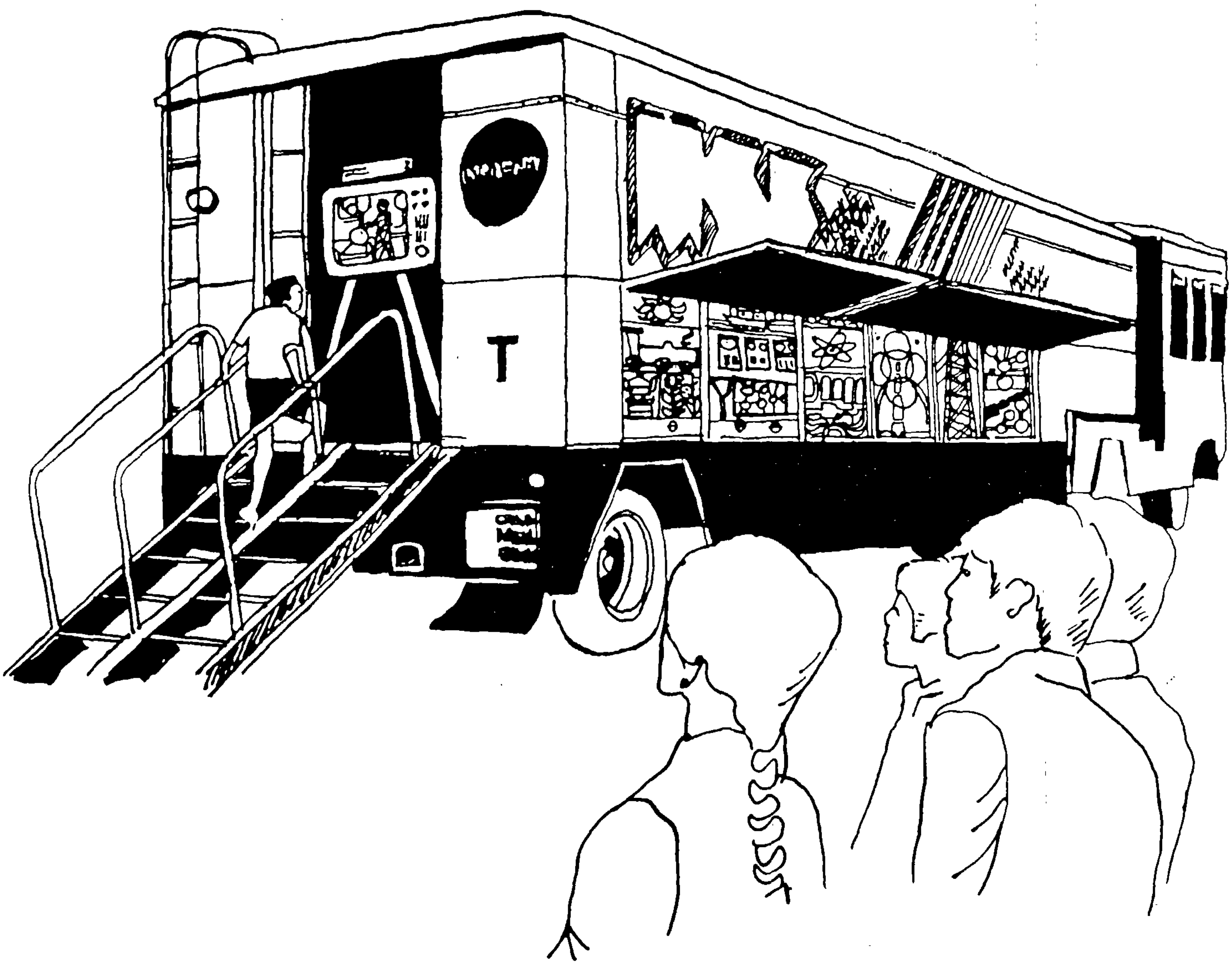
MOBILE SCIENCE EXHIBITION



First Published 1983 by the
United Nations Educational,
Scientific and Cultural Organization

Regional Office of Science and Technology
for South and Central Asia
17 Jor Bagh, New Delhi, India

Printed and bound in India by
The Radiant Process
6A, S. N. Banerjee Road
Calcutta-700 013

AMALENDU BOSE

With a Foreword
by
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FOREWORD

Mr. Amalendu Bose has rendered a signal service to the museum profession by producing this book on mobile exhibitions in a developing country at the invitation of U N E S C O. As founder of the first successful museum of applied sciences and technology in India, the Birla Industrial and Technological Museum, Calcutta, opened in 1959, his experience in teaching science and technology by use of museum techniques is unrivaled.

Recently, shortly before his retirement, Mr. Bose was able to create the National Council of Science Museums, to be in charge of the three major museums of this type—the Birla Industrial and Technological Museum, Calcutta, the Visvesvaraya Industrial and Technological Museum, Bangalore, and the Nehru Science Centre, Bombay, opened in 1977, but still in the process of construction of its permanent buildings—as well as to be sponsor, adviser, or administrator of a considerable number of smaller museums of the type, already operating, or planned, for different parts of the country.

Because of the diversity of the various regions of the country, their level of education and of science understanding, and the substantial progress the nation has demonstrably made, since Independence, in technological and industrial achievement, no more fruitful setting for the purposes of such a study as Mr. Bose's book could be imagined.

Mr. Bose bases his observations, record of facts and recommendations in his book firmly on his personal knowledge and experience. As a pioneer in making effective this type of museum designed to assist people to bridge rapidly the gap between their formerly traditional agricultural way of life and the contemporary industrialising urban society, what he writes has wide significance. Thoroughly understood and suitably adapted, it offers suggestions for other Third World Countries elsewhere than in Asia.

As prelude to the core of his subject—the mobile exhibition units serving rural areas—Mr. Bose makes a summary report on the development and use of travelling exhibitions on science subjects, including those organized and circulated by UNESCO soon after the last world war. He describes India's participation and the benefits in science understanding derived from them in this country.

He goes on to explain briefly how science exhibitions of this general model, which the two museums that he founded and developed—the Birla Industrial and Technological Museum, Calcutta and the Visvesvaraya Industrial and Technological Museum, Bangalore, provided for their respective regions, gained success, but likewise what handicaps and difficulties they encountered in finding suitable institutions to receive them and to make them available, not only to school pupils, but also to the population at large, which they were always intended to interest and instruct as well. He then proceeds to consider how exhibitions having the practical aims that his Museums had in view, in spreading and extending, at least to some degree, the benefits of the parent Museums to the rural areas, could be carried out. This effort leads to devising the self-contained mobile units, and to the search for a thoroughly satisfactory format for them.

Here, with precise data, diagrams and photographs of the various forms these mobile units were given, with due regard to the limitations of the roads and other physical constraints in the areas of their operation, lie the most important part of Mr. Bose's study. It becomes, in short, a manual for designers of mobile exhibition units, with ample information on every practical aspect of the use and value of the respective types devised over the years by the Museums of the National Council of Science Museums.

It should be noted that the officers of the National Council of Science Museums have contributed generously to Mr. Bose's book by making available for his use the drawings, photographs and the precise data that he required to make his study the valuable reference work that he has provided for the guidance of others who may be interested.

Some of the results observed from the successful operation of these mobile exhibition units are likewise recorded, while the administrative details required for disciplined operation have been indicated, if somewhat briefly, though obviously each country or each museum which undertakes such a programme must work out its own requirements. Thus very little information which might be helpful has been overlooked.

One can assert, without any exaggeration, that the information in the following pages is a most helpful account of practical museum extension services in a vast country needing and ready to profit by instruction in the sciences, to be valued, therefore, as a contribution to technical museological literature. It has been a privilege to have been able to study it with care. It is a pleasure to recommend it here, and to congratulate Mr. Bose on carrying out so successfully this assignment which is of benefit to us all.

GRACE MORLEY
Permanent Adviser,
International Council of Museums (ICOM)
Regional Agency for Asia
New Delhi, May 22, 1982

PREFACE

I was given an assignment by UNESCO in June 1980 to undertake the preparation of a study on the development of science and technology within the framework of societies and cultures with the help of mobile science exhibitions. This study is based on the experience of developing countries in general and India in particular and contains some suggestions and recommendations for UNESCO's action in this field.

In short this treatise reflects the influence of science and technology in urban and rural areas and deals with the dynamics of operation of mobile science exhibitions and a short survey of some of the areas to determine the impact on society. The mobile science exhibition programme has been one of the most successful programmes of the science and technological museums in India. This treatise has been prepared on the basis of the author's personal experience with the planning of science and technological museums in India since 1956 and later on as the overall administrator for over a decade ending with March 1979, first as Director of Museums of the Council of Scientific and Industrial Research (India) and later on as Director of National Council of Science Museums (India).

Contacts were established through correspondence with science museums/centres in some of the developing countries in Asia and information gathered as far as possible within the short time at my disposal. Personal visits to some Asian countries where science museums and mobile exhibitions have been introduced have been helpful and reports received from some others have been incorporated. The author sought collaboration from the National Council of Science Museums (India) and the whole-hearted cooperation of its Director Dr. Saroj Ghose and the members of the staff of the Council and its constituent museums, namely, Birla Industrial & Technological Museum, the Visvesvaraya Industrial & Technological Museum and the Nehru Science Centre made possible the compilation of this report containing extensive technical details. The section on "Electrical requirements in exhibition vehicles" has been specially contributed by Dr. Ghose and Mr. A. K. Dutta, Scientist (Electrical) in Birla Industrial & Technological Museum, Calcutta.

Particular gratitude is due to the following :

Mr. Paul Perrot
Assistant Secretary for Museum Programmes,
Smithsonian Institution, Washington D.C.

Mr. James Harrington
Director of Exhibits, Franklin Institute, Philadelphia.

Mr. Sigeru Fukuda
Director General,
National Science Museum, Ueno Park, Tokyo.

Dr. (Mrs.) Soledad Antiola
Director,
Science Foundation of the Philippines, Manila.

Dr. P. H. D. H. de Silva
Director,
Department of National Museum, Colombo.

Mr. P. C. Bandyopadhyay
Former Programme Specialist for School Science,
Division of Curriculum and Educational Research
of UNESCO, Hyderabad.

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Mr. Amit Sarkar
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The assistance and encouragement given by Mr. S. Passman, Director, Division of Scientific Research and Higher Education, UNESCO and Prof. Kholodilin, Programme Specialist, Section on Science & Society, UNESCO have been invaluable and greatly appreciated. Particular thanks are due to Dr. (Mrs.) Grace Morley, for writing a foreword to this publication and for taking meticulous care in going through the manuscript and making valuable suggestions. Mr. G. C. Mondal, Former Exhibition Officer, Nehru Science Centre, Bombay helped me in the art layout of this publication, for which I express my appreciation. Thanks are also due to Mr. S. K. De of Birla Industrial and Technological Museum, Calcutta who gave extensive secretarial help required for preparation of this report.

AMALENDU BOSE

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Chapter I

INFLUENCE OF SCIENCE & TECHNOLOGY ON URBAN AND RURAL AREAS IN FULFILLING ECONOMIC AND SOCIAL NEEDS

Introduction

Removal of poverty and attainment of economic self-reliance have been the aim of most of the developing countries, who have attained political independence from colonial rule. Experience has shown that economic growth is coupled with industrial and social development. It is also well recognised that science and technology exert an increasing influence on growth and development—material, industrial, economic and social. The greater the capacity of a nation to generate, transfer and utilise technology, the faster is its growth, progress and prosperity. It is further recognised that technology flow means also that technology should be put to work. In the words of Prime Minister Indira Gandhi "the role of science is not merely increased production through advanced technology, but it means changing the lives of individuals and of the nation......... Only science is capable of solving the social problems of our era." It is thus apparent that science, technology and development are inter-related and interacting systems with society.

Impact of Science & Technology

Let us examine how the development of science and technology can help to achieve the realisation of the goals of developing nations. For the sake of industrialisation, it is possible to import advanced technology from abroad at high cost and set up industries in the country to produce more and more goods and provide increased employment potential. But the great majority of people living in small towns and villages remain unaffected and the technology does not percolate to them. It has been the past experience that the expected benefits of urbanised technology and industrialisation have not been diffused to the rural hinterland. On the contrary it has created the problem of people migrating to cities, neglecting their villages and agriculture. This shows clearly the need for diffusion of science and technology to the grass roots—a technology which is appropriate to the way of life, a knowledge of science which makes them observant about nature and their surrounding and gives them a tool to improve their life. This type of "appropriate" technology must not be confused with primitive technologies, because these could be based on modern science. For example, a simple village cow-dung gas plant could make use of modern scientific expertise in the field of micro-biology, chemistry, chemical and mechanical engineering, even economic and social sciences. Improving some of the traditional skills and crafts in the village industries and development of technologies capable of being utilised in the cottage or in the small scale sector, have been engaging the attention of present day scientists. Instead of replacing the blacksmith's traditional forge by means of a modern contrivance like an electric furnace, which may eventually bring in other social inconveniences, it is argued that it will be much better if the village blacksmith is taught properly more effective use of some improved tools and prevention of heat wastage.

Science and technology are today very powerful tools for bringing overall progress and also acting as a catalyst for growth. Application of science and technology is for increasing production and promoting economic, social and cultural betterment of society. The benefits of science and technology should percolate to the majority of the population, particularly to those that live below the subsistence level in a developing country. To achieve this objective it is necessary that science and technology be taken to rural areas amidst their own environmental and cultural context without creating any social or economic imbalances. Application of scientific and technological know-how in rural areas can be, in many ways—improvement in traditional skills, technologies for better utilisation of resources, introduction of crops of more economic value, introduction of small industries, improving public utility facilities, like drinking water, latrines, sanitation and health, rural housing, roads and last but not the least creating a scientific awakening among the masses.

In a Workshop organized jointly in 1978 by the Council of Scientific and Industrial Research of the Indian Government and the Centre of Science for Villages, Wardha, Maharashtra State, it was observed that a small improvement in the field of technology, meaning thereby marginal changes in equipment, using some improved variety of chemical and also training how to apply a better finishing method, may result in a definite breakthrough in the economic conditions of the impoverished artisans. A village soap manufacturer is producing laundry and toilet soap for the rural and semi-urban areas. His cost of production is not competitive with that of an organised soap manufacturer, and he is eking out a miserable existence. Suppose some simple equipment is provided to him to retrieve glycerine out of the oil used for soap-making and he will have comfortable margin of profit and will be able to withstand the urban competition. A village leather worker is selling the tanned hide at a throw-away price, because he lacks knowledge of the appropriate chemical to turn an inferior hide into a better leather. Thus technology, as such, has a big role to play in revitalising the village industries.

Another problem in all developing countries is the widespread practice of superstition due to lack of scientific knowledge. Some of the superstitious practices are injurious to the health of the individual and to the community. Dissemination of scientific knowledge is the only way to obliterate such customs. A staff correspondent's report published in an Indian newspaper is quite interesting and reads as follows: "The Alipur Zoo (at Calcutta) authorities sell seven to eight bottles of rhinoceros urine each day to people who use it as a medicine, although the authorities doubt its efficacy. A senior official of the Zoo said that each bottle of eight ounces of urine costs Rs. 3.50 (about 40 cents). The officials said that the sale of rhinoceros urine started long ago. The people who buy the urine believe that it can cure asthma and cough". In the forests of North Eastern India the poor rhinoceros is slaughtered in large numbers by poachers in spite of vigilance by the forest wardens because many ignorant people believe that the concoction prepared out of its horn has aphrodisiac properties. There are many other harmful superstitious practices in other Asian developing countries and spread of science and technology would be the only means to fight against such practices.

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Chapter II

ROLE OF SCIENCE & TECHNOLOGY MUSEUMS/CENTRES

Dissemination of science and technology

There had been a lot of discussions on how to disseminate science and technology to the masses. Better science teaching in schools and colleges, introduction of better courses, improving laboratory facilities and inducting qualified teachers for imparting effective training in science and technology are no doubt helpful for raising the level of knowledge of the student population. But in a developing country in Asia, where there is even a dearth of primary schools, several decades may be required to establish an adequate number of schools to raise the minimum educational level in science. It will mean a long wait for a developing country to achieve its aim of spreading of science education in this manner. The biggest task to-day for every developing country is to orient its vast illiterate population towards a common goal for the upliftment of the country. Initiation into science is one of the goals ; inculcation of scientific temper in society is a prerequisite to the acceptance of science and technology, and without this foundation people will not be in a position to absorb the benefits of science and technology. People need to develop a level of science consciousness that will enable them to integrate the new and the old. The Science Foundation of the Philippines (SFP) made an extensive study in the field of continuing education and non-formal education and observed that the gap between daily life and the vastness of knowledge in science and technology is widening at an alarming rate, and that there is a need to adopt a strategy for total experimental learning of science. Let us look at the literacy trend in the world. It is already 500 years past since the printing press was invented but how many of the world's population can derive benefit from it? In 1970 2/5 of the world's adults lacked the capacity to make use of this invention. UNESCO estimated that on a percentage basis illiteracy is declining from 43% in 1960 to 39% in 1965, but because of the rapid growth of population, the number of illiterates is greater to-day than a few years ago. Since 1956 the youth sector of the Philippines has been pinpointed by the SFP policy makers as possessing the huge potential of becoming the spring board for disseminating scientific and technical information to the population. A 14-station net work covering the Philippine regional divisions has been implementing a pragmatic program on non-formal science-technology-environment education. At the core of this was the science club movement. A science promotion scheme was therefore launched in Philippines by organising science clubs throughout the country. The National Science Fair of 1971 witnessed the birth of a confederation of youth science club in the Philippines named, the Philippine Society of Youth Science Clubs (PSYSC), Inc., under the guidance of SFP. The advisers of the science clubs followed suit and formed the Science Club Advisers Association of the Philippines (SCAAP) Inc. Through these two prongs of the science club movement, SFP reaches the communities all over the Philippines with the aim of cultivating awareness of science, familiarisation with scientific investigations and utilisation of science and technology in every day living. In 1979, science clubs all over the Philippines numbered nearly 2500 clubs with about 200,000 members. The science club movement was meant for the youth, but what about the large cross-section of the society whom science education has to reach ?

The developing countries of Asia realized long since that to achieve a rapid development of their countries it was necessary to acquaint their citizens with the nature, contribution, dangers and potential of science and technology. People have also to be convinced that science and technology can bring improvement to their living conditions, economic growth and social welfare. Of the various experiments which have so far successfully been tried to transmit scientific and technological information in a meaningful manner have been activities such as science clubs, science camps, science fairs (plate I), film forums etc. An organization which can promote all such individual activities and can also project the impact of science and technology on society, is the "science and technology museum". Although such institutions have been in existence in Europe for more than a century and have contributed to a very great extent to the development of science consciousness, they are of comparatively recent origin in the developing countries, particularly in the Asian region. With the exception of Japan, the science museum was not widely known in Asian countries prior to the 1950's.

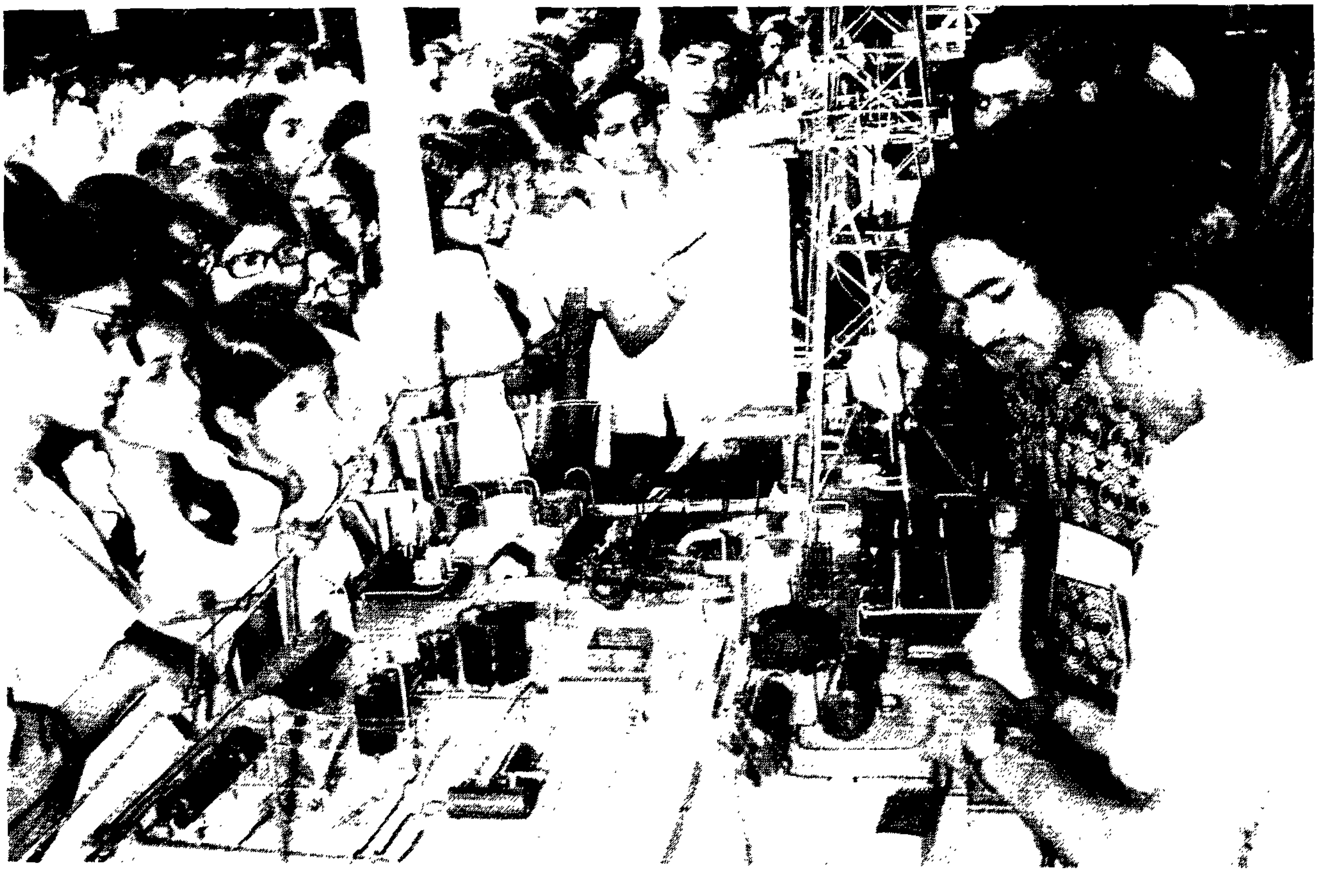

Plate I : In a science fair organised by BITM Calcutta a school student explaining his model of an oil refinery.

The Science Museum and its objective

The science museum, originally intended to serve as a depot for machines, models, designs and books on all branches of applied art, and originally limited to preservation of certain objects of reverence or of sentimental attachment to the people, grew in Europe very fast within the last one hundred years. It was gradually recognised as a place where scientific ideas were transmitted to the onlooker. Its collection contained historical objects, models, replicas and demonstration equipment with the help of which the principles of science were explained in a manner which was easily understood by the layman. Its function became distinct from that of a scientific book or text to understand which required an educational background. Originally when the science museum was set up it was intended to portray *inter-alia* a) the historical stages through which science and technology has advanced in the country as well as throughout the world, b) the fundamentals of science, its principle and phenomena and the various application of science in technology, and c) the landmarks of scientific research and invention and of the inventive genius of the great scientists of the past, so as to arouse curiosity and stimulate interest in the minds of the visitors. The objectives of science museums were continually being modified to suit the socio-cultural setting in which they were founded but its main function has always been the transmission of scientific ideas to the onlooker. The science museum movement in India started with the setting of a "pilot" science museum inside the National Physical Laboratory, New Delhi and with an industrial museum at Pilani in Rajasthan (India). The first full fledged Science and Technology Museum in a developing country, was set up at Calcutta in India under the auspices of the Council of Scientific & Industrial Research (CSIR) of the Indian Government in the year 1959, and was called Birla Industrial & Technological Museum (BITM)—named after the industrial house of Birlas who donated their ancestral building and adjoining land for this purpose. Based on the needs of that period, the objective of this museum was to portray a) the standard of technology in the present century, b) the contribution of technology to the activities of man and c) the application of modern method of technology in some of the Indian industries. Within a few years it was realized that these objectives were too narrow and inadequate compared to what could be achieved by an institution of the type of a science and technology museum. It was also realized that the objective of a science museum in a developing country should differ markedly from that of a developed country of the West. The level of understanding about science and technology of the vast majority of the population in a developing country is meagre. Obscurantism and superstition still persist in many regions, fruits of science do not percolate down to the bottom of the social ladder ; to many people, science was no more than an object of awe and wonder. In view of the commitment of the Asian developing countries to make the people receptive to new ideas and adaptive to new techniques, a new system of "preaching" science was required which would stress the "social commitment of science", meaning thereby that the science museums should educate the masses on science and scientific research that have relevance to the needs of contemporary society.

