the information services. The cooperation of the scientists with the library staff is necessary for the best utilization of the information resources.

References :

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WORKSHOP ON EXPERIMENTAL DATA HANDLING

A 15-day 'Workshop on Experimental Data Handling', co-sponsored by Bhabha Atomic Research Centre, Indian National Science Academy, Department of Science and Technology, Government of India, Indian Statistical Institute and Indian National Scientific Documentation Centre (INSDOC) will be convened at the Bhabha Atomic Research Centre, Bombay, from 1-15 November 1978.

This Workshop is to be attended by 30 participants which will include 10 from India and 20 from other Asian Countries. The topics to be covered include: Scientific, technical, techno-economic, and social data: their characteristics and differences; Problems of accessibility and dissemination of data for science and technology; Planning and design of

experiments; Basic statistical concepts and techniques; Data sampling, quantification, collection and analysis; Systematic and random errors; Errors in data handling; Critical evaluation of data; Presentation of numerical and non-numerical data; Guidelines for reporting data. Organization for data collection, reporting, dissemination; Recent trends and international programmes in data field - UNESCO, CODATA (Committee on Data for Science and Technology); and other related subjects.

For further information, if desired, please write to the Head, Library and Information Services, Bhabha Atomic Research Centre, Department of Atomic Energy, Government of India, Central Complex, Trombay, Bombay 85.

Disseminating Scientific Information

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In any given society, there are some people who are better informed of scientific matters, than others. Some others are better skilled than the rest, and some have better scientific attitudes than others. It is up to such fortunate people to impart their knowledge and skills, and to impart healthier attitudes, to the less fortunate deprived brethren. This transfer of information, skills and attitudes from one sector of the population to another comprises the essentials of communication.

Why should anybody engage himself in this complicated process of communication? In other words, what is the broad objective of communication. If communication were a mere academic exercise, it would be an individual pastime, and not a national responsibility. It is an overt axiom that scientific thinking, and applications of science, help to make the total quality of life better. Improving the quality of life is everybody's responsibility, and if it can be helped by communicating science, the responsibility of doing so rests with every knowledgeable person.

Communication, in science as well as in other fields, is often an unintentional process that goes on all the time, if in an intangible way. This occurs between persons, and between different strata of society. In fact, social living is an unending web of communication. This kind of part-of-way-of-life human interactions are insufficient if communication is to support development in a rapid, regular and positive way; for that purpose, the efforts have to be systematic, methodical, and objective. What needs to be communicated multiplies at a very high rate, and therefore, the need to share it has become an urgent one. That is an added reason why communication efforts have to be deliberate and designed.

In a planned communication design, at its very outset, there are certain basic factors for consideration.

To whom has the information to be given? In other words, who is the target population? This is the question unfortunately left unanswered in many communication attempts, and that precisely is the reason why many of them fail. Having focussed attention on a particular sector of the population to whom the message has to be carried, the important characteristics pertaining to that population have to be recognised, and assessed in terms of the planned communication activity. Their number, age and sex distribution, reachability, educational level, main occupation, needs, disabilities, relevant cultural

features, fads and customs are all important considerations. It is cognizance of these that help in the working out of a strategy. This procedure may be called **target population diagnosis**.

Examples of instances where a target population diagnosis comes in useful are legion. To quote but a few, if the population to be reached are comparatively few, mass media would be a waste. In such a situation, interpersonal communication would not only be the cheapest, but also the most effective. If the need is to give a message to the womenfolk of a village, the best situation for the display of a poster might be the community well. Little use it would be to employ mass media, if the message is meant for poor, illiterate and remote village folk. A message for the males in a fishing **wadiya** will hardly ever have an impact if broadcast at night. Literature pertaining to paddy fertiliser would be wasted on people working on tea plantations. Praising the virtues of meat protein would be wasted effort on a community culturally antagonistic to eating beef.

What are the objectives of the contemplated communication activity? Put in other words, what should the target population know and be able to do, once the communication exercise has had its effects; and how should their attitudes have altered as a result of the exposure? It is paramount that the communication strategist identifies the answers to these questions **prior** to planning any further steps. It is important that the objectives so derived should be stated in measurable terms.

Let us consider an example with a heavy practical bias. Suppose a planner recognises that the reduction in agricultural output in a certain village is due to a lowering of work capacity of the farmers, due to anaemia, brought about by hookworm disease, which is spread as a result of faecal contamination of soil. The broad aim of a communication procedure in these circumstances would be to reduce the spread of hookworm disease in that community. In order to achieve this ultimate goal, the communication process should be such that on its completion, the people are able to remember and state how hookworms spread, and how this spread could be prevented. There is no particular skill that needs be taught. The target population should develop a relevant attitude; that is, they should be convinced within themselves that hookworm disease causes production loss, and that its prevention lies essentially in their hands.

