

## SCIENCE CENTRES

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Science educators and policy makers all over the world are either busy advocating the setting up of science centres or in the process of getting museum authorities to transform science museums into science centres. Changes are already underway at the Science Museum in London, Deutsches Museum in Munich, Swiss Transport Museum in Lucerne, Tekniska Museet in Stockholm, Narodni Technicke Muzeum in Prague, Museo Nazionale della scienza e della Technica "Leonardo da Vinci" in Milan, Muzeum Techniki in Warsaw, Danmarks Tekniske Museum in Helsingor and the Palais de la D'ecouverte in Paris. Other science centres in Tokyo, Cairo, Singapore, Nagoya, and Seoul are adopting the view that not only is visitor-participation important but it is also necessary to show contemporary science exhibits.

### Quiet revolution

A quiet revolution is now underway as more and more people come to realise that the traditional museums can no longer be the preserve of a coterie of people but must be opened up to the hundreds and thousands of individuals who have suddenly found these places, which have themselves been undergoing change, to satisfy their needs of obtaining a non-formal and non-structured education. Director of Development, Stephen Thomas of the Rochester Science Centre notes that, "In the United States", for example, "museums are attracting more and more visitors. In fact, some thirty years ago 50 million visits were paid annually to 2,000 museums but today the figure has risen to over 300 million visits and new museums are increasing at the rate of six every week. In spite of this many segments of both urban and rural communities are not yet reached". It is, however, refreshing to note that in the last few years educators have woken up to the fact that a science centre can play a very effective role in the transmission and diffusion of knowledge to the public. The potential uses of this means of communication is being realised and utilized by more and more educators who see some of the limitations of the formal systems of education. Educators are turning to science centres to complement their education programmes in schools, colleges and universities.

The change that is spreading through the science museums which are being transformed into science centres will have a profound effect on new methods of teaching and popularising science. It is no exaggeration to say that sooner or later colleges and universities will have to turn more and more to science centres to make young people

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understand what they are trying to say and to make them see science in relation to the total experience of society. Only science centres with their flexibility in presenting science will be capable of bringing to the lay public and the general student population the latest advances in science and technology in simple three-dimensional terms. Since science centres are not constrained by the usual requirements imposed on formal education systems of completing syllabi and curriculums in a set period of time, it is possible for them to introduce new topics into their education and exhibits programmes long before they have penetrated the school and university systems. In this way they can act as powerful tools for the use of formal education systems which are already hard pressed by time and manpower shortages.

### **Learning through participation**

Science museums have by and large been the repositories of artifacts from the past and they tend not to worry too much about explaining science or making it understandable to the general public. They seem to be content in displaying historical objects. Science centres on the other hand have taken it upon themselves not only to explain science to the public but also to show how science is applied in industry. The very nature of their subject matter makes them innovative and experimental. The emphasis in science centres is on contemporary science and its implications for society in general. Rather than having a "hands off" policy, science centres in fact encourage the public to touch exhibits, push buttons, turn cranks, and listen to taped messages on telephones so as to get visitors to participate in a learning experience. The basic educational philosophy adopted is that one learns by doing things oneself rather than being a spectator of an event. Special education programmes which take the form of discovery lessons, lecture-demonstrations, talks, science film shows, technology projects and ecology study trips are normally run by the centres to supplement the formal offerings of local schools and colleges.

### **Supply of scientific manpower**

Japan and America are probably the only two countries in the world which have a prolific number of science centres and museums which have been set up to ensure that there is a continuous supply of scientific manpower for the smooth functioning of the various sectors of their industrial economies. In a highly competitive industrial world they cannot afford to see a "swing away from science" which, for example, Britain experienced in the mid-sixties and as a consequence "lost" about 4,000 potential scientists and engineers. Science has to be made palatable to youth so as to induce them to take up careers in science and technology. In passing, it is worthwhile to note that the London Science Museum is in the process of revamping its exhibits and using modern design techniques to present science to the general public and the student population. It is also interesting to note that the Deutsches Museum in West Germany is always quoted by students who register for university or technical institute courses in Munich as the place that first inspired their imagination to take up scientific careers.