As the BITM, Calcutta progressed newer and newer activities were introduced in the museum, one of which was "fixed time demonstrations", i.e., a fixed period of the day was set apart when a visitor could come and watch a series of important scientific demonstrations. Because of lack of adequate equipment in schools, which started growing rapidly after independence, it became difficult for the schools to arrange for demonstrations of all the experiments included in the high school syllabus and the science and technology museum came to the aid of the schools to supplement the science education in schools, as it had at its disposal a large number of models on physical sciences which were specially suitable for demonstration. The museum also introduced a novel method of "Science demonstration lectures", specially for students on subjects chosen from their school curriculum such as, properties of liquids ; principles of heat ; elements, compounds and mixtures, etc., using models made of inexpensive materials with no stress on artistic presentation. Sometimes enlarged mock-ups were used (plate II). The idea behind these demonstrations was that because of the rugged and simple look of the apparatus the students felt that they themselves could make the models and repeat the experiments. The museum also arranged lecture programmes on specialized subjects for the visitors to the museum with the help of the museum's own staff. Some of the subjects such as "Noise, music and sound", "Sense and perception", "Newton's laws of motion" became extremely popular with the visitors. With the availability of scientific and educational films, the museum started regular film shows every day. Some of the scientific films were of western origin and efforts were made to stop the English commentary and substitute in its place commentary in local language, sometimes dubbing of the film in local language was done. Films on the growth of new industries or technological development of the country were produced by the government or by the private sector and were made available to the museum and were fully utilised. Some of the films on "Development of steel industries in India" or "Hydro-electric projects" were widely appreciated in the 1960's. A scientific library was started for the young enthusiasts with popular scientific publications, books on model making, history of science and technology and on different hobbies. Simultaneously an archive was started with compilation of newspaper cuttings, photo-

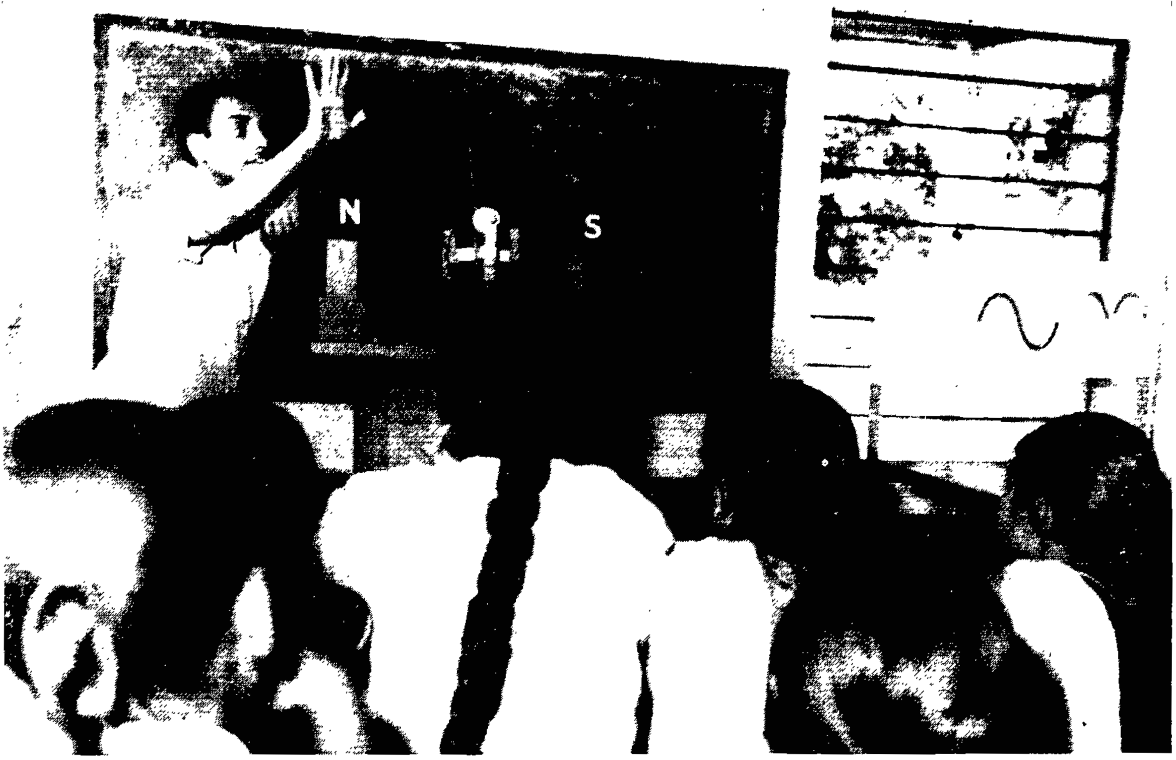

Plate II : A guide lecturer of BITM Calcutta conducting a science demonstration lecture on principles of electricity.

Plate IIa : Initiating a science club activity at BITM Calcutta.

graphs and other information on industrial and technological developments in the country.

This experiment in new methods of science education paid rich dividends in India. The science club movement also gained momentum and BITM, Calcutta lent considerable support to this movement. A large number of science clubs (plate IIa) grew up at various corners in India. The list of science clubs in India is quite impresssive and some of the important ones are listed in annexure III. BITM soon became a 'must' for all school-going children and the attendance rose in 10 years' time to 22,360 a month in January, 1969. The Council of Scientific and Industrial Research, responsible for setting up the first museum of technology and science embarked on another venture in the South of India. In 1964 units were set up for planning a second museum of science and technology at Bangalore and in 1965 the Visvesvaraya Industrial and Technological Museum (VITM) was born. The name was chosen as a tribute to the great Indian engineer, statesman, and inventor, the late Dr. M. Visvesvaraya. These two important science museums in a developing country attracted the attention of the museum world and the International Council of Museums, Paris (ICOM), considered whether help could be extended to other developing countries to set up similar science museums. In November, 1969, the International Committee on Science and Technology of ICOM, held a meeting of experts on science museums at Bangalore (India) in collaboration with the Smithsonian Institution, U.S.A., and the CSIR and decided that encouragements should be given by ICOM to countries desirous of setting up science museums as these institutions are recognized as one of the finest aids for education in science. It was also realized that inadequacy of science exhibits was standing in the way of rapid development of science museums. The possibility of setting up a Centre to produce Science Museum exhibits for other developing countries was therefore also considered, and it was recommended that one or more Science Exhibits Laboratories be set up to assist countries desirous of setting up science museums. It was also agreed that India would be suitable place in which such a laboratory could be established and that financing the project could be studied principally on the basis of using blocked funds in India owned by some countries and also using the manpower and resources of CSIR.

Science Centres

The science museum movement got a tremendous boost during the last 3 decades and the U.S. Science Museums could be mentioned as having made pioneering effort in embarking on a wide range of special educational programmes. Because of their emphasis on visitor-participation schemes and portrayal of application of science in society and industry, a new terminology called "science /technology centres" was coined for institutions of this category. Each of these centres is different from others, but all have a common scientific commitment to an educational mission. According to Victor Danilov although the various "science centres" are quite different, "they have three things in common. They are concerned with science and/or technology, they seek to communicate scientific and technical information to the public, and they make extensive use of participatory and other non-traditional exhibit and educational techniques in transmitting the information." As the idea of science/technology centres gained ground and as the usefulness of science museums in India became apparent, more and more developing countries started planning science museums or science/technology centres.

Progress in Asia

Pakistan authorised the setting up of the first science museum at Lahore at the national level in 1965. The museum was opened to the public in July 1976 and by the beginning of 1979 more than 150 exhibits were installed, fully operational. The museum on completion will have sections dealing with physical sciences, biological sciences and technology. In addition it will have a planetarium and reference library.

The Republic of Korea has now eleven science museums which act as science education centres ; the National Science Museum in Seoul, the Korean Children's Centre under the management of an education foundation and nine student science museums which were the products of the "Scientific way of life movement" and were constructed in the nine provincial capitals by the Ministry of Education between 1974 and 1975. These museums vary somewhat in size and scale but contribute increasingly to the public's better understanding of science, technology and industry and especially stimulate and influence the younger generation.

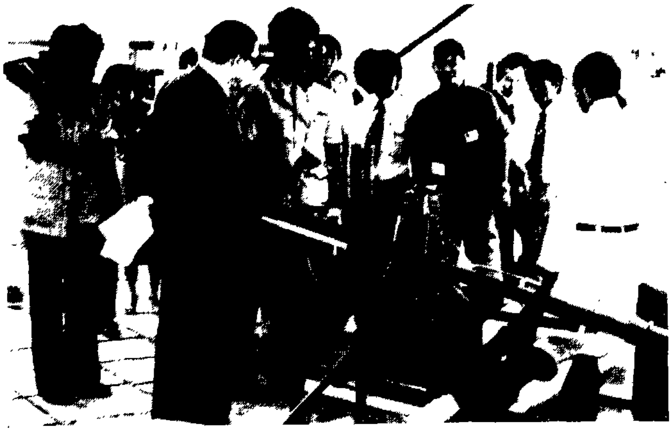

Plate IIIa : An agricultural machinery is demonstrated in Bangkok Science Museum.

The Bangkok Science Museum was founded in August 1979 and is a section of the "Centre for Educational Museums", which in turn is a part of the Non-Formal Education Department in the Ministry of Education (plate IIIa). The museum acts as a national resources centre of science and technology, to serve people both in school and out of school, helping them to understand science and its application through simple exhibits, demonstration lectures, as well as films, television and slides.

The Singapore Science Centre since its inception in December 1977 is performing its role as a non-formal educational institution, providing specialised facilities such as exhibits, science and publication programmes to the student population and the lay public (plate IIIb). Besides science talks, lecture demonstration, laboratory courses and film shows run throughout the whole year.

Plate IIIb : Students participating in School Science Education Programme in Singapore Science Centre.

Bangladesh has also recently set up the nucleus of a science museum in its capital city of Dacca.

In India further science/technology centres were set up in 1977 at Bombay, known as "Nehru Science Centre" and in 1978 at Patna, known as "Shrikrishna Science Centre". The rapid growth of such centres and their success encouraged the Government of India to constitute in April 1978 an autonomous society called the National Council of Science Museums with headquarters at Calcutta to develop new science museums and administer those which have been already set up.

Science has always been a part of formal education in the Philippines, but to complement formal education and enrich informal learning in science and technology, the Science Foundation of the Philippines, has initiated the Tuklasang Agham NE Pilipinas (Science Discovery Centre of the Philippines), to portray *inter alia,*—

- a show case of significant scientific and technological works carried out in the Philippines and abroad ;

- a store house of information from which to draw scientific knowledge through re-creation-oriented activities ;

- a resource for life science education, for industry and for community activities ;

- a workshop where Filipino Youth could draw inspiration for scientific pursuits to harness science more fully.

Its programmes are varied and extensive. It has provided for Ecocamps and Ecostudies to create an awareness of the environment, career development laboratory programme for motivating the young people through various activities to take science and technology as lifetime careers, such as, apprenticeship with the staff in laboratories and workshops to give the students opportunities for training and expose them to research laboratory methodologies and inspire them to adopt scientific habits and thoughts.

The science museum movement has spread extensively in the developing countries of Asia. Sri Lanka has made a headway with a plan for the establishment of the "Ceylon museum of Science and Technology" which will deal with the basic principles of physical and chemical sciences and their application in technology, industry, agriculture and in medicine with special reference to Sri Lanka —her problems and her needs. The establishment of school science museums appears to be a new concept altogether and Sri Lanka appears to have been the first country to establish such museums. It envisages the setting up of school science museum in each district on a phased programme, two to be established annually, in all 24 museums. Each museum covers a floor area of about 1000 sq.ft. Included in this exhibition frame is information on geology, fauna, flora, insect pests, animal parasites, pollution and conservation of the environment, etc., with special emphasis to Sri Lanka and the districts in particular.

Shortly Nepal, Indonesia and other Asian countries may follow suit. A list of science museums/centres established in the Asian region is enumerated in Annexure II.

District Science Centres

Since all the science museums are situated at present in the principal cities, they can serve city dwellers and those staying in and around the cities. The vast mass of urban and rural population of the developing countries in Asia would find it difficult to come to the museums in the metropolitan cities. Thus means have to be found to serve this important group who form the bulk of the population in the developing countries where agriculture is the main occupation and the largest percentage of population dwell in thr rural areas. After the end of the colonial rule in India, an effort was made to accelerate the progress of science education and a number of "Vigyan Mandirs" (Temple of Science) were set up in India in the rural areas. In these institutions people could come and learn about scientific methods of agriculture, testing of soils, use of fertilisers, rudimentary principles of science, water purification, improvement of hygiene and public health etc. These institutions were in the interior of districts and were initially in charge of young scientists enthusiastic about serving the public. Unfortunately there was no central infrastructure from which scientific and technical guidance could have been extended to these Vigyan Mandirs. No repairs or replacements were easily available for the installations, displays and demonstration equipment. Being cut off from the cities due to bad road communication, these institutions slowly fell into disuse and scientists lost their enthusiasm and felt a general reluctance to serve in rural areas. The Vigyan Mandirs thus died a natural death, but the experience was not lost. It is found out that if some science centres are established in districts or subdivisional towns in under-developed areas, under the direct supervision and control of the science museum/centre in the metropolitan cities, rural-based and result-oriented programmes can be undertaken to benefit the small urban centres and also the surrounding rural areas. These organisations could be called District Science Centres or Community Science Centres, where efforts could be made to present the benefits of science and technology in a suitable manner to facilitate understanding by the villagers. Newer, better and easy to adopt methods, techniques and practices could be presented before the public which would have a striking appeal. They would be aimed at development of agricultural techniques and production, improvement of health and hygiene, better utilisation of the environment, adoption of good habits for community living, job-oriented training, etc. In short, all such programmes should basically concentrate on imparting a sense of self-sufficiency for certain aspects of the rural community. The Centre should hold special exhibitions of local and current interest from time to time and conduct science demonstration lectures, training programmes and special workshops, more or less like the Science Museums/Centres. School-going children could be encouraged in their creative endeavour and scientific experiments for which insufficient facilities exist in the schools in the suburban and rural areas. Special training programmes on repair of agricultural implements, repair of rural transports such as bicycles, rickshaws, bullock carts, etc., could be organised through various programmes. Other training programmes on "Leather products", "Carpentry', "Plumbing", "Repair and maintenance of useful gadgets and mechanical contrivances", "Making of small agricultural tools, candles, lamps", etc., might be added.

In view of the importance of district science centres, two experimental District Science Centres were set up, one in Eastern India at Purulia in West Bengal by the B.I.T.M., Calcutta, and the second in Southern India at Gulburga in Karnataka State by the VITM, Bangalore; they proved a success. The Planning Commission of the Government of India had earlier set up a Task Force on Science Museums to formulate the development of Science Museums in the country during the Five-Year Plan Period. This Task Force recommended *inter alia* that science museums should ultimately be established in all districts (there are more than 400 districts in India) and that 20 such district level science museums should be set up in the 5th plan period. Because of financial constraints only 2 District Science Centres at Purulia and Gulburga were set up, but in view of the usefulness and impact of such centres, the National Council of Science Museums of the Government of India, formed a Study Group to decide on (a) the conceptual development ; (b) the infrastructure ; (c) method of collaboration ; and (d) the selection of sites for the proposed District Science Centres. The recommendations of the Study Group were as follows :

Conceptual Development

1. Purpose : The District Science Centre will be developed as an activity based learning centre to

   i) develop scientific aptitude and thinking by encouraging curiosity and the questioning processes ;

   ii) encourage critical analysis of the social, cultural, technological and natural environment ;

   iii) inculcate an ability to identify problems and work towards appropriate solutions ;

   iv) collect and disseminate information relating to science and technology on demand ;

   v) promote and support innovative and experimental activities in pursuit of the purposes of the centre.

2. All District Science Centres should have a common basic core element concentrating on as many as possible of the following subjects :

   (a) Methods of science, incorporating physical, natural and social sciences.

   (b) Agricultural sciences, with special reference to agricultural technology, soil and water conservation and management, food, fodder and ecology.

   (c) Energy, craft and cottage industries.

   (d) Health sciences with special reference to social hygiene, preventive measures, family welfare, food and nutrition.

   An individual District Science Centre should necessarily not strive for all the activities as mentioned above. Programmes may be developed based on the available human and other resources, and on the actual needs of the area.

3. Each individual District Science Centre will emphasise on topics of local type and relevance, in addition to the basic core element.

4. The District Science Centre will assume the role of an organizer for various programmes through the involvement of the local people and of relevant agencies.

Although District Science Centres were considered extremely important, the Study Group, considering the financial constraints and lack of adequate trained manpower, could not recommend more than 5 District Science Centres to serve as pilot projects for the development of future centres during the 6th plan period (1980-81 to 1984-85). It will be evident therefore that even for setting up district centres in all the 400 districts several decades may be required.

New thinking has therefore to start as to how science and technology could be taken to the common man without inordinate delay. The only practical solution appears to be in taking the message of science and technology to the door of the common man with the help of travelling or mobile exhibitions.

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Chapter III

ORIGIN AND GROWTH OF TRAVELLING SCIENCE EXHIBITIONS

Introduction :

Travelling exhibitions for carrying collections of art and culture from large museums, art galleries, and cultural institutions to the provinces or to smaller institutions in districts have been in vogue for more than a century. In view of the importance of travelling exhibitions a publication was brought out by UNESCO in 1953 entitled "Manual of Travelling Exhibitions", which mentions that travelling exhibitions originated in one of the leading museums of Great Britain, namely, the Victoria and Albert Museum, London with their launching in 1850 the loan of works of art. Because of the usefulness of such exhibitions in countries having vast land areas, travelling exhibitions were adopted in Canada in the early 20's, followed by the United States, South Africa and Australia. Since the close of the war in 1945, this activity has increased and spread internationally and according to the above manual, museums in the following countries made use of travelling exhibitions : Australia, Austria, Brazil, Canada, Czechoslovakia, Denmark, England, France, India, Ireland, Israel, Italy, Lebanon, Mexico, the Netherlands, Norway, Pakistan, Poland, Scotland, Sweden, Switzerland, the United States of America, the Union of South Africa and Wales. Particularly after the 2nd world war there has been an increased awareness of the necessity and the moral obligation to extend educational opportunities and to make cultural values more readily accessible to all, without regard to social distinction or geographical isolation. Mrs. Grace Morley in her foreword to the above publication has neatly summarised the objective of travelling exhibitions as follows : "Going from country to country, they furnish an intellectual and cultural interchange of great value and broad influence. They can be used very profitably to enrich education at all levels and in all fields, and can be adapted as needed to impart information, to give instruction and to offer pleasure". So much development took place in this field that a further publication was brought out by UNESCO in 1963 entitled "Temporary and Travelling Exhibitions" which contained a wealth of material on various aspects and techniques of travelling exhibitions, such as assembly, display, packing, transportation, insurance, etc.

Immediately after the 2nd world war, industrial and technological exhibitions were arranged by manufacturers to display their modern machines and tools and to revive their business. Also there was a realization that in many developing countries on account of abrupt changes from a rural economy to an industrialised society the people from such countries had to be educated on the usefulness of new industrial products. Some museums in European countries arranged exhibitions dealing with public health programmes, such as cause of diseases and their prevention and cure, which were used to supplement school health education programmes. In a number of countries (Poland, France and the United States) mobile units were constructed using either a modified bus or a truck or tractor-drawn trailer to carry exhibition materials. It was realized at that time that sooner or later mobile museums or similar units probably would be constructed in the under-developed countries as highways improve and the need for didactic exhibitions in rural areas becomes more evident. Such statements were prophetic as will be evident in subsequent chapters.

UNESCO trevelling science exhibitions

Travelling exhibitions in the field of science are of a more recent origin and UNESCO has been a pioneer in this field. In the earlier programmes of UNESCO, long before the launching of the United Nations Development Programme (UNDP), international co-operation in scientific fields between scientific communities was one of the main planks of activity. It was argued that as a normal corollary to this specialised activity, layman's awareness in scientific knowledge and about the work of men of science could also be improved. Popular science writers, popular science lecturers, radio broadcasters were mobilised in various countries to inform the man in the street about what science and technology have done to promote social development. Some schools and universities in certain countries organised periodically science exhibitions which drew a large number of curious people. However the demonstrations which formed a part of such exhibitions, were treated just as "magic" rather than as a method of spreading knowledge. Visitors to these exhibitions left with impression that some secret tricks were definitely involved, in spite of full explanations offered by the demonstrators.

There were permanent science exhibitions, where exhibits were changed from time to time in some of the industrially developed countries and these have evolved their own policies of action as a result of their experience with visitors. In Paris, the Palace of Discovery, whch is the permanent science exhibition, was organised and managed by the University of Paris, a unique feature. When UNESCO decided to emphasise the role of exhibitions in popularisation of science, it naturally asked for advice from the leading directors of popular movements of science, that is to say, writers, lecturers, model designers, museum directors and the like, and advisory committees were formed. These committees suggested a few themes on which exhibits and panels could be organised and demonstrated. The themes were chosen with a view to making the common man understand the social functions of science. The technique was as follows : if a simple measuring instrument was demonstrated, side by side its indiviaual components were taken apart and displayed. Alongside more complicated developments were shown and their various applications in industry explained. The objective was to explain the science behind it and how it was put to different uses in the course of development of technology. Between 1950 and 1959 UNESCO prepared 5 travelling science exhibitions. Because of the expansion of UNDP projects consisting of specialised technical programmes in member-states, in order to boost economic development and supply of equipment, the interest of the layman had to be shelved, and the travelling science activities stopped abruptly. Two out of the five UNESCO exhibitions travelled one after another, in Asia on invitation of member-states who agreed to bear the cost of local organisations.

Two exhibitions with themes "Our senses and the knowledge of the world" and "Energy and its transformation" travelled in Asia. The first one from 1951 to 1959, visited Japan, Indonesia and India. In Japan it was shown in Tokyo and Osaka, in Indonesia at Djakarta, and in India at 11 State capitals. The second one on "Energy and its transformation" opened in 1956 in New Delhi, and after being shown at Ahmedabad, it travelled to Signapore, Kuala Lampur, Bangkok, Saigon, Manila, Taipeh, the four cities of New Zealand—Auckland, Wellington, Christchurch and Dunedin—and Colombo. The exhibition which travelled round Latin America for more than a year dealt with physics, astronomy and science clubs, and the exhibition which toured in Europe and extensively in the U.K. was entitled "Man Measures the Universe". It showed the techniques and the instruments utilised for effectively measuring the distance between the infinitesimally small to the infinitely large, and its tour took place in 1954. Another exhibition entitled "New materials" was devoted to materials which science and technology had put at the disposition of mankind, i.e. to say, essentially plastic materials and compounds. It was organised in 1952 at the request of some member countries of Middle East and Near East, and it was presented in seven countries.

The exhibition "Our senses and the knowledge of the world" which was extensively shown in India, consisted of 50 experiments which members of the public could themselves perform. It began with the characteristics of each of the five human senses : touch, hearing, smell, taste and sight and explained how the range and strength of sense organs : the eye, the ears, the skin, the nose and the tongue can be increased or improved by scientific tools. It showed how thanks to the apparatus devised by scientists, the powers of the senses had been greatly extended. For example, in the section on 'touch', certain instruments were displayed which gave a person more precise information, such as the thermometer for temperature, the balance for accurate weighing, the micrometer for measuring small thickness, etc. How sound is produced by vibrations was shown in the next section, along with the phenomenon of hearing, followed by the different techniques of increasing the scope and power of human hearings, for example, the amplification of sound, the preservation of sound by recording or the transmission of sound over long distances. The function of the eye and how it worked and the instruments and techniques used to augment the power of eye-sight opened up before the visitors, the entire science of optics explained in a most popular manner. There were also displayed optical instruments such as magnifying glasses, microscopes, telescopes, photographic cameras, cinematographic cameras, television etc. The general scheme of presentation in this exhibition is worth mentioning.

The exhibits which could be demonstrated and which comprised either a model or a scientific apparatus were placed on a number of tables. Panels preceded the exhibits and provided the written matter as also illustrations explaining the exhibits (plate IV and V). Some of the experiments needed the help of demonstrators who stood behind the tables. For performing the experiments, usually done by volunteer demonstrators texts accompanied each experiment. For example the experiment on "Keenness of Sight" provided the following direction for experiment :

KEENNESS OF SIGHT

SIGHT EXPERIMENT—I

How to perform the experiment :

Take hold of the electric switch on the right of the apparatus and stand facing the apparatus on the edge of the circle drawn on the floor.

Press the button so as to obtain the maximum light. At the bottom of the box is a series of rings of decreasing sizes : each of these rings is opened at a different place.