That is not all. A very important aspect of this exercise would be to motivate the people to build latrines and **use them.**

The question that arises now is the content of the message. In order to achieve the specific objectives decided upon, what is the data that should be given to the target population? It is important that all relevant information be given. It is even more important that unnecessary and superfluous details are not given. With regard to the situation outlined above, it would be pertinent to tell the people that hookworm ova are passed in infected faeces, that they develop into larvae on the soil, that the latter enter bodies of healthy people by penetrating soles of feet, that they then become adults and live in the bowel, and that they suck blood causing anaemia which is responsible for weakness, lethargy, etc. It should be stated with emphasis that this harmful sequence of events cannot occur if faeces are deposited in lavatories. It would also be important to include the fact that State assistance could be had for building of lavatories, and how such aid could be obtained.

The message to be given, with what objective, is now clear. How could the people be motivated to follow this advice? This depends firstly, on the attitudes the programme has been capable of inculcating in the people. If they now believe that hookworm disease is in fact responsible for causing material loss, and if they are convinced that the arrest of spread of this disease depends upon the building and use of lavatories, the foundation for motivation is laid. Immediate personal benefit is about the most effective motivating force. The authoritative stature of the communicator and the confidence he has built are other factors responsible for motivation. Feasibility (from the point of view of the target group) of the suggested action, and examples of such action by peer groups, or esteemed groups are also helpful inducements.

The next step in the communication process is the actual transfer of the message. How best could this be done? What medium should be used? Naturally, the answer to these questions would depend upon the characteristics of the recipient population. This aspect was gone into at the outset.

Whatever methodology is used in communication, here are some important considerations to remember. **Never over-estimate the comprehending capacity**

of a target group, particularly with regard to technical language and scientific and rational thought. This is an ultra-truism when applied to the kind of population it is our sacred duty to deal with the semi-literate rural sector, drowned in traditional belief and irrational thought.

Whether the mode of communication is interpersonal or mass media, poster, printed word, spoken word, music drama or traditional media, there are a few rules worth following. **The shortest message is the best understood, and most retained. Short sentences and simple language help understanding. A technical word not explained is wasted. People welcome material when presented in form as applied to them. Repetition, up to a point, helps retention. Examples and anecdotes arrest attention and are so convincing. Pictures and diagrams can do wonders not only in enhancing comprehension, but also in assisting motivation. Posing questions make people alert and receptive.**

One caution about pictures and diagrams. What is so simple and obvious to the communicator may be complicated and meaningless to the observer. For instance, in a health education film strip, the close-up of a fly filled the screen; the response of some viewers was that such flies do not come to their village! It is unbelievable that once, a line diagram depicting a pregnant woman was not identified as such, by almost two thirds of the reader population in a village.

A communication process should necessarily be followed by two activities. The first of these is the provision of the service component relevant to the message given. For instance, there is little point in educating people about vaccination and its advantages, and giving them the necessary skills to look after vaccinated children, and motivating them to vaccinate all their children, if the local health authorities cannot provide the service. In fact, such educational programmes cause frustration in the target group, thereby making them insensitive even to other communication programmes.

The second activity that should follow an educational exercise is an evaluation of its impact on the target. That is, a measure of the effect the programme has had. This activity may be difficult, but is essential. There are several ways of setting about it, but that is another matter.

“There is no doubt that economic and social progress depends to a large extent on the transfer of scientific and technical information. The developing countries must therefore be helped to equip themselves with an infrastructure which will enable them to have access to the sources of this information and to make the best possible use of it, according to their needs.”

René Maheu
Former Director-General of UNESCO

Information Requirements of Scientific and Technical Personnel*

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Science means knowledge and the function and objective of a scientist is to acquire knowledge. A student acquires knowledge on subjects on which knowledge is already available but a scientist aspires to acquire knowledge on subjects hitherto unknown. The basic knowledge acquired by the scientist is applied by the technologist for practical purposes. The needs of technologists and scientists are common in that they both wish to resolve a problem. The scientist needs to elucidate basic phenomena whereas the technologist uses this elucidation in practice.

Therefore a scientist needs to have all the background information that might be available and which may be of relevance in achieving a solution to his specific problem. Library facilities must be in a position to provide such information. This information will come in various forms:

(a) Textbooks

Textbooks introduce the reader to basic collated information on a particular subject. They are often simplified and omit many details. The collation itself takes time particularly in fields which are intensively researched into. Textbooks are therefore often somewhat outdated as they are published. They are behind the front line of information. They are, however, invaluable in providing the background required by scientists.

(b) Periodicals

The frequency of appearance of periodicals is subject to much variation. The less frequent the appearance of the periodical the more out-of-date it would generally be. For example, the annual reviews on such subjects as Plant Physiology, Applied Entomology, Biochemistry, etc., collate information on selected subjects considered to be of importance at a particular time. Other periodicals do not attempt collation but merely report recent research. In the case of annual reviews although they are less outdated than textbooks, they are nevertheless at least 2 years old at the time of publication. First-hand information is therefore required in the form of periodicals more frequently published than annually. Even in monthly periodicals, the information may be about one year old at the time of publication.

(c) Reprints

A scientist requires reprints of his own, of some articles which are of special interest so that he could

refer to them whenever he so desires. This is particularly true of articles where there are many experimental details or tables which cannot be remembered or easily copied. The acquisition of reprints is sometimes somewhat difficult as large numbers of reprints of any article, particularly of the older ones, are not always available. He therefore has to resort to photo-copying, a service that is vitally necessary. When articles needed for continuous reference are voluminous, photo-copying may be prohibitively expensive. He would therefore need to resort to microfilming such articles.