### **Deutsches Museum**

Each science centre approaches its educational mission somewhat differently usually as a result of its community needs. The Deutsches Museum which occupies a

floor space of 89,000 sq. m and is operated on an annual budget of US \$ 2 million is one of the largest science museums in the world. It employs a staff of 324 persons, and has about 800,000 to 1,000,000 visitors a year. Being a society geared to high technology industries it has devoted a larger share of the exhibit space to physics than to any other subject. The subject matter is represented in three ways: displays of original apparatus, historical reproductions and actual demonstrations. Demonstrations include exhibits for the participant to watch, those that follow a sequence after he pushes a button and those in which he does it all. For example, with pulleys, weights, levers and springs you can test the laws of statics and simple dynamics. By pushing a button you can cause the vacuum in a discharge tube to improve gradually as the dark and bright spaces become shorter and more numerous. With a crank you can move a light bulb along two parallel wires and, as it dims and brightens, observe a standing wave pattern. With another you can move a thermal element under a spectrum and see that the greatest heat is delivered out beyond the visible in the infrared. Some of the experiments require a demonstrator and these are given at prescribed times during the course of the day.

### **Evoluon**

A science centre using the most modern techniques in exhibit design and the communication of science to the public is the Evoluon in Eindhoven in Holland which was established by the Philips organisation in 1966. In fact, the Evoluon and the Ontario Science Centre in Canada are the two most outstanding and modern science centres in the world. The Evoluon depicts the evolution of science and industry, with an emphasis on scientific principles, applications and consequences. The underlying philosophy of the exhibits on display is to get the message across to the visitors that technology is the servant of man. As a consumer, man cannot do without technology. He has to organize technology to meet his consumer needs by matching human labour to man's capacity and potential.

Although the exhibits are presented in a thematic form, they do not follow a rigid sequence of ideas. The visitor is alternately confronted with logic and surprise: matter and man, "don't touch!" and do-it-yourself, today and the future, the topical and the historical, and so on. The physical science and technology exhibits are devoted to themes on sound, light, matter as the key to all production, the electron, equipment and systems, and manufacture and production control. Every year at least 10 per cent of the exhibits are either improved or replaced. The Evoluon itself is evolving in order to continue living in a changing environment.

The need to catch potential scientists while they are young led the Evoluon to establish a "Prelude to Technology" section which has a large number of participatory type exhibits. The Evoluon's appeal to youth has made it a focus for several youth activities such as science study weekends for secondary-school children, a young people's laboratory and a meeting place for young scientists both nationally and internationally.

### **London Science Museum**

The London Science Museum, one of the oldest institutions of its kind, is in the process of modernising its exhibits display in keeping with the latest advances in the com-

munication of science to the public. One of the areas which draws a large crowd of people is the Children's Section where both adults and children are able to participate in the exhibits and see how things work. The Museum has a travelling exhibition which takes science to the outlying areas in the country. A comprehensive education programme consisting of talks, lecture-demonstrations and science films is very popular with schools, colleges and adult groups.

### **Ontario Science Centre**

The Ontario Science Centre according to Toronto architect Raymond Moriyama was dedicated to the pursuit of knowledge and understanding of the contemporary world we live in. Discovery was the key to the perception of scientific and technological knowledge. Built at a cost of about US \$ 30 million, it provides 40,500 sq.m of floor space of which 13,500 sq. m is for exhibits. The exhibits are estimated to have cost about US \$ 5 million. Again the philosophy here has been to exploit the unique characteristics of the exhibit medium, so that the visitor can touch, pull, walk into, operate or otherwise actively involve himself with the exhibit whenever possible. The only other science centre of comparable size in North America is the Museum of Science and Industry in Chicago. Most of the 450 exhibits in the Ontario Science Centre were planned, designed and fabricated by the Centre's staff. The staff includes scientists, engineers, designers and fabricators. There are about 14 scientists and engineers, 12 science teachers, 58 guides, 20 designers, 67 fabricators, 14 building maintenance officers, 33 management and administration personnel, 10 secretarial personnel and 27 security guards. The annual cost of operating the Centre and of renewing its exhibits at the rate of 15 per cent a year is about US \$ 4 million. On the average about 1.3 million people visit the Centre a year.

Two major exhibit innovations are: firstly, the presence of elaborate laboratory apparatus for use by industry, institutions and talented students under the supervision of the Centre's scientists. This equipment is on display in public areas and its use is demonstrated to the public. Secondly, a science arcade has been designed primarily for young people but fascinates adults as well.