To test your ability to see details, try to find, starting from the top, the smallest ring whose opening you can still locate. If you usually wear glasses, keep them on for this experiment, as keenness of sight can only be measured if defects of the eye are first corrected. Then press the

Plate IV: Experiment on Keenness of Sight. UNESCO Travelling Science Exhibition Courtsey UNESCO

Plate V: Experiment on perception of distance with one eye and both eyes. UNESCO Travelling Science Exhibition. Courtesy : UNESCO.

button so that the light becomes dimmer, and try to find the smallest ring in which you can still see the opening.

You will notice that you stop at a larger ring. This proves that we can distinguish details better when the objects are in a strong light than when they are in a weak one. If you compare your results with those of another visitor you will realize that keenness of sight varies according to individuals.

Conclusions :

These rings constitute one of the methods used to measure keenness of sight of people. They are used as tests in certain professions.

The exhibition "Energy and its transformation" began with the concept of work and energy and touched upon the different forms of energy such as wind energy, tidal energy, heat energy, electro-magnetic energy, chemical energy and nuclear energy. The conversion of one form of energy into another form and the principle of conservation of energy was the highlight of the exhibition. The exhibition tried to project the role of energy in human economy, its future possibilities and the evolution of man's energy requirements. Even in those days when there was no sign of the energy crisis, there was a large section on the various methods of utilisation of solar energy.

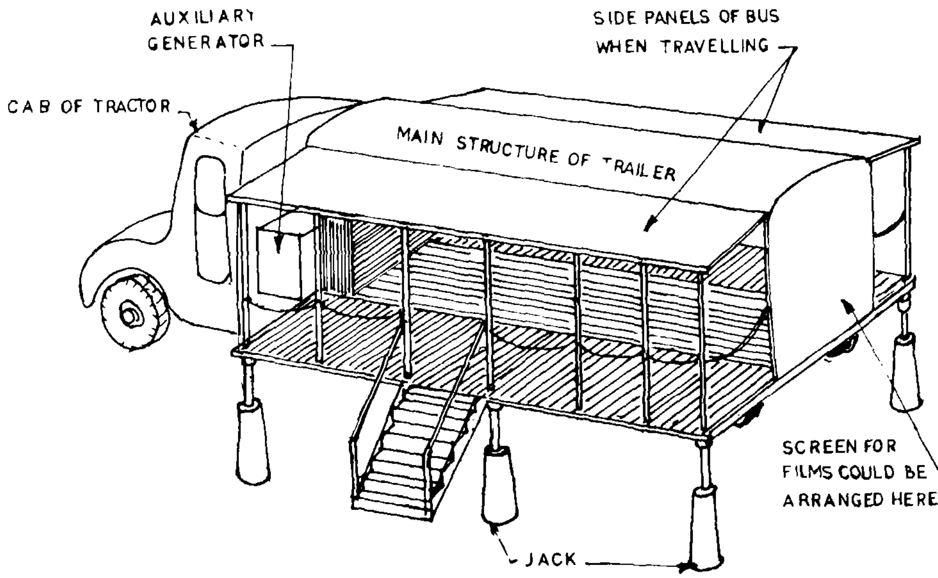
The exhibitions with the two themes which were extensively circulated in Asian countries had relevance to every man. They brought home to visitors that science was not an irrelevant pursuit of the human mind. All exhibits were made with simple details and every scientific principle was explained in the panels with the help of text, diagrams and photographs. Although the exhibition did not touch upon the subject of exploration of natural resources, it was expected that the knowledge of expanding powers of the human senses will inspire a common man to enquire about what is buried under the soil or hidden under the ocean. In this way a common man was informed about the beginning of technology by applying science. "Energy and its transformation" showed how one form of matter or energy could be changed into a different form to serve mankind. Man's transport for his mobility, his mechanical equipment, capacity of storage, forms and means of transformation of matter and energy, all this expanded his horizon, his ability to cope and battle with nature. In other words, a "scientific attitude" was developed among people from all strata of life. In science an individual's observation, or rather technique of observation and recording of observation results has to become universal, that is to say, what one person observes, another should observe the same under similar conditions. This was the doctrine that was preached. The idea of travelling science exhibitions originated in the belief that the present age demands a scientific way of looking at social and economic problems. If people can discard their traditional way of thinking and look at the world afresh, with socially acceptable measuring tools and gauge the evils with which society is plagued, an informal public opinion will grow, which will be conducive to all-round development.

The mode of operation of the exhibition was as follows : All exhibits were designed in detachable units except the textual and photographic panels. Each exhibit had its own mounting and folding tables so that the receiving countries had nothing to worry about mounting. The exhibits were packed in separate boxes and put in crates. The total weight was around 15 tons packed in 12/24 crates. The UNESCO Director arrived in advance in order to receive the crates and was the only official from UNESCO. He had also to visit the next exhibition place in another country in advance to discuss organisational matters, for selecting the exhibition sites, train volunteers, etc. Local arrangements were made by the receiving Government which consisted in providing a hall for laying out the exhibition measuring 3000 sq. ft. (occassionally the exhibition was squeezed into 2000 sq. ft. when bigger space was not available) and deputing a liaison officer supported by 25/30 volunteers/demonstrators, who were invariably science teachers from schools or university science students. When exhibits got broken in transit the receiving country had to find repair shops, the costs being borne by UNESCO. The duration of exhibition varied from 2 weeks to 4 weeks, unpacking and packing took nearly 4 weeks while shipment from one country to another took 4 to 8 weeks depending on the distance and availability of direct sea transport.

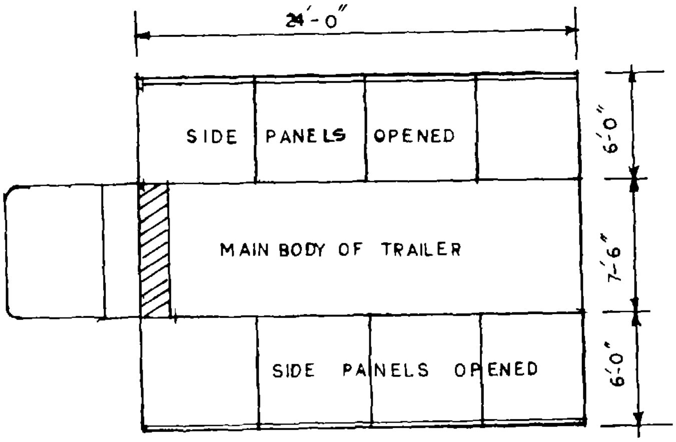
UNESCO could prepare the exhibitions because it could secure international co-operation and also could foster dialogues among experts who have been engaged in similar popular educational activities. Had the programme continued, national committees for science education could have drawn on the knowledge and resources of UNESCO, which meant the expertise of leading personalities of various countiies who came at the call of UNESCO. The exhibitions needed follow-up programme in the countries where these were shown. The thought of extension work should have not only engaged the mind of administrators but also of industrialists, political thinkers, sociologists, economists and development planners. The UNESCO exhibitions were of educational importance, and therefore it was all the more necessary to explore their impact there to produce the urge to use the fruits of science and technology which were not limited to national boundaries. Science needed trained hands to use technological tools and equipment—tools to map development patterns and equipment to begin operations for production. The culture and social pattern of each country is distinct from that of other, and therefore the themes of UNESCO science exhibitions and their presentation were carefully chosen. The message of utilisation of science was the underlying theme. What UNESCO prepared was a very good pattern which was later proved by experience as an universal scheme of presentation of selected science subjects. On it much national work could have been done to make a country-wide impact and increased public awareness of what science has done and can do to improve man's condition, his powers of production, and also certainly his style of life.

More than 21 years after the discontinuance of these science exhibitions, there was again a clamour for its revival. At a "Workshop on the establishment of Science Museums in Asian countries", organised jointly by the UNESCO and the National Council of Science Museums, India, held in Bangalore, in February, 1980, it was unanimously recommended that UNESCO resume its programme of travelling exhibitions in science and that it expand the previous level of the programme by the creation and circulation of a larger number of exhibitions on science subjects. This recommendation was made as a result of the recognition that the benefits that followed from UNESCO's previous programme of travelling exhibitions on significant aspects of science and technology in relation to the needs of man and society, provided a suitable means for advancing the UNESCO programme of "Popularization of science" in developing countries.

In September 1964, under the auspices of UNESCO/FAO, a museobus was designed by W.T.O'Dea, former Director of the Ontario Science Centre, which was based on a Berliot tractor with a special trailer (fig.1). Only one could be built



IMPRESSION OF UNESCO MUSEOBUS



EXHIBITION AREA (APPROX 470 SQ FT) Fig. 1

because of restricted budget although it was estimated that on the basis of building a fleet of such buses further improvement could be effected and the cost limited to U.S. dollar 25,000. The exhibits which could be carried in the museobus was paid for partly by the FAO in addition to the cost of the vehicle. Not much was known however about the various exhibitions arranged subsequently.

Travelling Science Exhibitions in North America

Better known as "Museum on Wheels' travelling exhibitions were introduced in the United States from the beginning of this century. The need for such exhibitions was so great that a service organisation with responsibilities for organising, circulating and offering exhibitions came into existence as early as 1909. Up to now 14 "not for profit" travelling exhibition services have been founded in the United States in addition to a few other which are operated for profit. These organisations came into existence because of the need to make available worthwhile temporary exhibitions at a reasonable cost to the public. Originally such exhibitions dealt with art andhistory, but in the course of time a great many travelling exhibitions also dealt with science, technology and natural history. The Smithsonian Institution travelling exhibition service has a diversified offering of exhibitions in the field of art, history and science. Some of them are from the Smithsonian's own sources and some others from the outside. Similarly, the Association of Science-Technology Centre Travelling Exhibition Service, which was founded in Washington D.C. in 1974, started with science and technology-oriented travelling exhibitions but later on expanded its scope to include natural history, history and art. These agencies ordinarily provide not only exhibits of a circulatory type, but also "serve as stimulators, organizers, brokers, facilitators and distributors in supplying exhibitions ranging from small panel exhibits to elaborate three-dimensional shows".

Individual museums in the U.S. also introduced circulatory exhibitions in order to reach audience who do not normally have a chance to visit the museum. Such exhibitions can be classified as "travelling exhibitions" or "Mobile exhibitions" depending on the manner of operation. A precise distinction has been made by Ms. Carol Supplee that a "Mobile Museum is a unit that is equipped to carry on the activities of a museum within or around the unit itself". A travelling exhibition is distinguished from a mobile exhibition, in that it is portable but is installed in an exhibition hall. The above definition will be used throughout this report with reference to Asian countries although in the United States often a mobile museum denotes "a museum that moves on wheels" irrespective of whether the exhibits are portable or installed in some building.

It appears that the Illinois State Museum launched the first mobile museum programme in 1948 followed by a number of other museums. The Science Museum of Virginia was a pioneer in organising mobile science exhibitions as early as 1965, called "Trans-Science I" for establishing public awareness and for stimulating interest in the museum. The aim of travelling science exhibitions and mobile science exhibitions in the United States is to take science programmes to areas where people seldom have opportunity to visit a museum. Such areas cover rural and industrial communities, ethnic groups and reservations. Programmes are also arranged for hospitals, detention centres, homes for senior citizens and schools for the handicapped—all confined groups.

Different museums utilise different exhibition techniques. The Children's Museum in Nashille, Tennesse once provided an exciting exhibition on earth science dealing with the natural resources of the area and the application of these resources. It wanted to highlight that primordial seas once covered most of what is now Tennessee, bearing vast mineral resources and fossils behind. Hence exhibits dramatised commercial products such as cement, glass, etc. made from resources deposited by the ancient sea. On entering the van, one could see rough glass and smooth, quarried limestone, and a building block to offer comparisons. Various animation techniques were utilised to dramatise the show. Colourful light, flashing and undulating, high fidelity taped music created an inviting atmosphere whereby young people were attracted. Pop boxes were provided to show an astronaut outside his space capsule and an astronaut inside his diving saucer to give an idea about the excitements offered by space projects.

Organizers of mobile museums in the U.S. claim that mobile exhibitions have also been very effective in institutional and public education. Engineering departments of the University of North Carolina and Texas attributed their increased enrollment in engineering courses to the special programmes on "This Atomic World" organised by Oak Ridge Associated Universities (ORAU). This programme comprised of twenty-three trucks, loaded with demonstrations and exhibits which were driven from school to school by specially trained teachers. At each school the teacher conducted five or six activities such as laboratory experiments for physics, chemistry or biology classes, teacher workshops and career guidance sessions. Some of the programmes arranged by ORAU visited state agricultural fairs and with the help of its own geodesic building conducted live lecture demonstrations. Another Atomic Energy Commission and ORAU programme was a mobile laboratory with equipment for work with radio isotopes. It visited small colleges where laboratories of this type were deficient. Students and teachers worked in the van, eight at a time, for a period of hours and days. It thus served a small number of near-professional persons with an educational programme of considerable depth.

The Lawrence Hall of Science, Berkeley introduced a 'Discovery Van' packed with materials from which teachers could make mathematical puzzle and games, transistor circuits or pinhole cameras, beam balances or an environment for class room animals. It was considered an in service workshop for teachers who wanted to solve problems and share ideas in science and mathematics teaching by constructing new learning materials or adopting old ones to new needs.

The Museum of Science and Industry, Chicago, presented 30 or more special exhibitions every year. Almost a third of these were of the travelling type. In addition, the Museum developed one travelling exhibition a year. Since outside source of support was required for these projects, the theme of the exhibition had been to meet the interest of the supporting group, but because of the immense popularity of the Museum, it always found interested parties to give support. Such travelling exhibitions dealt with scientific, industrial and cultural subjects. The museum also received travelling science exhibitions from other countries. During 1976 American Bicentennial Year Celebrations, the museum had 12 foreign exhibitions from 10 countries.

The Franklin Institute, Philadelphia, another important science museum in the United States, arranged travelling exhibitions to visit student groups from kindergarten to high school and to scout gatherings and other important assemblies. The show included demonstration on physics and chemistry dealing with subjects such as "Hot and Cold"—a feature in which extremely cold liquid nitrogen was used to explore the three states of matter and the change matter went through when heat was added or taken away ; or "Energy transformation"—a feature where solar operated motors, steam engines, bike wheels, pulleys and even small explosions were used to illustrate different forms of energy and how they were converted from one form to another with greater or lesser efficiency, and so on.

The British Columbia Provincial Museum designed two large multi-media school kit-exhibits and circulated them through the Museum staff from January 1973 to June 1975. One was on Marine Biology and consisted of artifacts and specimens. The kits required eight or ten hours of concentrated attention and activity on the part of the students. These visits increased both learning and motivation to the maximum.

Various designs of mobile vans had been in use in the North American continent for exhibition purpose. The History mobile designed by Michigan Department of State had a seventy foot overall length which often posed parking problems and as a result, the History mobile used to be stationed in a central location where neighbourhood schools used to bring their social studies classes. The Children's Museum in Nashville used a tractor and trailer, combined into an articulated unit, covering a standard furniture van to serve as a museum trailer.

According to Ms. Supplee basically two types of vehicles are used for mobile programmes, (a) trailer hauled by a tractor and (b) a step van/bus. The trailers vary in size : 7' $\times$ 16', 8' $\times$ 30', or 8' $\times$ 40', or 10' $\times$ 50' and provide exhibition spaces upto 500 sq.ft. Where vans of the type of a bus or a step van were used, their sizes could be 24' to 35' long.

It was reported that the South Carolina Arts Resources Transportation Service (ARTS) had a 45 foot mobile studio, which had a built-in dark room, and accommodations for painting, print making, film making and pottery.

The Trans Science I of Virginia contained a 30 foot domed area on which was screened a computerized audio-visual programme on man-made satellites.

Because of the ready availability of halls where exhibitions can be conducted and infrastructural facilities are readily available, the experience in the US had been that travelling exhibitions which can be unpacked and set up easily in local buildings were generally more efficient. A mobile van in which students circulated proved less efficient in terms of exposure time per student. The mobile unit had of course one advantage over the ordinary travelling exhibition of being self contained, thus eliminating the problem of adapting an exhibition to fit into rooms of different sizes and presenting different lighting problems. The risk of theft, fire or vandalism was also less.

Indo-US travelling exhibition on Technology

As an example of a very successful travelling science project could be cited the exhibition produced by the Franklin Institute of Philadelphia and the Council of Scientific & Industrial Research of the Indian Government under the auspices of the Indo-US Sub-commission on Education and Culture. The exhibition entitled "Technology—the American Experience", depicted how technology developed in America to meet the needs of the people who were living in a vast land with its endless mountains and very cold winters. The major objectives had been *inter-alia :*

a) to provide a history of the development of American Technology ;
b) to show that technology was shared among countries and adopted by them according to their own needs and purposes ;
c) to provide examples of co-operation between India and the U.S. ; and
d) to gain recognition for Indian Science Museums/Centres.

The exhibition was divided into five sections—the first section defined the broad scope of the development of American Technology. The other sections—"Food and Health", "Clothing and Shelter", "Communication and Transportation", and finally "Technology for the future"—described in more detail some of these developments in meeting people's needs.

At the entrance to the Food and Health Section there was a part of an agricultural research lab with several devices for testing soil samples. To such laboratories located throughout the U.S. a farmer can send samples of soil taken from his fields. A pH meter measured the level of acidity of the samples, a spectrophotometer and other instruments determined the concentration of various ions, and then a computer prescribed the economically effective amount of chemicals and fertilizers required. At the end of this section, the visitor saw the doctor's examining table and some other equipment found in a typical rural health clinic in the U.S. The visitors could see the electric signals of a heart beat in the screen of an instrument.

In the demonstration area of "Clothing and Shelter" the visitor had an opportunity to watch a sewing machine in operation to make button holes and alterations to clothing. In the housing exhibit the visitor saw an example of the movement in America toward use of modular construction. Units, such as the fibre glass shower booth and the plumbing system were factory built and shipped to the building site for quick installation.

The transportation of ideas, goods and people was highlighted in the next section. Visitors could watch themselves on the colour television screen and see the advances made in electronics. A machine that can automatically prepare copies of documents by means of a push button device was also an added novelty.

Although scientific research and technological achievements have made great advances in America and around the world in the last two centuries, there were still many problems to be solved. Some of these problems were highlighted along with the progress of research in regard to them. The prototype instrument panel for the Apollo Space capsule as also a real space suit for the astronauts, which the visitor saw was a symbol of the start of the space era.

The conceptualization, research, design, construction and installation of the 6000 sq.ft. exhibition took only 12 months. The design criteria included the use of an easily assembled chrome-plated steel tubular system (plate VI) which ordinarily created five circles. In each circle there was a "Pie-slice" platform (plate VIa) where two guides were located. With a low traffic flow, these guides could perform several operations and give explanations. In some areas, artifacts were located in cases in the wide aisle (plate VII). Around the periphery at the remainder of each circle were several panels (plate VIII) with photographs, artifacts and text (in both English and the regional language. Altogether 6 languages were used in 6 different cities). In each of the areas there were also 2-3 slide shows with alternating English and regional language audios. In the final section there were five movies with English language audio. The design allowed space for traffic to flow through while visitors could halt to see the shows that especially interested them.

Plate VI : Indo-US Travelling exhibition 1978. Portable steel tubular system was used with panel printed by silk screen.

Plate VIa : Indo-US Travelling Exhibition 1978. "Pie-slice platform where two guides demonstrate on sewing machine to make button holes.

Plate VII : Indo-US Travelling Exhibition 1978. Many of the artifacts were displayed in transparent cases.

Plate VIII : Indo-US Travelling Exhibition 1978. Photographs of historical value, supplemented the artifacts.

Most of the artifacts were collected from various sources in the United States, or from the Franklin Institute's own collections. The chrome-plated steel tubings were also designed and manufactured in the United States after making sure that the entire display would fit in an area of 6000 sq.ft. of covered space of different shapes that were readily available in the six metropolitan cities in India : Ahmedabad, Delhi, Bombay, Bangalore, Madras and Calcutta, where the exhibition was scheduled. The items produced in India included : the plastic panels, graphics, mounts for pictures, lighting and electrical systems, carpetting, platforms and packing crates. (The latter were made at the National Institute of Design, Ahmedabad and helped considerably the transport of the exhibits efficiently in the least possible space in the various cities in India where the exhibition was held.) Services provided by Indian firms included translation, type setting and silk screen printing of all texts, taping of narrations for slide shows, painting of murals and audience research. The 74 crates were of various sizes varying from a large size of 9'6" × 4'6" × 3'5" to a small size of 3' × 3' × 1'9" and 17 to 18 five tonner trucks were required for transporting the exhibit material from one city to the other. Usually it required 7 days for dismantling and packing the exhibits, while 7 to 10 days were required for assembling the exhibition at the new site, depending on manpower and facilities available. The physical movement of the exhibits from site to site was accomplished with a minimum of damage. Services, particularly electric power, were usually satisfactory. The programming of the exhibition was slightly intricate because various climatic and other factors had to be taken into account. While the inauguration at Ahmedabad in January 1978 was made to synchronise with the annual session of the Indian Science Congress and the exhibition at Delhi took advantage of the presence of the National Book Fair which was held simultaneously and attracted a large crowd for the first two days, the other exhibition dates took into consideration the weather charts of India so as to avoid the extreme hot weather and monsoon of the country. The exhibition ended in December 1978 at Calcutta and was altogether open to the public for 159 days in one year. A total of 880,000 people visited it. The demographic profile at four locations showed interesting facts : about 72% attenders read English; Ahmedabad had the lowest rate of around 40%. The education level was quite high with 87% secondary school or higher and 60% college or higher. Occupations included: students 31%, professional or business —30%, clerical workers—12% and self-employed—10%. Over 80% of the visitors were male.

Research evaluation of the data obtained in Ahmedabad and New Delhi showed that the exhibition was effective in obtaining a significant gain towards most of its objectives. Some of the stated goals were as follows:

(a) historical development
(b) free enquiry/enterprise
(c) benefits all society
(d) shared among countries
(e) Indo-US Cooperation
(f) continued technology in India
(g) recognition of Indian Science Museums

The general ratings of the exhibit showed 86% saying very good or good; 60% said they learned a great deal or quite a lot, and only 4% of the exhibit was felt to be unclear. In a free response to "what do you believe is the main idea of this exhibition?", over 62% mentioned goal (a), only 7% mentioned goal (c) and none agreed with the goals (b) and (d). It was encouraging to note that only 3 1/2% felt that the exhibit's goal was to show how far India is behind the US. Also encouraging was that some mentioned other goals: (e) 2%; (f) 14%. This exhibition may influence other countries of the world about the usefulness of travelling science exhibitions in building up bridges of understanding between countries through the medium of science, technology and their impact on society.

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Chapter IV

INTRODUCTION TO TRAVELLING AND MOBILE SCIENCE EXHIBITIONS IN INDIA AND IN OTHER ASIAN DEVELOPING COUNTRIES

Introduction

Although Osborn's "Manual of Travelling Exhibitions" published in 1953, mentions the use of travelling art exhibitions in India and Pakistan, hardly any attempt had been made to introduce Science Exhibitions of the travelling type in India, or in any other Asian developing countries at that time. It is only in recent years that exhibitions on science and technology and on their importance in the life of the common man, as distinct from exhibitions on industrial products and machines are being held on a large scale in developing countries. Also of recent origin are exhibitions to highlight the knowledge of the technology of the past which although useful was lost during long periods of foreign domination. Such exhibitions help in the revival of past achievements of the country, the growth of appropriate technology and its utilisation for economic and industrial uplift of the country. Sri Lanka recently started science exhibitions of the circulating type on the theme "Technology for basic needs", covering priority areas, such as food and nutrition, energy and transportation. These exhibitions focus on the important research done in the country, for example, a new type of solar dryer to harness the natural dry climatic conditions of the country to dry various fruits, cereals, yams, etc ; utilization of flour from locally grown crops, such as tapioca or manioc, in bread or other bakery products ; or development of inexpensive baby cereal food of balanced nutritive quality and attractive flavour ; or manufacture of heat sterilized bottled coconut milk etc. Research in these fields has been of immense benefit to the needs of the common man. The exhibition also displays a modernised bullock cart designed for higher load carrying capacity than the traditional cart, carrying twice the load but reducing the damage to roads in order to induce the layman to adopt appropriate technology to meet his needs for transport of goods, but at the same time minimising the effective load on the bull.

Sri Lanka also introduced for the first time a mobile museum service on January 1980. This museum carried 35 drawers, each drawer serving as an exhibition case. Both cultural and scientific collections were represented. Under this project educational films will also be screened and museum publication will be sold. The Republic of Korea has introduced travelling science exhibitions which comprise items selected from the nation's annual science fair, about 74 prize winning exhibits to travel to two different provincial capitals each year after the fair. These fairs were introduced by the National Science Museum in Seoul to stimulate local interests in the better understanding of science and technology.