(d) Abstracts

In order to cater to scientists interested in fields in which large numbers of papers are published there are many abstracting facilities such as the Biological or Chemical Abstracts. These are expensive publications and are not within financial reach of many of our libraries. It is necessary therefore that these be made available to scientists if they are not available in their libraries.

(e) Thesis

A thesis differs from a normal research publication in that it represents a concentrated effort on the part of a young researcher working on a particular subject for up to five years.

Usually, extracts from theses are published in appropriate journals. Theses are voluminous and are not normally published in their entirety. They are usually available in the libraries of the University which awards the degree. As only a very few copies of a thesis are produced it is necessary to have a complete list of theses and where they are available, so that scientists could have access to them.

(f) Personal contact

Scientists require personal contact with other scientists in order to exchange information and in order to short circuit the delays which are necessarily encountered in the process of publication. A scientist would therefore need to know who is working on projects further to what he is interested in.

Having obtained the background information from publications and other sources a scientist will now develop and consolidate his ideas. He will need to fit his ideas into a hypothesis congenial with all the known facts. This is the objective of scientific experimentation.

* Extracts from a lecture given at the "Workshop on Scientific and Technical Information" held by the National Science Council.

Let us assume that the experimentation has been successful and that positive results have been obtained. These results will have to be evaluated in the light of his own and other people's criticisms. Here again, he has to recourse to the literature in order to present his results together with a logical discussion in the paper that he may be preparing for publication.

Finally, he has to make his results available in a published form and will need to present his paper to publishers, or orally to learned societies, with appropriate photographs, drawings and graphs of his own and perhaps reproductions from other people's work. He may need photographic reproductions or photostat copies of material from elsewhere. He would also need to conform to the requirements of a specific journal in which he intends to publish his paper, and would need recourse to such documents as the World List of Periodicals.

So far, I have been referring to scientific research and its application to technology in a general sense. In general, it would be correct to say that the needs of scientists everywhere are common. Science recognizes no national barriers and science is independent of the variations inherent in different human societies.

A doctor in any country would like to know the cause of cancer and an engineer in any country would like to know the latest development in solar heating. However, a doctor in Sweden may be less interested in Malaria control than a doctor in the tropics. There is therefore a difference in the type of research conducted in different countries and our country is no exception. For instance, in agriculture our major research institutions work on rice, tea, rubber, coconut, etc., whereas agricultural scientists in many countries would do no research at all on these crops. I will briefly attempt to list the types of scientific research which are undertaken in our country although this is perhaps already well known to you.

(a) Medical Research

Substantial research is done in this country on preventive and curative medicine. Our doctors work under extremely difficult conditions where equipment, drugs and medical facilities particularly in research institutions are in short supply. There has been much interest in indigenous forms of medicine with great emphasis on medicinal plants which are locally available and for the use of which there appears to be great potential.

(b) Agriculture

Hundreds of crops are grown in this country but only a few are backed up with adequate scientific research. Research is at present in progress on our major agricultural import rice and our major exports tea, rubber and coconut. In addition there is substantial research

on cereals, root crops, tree species, spices, beverages, etc. Considerable effort is being expended on essential oil crops, sugar cane and medicinal plants.

(c) Horticulture

In Sri Lanka, we are able to grow over 50 different kinds of edible fruits and many vegetable species. Only a very few of them are backed up with adequate research. We have good possibilities of floriculture, particularly in the export market. I need only mention the example of a small country like Singapore which exports orchids and other horticultural plants.

(d) Veterinary Research

Considerable research is being done on pasture and fodder grass production and the improvement of our breeds of livestock. We have had a chronic shortage of milk foods over several years and unless we can improve livestock this shortage is likely to continue.

(e) Physical and Chemical Sciences and Industrial Technology

In order to improve our industries, it is necessary that industrial ventures receive substantial backing from Government and the scientific community. Some of our industries are merely transplants of foreign technology. Such industries which are heavily dependent on foreign exchange are the first to suffer when foreign resources become curtailed. Other industrialists utilise local raw material with only a small imported component. These industries need a lot of research in order to make the best use of our local raw materials. Very little information is available on the nature of many of our raw materials and their suitability in industry. Much attention is being focussed by many of our scientists on this subject and the more information we have on local raw materials the more viable and useful our industries are going to be.

Industrialists would naturally like to make their industries more efficient but they may not be able to do so without scientific and technical backing. They may however have accumulated a lot of technical information regarding their industries. This pool of information might well be tapped and brought within reach of scientists who might sift it further and find something new and thereby contribute much to these industries. There are other industries where our raw materials are being exported. Here again, everybody is keen that our raw materials should be exported in a processed or semi-processed form and not directly as crude products. Information on these lines would be greatly helpful to our scientists.

In industrial research, much of the science is known and it is largely a question of applying suitable technology. We are not a technologically advanced country but it will be possible for us to develop our

own technology further, particularly where raw materials are locally available. In technologically advanced countries, machines replace human beings. What we require are technologies which could utilize our ample human resources rather than be dependent heavily on machinery.