One example of the laboratory apparatus programme is the use of the electron microscope with a magnification of 500,000 donated by Philips Electronic Industries. Once every hour visitors are given an explanation of the instrument and its functions. The magnified specimens can be seen by visitors on a closed-circuit television camera. Other equipment includes infrared and ultraviolet spectrophotometers, a nuclear magnetic resonance spectroscope, a mass spectrograph, a full computerized and automated X-ray diffractometer and an automatic carbon-hydrogen analyzer. A working weather station, an amateur radio station and a glass-blowing shop are all on display for visitors.

In the science arcade visitors can by pedaling a bicycle generate electrical power that turns on lights, plays music and projects their images on TV tubes. To demonstrate inertia, visitors start turning two discs identical in size and shape. However, one is made of aluminium and the other of steel. Visitors have difficulty getting the steel one moving. Then, they slow the discs down and find that the steel one has more momentum than the

aluminium one. These are just two of the 90 exhibits in the arcade. Other exhibit themes deal with such topics as molecular science, space science, earth sciences, lasers and holography, communications, engineering, transportation, life, and Canadian resources.

There are also lecture-demonstrations on various topics. At the Hydro Spart Demonstration show visitors are fascinated when the static electricity on a Van de Graaf machine makes the hair stand on end of a participant in the demonstration. Elsewhere, an audience is enthralled by the sight of liquid nitrogen boiling in a vacuum-jar. The demonstrator uses it to cool a piece of plastic tubing to the point where it is brittle enough to be smashed with a hammer.

Theatre presentations on various topics such as ecology, pollution, energy, computers, and hormones are also given by the Centre's staff. The Ontario Science Centre also offers science programmes to schools which are aimed at complementing the Ontario school curriculum. Since there is a weakness in the teaching of science in elementary schools the Centre helps to make up for this deficiency in the system. In addition, the Centre also conducts project work for talented students.

### **The Chicago Museum of Science and Industry**

In Chicago the Museum of Science and Industry operating on a yearly budget of US \$ 4 million is visited by three million people annually. The Museum has 2,000 exhibits in 75 exhibit halls that cover 4.6 hectares of floor space. The Museum of Science and Industry seeks to supplement the formal school programmes with guided tours of exhibits, demonstrations of scientific principles, and special theatre programmes. It also serves as the site for science, industrial education and other programmes presented by the Chicago-area schools. It also serves as the advisory board for science and industrial education. It has been a pioneer in experimental methods of presenting scientific and technological information. The Chicago Museum is developing a Science Information Centre to replace the Museum's library. It will have books, films, computers, microfiche, television and optical scanners. Visitors will also be able to view "filmed" books in small theatres and have access through computer terminals to banks of scientific data. The Museum is also designing a special science-oriented exhibit for pre-school children in an attempt to make scientific principles and applications meaningful to boys and girls between three and six years of age. The exhibit will be built to pre-school scale.

The Chicago Museum is best known for its full-sized operating coal mine, chick-hatching incubators, an actual captured German submarine, a giant 5 metre walk-through heart and an exhibit on the history and technology of the circus.

Among other exhibits are the actual Apollo 8 spacecraft, a theatre utilizing new multimedia techniques, and exhibits dealing with steelmaking, photography, automobiles, petroleum, chemicals, aviation, food, natural gas, mathematics, tools, newspapers and health.

Science centres are busy looking into ways of communicating science effectively to the public in an age which is becoming more and more technology based. In doing this, they are also aligning themselves to the educational systems in their countries and thus helping to play a very important and useful role in the education of youth.