Indonesia has already started the holding of Nusantara travelling exhibitions coordinated by the Directorate of Museums and organized by the National Museum and the regional museums in the provinces. By having Nusantara travelling exhibitions throughout the whole country, using the rich collections of the National Museum in Jakarta, and then combining with them the existing collections of the regional museums, which host the exhibition, the public in different parts of the country is shown that "Bhinneka Tunggal Ika" (unity in diversity) is not only a slogan, but a very important part of the National State philosophy of 'Panchsila', and that the Nusantara conceptual idea will not only be accepted but it will strengthen and fuse the entire population, consisting of so many ethnic groups, cultures and traditions, into one nation.

Bangladesh has made headway in introducing mobile exhibition buses for carrying objects of cultural origin to the masses. The exhibition buses are more or less of the same design as those introduced in India, which will be explained in subsequent chapters. But the fact that Bangladesh has been able to put the museum on wheels, augurs well for her citizens and in the near future science and technology could be likewise taken to the masses.

Since the middle of 1982, the Centre for Educational Museums at Bangkok, has developed a mobile science exhibition unit comprising a pulling unit and a trailer (Plate VIII-a and VIII-b) and has already embarked on a mobile science activity to serve the people outside Bangkok. The theme of the first exhibition is "Water and farm management" and it consists of a number of window-type exhibits fixed to the trailer (the design closely following that developed by the Indian science museums) ; but the unit also carries a number of demonstration equipments which are taken out in the open and demonstrated before the farmers. There is no doubt that as soon as such exhibitions are introduced on a wider scale in developing countries, the impact of science and technology will be widely felt.

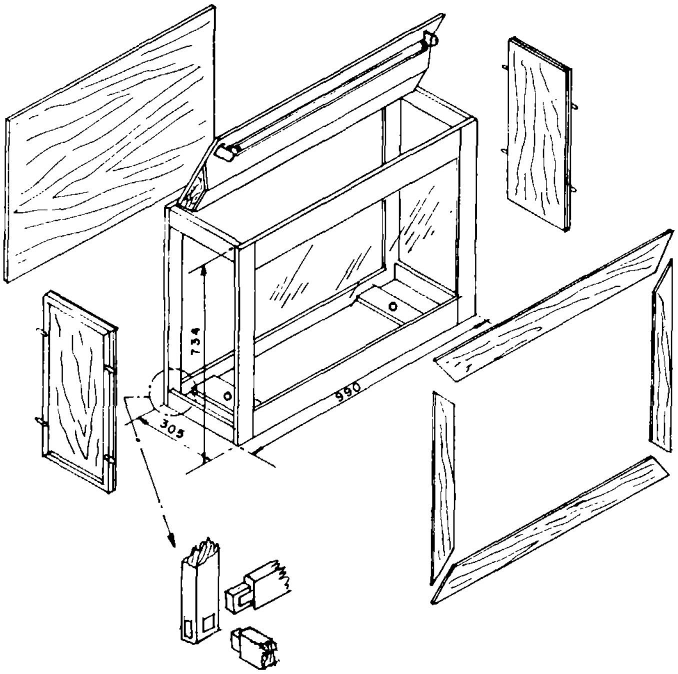
Plate VIIIa : The Thai mobile exhibition unit getting ready to move out.

Plate VIIIb : The outdoor demonstration equipment is being taken out from the Thai Mobile Science exhibition unit.

Indian Travelling Science Exhibitions

Extensive investigations started at the Birla Industrial and Technological Museum, Calcutta (BITM) from the beginning of 1966, on making use of travelling exhibition in dissemination of science and technology to the masses in the rural areas of Eastern India. A group of scientists and engineers, headed by Dr. Saroj Ghose, undertook a study of the various circulatory and travelling exhibition systems in vogue in the developed countries, particularly in the U.S., as well as the UNESCO's travelling science exhibitions in order to evolve a suitable system which could be adopted in the rural areas of Eastern India without much difficulty. It was observed that in all such exhibitions, objects (artifacts, models, replicas, dioramas, instruments, demonstration equipment, etc.) of various shapes and sizes were used and these were displayed on pedestals or support artistically designed and hence of different shapes. The packing of such materials, their transportation, and eventual dismantling and presentation in a rural centre would require skilled packers and display artists which are unheard of in a rural centre. Similarly loading and unloading of packing boxes of varying volumes would require trucks of varying capacity at rural centres, the availability of which at such centres was hardly possible. It would also require a well documented packing invoice and experienced men at the despatching and receiving ends. It was therefore evident that an altogether new system had to be evolved. After careful research by Dr. Ghose and co-workers, it was found that the housing for exhibits or cabinet needed standardization and that such housings/cabinets should lend themselves to being carried in trucks without being packed in boxes or containers so that loading and unloading would be a simple routine affair. A trial was made with an exhibit housing/cabinet of rectangular size measuring 39" × 29" × 12" (990mm × 734mm × 300mm) made of teak wood and commercial plywood, which proved quite suitable for serving as a housing for the exhibits, models, dioramas or demonstration equipment required for the travelling science exhibitions. These cabinets could be very quickly fabricated by the local carpenters as illustrated below:

MOBILE EXHIBITION CABINET (1967-Model) OF BIRLA INDUSTRIAL & TECHNOLOGICAL MUSEUM CALCUTTA



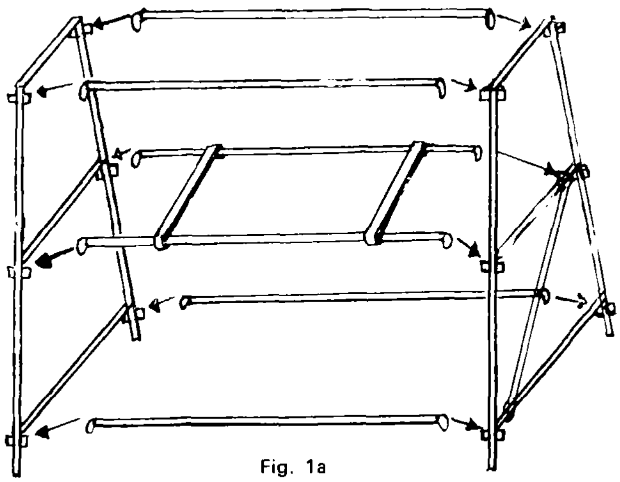
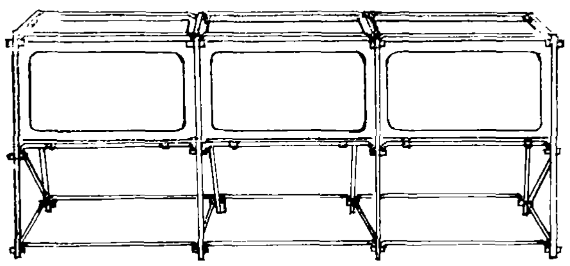


Fig. 1a

headquarters staff can reproduce the exhibit mechanism in a prototype in no time. The most important advantage is that a standard size pedestal or mounting for the cabinet could be used—and that was exactly what was done. A completely novel type of display stand was designed (fig. 1a) using 3/4" diameter light-gauge conduit pipes, which were often available in the second hand market from rejected boiler pipes. Each stand had an arrangement so that it could be joined to another stand by means of a simple coupling device.

It was thought at that time that schools would be requested to provide their assembly hall or auditorium or entrance lobby for holding the science exhibition, which of course they readily agreed to do. The exhibition stand was quite versatile inasmuch as it could be joined to give a



There are other advantages in using standardized cabinets. The design of exhibits and their graphics can be done well in advance and since one cabinet is just the same as the other, the model maker can commence with the fabrication work as soon as the graphics are ready, making use of any available cabinet. If defects develop later on, in an exhibit mechanism at a later date, when the exhibition unit is away from headquarters, the exhibition staff can get instructions through the post as to how the defect can be rectified as the

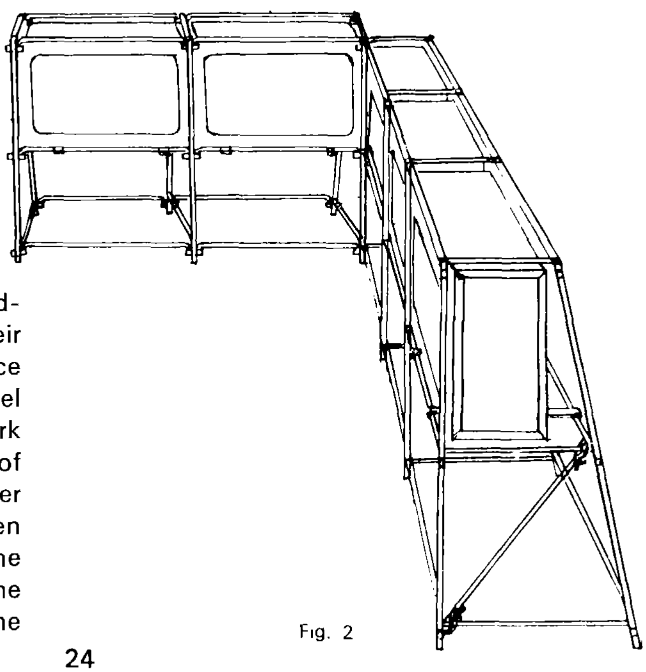


Fig. 2

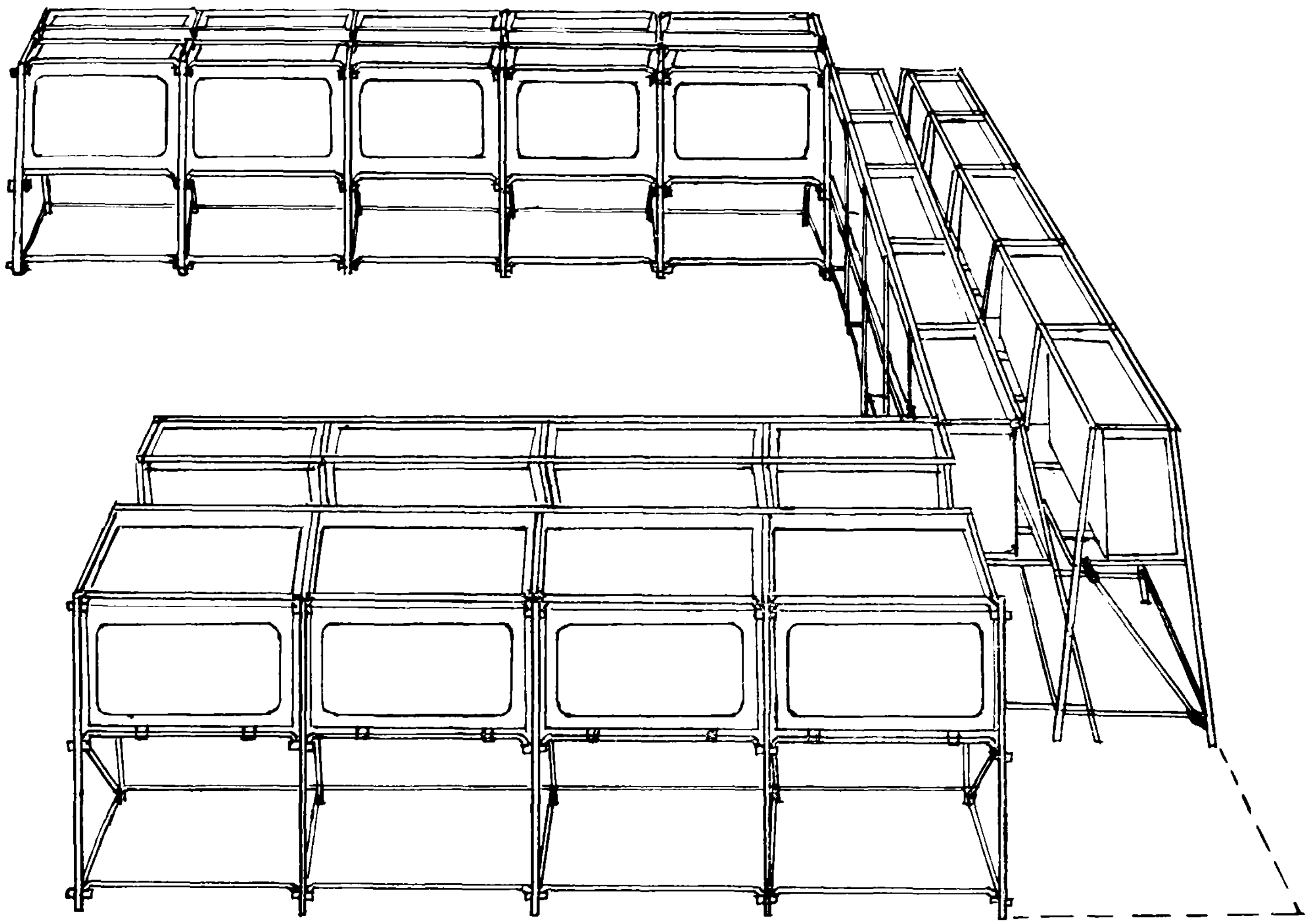


Fig. 3

long length or to form an enclosure (fig. 2 & fig. 3), depending on the area available.

In November 1965, the first travelling science exhibition with the theme "Our familiar electricity" was inaugurated in a school about 16 km away from BITM Calcutta. 28 exhibits were developed to make the school children and the public more familiar with electricity. Why does an electric lamp glow ? How does an electric fan rotate ? How is electric wiring done in a small domestic house ? How does an electric heater function? These and many other questions were answered in the science exhibition. Also since radio and telephone had been familiar objects even in rural areas, the exhibition displayed a telephone receiver with a transparent body wherein all the inner parts were visible. Two visitors could talk to each other, which caused considerable flutter among the village boys and girls. A radio receiver with all its component units visible and receiving transmissions from a nearby broadcasting station was another attractive feature of the exhibition. All the cabinets had plug bases mounted on the front or on the side and with the help of a simple wiring system all the exhibits were made to work. The dismantled stands and the 28 exhibits already wired could be loaded on small trucks of the size of 4572 mm $\times$ 2134 mm (15' $\times$ 7') of carrying capacity of 2 tons, which visited rural schools and the entire operation of unloading the stands and exhibits from the truck, placing the exhibits on the display stands, plugging in the electrical connections etc. did not take more than 2 hours. The guide lecturers who are normally employed in the demonstration of exhibits in the permanent halls of the museum, used to accompany the travelling science exhibition and with the help of the standardized display stands they could arrange the exhibition without knowing in advance the size and shape of the hall where the exhibition was going to be held—a feat which is never possible with any other type of exhibitions where invariably the assistance of display artists are required for arranging a display.

The second exhibition on the theme "The Science of Motion" was inaugurated in a completely rural setting (plate IX). The exhibits dealt with the fundamentals of different types of movement, and included : action and reaction ; the experiment of falling bodies ; gears ; systems of pulleys ; the lever and its application ; wheels and their speed, etc. (plates IXa & IXb).

The travelling exhibitions continued to be received with much enthusiasm in schools situated within 50 to 60 km of the museum at Calcutta, where halls or school gymnasiums were available. Guide lecturers from the museum were made available for guiding the visitors to the exhibition. The maintenance staff from the museum used to look after sudden breakdowns and so on. Within this small operating zone, there have been a number of unbridged rivers and instead of transporting the exhibits on trucks, these were carried in instalments in Willis Jeep crossing such unbridged rivers in ordinary country boats (plate X) in order to reach village schools.

It did not take very long to find out that not many small town or village schools in India could provide halls where the exhibition could be arranged. Schools were somtimes reluctant to permit an exhibition indoors being made open to outside visitors for fear of disruption of studies. In many schools the required electrical power essential for operating the exhibits and for general illumination of the cabinets, was not available. It was therefore realized that the above problems can only be solved by devising a mobile exhibition unit which could serve as an exhibition hall and be self-contained with regard to all other facilities. In fact the ideal system was considered to be carrying a miniature museum, with all its infrastructural facilities, to the rural areas. Research

Plate IX : Inauguration of travelling science exhibition on "The science of motion" at a district school.

Plate IXa : Travelling exhibition on "Science of motion". The stands can conform to the shape of the room.

Plate IXb : Travelling exhibition on "Science of motion". Advantages of inclined plane are displayed with illustration and models.

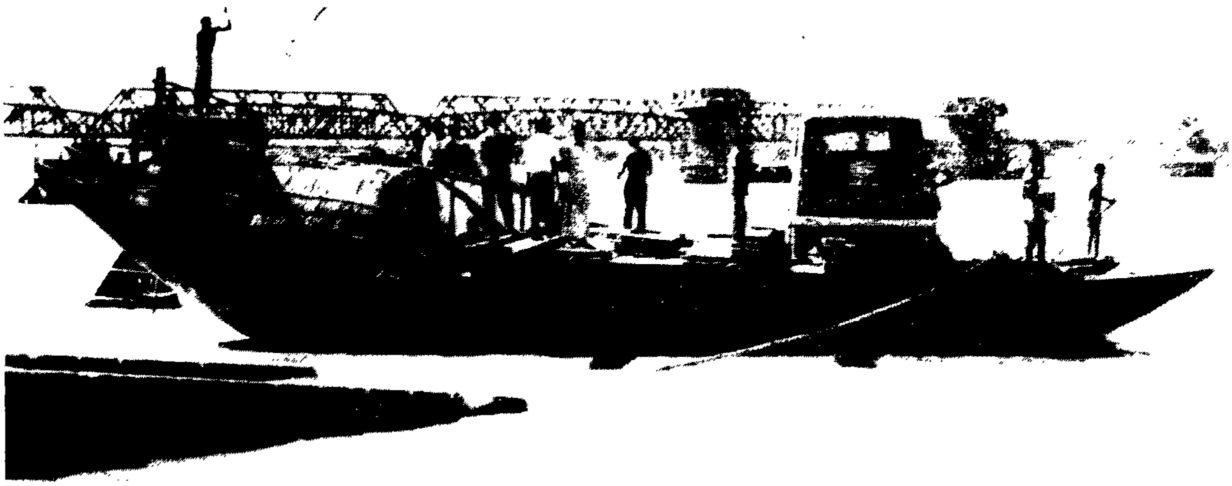


Plate X : A Willis Jeep with exhibits and demonstration equipment crossing unbridged river on country boat.

Plate **Xa** : With the help of standardized portable exhibits and stands science museums/centre in remote areas can be set up speedily. The Purulia Science Centre (in West Bengal) was set up initially in this manner.

was therefore again needed to design and develop a suitable mobile science exhibition unit for the rural masses that would meet the above requirements.

In spite of the limitations of the travelling science exhibition, there are certain inherent advantages. Whenever the science museums/ centres under the National Council of Science Museums have been requested to set up a district science centre they have been able to take speedy action with the help of portable exhibits and portable stands. In fact, in the initial stages of the development of new science centres in Purulia (West Bengal) and in Gulbarga (Karnataka) this was the *modus operandi* (Plate Xa). Travelling science exhibitions will therefore still have a future and will continue. Recently the BITM Calcutta, has undertaken the development of an exhibition on the theme "Know mechanisms around you". This exhibition will attempt to explain the operational mechanisms of some common appliances or gadgets such as a dot pen, a water tap, a hand pump, etc., so as to enthuse the village artisans to have new ideas which might help them to create something new on a cottage industry scale. These exhibitions could be carried in smaller boxes and could be mounted on framed structures provided with castor wheels. While being transported, the cabinet can be telescoped inside the frame and while being displayed it can be drawn out and fitted on the top of the same frame at an appropriate level, thereby introducing greater mobility (fig. 4 and fig. 5) and presentation in groups.

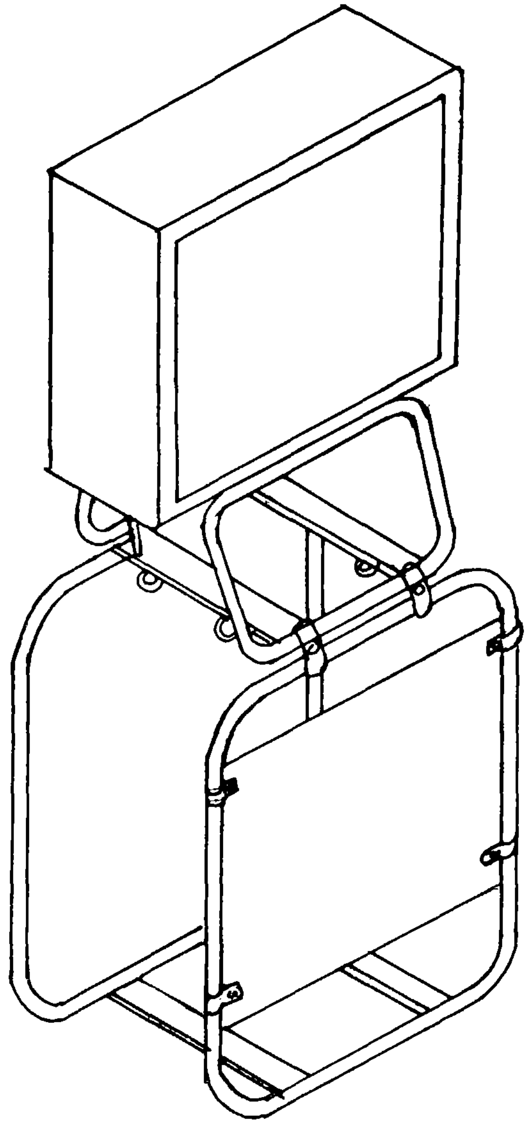


Fig. 4

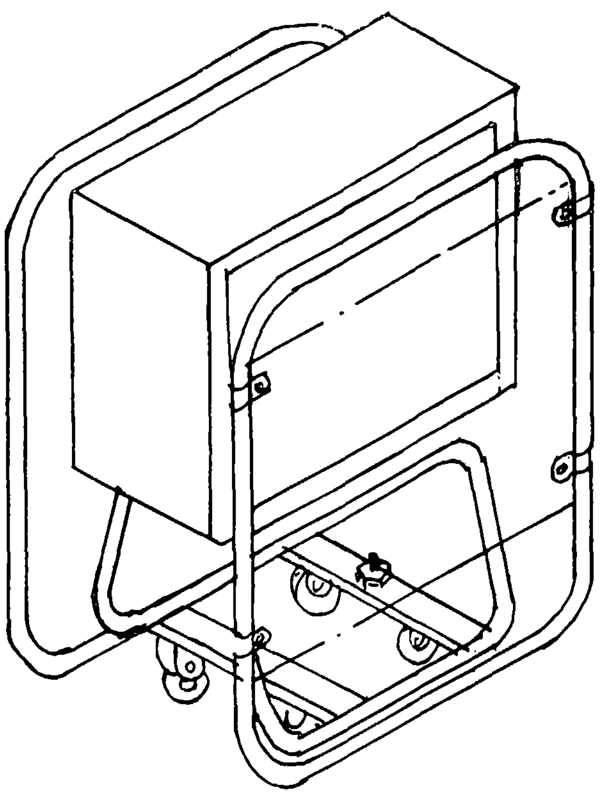


Fig. 5

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Chapter V

DESIGN AND DEVELOPMENT OF MOBILE SCIENCE EXHIBITION UNITS IN INDIA

Introduction

In designing a mobile science exhibition unit suitable for urban and rural areas in India, the following factors were taken into account :

a. The exhibition vehicle should carry the minimum number of exhibits required for presenting a sequential story for a suitable exhibition theme ; the vehicle itself should serve as an exhibition hall of reasonable capacity and should be capable of negotiating the district and rural roads.

b. The exhibition should be laid out in the vehicle at the starting point itself so that no additional personnel would be required to arrange the exhibition layout at the destination. The cavities or enclaves set up inside the vehicle for installing the exhibits and for securely fastening them in position in order to prevent damage during transit, should be permanently designed and should not be altered according to the theme of the exhibition and the size and shape of the exhibits, since any redesigning and re-installation would be expensive and time consuming.

c. The personnel required for organizing the exhibition should be able to travel along with the unit, carrying the minimum amount of spares for maintenance and repair facilities.

Museobus type I

Dr. Saroj Ghose and his co-workers at BITM, Calcutta, who had earlier evolved the travelling science exhibition system, undertook the design of a suitable bus body which could satisfy many of the above requirements. Since the standardized box type exhibit housings/cabinets were found successful in the earlier travelling exhibitions, they experimented with the same portable housings

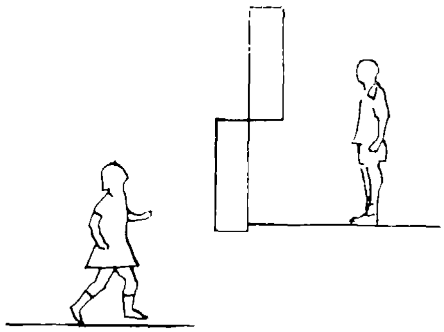


Fig. 6

and tried to find out how these could be fitted in the bus body. The maximum length of a bus was fixed by the West Bengal State Transport Authority as 364" (9250 mm) and its width within was restricted to 96" (2400 mm) and the height from the ground was limited to about 120" (3048 mm). Since each of the earlier exhibit housing units measured 39" (990 mm) in length, the number that could be accommodated along the length of the bus became extremely restricted after providing for a driver's cabin. After a series of experiment in 1966 a very satisfactory practical solution was found, namely, that the exhibits should be capable of being viewed at two levels (fig. 6) so that within a given space in a bus two exhibits could be fitted one over the other ; one set of exhibits can be viewed by the visitors standing on the ground outside and the other set of exhibits can be viewed from inside the bus, the platform of which was at a higher level (fig. 7).