(f) Engineering

The engineering services in this country need a vast amount of technological information to support it. We have made vast progress in irrigation works and the construction of hydroelectric power schemes, etc. Basic knowledge is known but we need technological backing to make the best use of our engineers.

(g) Economic research

Economics abuts all branches of science and technology and it is necessary that information on economic factors be made available to scientists and technologists. Sometimes scientific innovations and technological achievements cannot be made use of because of economic or social factors. The social sciences and economics are important aspects of science and information in these branches of science is always useful to all the other branches of science.

(h) Statistics

Statistical information is often required by our scientists and more so by our technologists. Some attempt at collation of the information is contained in the numerous annual reports of various institutions in Sri Lanka with the objective of making the statistics contained in these reports easily traceable and assimilable by our scientists and technologists.

Research in other countries

It is very necessary that our scientists be aware of the research work going on in other countries. Some of this research is beyond the capacity of this country to indulge in, for example, nuclear research. Nevertheless, there are many branches of science in other countries where their research will be of use to us, if it is suitably adapted to our conditions. The pure forms of research of a more academic or fundamental nature will normally have less relevance to us than the applied or more practical forms, because the benefits can be obtained quicker. Our scientists would like to know who is working in their fields in other countries and would like their research findings made available to them. It is useful to remember that **research done in tropical countries is of great relevance to us**, very much more so than the research, however advanced, that is done in the temperate countries. Our conditions are very similar to those in other tropical countries, particularly in **South and South**

East Asia and we should attempt to come closer to such countries. All of them are poor like ourselves. We can expect to benefit from their research and they from ours.

This brings us to an important consideration and that is the subject of language. Research done in Japan, China, Indonesia, and other countries in our region are slow in coming to us because of the language barrier. Translation services are therefore an important need for all scientists in order to obtain information that is very vital to them. Traditionally, our scientists have been studying French and German as foreign languages in addition to English. In order to benefit from research in tropical countries more languages may have to be studied, but as you can see this poses a problem in itself. If libraries can therefore obtain **translations of scientific literature in foreign languages in an abstracted form** and make these available to our scientists it would be extremely helpful.

In Sri Lanka there are extremely few scientists, the reasons are many, but one of the most important is that we do not seem to produce enough scientists. When scientists are in short supply, the best use must be made of them. This could be achieved by bringing them together whenever possible and providing them with their research needs so that they do not spend much of their time searching their requirements. As far as you are concerned these needs centre on information. If you, were to know who our scientists are, where they work, what work they do, what their objectives are and what success they have achieved, then you may be able to help them save their time and not duplicate work that has already been done or is being done elsewhere. Our small number of scientists must be in communication with one another. This is not too difficult to achieve if we were to have appropriate directories and if these directories are maintained up-to-date.

This applies not only to personnel themselves but also to apparatus and equipment, which is extremely hard to come by and if expensive very difficult to obtain. If our libraries in each research institution were to have lists of expensive equipment which is often maintained by trained personnel, then each institution may help another institution to get its work done quicker. The same is true of library facilities. If up-to-date inventories of library material are available, then scientists would have easy access to such information.

It would always help if librarians were to find out the meaning, the significance and the potential impact their work would have on the well-being of the people of this country. This would encourage them to assist the user further and perhaps inspire them to provide a better, more efficient and even more meaningful service to our scientists.

Sri Lanka Scientific and Technical Information Centre (SLSTIC) of the National Science Council of Sri Lanka

N. U. Yapa

Librarian, National Science Council.

The National Science Council has expanded its Documentation and Information Division into a Scientific and Technical Information Centre. The basic objective of this Centre, which is designated the Sri Lanka Scientific and Technical Information Centre (SLSTIC) is to collect, process and disseminate information relating to Science and Technology.

SLSTIC fulfils this objective by (a) library resource development (b) coordinating with other libraries and (c) providing information and documentation services.

SLSTIC does not intend to build up a comprehensive collection of books, periodicals, etc., as it would lead to duplication of resources available in other libraries. Instead, it concentrates on subject areas which are not covered by other local libraries in order to fill the gaps in the library resources of the country. Three special subject areas have been identified by SLSTIC for information development, namely, *Science Policy*, *Science Education* and *Environment*. Apart from these collections, SLSTIC endeavours to develop a collection of reference books which are not available in most other local libraries.

With the cooperation of other local scientific and technical libraries, SLSTIC has initiated a National Science Information Network. This network helps SLSTIC as well as other libraries to exchange and transfer information and to share their resources with a view to utilizing locally available information sources in the most economical way. Hence, SLSTIC'S information and documentation services are not restricted to its own stocks.

Some of the current activities of SLSTIC and the services provided by it to scientific personnel in Sri Lanka are as follows:

Union Catalogue

In keeping with its objectives of coordinating the resources of Sri Lanka libraries, SLSTIC has inaugurated the compilation of a Union Catalogue of Scientific and Technical books in Sri Lanka. This is the first of its kind compiled in Sri Lanka.

At present 20 libraries send information about their new acquisition to SLSTIC to be included in the Union Catalogue.

This Union Catalogue helps to locate locally available

scientific books, promotes inter-library lending, avoids duplication of materials, etc. Additions to the catalogue are published in a quarterly bulletin (Current Science Bulletin) which is distributed among the participating libraries.