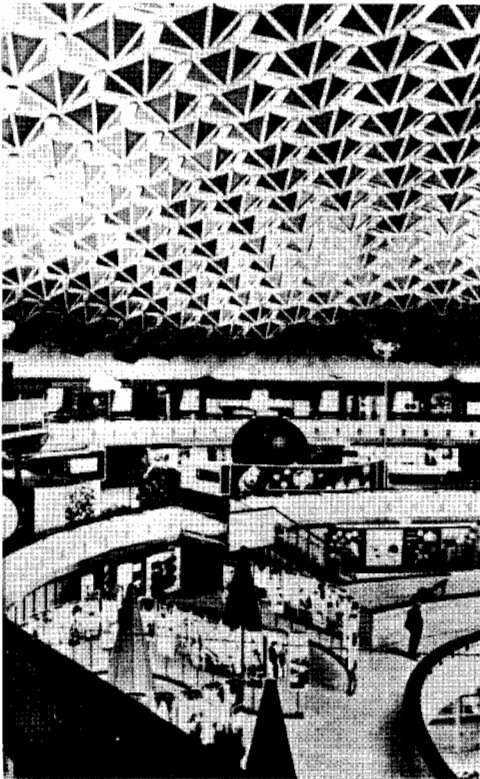


Fig. 1 (left) Interior view. Evoluon, Eindhoven, Holland.

Fig. 2 (bottom left) Exhibit on Tic Tac Toe. Ontario Science Centre, Canada.

Fig. 3 (bottom right) Exhibit on Health. California Museum of Science and Industry, U.S.A.



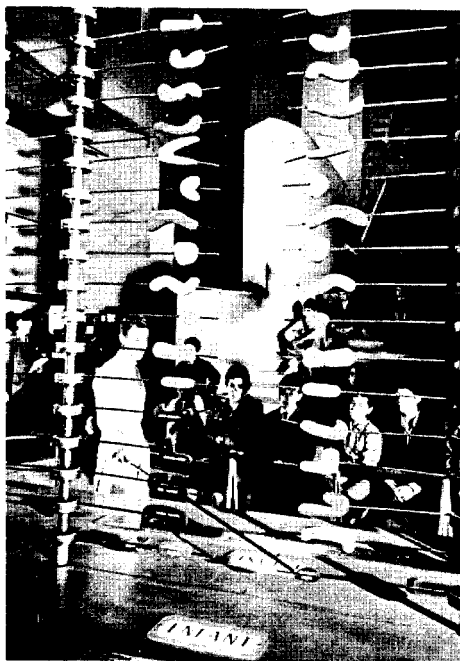


Fig. 4 Exhibit on Heredity. Palais de la Decouverte, Paris.

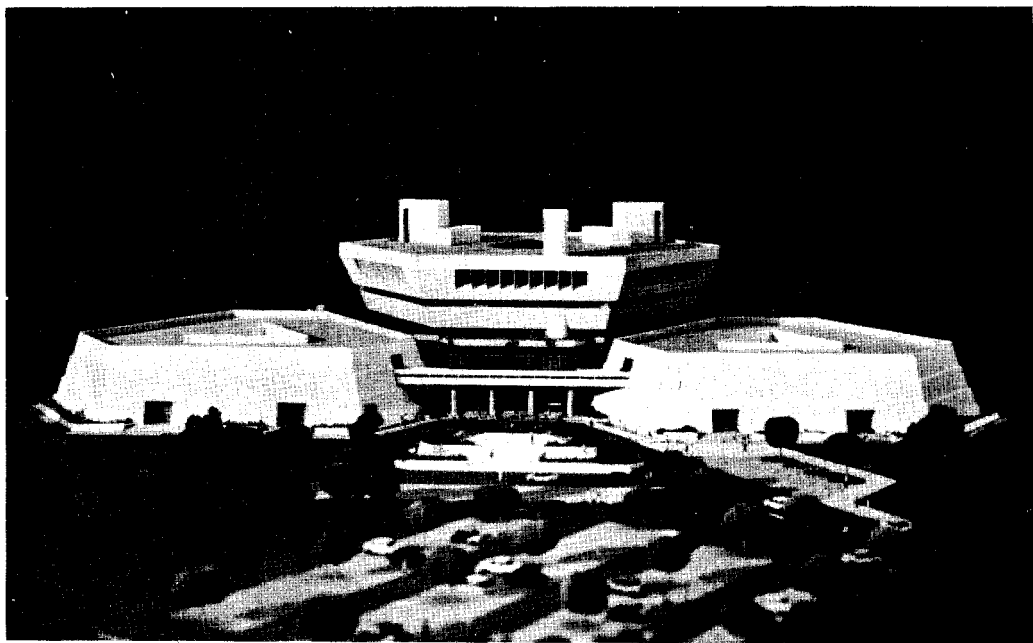


Fig. 5 Model of Singapore Science Centre now under construction.