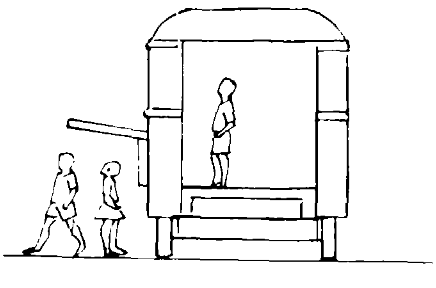


Fig. 7

The logical way of presentation was therefore to fix a row of window case exhibits on both sides of the interior of a bus at eye level of the visitor and another row of window case exhibits on both sides of the exterior of the bus body at the eye level of the visitor standing on the ground.

The design was thereafter put into practice. In many of the Western countries, the designers could experiment using an old telephone truck, a school bus or Greyhound Coach and remodel it. But in India this is not possible because in view of the high cost of transport vehicles, a vehicle is discarded only when it is beyond remodelling or renovation. A new Bedford Chassis with petrol engine of 216" (5486 mm) wheelbase and of an overall length of 297" (7544 mm) was purchased for the required conversion. The length of the chassis (fig. 8) was extended by another 1600 mm by welding an extra channel to the existing side members (fig. 9). According to another regula-

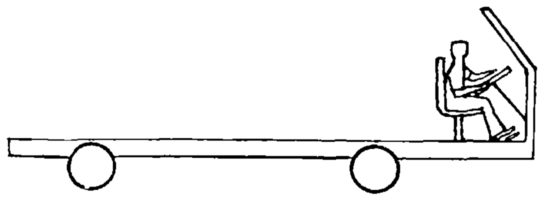


Fig. 8


Fig. 9

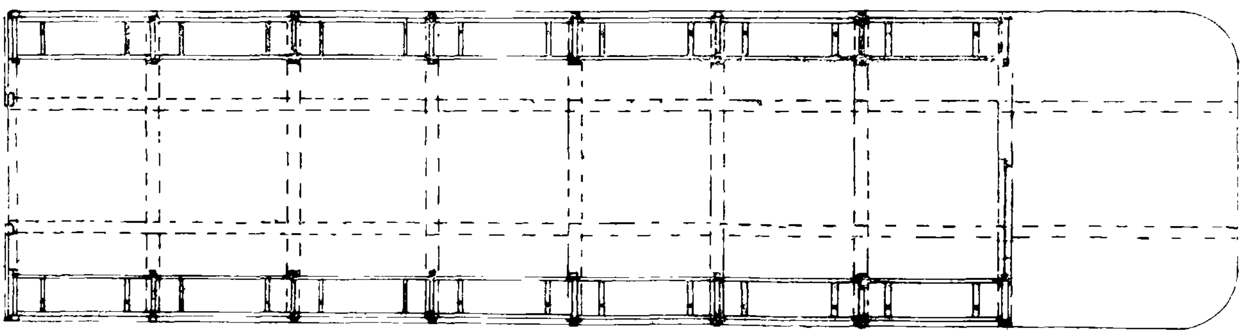


Fig. 10. Sectional plan showing the position of vertical props and exhibits racks.

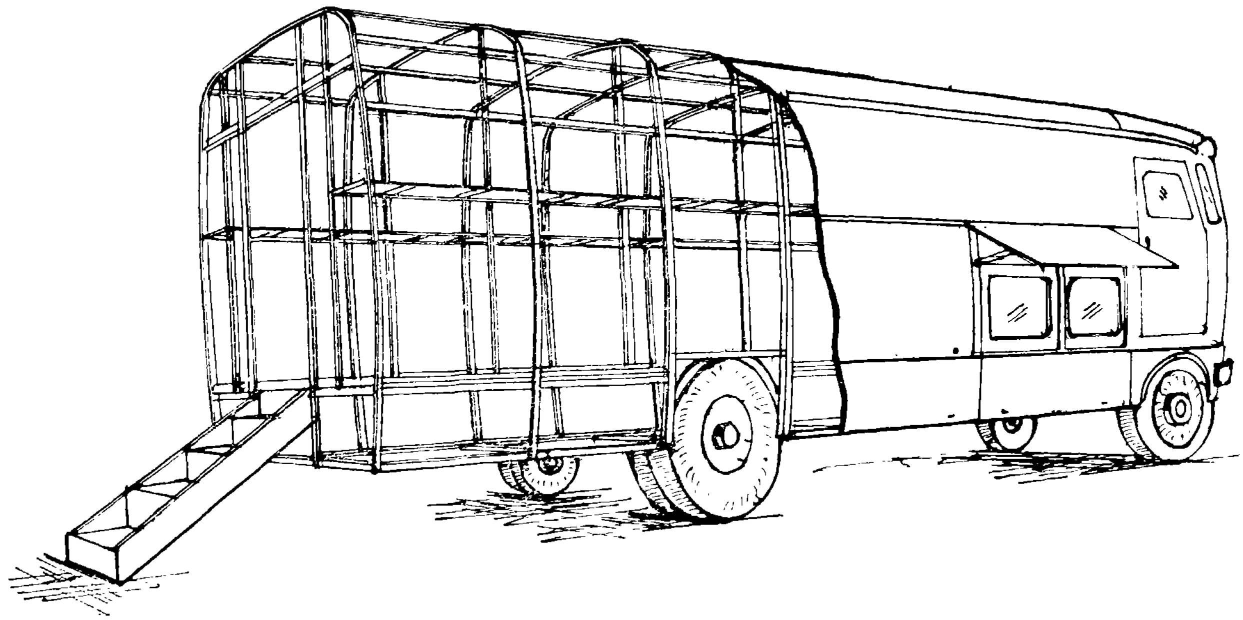


Fig. 11. Perspective view showing internal structure.

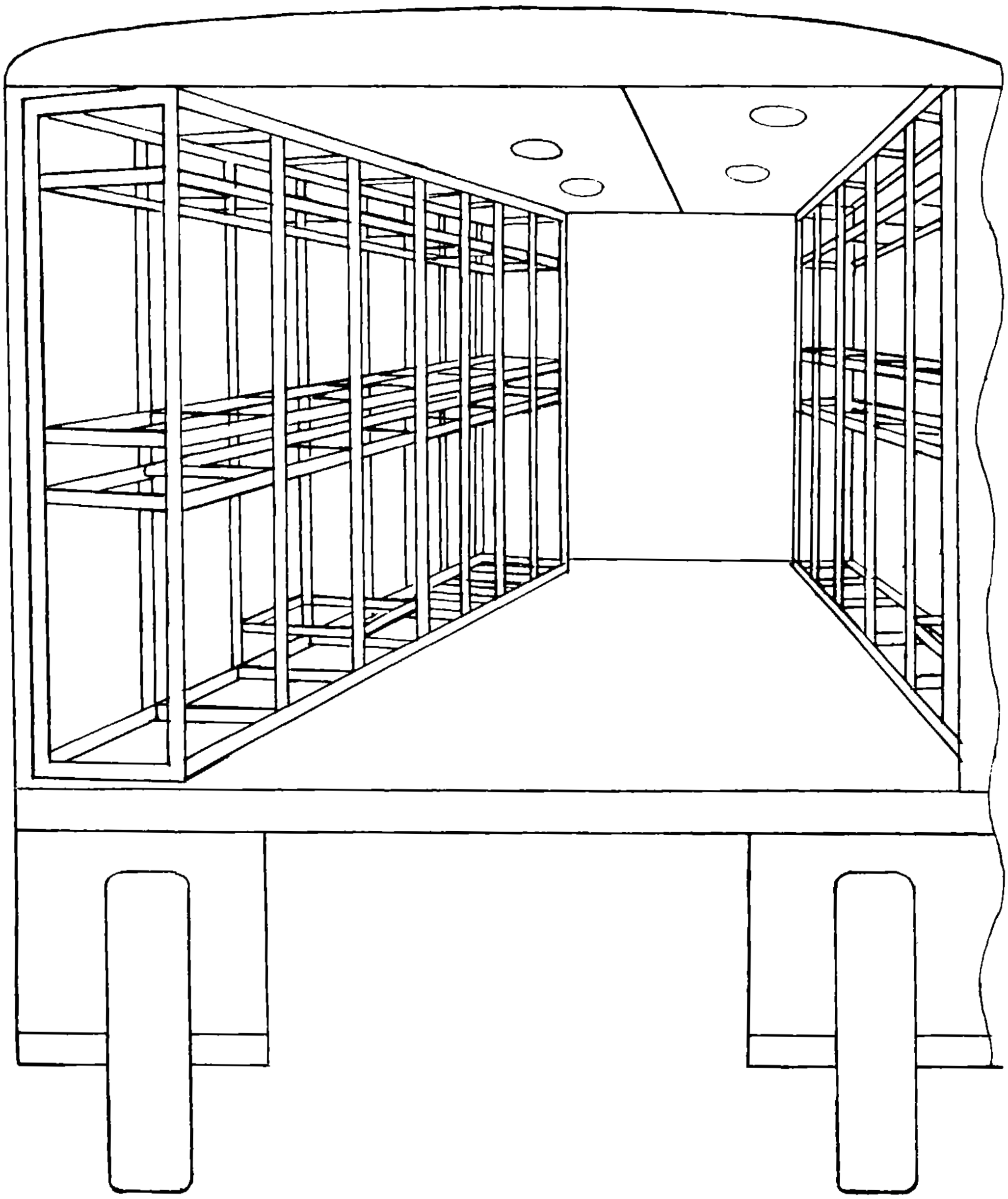


Fig. 12. Perspective view from the rear end.

tion of the Transport authorities, the extended portion of the chassis should not exceed 50% of the length of the wheelbase.

Since the chassis frame width as obtained from the manufacturer was only 1000 mm (39"), 8 nos. of cross members of 2400 mm each, were placed across the chassis and welded in position. On each side on the extremity of the cross members, two lines of 8 nos. of vertical props made of m.s. channels, separating one line behind the other by 356 mm (14"), were erected. The spacing between successive props was maintained at 1065mm (42") (fig. 10). At that appropriate heights of the vertical props, m.s. angles were placed horizontally and welded to form racks, one over the other (fig. 11 & fig. 12). In this way 14 nos. of cubicles were formed on each side of the chassis

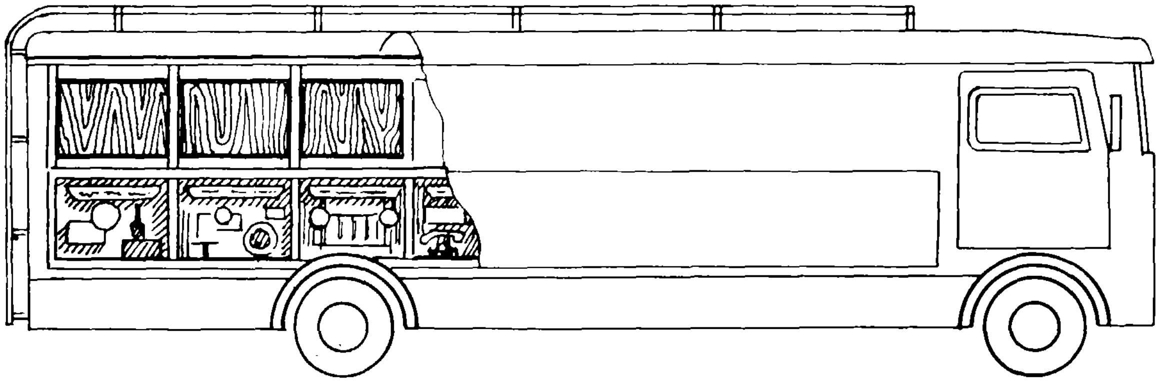
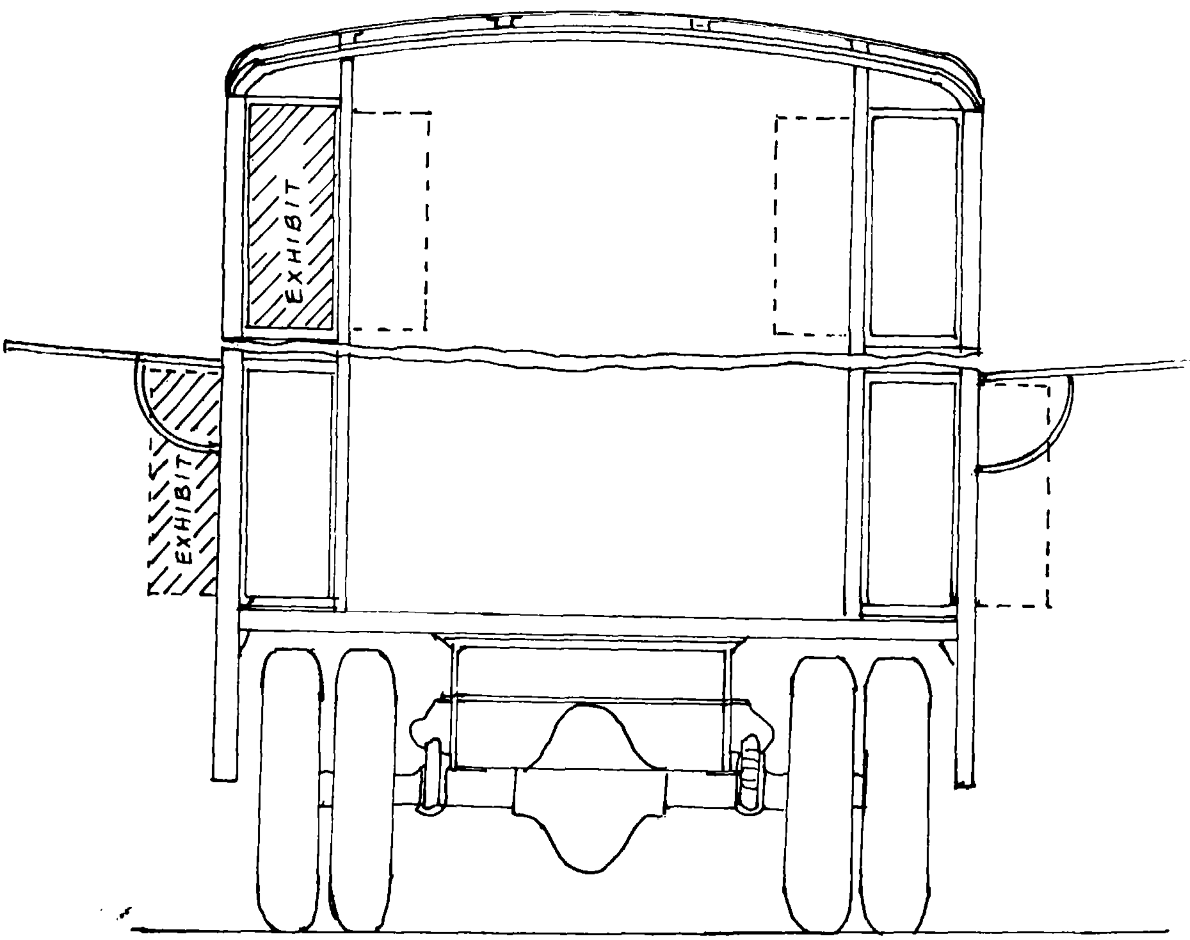


Fig. 13. Cut away view of loaded museobus

in such a manner that one standard cabinet of the size 990 mm $\times$734 mm $\times$ 305 mm can slide on the top portion of the cubicle and another of the same standard size can rest on the bottom portion (fig. 13). Thus it was possible to view the exhibit on the upper level from inside the van and the exhibit on the lower level from the outside by standing on the ground (fig. 14). A complete framed structure was thus obtained in which out of 7 cubicles on either side, one became slightly

Fig. 14. Arrangement showing the fitting of exhibits in the upper and lower level.



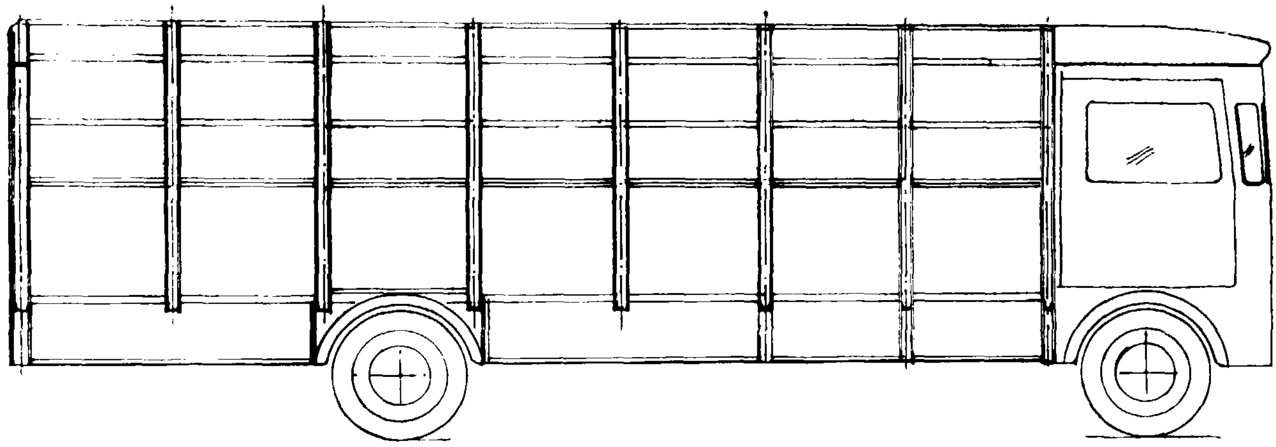


Fig. 15. Body frame showing one cubicle shorter than the rest.

shortened as it was formed over the hump formed by the rear wheel and consequently required a cabinet of shorter dimension (fig. 15). The entire framed structure was thereafter covered on the outside with aluminium alloy sheets in such a way that the bottom cubicles remained uncovered (fig. 16).

Separate hinged shutters were constructed to cover the bottom cubicles (fig. 17). All the 4 nos. of shutters, of which one was of different

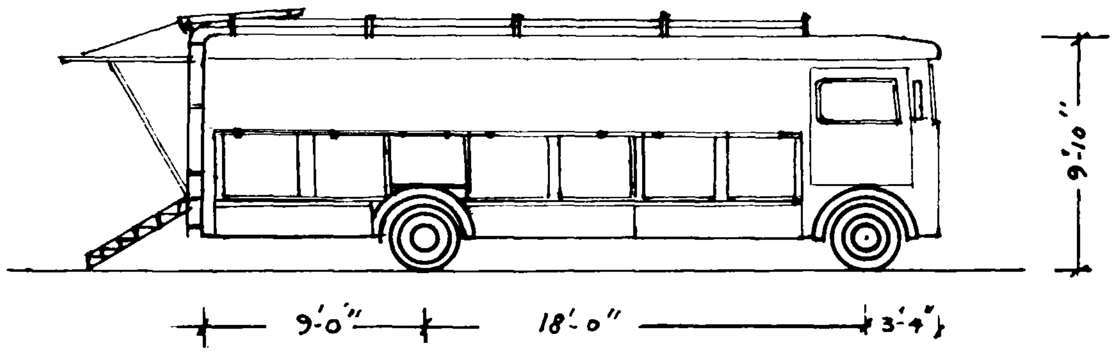
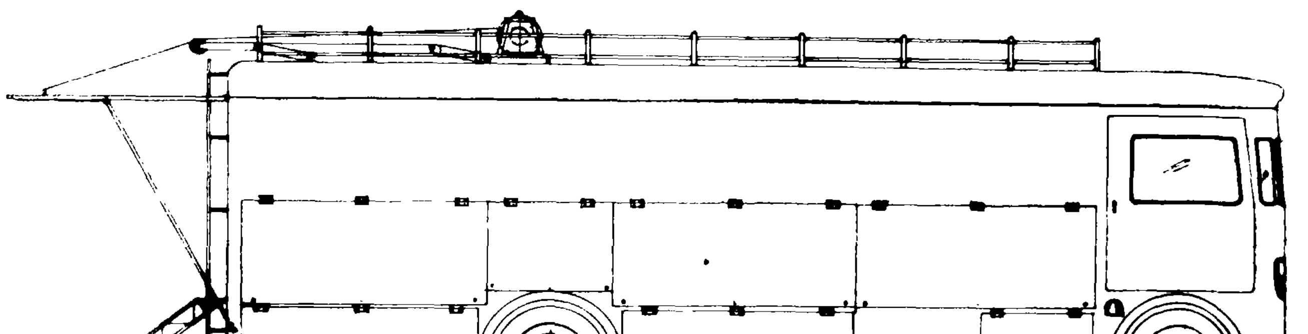


Fig. 16. Showing uncovered bottom cubicles.

Fig. 17. Elevation showing winch to raise the door.



dimension, could be used on collapsible brackets (fig. 18), and when lifted provided an attractive view to the visitors and also acted as a sunshade (plate XI).

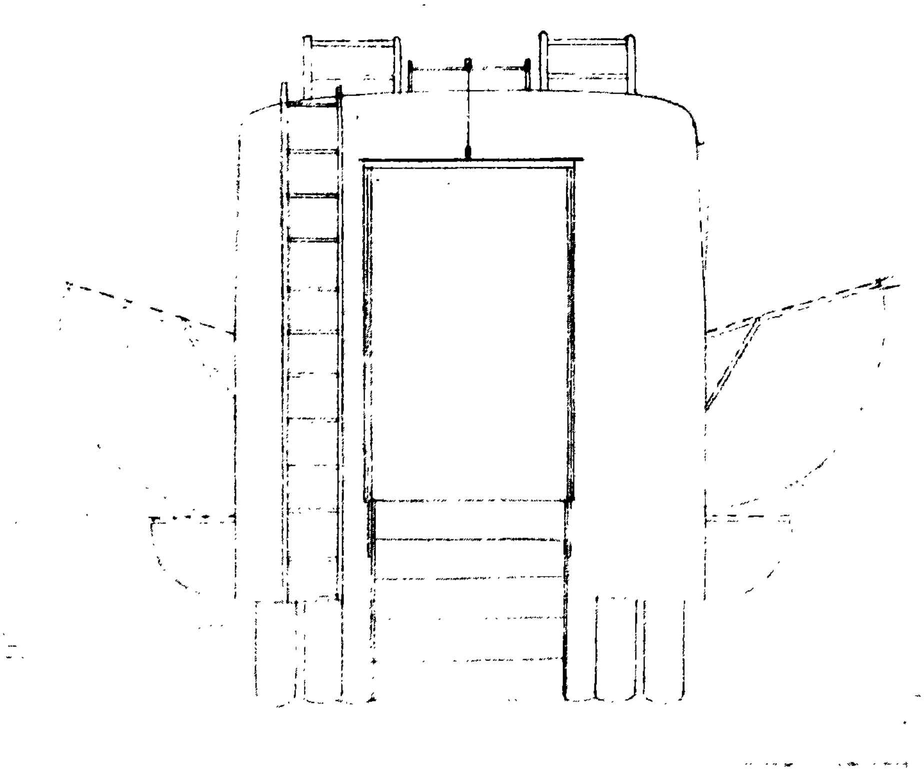


Fig 18. Rear entrance with detachable ladder.

Plate XI : The museobus type I conducting exhibition at a rural area. The raised shutters act as sunshade.

Plate XII : The interior of the museobus is panelled with veneered plywood moving on hinges

Plate XIII : The bottom row exhibits have their rear side facing the interior. They can be removed from the cubicles only by opening interior panels.