Union List of Periodicals

This is a Central Catalogue of Scientific and Technical Periodicals acquired by the libraries in Sri Lanka. Whereas the union catalogue records the book acquisitions, the union list will record the periodicals. This is being compiled and would be issued shortly.

Indexing of Scientific Literature

One of the earliest services started by SLSTIC is the indexing of local scientific literature. The main objective of this service is to record and analyse the national output of scientific and technical literature. The information is issued in the form of a quarterly bulletin The Sri Lanka Science Index.

SLSTIC's national indexing service is designed to include all forms of published and unpublished documents, giving special emphasis to periodical articles, conference reports, research reports, newspaper articles, etc.

Reports Depository

Work on building up a national depository for scientific and technical reports has been started. This collection includes R & D reports issued by scientific and technical institutions, seminar and conference documents and reports prepared by individual research workers.

SLSTIC has received reports issued by Scientific and Technical Institutions through more than 100 coordinating officers nominated by the institutions concerned for this purpose.

Inter-library lending

One of the services provided by SLSTIC to local scientists is lending of reading materials. SLSTIC borrows books from other libraries, too, for the purpose of lending. Requests for inter-library loans should be made by the library of which the requestor is a member. Inter-library lending facilities have been granted to SLSTIC by more than 25 libraries.

Photocopying Services (locally available publications)

SLSTIC undertakes the supply of photocopies of scientific documents at comparatively low rates. This service includes the location and procurement of the original document for copying. Requests for photocopies could be sent by post.

Photocopy Procurement Service: (documents not available locally)

When the original is not available locally SLSTIC endeavours to procure photocopies from foreign sources. The British Lending Library which holds a vast collection of periodicals and reports has been selected by SLSTIC for obtaining photocopies. Payments can be made to SLSTIC in local currency for this service.

Environmental Information Service

For the benefit of scientists who are engaged in research and study on various aspects of the environment, SLSTIC has inaugurated an Environmental Information Service. A survey of information requirements to evaluate the interests of individual scientists is being carried out by SLSTIC. These scientists will be supplied with information relating to their fields of interest.

A quarterly, Environmental Acquisitions, is published and distributed among scientists in the relevant fields.

Annual Reports

One of the functions of the information centre is to maintain an organised collection of annual reports of Scientific and Technical Institutions. This collection now consists of more than 500 annual reports of various institutions.

Library Services

Apart from the above special information services, SLSTIC performs the usual library services to its members. Literature searches, compilation of bibliographies, and provision of reference facilities are some of these services.

Publications

SLSTIC prepares several occasional and regular publications. Besides the documents produced by SLSTIC, other publications of the National Science Council are also available for sale or for reference at SLSTIC. Among them are the following

(a) Information Bulletins

Sri Lanka Science Index (Quarterly)
(described above)

Current Science Bulletin (Quarterly)
(described above)

Environmental Acquisitions (Quarterly) (described above)

(b) Directories

Directory of Scientific & Technical Personnel-1974

Directory of Scientific Research Projects 1970-73

Directory of Scientific Research Institutions
in Sri Lanka - 1976.

Current Foreign Science Serials in Sri Lanka
1975.

Sri Lanka Scientific & Technical Periodicals
Directory.

Union List of S & T Abstracting and Indexing
Services in Sri Lanka libraries.

Directory of Scientific & Technical Libraries
in Sri Lanka.

(c) Seminar Reports

Environmental Management in Sri Lanka.
Science Policy and Planning
Man and his Environment
Sun-drying Methodology

(d) Periodicals

Journal of the National Science Council
of Sri Lanka (Bi-annual)
Vidurava (Quarterly)

(12) Future Activities

SLSTIC has planned to undertake the following tasks in the future:

(a) Patent Procurement Service to supply foreign patents and patent literature at the request of libraries and individual scientists.

(b) Procurement of translations to obtain translations of scientific and technical articles in foreign periodicals on request.

(c) Panel of translators to appoint a panel of translators who would undertake translation of scientific documents.

(d) Audio-visual services the centre will collect audio-visual material which will be accessible to other libraries.

(e) Training Service the centre will provide in-service training for library personnel.

Scientific Information for Developing Countries

Nimala Amarasuriya

Scientific Officer, National Science Council

Information is one of the basic commodities of our civilisation. Current and relevant information concerning any problem is essential for decision-makers for action in any field. The total exchange of information includes cultural, economic, scientific and technical components. In our increasingly technically-based civilisation, Scientific and Technical Information (STI) is a key element for progress and development.

STI in its widest sense can be defined as "information on the status, progress and results of research development and other scientific activity, and on the application of such results, together with any other information of potential use in any scientific or technological activity."

It is a recognised fact that national economies are dependant to an ever-increasing extent on the application of scientific and technical knowledge. Therefore, the system by which STI is disseminated in a country plays a significant role in furthering growth processes. STI, as a major resource should be given the same importance as other factors in the economic growth of a nation. For rapid development, information on relevant research and technologies should be readily available to research and development personnel, scientists, technologists, industrialists and administrators. Developing countries are constantly urged to channel more of their resources into increasing the output of scientific research. But, it is just as important to utilize financial resources on the **maximum utilisation of existing STI**, as it is to spend on further research.