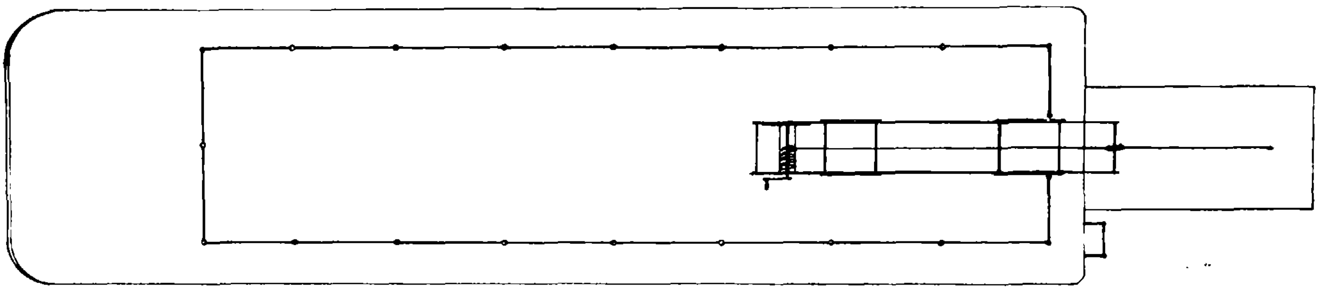


Fig.—19

According to the design, it was therefore possible to accommodate 28 Nos. of exhibits in the museobus. The interior of the museobus appeared like a corridor in a building with exhibits on stands on both sides placed at the eye level of the visitor, the width of the corridor being 66" (1676 mm). The interior of the bus was panelled with a framed structure covered with veneered plywood (plate XII), the entire panel moving on hinges so that by opening out, the same exhibits with their cabinets could be removed from the cubicles (plate XIII). Access to the exhibition area was provided by a detachable aluminium ladder placed at the rear opening of the museobus through which visitors entered (fig. 18). This opening of 42" (1067 mm) can be closed by a single panel flap door hinged at the top to the body of the bus. The door is made by fitting aluminium sheet over an iron framework and can be raised or lowered by means of a steel rope operated by a hand driven winch placed over the roof of the bus (fig. 19). An aluminium ladder fixed at the rear of the bus permits a person to climb to the roof and operate the winch. A storage area constructed on the roof with iron railings provided enough space for placement of baggages of the exhibition team. The flooring inside is made by fixing m.s. plate over the bed of the chassis and covering the same with linoleum to protect it from rusting and also to diminish the sound of moving people. Below the chassis, storage spaces are designed with suitable protective covers to keep tools, spare parts and other accessories. Inside the driver's cabin, two more persons can sit in the additional seat provided. At night, when the day's exhibition is over the exhibition staff can utilise the interior space for their night's rest in case no other lodgings are available elsewhere.

The museobus type I was inaugurated on December 20, 1966, with an exhibition on "Transformation of energy" and within the next four months covered 48 schools and community centres and attracted a crowd of 90,000 visitors.

Exhibition trailer and tractor (Type A)

Shortly after the launching of Museobus (Type I), the design of another exhibition vehicle was undertaken by Ghose and his co-workers at BITM, Calcutta. The reason for deciding on a new design was as follows. It was felt that along with a mobile exhibition on science and technology, there should be simultaneously other programmes to intensify the message of science in the same locality and in adjoining areas. The programme would comprise science demonstration lectures in schools, organisation of students' science seminars and students' hobby centres, and setting up of science clubs in selected institutions, while science exhibition was in progress. The design conceived was an unit of two vehicles—a trailer in which exhibits would be mounted, pulled by a tractor constructed like a bus. The trailer van with the exhibits could be detached at the exhibition site and the tractor unit could move on to neighbouring schools with some of the team members to carry on the educational extension programmes. In order to fulfil the assigned objective the tractor should have arrangements for carrying science demonstration lecture equipment, film projectors, films, hand tools, raw materials and chemicals for experiments. In addition, the tractor could also provide arrangements for the staff. Another factor that influenced the design of the exhibition trailer was the need to improve the ventilation system inside the exhibition area, because in a trailer it was possible to provide an entrance and an exit separately. In addition to improving visitor circulation it would help in improvement of air circulation. In western countries the exhibition trailers have air-conditioning arrangements to improve visitor comfort, but such a system can hardly be introduced in the Indian made exhibition vans, due to the prohibitive cost of the air-conditioning unit and to lack of adequate power supply in urban and rural areas. Even the portable generators carried by the exhibition vans could hardly produce the power required for operating an air-conditioning unit. One had therefore to rely on exhaust fans or forced air fans and also on the natural air circulation arrangements.

The regulation of the State Transport Authority prescribed the overall length of a trailer-tractor combination unit and its coupling arrangement to 540" (13716 mm), of which the trailer length was limited to 288" (7310 mm). The designer had therefore to work within the above limitations. The petrol engine driven Bedford truck chassis of a wheelbase of 120" (3048 mm) was available in

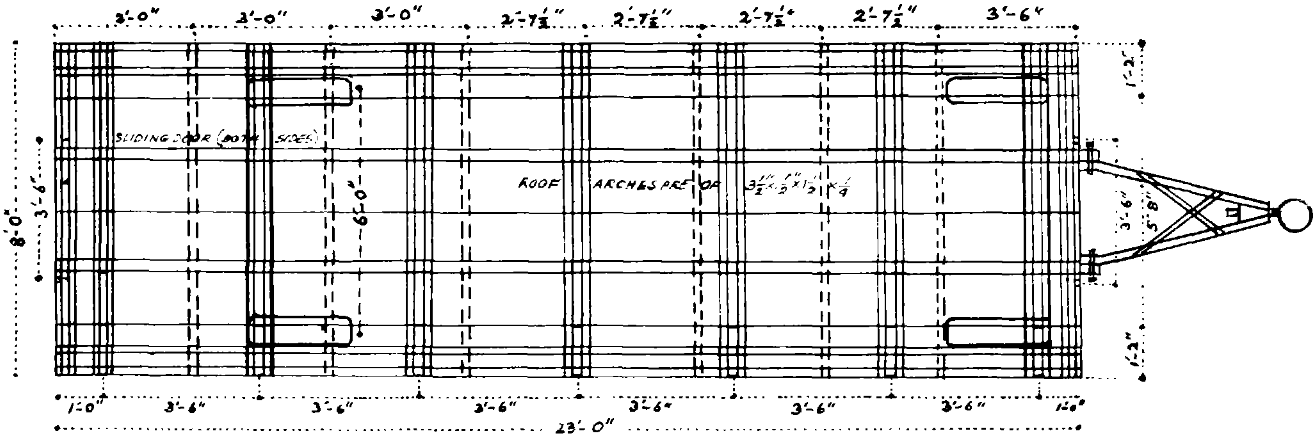
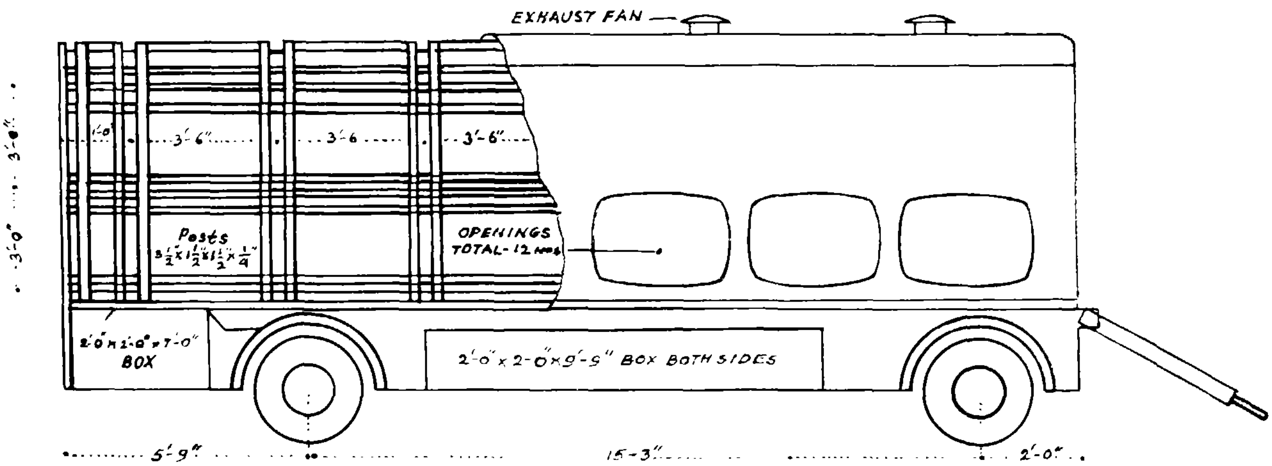


Fig.—20 Plan.

Fig.—21 Elevation.

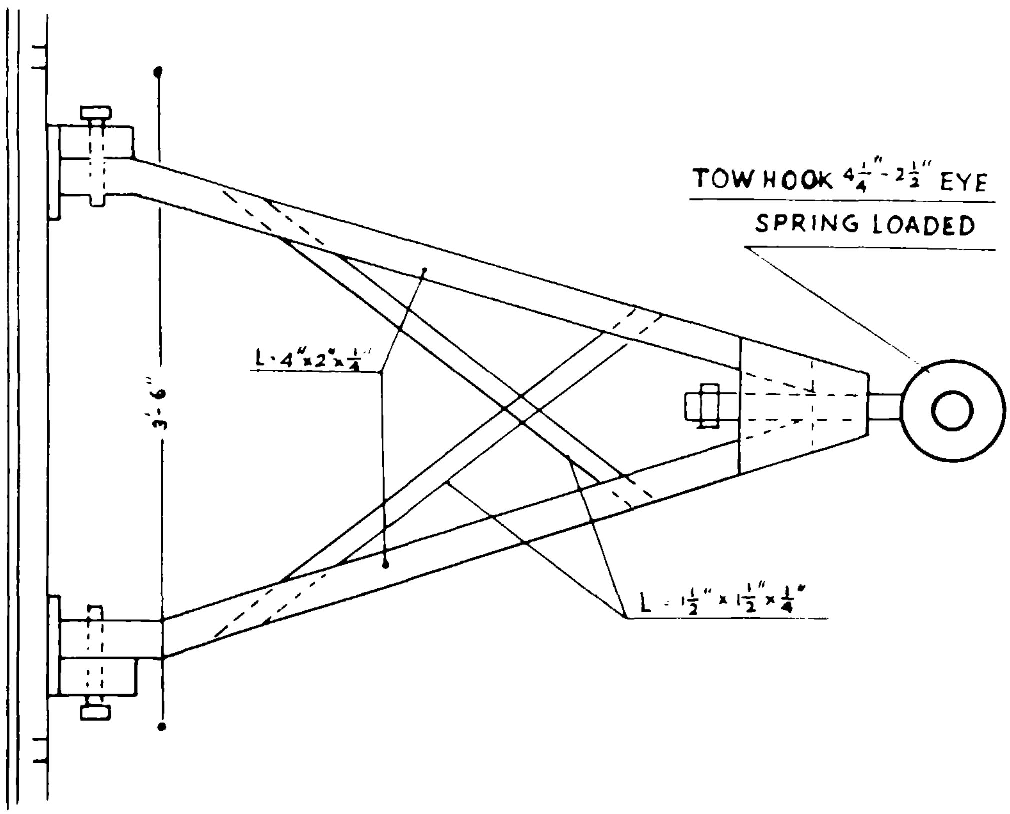


the market and was suitable for hauling a loaded trailer. Unfortunately a trailer of the required specifications was not a standard manufactured item and hence a trailer chassis was specially fabricated with the following specifications :

Overall length 276" (7010 mm)
Wheelbase—183" (4648 mm)
Chassis width 40" (1016) mm)
Ground clearance 40" (1016 mm)
Tyres—4 Nos. 7.50 × 16—8 ply

Channels were placed across the chassis to give a width of 2400 mm and vertical props were erected at intervals of 42" (1067 mm) on both sides of the trailer. Following the same construction procedure adopted for the museobus, six cubicles were made on each side of the trailer with upper and lower housings for cabinets. In all there were 12 housings in the trailer for 24 exhibits (fig. 20 and fig. 21). The 12 Nos. exhibit windows on the lower level which faced outward were provided with 6 Nos. of hinged shutters, one shutter for two windows. There were two openings on the two ends of the trailer measuring 42" (1067 mm) width, one for serving as entrance and the other as exit of visitors. The openings could be closed by means of sliding doors, instead of the flap door provided in the previous museobus which could be manipulated easily, as the doors could slide in grooves. Removable ladders with aluminium steps were provided for the exit and entrance. For hauling the trailer a tow hook was bolted to the chassis frame and the eye of the hook was spring loaded so that when brakes were applied to the tractor and the force was transmitted to the trailer, the spring served as a moderator (fig. 22).

Fig.—22



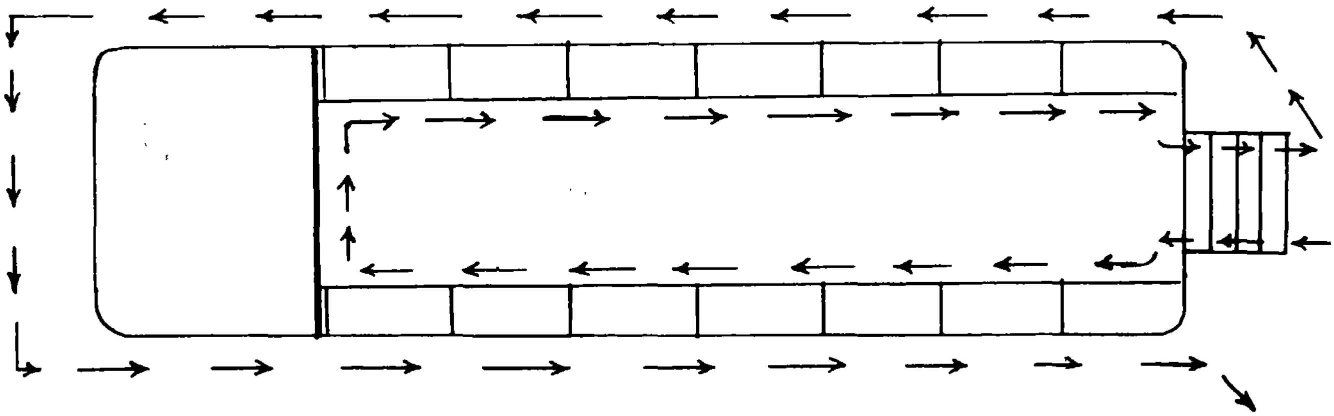
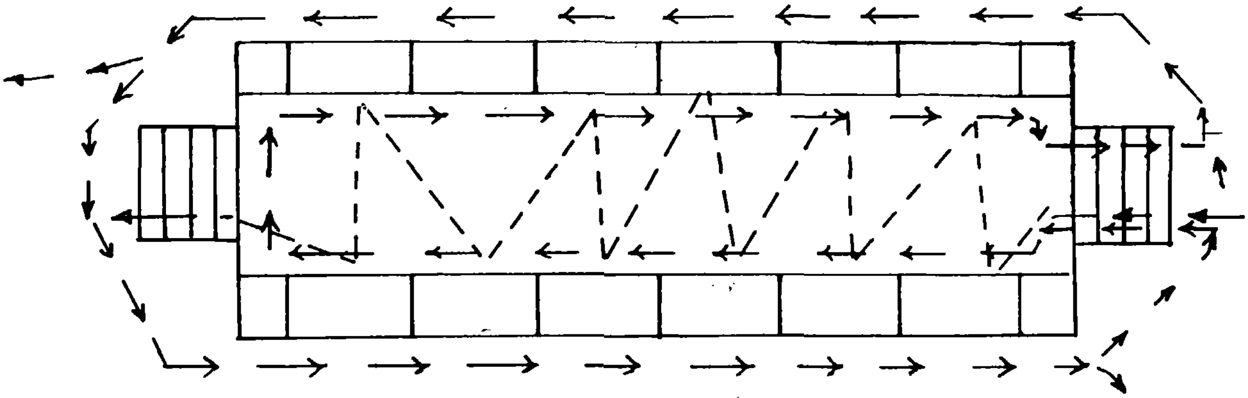


Fig.—23 : Circulation inside a museobus.

In order to insulate the trailer from heat, the roof of the trailer was covered with a aouble layer of aluminium sheet and in between a 25 mm layer of thermocole lining was provided. 4 Nos. of exhaust fans of size 12" (305 mm) were fixed on the ceiling of the trailer van in specially made housings to provide ventilation to the interior of the vehicle, which together with the two openings on the two ends of the vehicle facilitated a free circulation of air. The circulation of visitors in the museobus and in the trailer was naturally different and it is shown in fig. 23 and fig. 24 respectively.

The construction of a body on the Bedford chassis posed few problems. By means of one partition two compartments were set up in the tractor—the driver's cab in the front and the equipment store at the rear, with a connecting door in between. The store measuring 131" ×84" (3581 mm ⁄ 2133 mm) had plenty of open space for carriage of equipment, projectors, screen, films, small tools, etc., that are normally required for conducting educational programmes. It had in addition 3 Nos. of long seats, two of which could be used as sofa-cum-cabinets. Underneath the seats there were arrangements for storing the

Fig.—24 : Circulation inside a trailer.



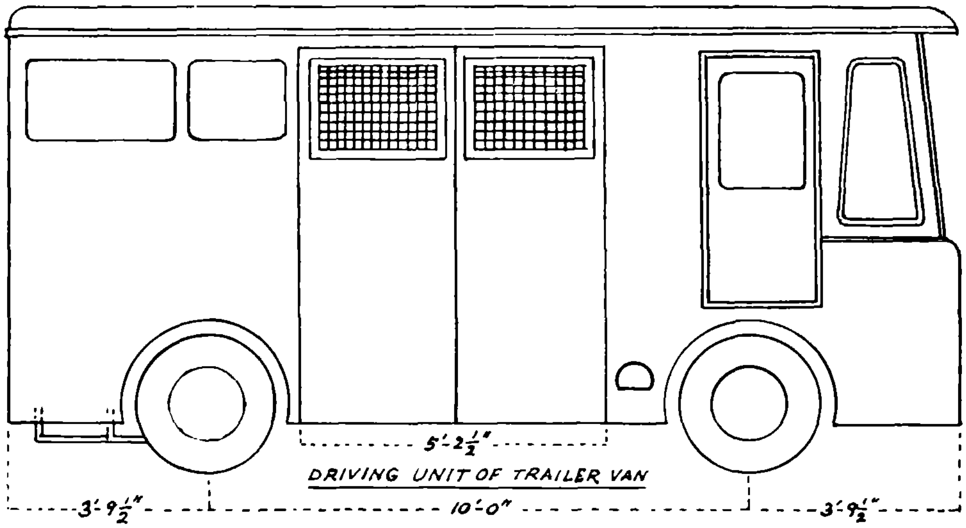


Fig. 25

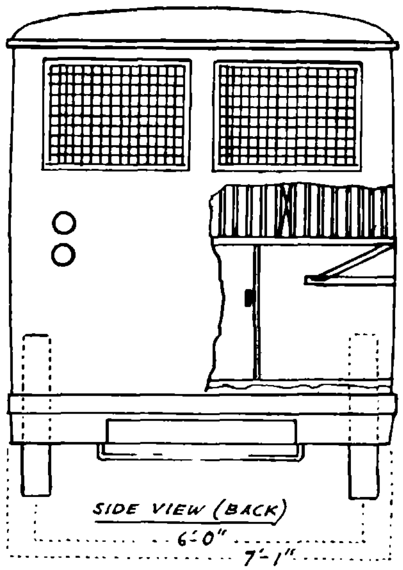


Fig. 26

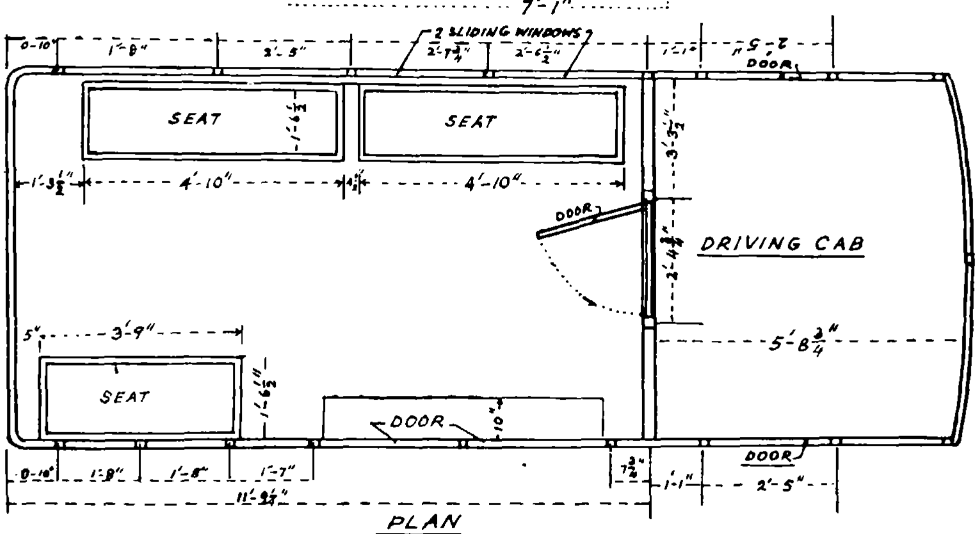


Fig. 27

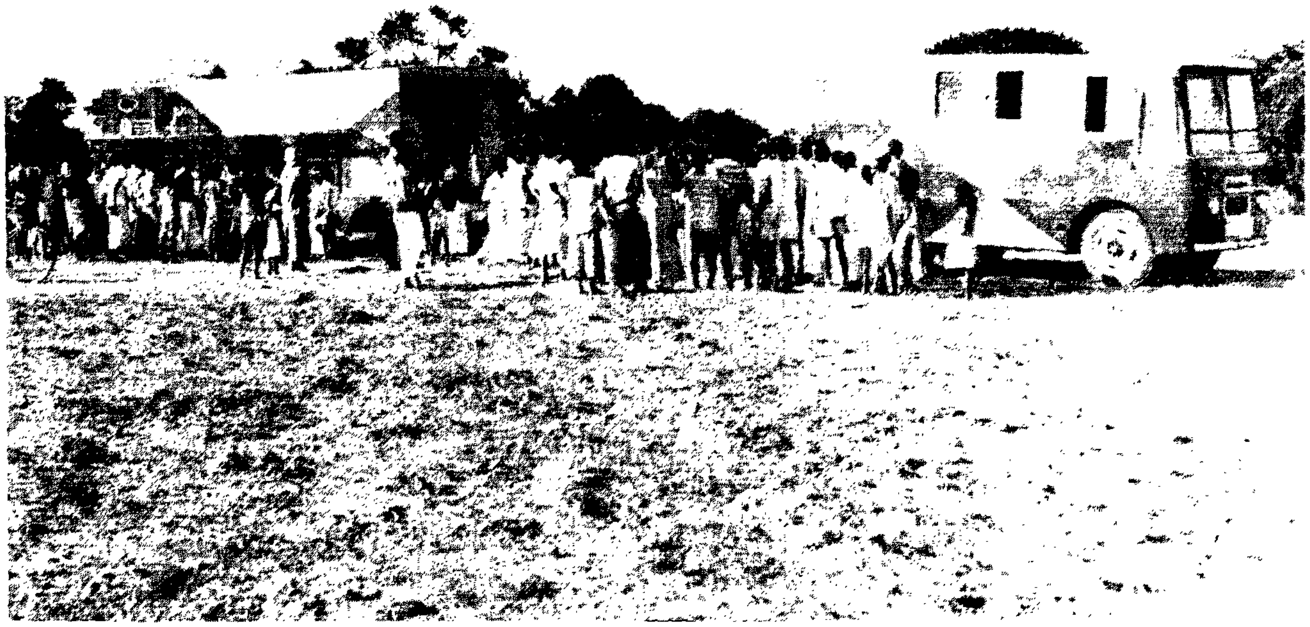


Plate XIV : The tractor detached from the trailer before exhibition; it is ready to proceed to neighbourhood school for other educational programmes.

personal baggage of the individual members of the team, together with their cooking utensils and crockery required for housekeeping purposes (fig. 25, fig. 26 and fig. 27).

The tractor had a coupling hook at its rear to which the tow hook of the trailer could be attached and then the unit was ready for the road. The trailer unit was commissioned in 1968 and proved very popular, although its manoeuvrability was not so good as the museobus (plate XIV). A tremendous enthusiasm was generated by the tractor which could visit neighbouring schools while the trailer continued with the exhibition. It also helped to initiate a hobby centre and science club movement in many of the rural schools in Eastern India which benefited immensely from the experience and guideance given to the school authorities by the roving staff of the BITM, Calcutta. In fact the schools were encouraged to open a hobby centre in their premises, if there was a spare room available, and BITM, Calcutta, loaned them hand tools, and presented them with raw materials for model making, such as scrap timber, plywood, metal foils, etc. which were usually rejects from the museum's workshop at Calcutta.