Some countries notably the developed countries have realised this fact and have taken steps to improve the handling and dissemination of information. New and more sophisticated techniques and methods of librarianship, bibliography, retrieval of material, reproduction, and computerized on-line databases have been developed to provide immediate search capability. Although STI is an international resource, the existing worldwide scientific information systems have thus evolved in such a way that the greatest benefits are to the more advanced countries. The less developed nations which require STI most for furthering growth processes are therefore placed at a disadvantage. Instead of a free flow of organised information from the affluent to the developing countries, an 'information gap' has thus been created. The gap between a developing country and the more developed world is increased by its inability to cultivate an awareness of current ideas, techniques, materials and methods, and to its failure to introduce them quickly and effectively into operation.

One of the main problems of information specialists the world over is the ever-increasing speed with which

information (especially STI) is being generated. The rate at which STI is produced today is so great that according to De Solla Price "Any young scientist standing now and looking back at the end of his career upon a normal life-span will find that 80 to 90 per cent of all the scientific work achieved by the end of his period will have taken place before his very eyes and that only 10 to 20 per cent will antedate his experience."¹ It is estimated that at present some 2 million documents and articles, 50,000 journals and over 30,000 books on science and technology are published yearly.

The exponential growth of science literature is illustrated by the fact that Chemical Abstracts in 1930 contained 54,000 abstracts and in 1962 some 165,000. The number increased to over 200,000 by 1970. One of the reasons for the flood of literature is that the results of scientific research are published not only for the communication of information but also for priority and prestige reasons. This situation has made it impossible for any individual to scan and remember all of the literature that has a reasonable probability of being of use later.

The generators of information are mainly the developed countries. This flood of data creates problems relating to assembling, storage retrieval and dissemination to make it available to the user. The 'information explosion' has grown to such phenomenal proportions that it cannot be handled by conventional libraries and other agencies. New methods and technologies have evolved such as on-line data processing by computer for the rapid transmission of information.

'The computer is seen as the only method of coping with the continued expansion of knowledge: there are, for instance, over 400 new chemical compounds reported in the literature every working day'.² Developing countries are dependant for much of their requirements of STI. However, much of the modern technology needed for establishing computerized services is either too expensive or does not meet the requirements of the less developed nations. Thus, these countries lacking modern technology are faced with the economic impossibility of individuals or organisations retrieving current and relevant literature on any topic.

Together with the problems caused by the information explosion is the growing isolation of users and seekers of information in the developing countries. Personal contact between scientists at conferences and other formal and informal gatherings plays a significant role in the dissemination of STI. Inadequate

financial resources to attend regional and international conferences deprive our scientists of this avenue of obtaining current information.

The problems confronting developing countries in obtaining necessary STI, therefore are due to a variety of causes. The flow of information from generator to user too, is hindered in many developing countries. The reason for this bottleneck is that the existing information handling systems such as libraries and documentation centres are often dispersed and poorly coordinated. Lack of trained and specialized manpower, technical knowhow and equipment are major setbacks. Raising the level of education in the field of informatics and the transfer of information technology are dependant on the available, often meagre, financial resources. Direct transplantation of information technology from the advanced countries is also not advisable when the infrastructure of the existing information system is unable to assimilate and maintain them.

In recent years, the problems confronting developing countries in obtaining necessary STI has attracted the attention of international organizations, both governmental and non-governmental. The National Technical Information Service (NTIS) was formed by the U.S. Government to disseminate STI to less developed countries. The NTIS has a large range of secondary abstracting and indexing services orientated towards national and international development. Although the NTIS is principally in the American region, it has also been extended to the African and Asian Regions.

In 1967, UNESCO and ICSU (International Council of Scientific Unions) undertook a joint study to resolve these problems and consequently in October 1971 the UNISIST programme was launched by the UNESCO member states. The UNISIST Report (1973) states that 'The developing countries need coordinated international assistance to develop their national information systems, in a compatible fashion, to train their information specialists, teachers and managers, and to seek and adapt new communication and information handling techniques to their specific needs'.

One of the main functions of the UNISIST programme is to stimulate information flow particularly to the benefit of the developing countries. The programme does not directly provide STI to users but acts as a catalyst on the development of information systems and by technical and financial assistance projects. The activities of UNISIST help countries to establish their own information infrastructures through developing information systems and databanks and through the use of modern techniques. The need for a high-level national focus to coordinate information activities both on a national and international scale was established by UNISIST. The lack of a coordinating focus for STI within any country leads to the development of mutually incompatible and heterogeneous internal information systems and to wasteful duplication of

resources. It also leads to delayed application of the results of research and causes serious information gaps between countries.

Some countries already have a national focus for STI while others are moving towards the establishment of one. The government of India recognising the need for a planned integrated information system established the National Information System for Science and Technology (NISSAT). NISSAT coordinates information facilities available in the country at regional and at sectoral level (Agriculture, Industry, etc.).

UNESCO sponsored a consultancy mission to Sri Lanka in 1968 to advise on the establishment of a national scientific documentation centre. The report on this mission stated that 'in respect of STI the analysis of the resources of existing libraries in the country and the possibilities for their further development towards filling the needs of the future, has indicated the urgent necessity for rapid development in this field if industrial and agricultural development is not to be seriously hampered'.

The Cabinet in 1969 approved the proposal of this mission to establish such a centre and the National Science Council of Sri Lanka was nominated as the national focal point for scientific information activity. Within the National Science Council, the Sri Lanka Scientific and Technical Information Centre (SLSTIC) was established to serve as a clearing-house for STI and to coordinate information activities among the national Scientific and Technical libraries.

Considering the problems existing in developing countries to obtain STI: the ever-increasing flood of scientific literature in an increasing number of languages, the lack of trained documentalists and other personnel, poor coordination and disorganization in existing facilities, limited resources and the lack of information technology, the establishment of a national information centre is a difficult but all important undertaking. According to UNESCO "there is no doubt that there is a relationship between the possession of current scientific information and economic progress. Although no systematic evaluation or study of the pay-off from information systems has yet been made, it is accepted that technological change is observed to occur in information rich areas. This change brings to those that effect it, greater productivity per man hour expended and a more stimulating working environment that induces more change."³

References:

1. D. J. De Solla Price, (1963) *Little science, big science*. Columbia University Press. p. 2.
2. Denis Grogan (1976). *Science and Technology. An introduction to the literature*. Clive Bingley. London. p. 192.
3. Unesco (1969) 1159/BMS. RD/DBA.

An Introduction to Consolidation and Analysis of Information

N. U. Yapa

Librarian, National Science Council

Information scientists are mainly concerned with the provision of appropriate information rapidly, economically and authoritatively to the users.

A document (or pre-packaged information) usually aims at a certain user or a group of users and hence it would not satisfy the needs of another user or group having different interests. The information acquired by a library or an information centre would not be appropriate to all categories of users. It is considered that supplying irrelevant information to a user is an uneconomic and undesirable exercise. This means that information generated from a certain source cannot be transferred, as it is, to the user.

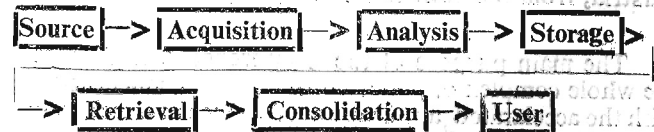
Available pre-prepared information has to be converted to a new product in view of satisfying different categories of users. Preparation of documents (or information packages) has to be done taking into consideration the user needs and aiming at saving the time of the users. This is done by extracting, condensing, digesting and evaluating the already available information. This technique is called 'information consolidation'. To accomplish this, obviously, the information scientist should have a background knowledge of the subject concerned.

Consolidation is not merely gathering the relevant information and forwarding it to the users. The information scientist goes a step further by evaluating and condensing this information and creating a usable information product. In doing so, he should ensure that the reader does not receive invalid and inappropriate information. Digests, the state-of-the art reports, surveys, compendia, are some of the information products prepared by consolidation.

Consolidation cannot be done straight away from an information resource. To facilitate consolidation the resource has to be systematically organized. The documents in the resource have to be analysed to disclose the hidden information. A document such as a book, report, periodical etc. would contain information outside the envisaged subject field. This information would not be revealed unless the document is analysed. Indexing, classification, cataloguing and abstracting are some techniques used in information analysis.

The analysed information is then stored in a retrievable manner.

Acquisition, analysis, storage, retrieval, consolidation and dissemination are different stages of the information transfer. Analysis is done at the input stage and consolidation at the out-put stage.



These two techniques are usually done by an Information Analysis Center (IAC). Scope of IAC is usually confined to a special subject field. The IAC's are manned by information scientists having a thorough knowledge in the subject field. Their duty is to gather appropriate information on the subject by extracting hidden information from documents on broader and allied subjects, to evaluate the information in order to filter off unwanted and undesirable information, to store such information in a retrievable manner and finally to consolidate information in view of satisfying the particular need of a user.

The new trend in the information field is concerned with the establishment of IAC's on various special subjects with a view to supplying the scientists and research workers, who cannot afford wasting their valuable time in searching for information, with most appropriate and condensed or summarised information.

Unesco definitions:

Consolidation: The merging and synthesis of scientific information or data on a given subject in the form of compendia, surveys, state-of-the-art reports, etc. 'Evaluation' and 'Compression' are implied in the process.

Analysis: (a) in general the expression of document of contents in a form different from the original through operations such as abstracting, indexing, translation reviewing, evaluation, etc.

(b) more specifically, in 'information analysis' the combined use of these operations to provide definite user groups with evaluated bodies of knowledge; **information analysis centres**, the organizations responsible for this function.

United Nations Conference of Science & Technology for Development (UNCSTD)

Vienna, Austria.

August, 1979.

A major United Nations Conference on Science and Technology for Development will be held in Vienna, Austria, from the 20th to 31st August, 1979.

The main purpose of the Conference is to discuss the whole complex of policy considerations concerned with the accelerated application of science and technology to development at the national level and with increased international cooperation. A basic tenet of the Conference is that finding how best to apply science and technology to development rests ultimately with the countries themselves. The problem should not be left exclusively in the hands of international experts however well-informed or well-intentioned they may be.