Exhibition trailer and tractor (type B)

In 1969-70 when VITM, Bangalore, wanted to introduce mobile science exhibitions in southern India operating from their headquarters at Bangalore, the occasion came to review the earlier design of the tractor and trailer unit (type A). The roads in southern India were better than those in the eastern region because of soil conditions and because the monsoon was less prolonged. As a result the vehicle could move a little faster there on wider roads having less congestion of traffic, but in many areas on the Deccan plateau the trailer had to negotiate a number of slopes of higher gradient. Accordingly there was a need to improve the steering system as well as the braking system. A driver seated in the tractor should be able to

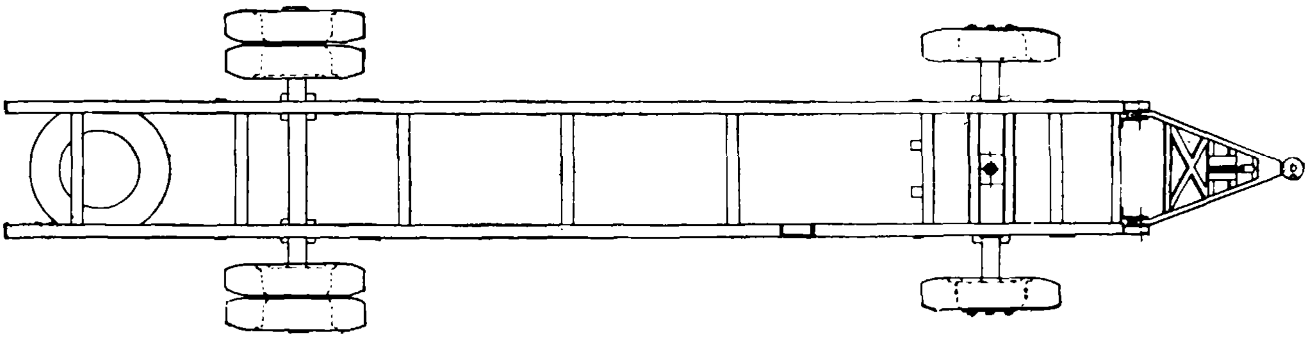


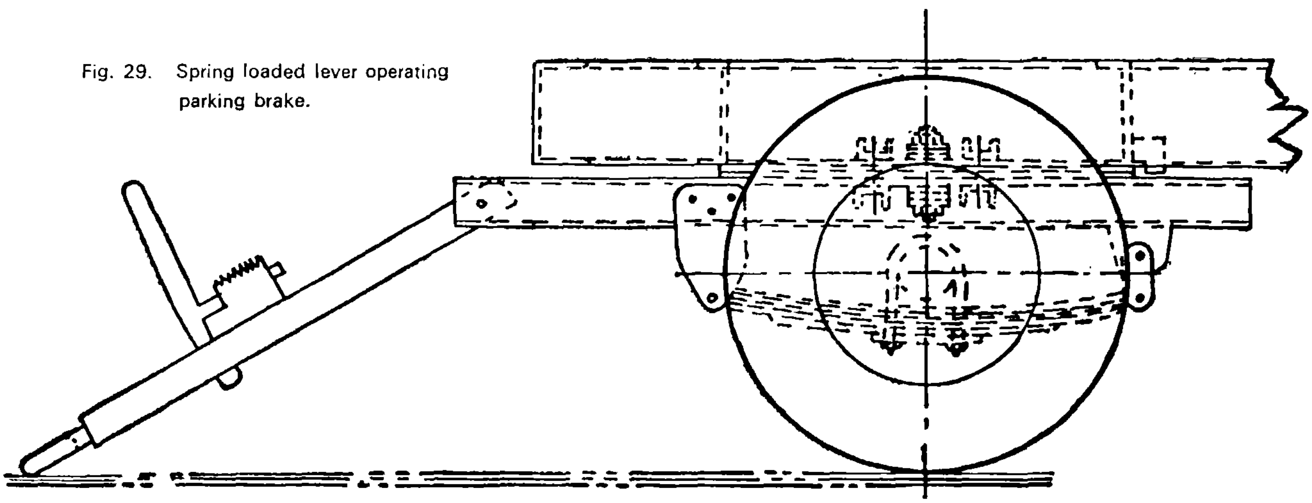
Fig. 28. Trailer chassis.

stop and park the vehicle either by applying the foot brake or pulling the hand brake. The wheels of the previous trailer were of substandard size and replacing wheels posed difficulties. Also instead of two rear wheels in type A, 4 rear wheels were required for carrying exhibits and other equipment placed in the trailer. Further the tractor and trailer of type A, were of different height and for the sake of appearance some change was desirable. Two modified designs were adopted in VITM in 1970 and 1971, one after the other, and the 1971 model needs some special mention. To meet the changes, a trailer chassis of the following specification was ordered from the manufacturer (fig. 28) :

Overall length	– 288" (7320 mm)
Wheel base	– 179" (4540 mm)
Ground clearance	– 37" (940 mm)
Frame width	– 34" (860 mm)
Tyres	– 6 Nos. 7.50 $\times$20 $\times$12 ply.

The towing arrangement was modified by fitting on the tow bar rod a lever which the driver could pull by this hand brake and which could operate the mechanical over-run brake-cum-parking brake system of the trailer (fig. 29). The towing and turning arrangement was made by providing a conventional steering arrangement fitted to the front axle of the trailer (fig. 30) and linked to the tow bar, so that the trailer could also turn around bends along with the tractor. The construction of the cubicles were made in the same manner as in type A, but because of the slightly longer length of the trailer chassis, in addition to the construction of 6 nos. of cubicles for the exhibit housings, it was possible to construct at the two extremities of the trailer two more cubicles of 450 mm $\times$ 2120 mm, where fire extinguishers, main switches for the exhibits and controlling switches for the overhead fans and lamps could be located (fig. 31 & 32). Access to the exhibition area was made possible with the help of a pair of removable ladders 595 mm wide provided with railings on both sides of the trailer. Visitor movement became slightly easier in this way. Also with the two ladders placed side by side, it was possible to slide down the exhibit housings/cabinets for unloading, as sometimes descending with the exhibits by the steps became slightly risky (plate XV).

Fig. 29. Spring loaded lever operating parking brake.



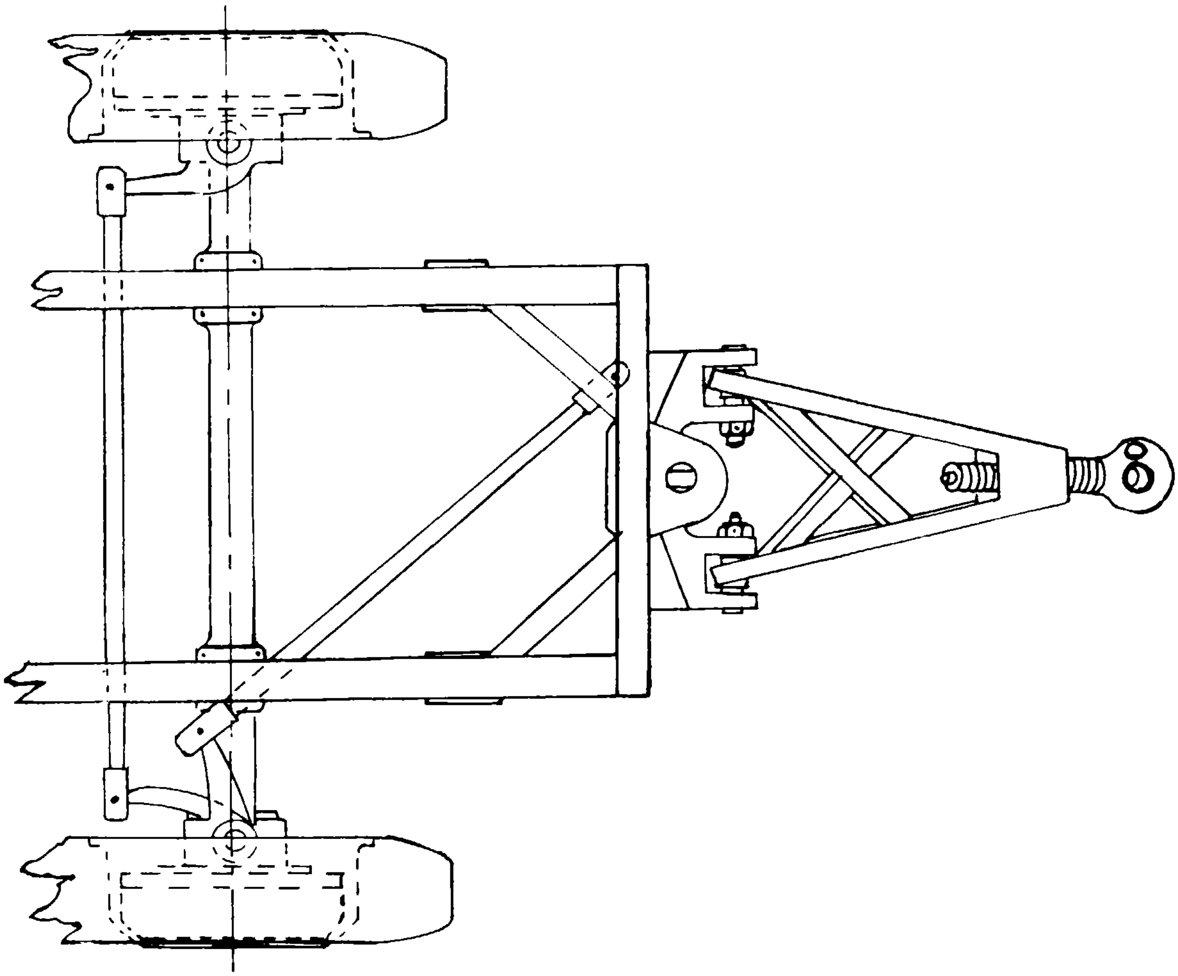


Fig. 30. Conventional steering System.

Fig. 31. Cutout Elevation of trailer showing the frame structure, ladder, stepney and storage positions.

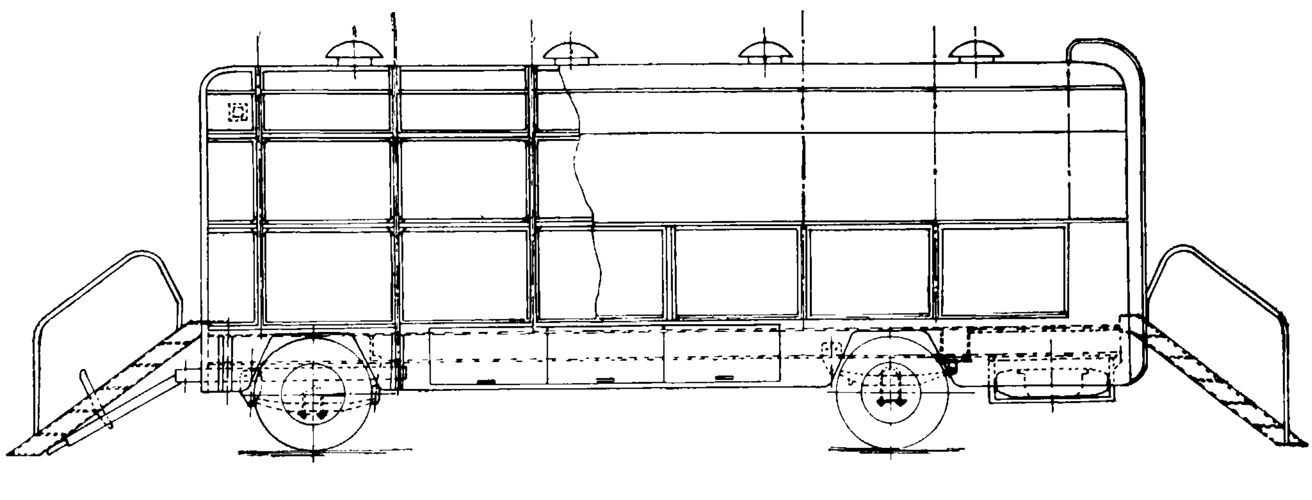


Plate XV :
The usual method of loading and unloading an exhibit. Sometimes it proved a little risky because of high steps

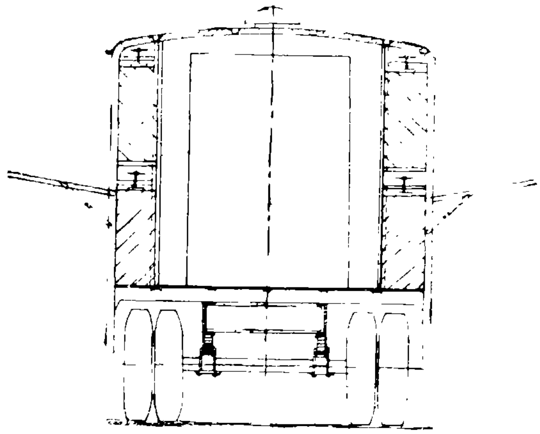
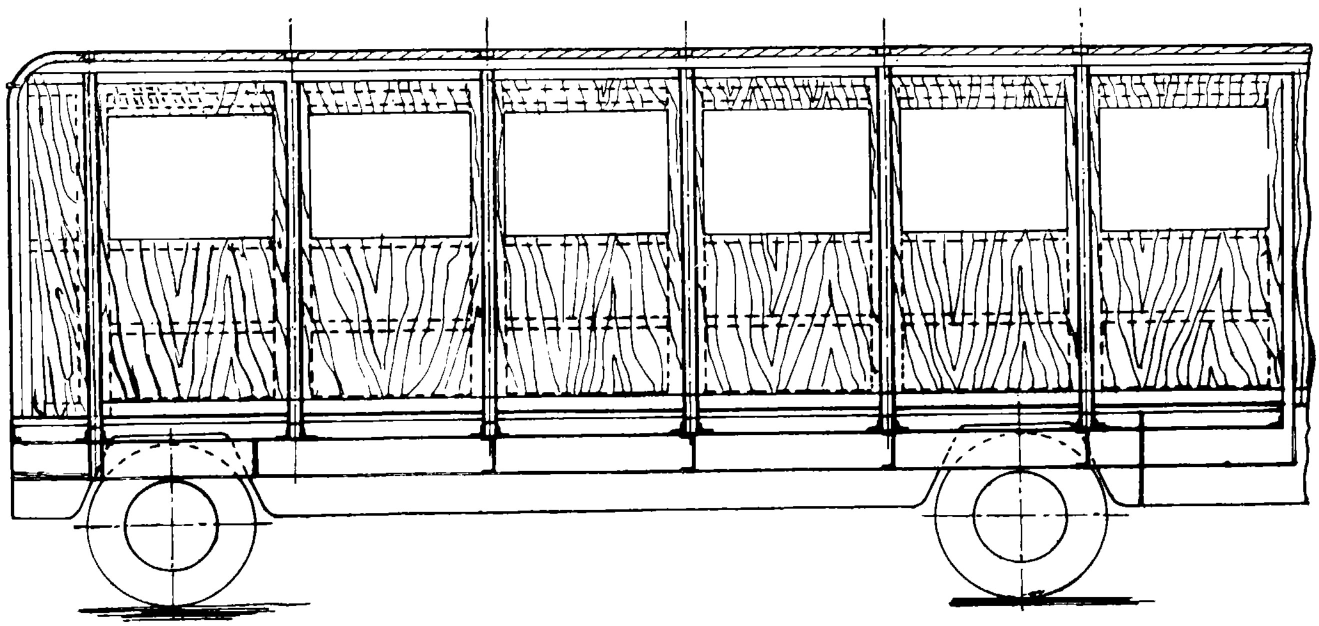


Fig. 33. Sectional Elevation showing clamping of exhibits.

Fig. 32. Sectional Elevation showing the Exhibits at upper level.

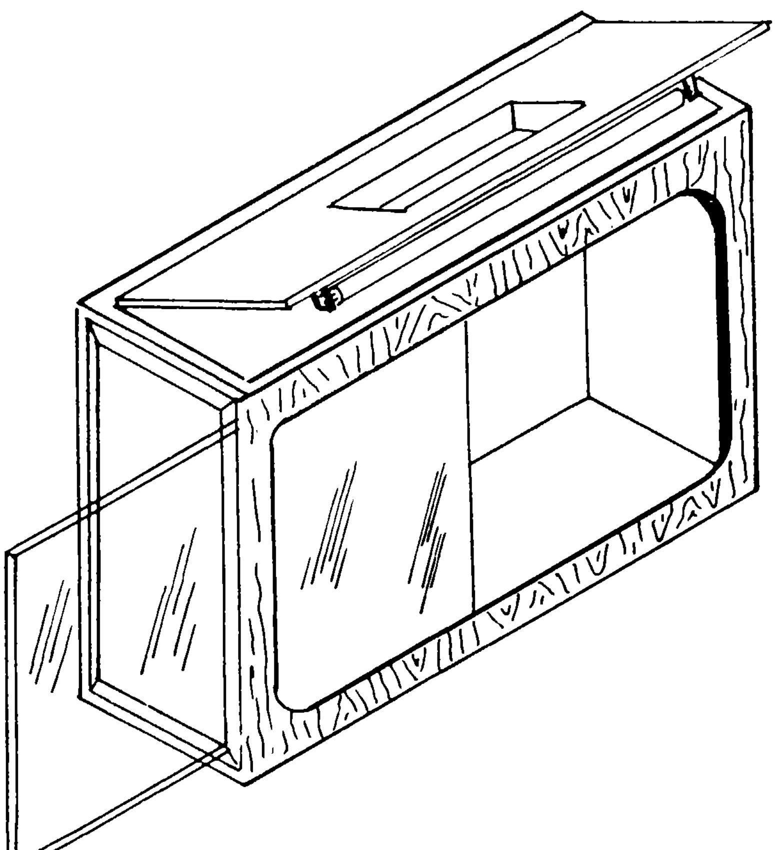


Each cabinet was secured in position in the trailer, firstly by providing a hole under each cabinet which would fit over a pin fixed on the rack, and secondly, by clamping each cabinet in position with the help of a special clamp. Thus 24 clamps were needed for 24 exhibits (fig. 33). In this way the sliding of the exhibits was prevented when the trailer turned round corners or stopped suddenly. Some changes were introduced in the cabinets to make them more sturdy and permanent in nature, since many of the exhibits required electromechanical control devices and other gadgets which increased the weight of the cabinet from an average of 35 Kg to an average of 50 Kg. The original dimension of the cabinet, namely 990 mm × 730 mm × 305 mm was kept, but the following modifications were made :

Instead of teak-faced ply on the front, which was susceptible to moisture and soon lost its glaze, synthetic 'Decolam' sheet of 1.5 mm thickness was pasted on the front of the cabinet. The side covers were fitted with a double ball-catch system so that these could be removed quickly for repair and maintenance. A box was fitted underneath the top cover for housing the choke, starter and condenser, required for the flourescent tubes so that the entire box with fittings could be replaced during breakdowns, and for lifting the top cover simple 20 mm diameter holes were provided (figs. 34, 34a).

Important design changes were made in the interior and exterior of the tractor. The height of the tractor and its width were made of the same size as the trailer and apart from making the combination more homogeneous the cubic capacity of the trailer increased (plate XV).

Fig. 34. Front view.



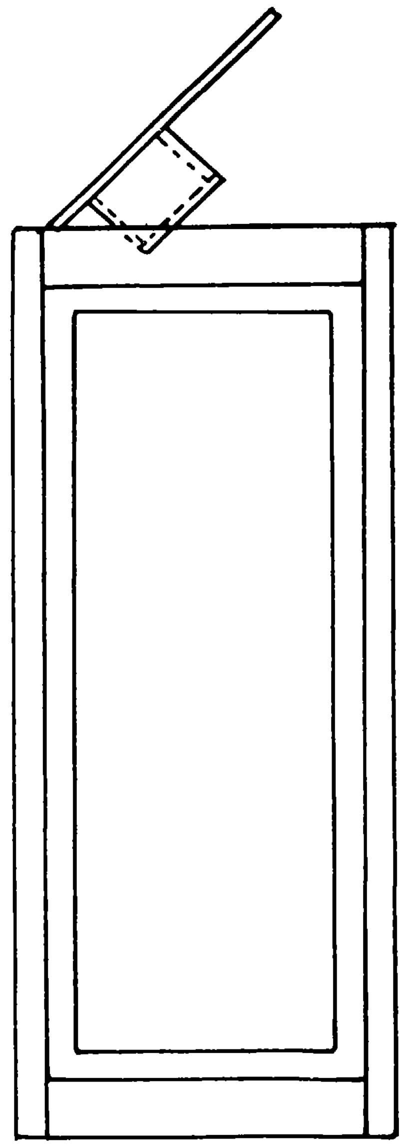
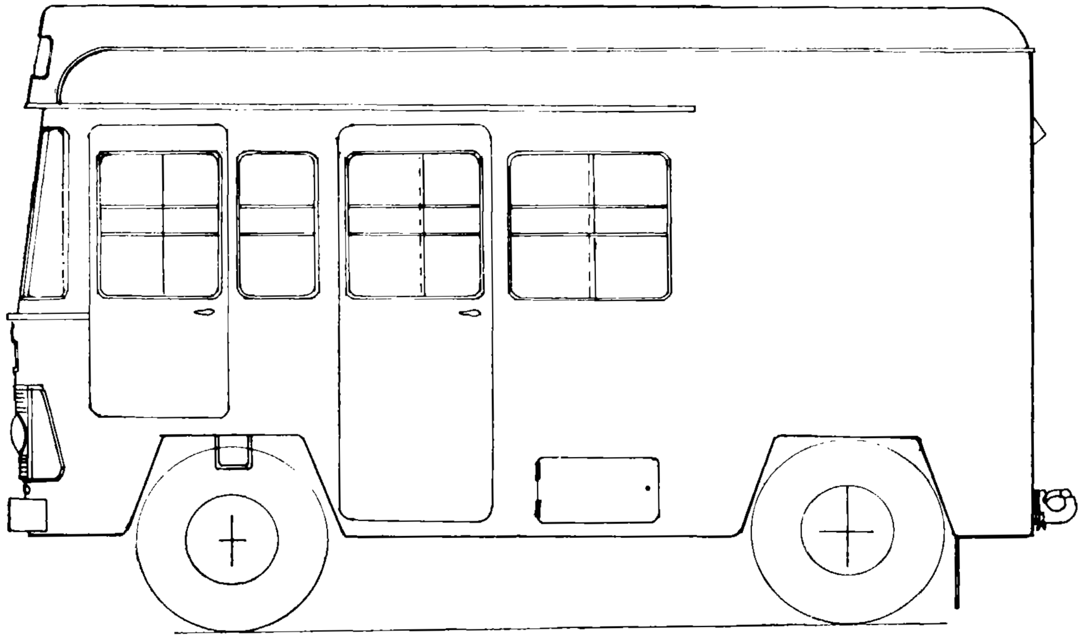


Fig. 34A. Side elevation.

The number of windows in the tractor was increased and travelling long distances in the summer months became less strenuous (fig. 35). In the interior of the tractor, while basically the space behind the driver's seat was meant for carrying demonstration equipment, generator, film projector etc, re-arrangements were carried out for the seating of the team members. A two tier berth similar to a railway sleeping coach was installed. While two or even three persons could sit on the lower berth, at night the head rest could be raised and suspended from a couple of chains, thereby converting it into a sleeping berth (fig. 36).

Fig. 35. Elevation.



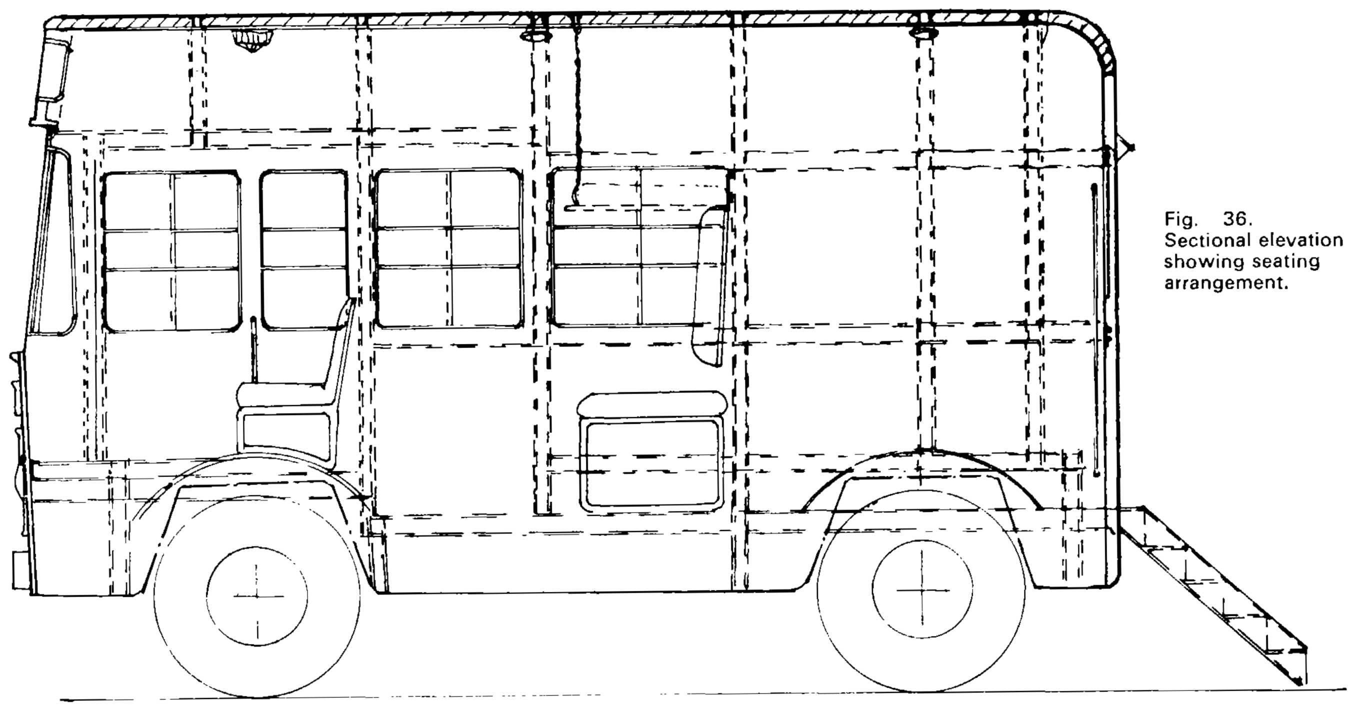


Fig. 36.
Sectional elevation showing seating arrangement.