It follows that national analyses will lay the foundation for the work of the Conference, and national papers will accordingly be among the most valuable documents to assist decision-making at Vienna in 1979.

The basic objectives of the national papers is to provide an analysis of economic and social problems to be solved with the help of science and technology and to take account of a large and varied constituency of national opinion.

To that end, the general pattern of preparation of national papers has involved thorough discussion among members of the national committees. Frequently, the papers are a synthesis of many contributions prepared by high-level scientists and technologists, social and economic planners, government ministries, professional bodies and other non-governmental organizations. In many countries it was the first occasion when representatives of these sectors pooled their knowledge at a ministerial level so as to draw up a plan that would integrate technology into long-term development planning.

Some 65 developing countries asked for, and have received, technical assistance from advisers in drafting national papers. These advisers were selected by Governments from a short list drawn up by the Conference secretariat. Their principal role was to catalyse and maximize the contribution of local experts and to stimulate the bringing together of as wide a spectrum of national opinion as possible.

As papers are received at United Nations' Headquarters, their contents are being analysed so as to provide an input for the draft outline of the programme of action for the Conference and for the preparations of discussion papers relating to the various items of the Conference agenda. The draft outline will be reviewed at the third session of the Preparatory Committee in New York in September 1978.

A major contribution to UNCSTD will be the regional action plans. These will represent the consensus of opinion within each of the world's five major geographical areas. Sub-regional initiatives, however, are being actively encouraged, both as part of the preparatory process of the Conference and to lay the seeds for effective follow-up after Vienna.

These activities recognize that smaller groupings of nations within the principal regions often have much in common beyond geographical proximity. In science and technology, as across a broad range of economic, social and cultural sectors, sub-regions are a highly appropriate setting for stimulating thinking about shared problems and possible common solutions.

The United Nations' Economic and Social Commission for Asia and the Pacific (ESCAP) organized the first Regional Preparatory Meeting for UNCSTD at Bangkok from 8 to 12 December 1977. After a detailed discussion of the socio-economic development needs of the region the meeting agreed on the following five subject areas (a) food and agriculture (b) natural resources (c) energy (d) health and nutrition and (e) industrialization.

The UNESCO Regional Office for Science and Technology for South and Central Asia and the UNCSTD Secretariat jointly in cooperation with ESCAP convened in New Delhi from 7 to 9 February a 'Sub-regional Meeting of Experts for Preparation of National Papers for the UNCSTD' to share ideas and experiences in preparing for the Conference. The Meeting was attended by 20 specialists from Asian countries.

The Secretary-General of UNCSTD has emphasized that the preparation of national and regional papers should proceed simultaneously, reinforcing each other. According to the views expressed in several forums, the preparation of the national papers might well be a continuing process, and the national focal points for UNCSTD preparations could continue to function during the conference and even afterwards as a network for coordination and implementation of the conference's recommendations.

UNESCO.

● Meeting of Experts on "Information Consolidation—a Tool for Technology Transfer"

12th to 16th September 1978.

An international symposium on "Information Consolidation a Tool for Technology Transfer" is scheduled to be held in Sri Lanka, sponsored jointly by UNESCO and the National Science Council from 12th to 16th September at the BMICH.

The decision to hold the symposium in Sri Lanka was a result of the discussions between Mr. L. E. Samarasinghe, Chief, Section for Development of Information Infrastructure, Division of the General Information Programme, Unesco, Paris, and Mr. L. C. de S. Wijesinghe, Acting Secretary-General of the National Science Council, during Mr. Samarasinghe's recent visit to Sri Lanka.

The meeting will be essentially an expert meeting consisting of about 20 international experts representing relevant subject fields such as:

- * information policy and management,
- * established national and regional information analysis centres,
- * natural information systems,
- * information users,
- * economic planning, etc.

It is also intended to invite some international organizations interested in supporting information consolidation activities at national, regional and international levels, both morally as well as financially.

The overall objectives of the meeting are:

- Within the frame-work of the world information network, towards the building of which the UNISIST programme of UNESCO is playing a vital role, and of national information systems (eg. SLSTIC), to define the needs and problems in information consolidation at policy level (governments) and at extension services level, particularly in agriculture and industry.
- To promote solutions and to establish a programme of action to meet the identified needs.

"The need to perfect a system of scientific communication, which has been felt ever since science existed, began to make itself apparent even more markedly after the beginning of the present scientific and technological revolution. This is due partly to the enormous quantity of scientific information amassed through scientific research and partly to the ever greater economic and social importance attaching to the fastest possible introduction of scientific discoveries into industry. Science has changed from being the personal occupation of a small group of workers to a broad sphere of human activity, organized and directed like the major branches of the economy. To increase the effectiveness of the scientific information system, therefore, is to provide a great potential for increasing the productivity of research workers and an important means for speeding up the process of bringing the achievements of science to the consumer."

V. AMBARTSUMIAN
President ICSU
Unesco Bulletin

Any information concerning scientific activities, projects and current research as well as comments and viewpoints will be received with the greatest interest. As the publication is mainly for information purposes, the National Science Council takes no responsibility for the views adopted by the authors, the facts presented or the interpretation of these facts.

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