Museobus type II

In 1977, one more mobile exhibition unit was needed for carrying on the new programmes of the BITM, Calcutta and investigation was undertaken afresh to decide whether a bus type or a trailer and tractor type vehicle would be suitable. Because of the narrow roads and hilly terrain of North Eastern India where the vehicle would ply, it was decided that a "bus type" vehicle would be more suitable. The previous design of Museobus type I was therefore reviewed and the following modifications were found necessary :

a. Owing to the recent energy crisis, the price of petrol increased steeply compared to the price of diesel. (Even after several price hikes the cost of one litre of petrol at Calcutta in 1982 was Rs. 6.13 or 77 cents, while the cost of one litre of diesel was Rs. 3.09 or 39 cents). As a result of this situation Indian automobile manufacturers were producing passenger coach chassis fitted with diesel engines in larger numbers. It was therefore decided to use a diesel engine driven truck instead of one with a petrol engine, although the capital cost of the former was substantially higher.

b. Additional storage space was required in the museobus for the storage of spares, accessories, the film projector, the projection screen and a portable generator for improvement of services.

c. It was necessary to have more seating accommodation for the team members, and some sleeping berths, in case lodging for the night was not available in out of the way rural areas.

d. Out of the 28 exhibit housings in type I, two of the housings were of non-standard dimensions and there was sometimes confusions during replacements. It was therefore desirable to have uniform exhibit housings throughout.

e. The flap door at the entrance of the vehicle was bulky and heavy and hence raising and lowering it was slightly hazardous.

A Hindustan Bedford passenger coach with diesel engine was readily available in the market with a wheelbase of 216" (5486 mm) and an overall length of 297" (7544 mm) fitted with 6 tyres of size 8.25 × 20 × 12 Ply on which body

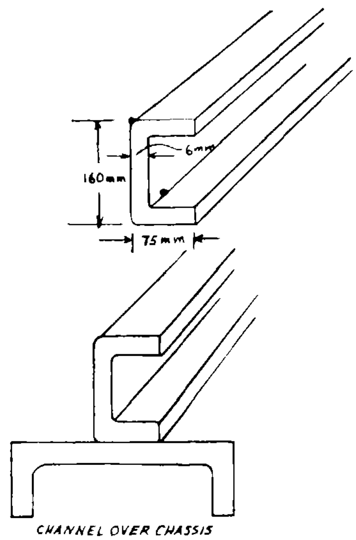


Fig. 37

building was started. In order to eliminate the hump the floor bed had to be raised 160 mm. Accordingly after extending the length of the chassis by a further 1600 mm by welding extra channel to the existing side members, 13 nos. of m.s. channels of 160 mm × 75 mm × 6 mm were welded crosswise over the chassis frame (fig. 37).

In this way the bed of the chassis was just over the hump and thereafter diamond type cover plates of 12 mm thickness were placed underneath the channels for extra strength (fig. 38, fig. 39). As per the modified design, 6 nos. of cubicles were constructed by erecting two rows of vertical props on the side extremities of the chassis (museobus type I had 7 cubicles). Each cubicle had arrangement for the placing of two cabinets, one on the upper level and the other on the lower level, i.e. in all 24 cabinets could be accommodated in museobus type II. A length of 2756 mm was still available along the length of the chassis for constructing the driver's cabin and other facilities. With the help of two partitions an area of 2400 mm × 1691 mm was built for the driver's cabin where a wider seat was provided for 2 more staff members and another area measuring 2400 mm × 1065 mm was set up behind the driver's cabin in which two tier berths like the railway sleeper coach was constructed (fig. 40). The design also provided a large number of storage spaces, 6 nos. in all, on both sides of the bus in which a wide variety of objects like spare wheels, ladders, personal baggages of staff, tools etc. could be stored (fig. 41). The suspended type of flap door

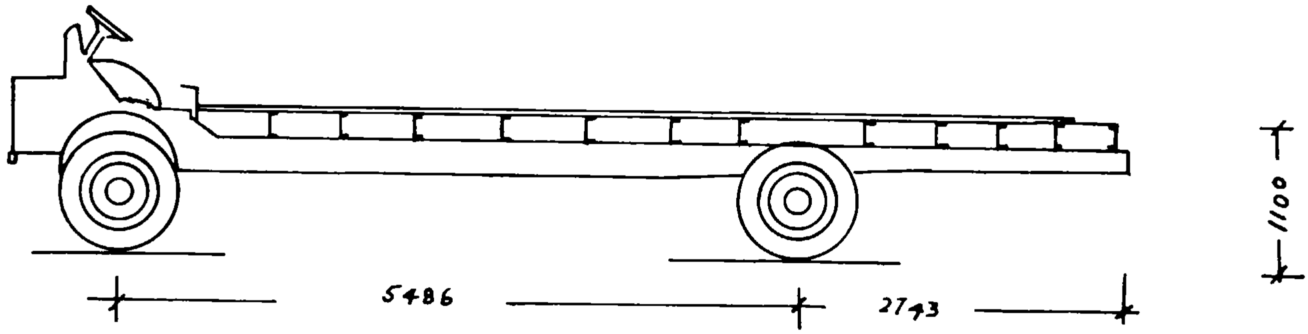


Fig. 38 Elevation of chassis after fixing of cross members.

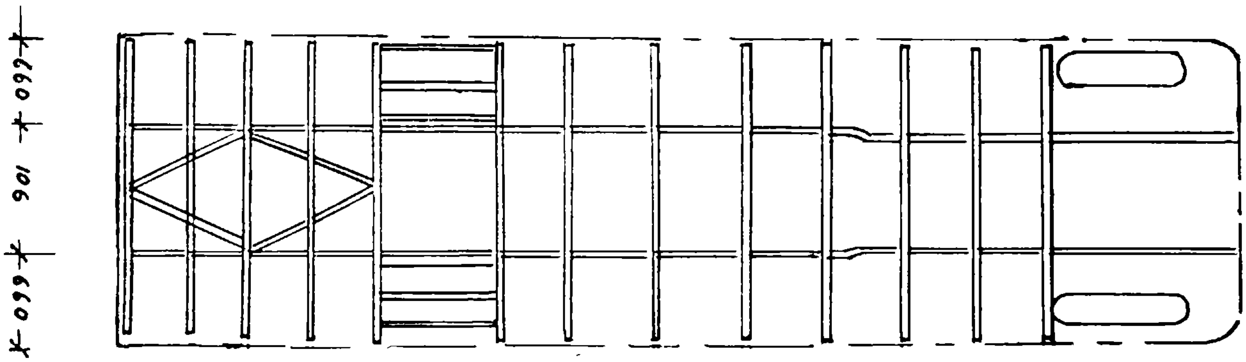
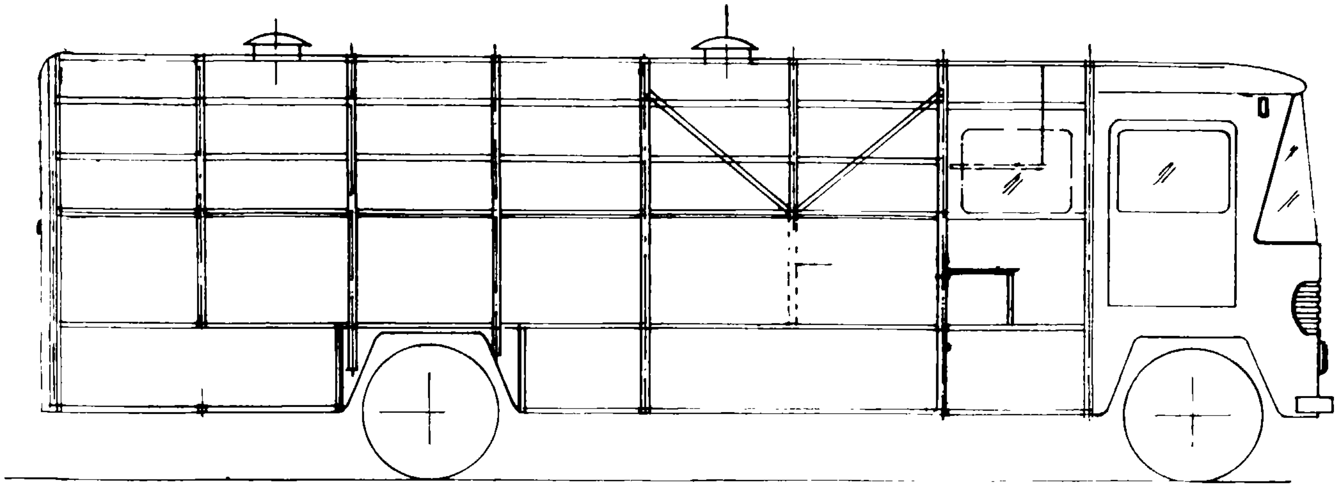


Fig. 39 Plan view of chassis showing the longitudinal and cross members.

Fig. 40 Sectional elevation.



was replaced by a pair of sliding doors which were easier to manipulate and the entrance and exit was through the same door. Changes were made in the ventilation arrangements by constructing two domes on the roof to admit fresh air and fixing a number of revolving fans suspended from the ceiling of the bus (fig. 42 and 43). Because of two additional windows in the front cabins, the team members could also travel more comfortably (plate XVI). Interconnecting doors (fig. 44) were provided with the exhibition area so that the demonstrator can move quickly from exhibition area to the switching area for switching over from the towns electric supply to the supply from the stand-by generators when there is power failure.

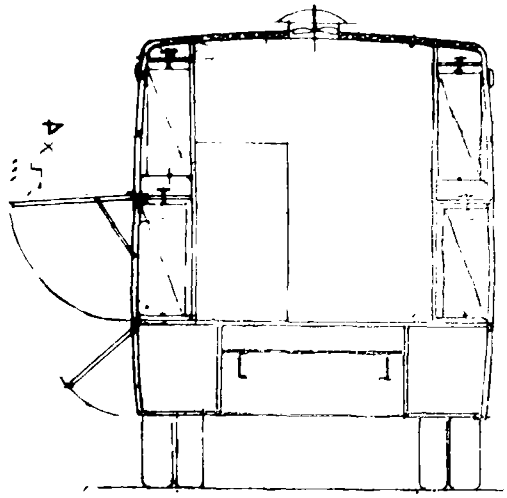


Fig.—41 Sectional rear view showing storage and window shutters.

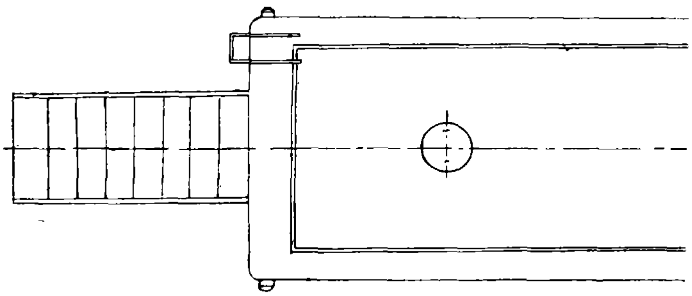


Fig.—43 Roof plan showing domes.

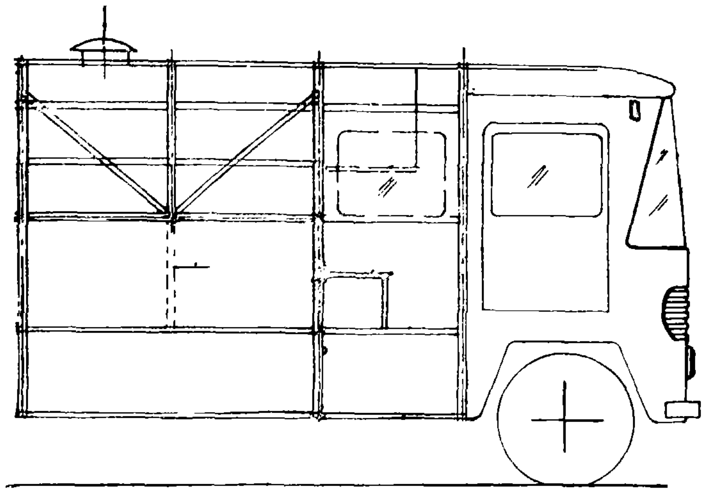


Fig.—42 Elevation showing window shutters and domes.

Fig.—44 Showing interconnecting doors.

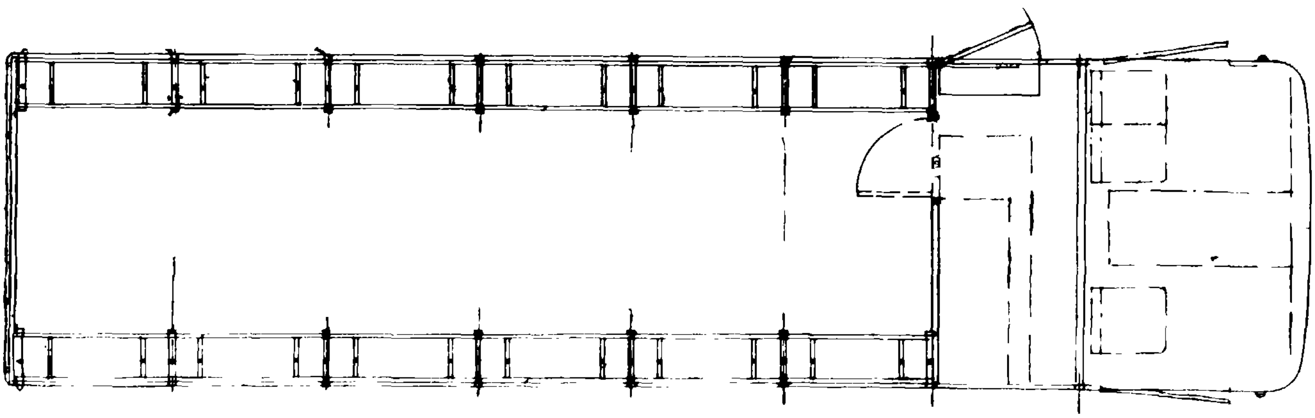


Plate XVI : Museobus Type II operating an exhibition inside a school campus. Note improved appearance and additional windows.

Museobus type III

Simultaneously with the planning of the Nehru Science Centre (NSC) at Bombay, it was felt that a mobile exhibition programme for the western region of India could be started with NSC, Bombay as the focal point. This was also an occasion when earlier designs could be reviewed. It was noticed that the museobus type I had a visitor movement area of 7925 mm × 1676 mm (312" × 66"), while the type II had a further restricted area of 6500 mm × 1676 mm (256" × 66"). The more popular the exhibition became the more visitors it attracted, and regulating the entry of visitors became difficult. Although visitors could stand in front of the exhibits on both sides back to back quite comfortably, whenever groups of 15 to 16 students were collected together for demonstrations of particular exhibits, viewing of the exhibits became extremely difficult (plate XVII). Research was therefore needed to produce a design whereby the exhibition area could be widened keeping in mind the limitations of length, breadth and height fixed under the regulations of the State Transport Authority. Ghose and Bhaumik at BITM, Calcutta, found that if the vehicle could be provided with a special mechanism by means of which the side walls could expand when required, interior space would correspondingly increase, and provide larger exhibition area. Since the cabinet housings were installed on both sides of the bus, the design provided for the entire set of housings being drawn out at the time of the exhibition, thus widening the visitor movement area. The Linder museobus introduced in France a few years ago, for carrying art materials, had a hydraulic arrangement by means of which the bus which was normally 2500 mm wide expanded to 7000 mm. This gave the visitor a sense of space and the area of 56 sq. metres was large enough to allow the paintings to be viewed from a distance. Unfortunately hydraulic operation would cost enormously in India, and would pose manufacturing difficulties. Accordingly a mechanical system, involving manual operation was developed. For implementing the design, the same type of chassis as in museobus type II was produced, namely, a Hindustan passenger coach chassis of a wheelbase of 5486 mm (216") with an overall length of 7544 mm (297") fitted with a Bedford diesel engine. The chassis was extended to the maximum permissible length of 9246 mm, and then the bed of the chassis was raised to eliminate the "hump". 14 nos. of cubicles were constructed over the chassis but each one was of a moveable type measuring 1829 mm × 1041 mm × 356 mm (72" × 41" × 14"). These cubicles, each for one pair of upper and lower exhibits, could be pushed

Plate XVII : Groups of children crowd round the exhibit making it difficult to carry on demonstration for all.

out individually (fig. 45). The housing cubicles were mounted on rollers so that they could easily slide (fig. 46 and fig. 47). Underneath each cubicle 14 pairs of rollers were fixed (fig. 48, fig. 49 and fig. 50) for facilitating movement. One pair of steel pipe prop was provided for supporting each extended cubicle so that the 14 cubicles with 28 exhibits were supported on 28 props. These props were like mechanical jacks. During exhibition the housings were manually pulled out (fig. 51) one by one, and the pulled out housings with exhibits were made to rest on these mechanical jacks which were normally folded while the vehicle was on the move and remained locked in position. The props or jacks were telescopic in nature, fitted with heavy duty spiral springs capable of being adjusted to different heights depending on the ground level. Where the ground was too uneven, metal plates were put underneath the jacks for levelling. While on the move the jacks could be folded and kept underneath the chassis in a locked position.

At the time of exhibitions, when the cubicles have been pulled out the overall width of the bus increased to 4115 mm from 2438 mm and the visitor movement area correspondingly increased to 7620 mm $\times$2438 mm, which represented much wider space than before. The exterior of the bus while the exhibition was in progress as also its interior could be seen from fig. 52, fig. 53 and fig. 54.

Inside the driver's cabin, in addition to the driver's adjustable seat, a double seat was provided for two more staff members (fig. 55 and fig. 56). By means of an interconnecting door between the exhibition area and the driver's cab frequent checking and inspection were possible because the electrical control board and fire fighting equipments

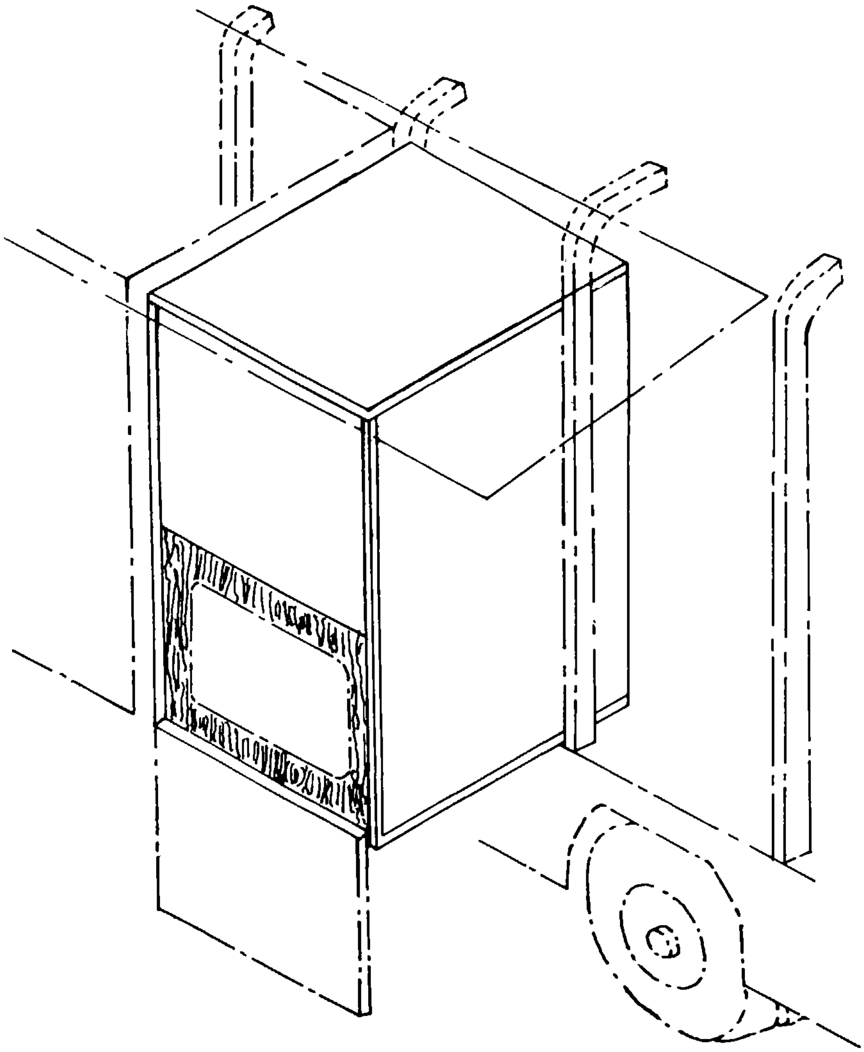


Fig. 45 Exhibit housing drawnout.

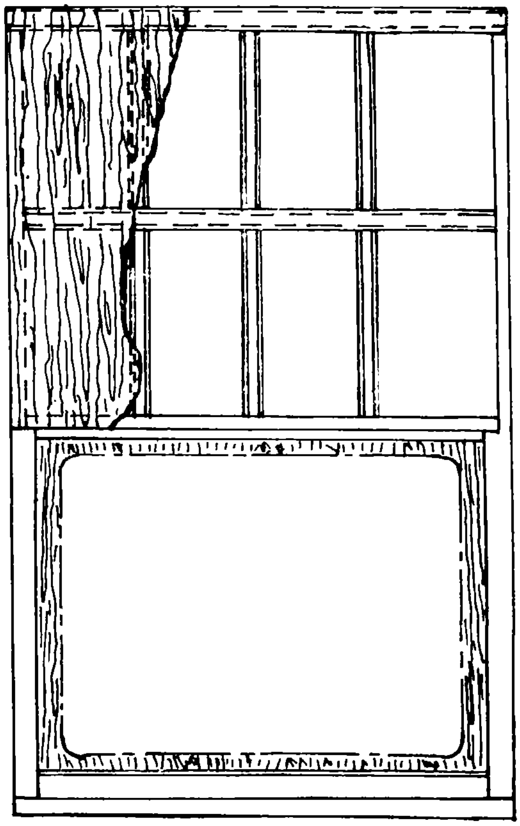
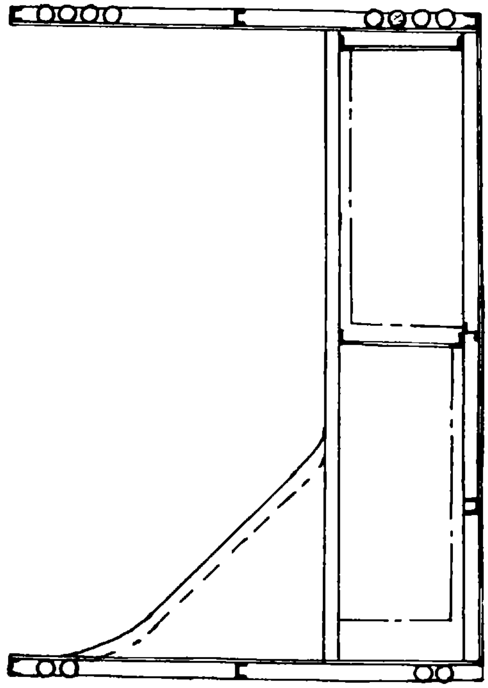


Fig. 46 Side view.

Fig. 47 Elevation.



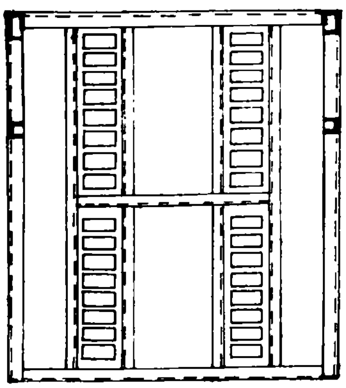
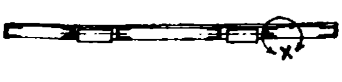


Fig. 48 Plan view.

Fig. 49 Rollers.



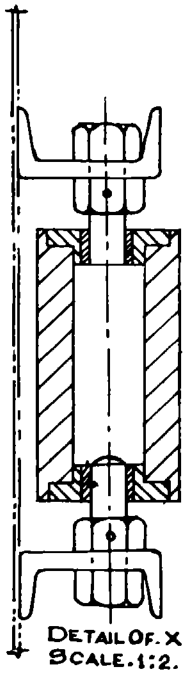


Fig. 50

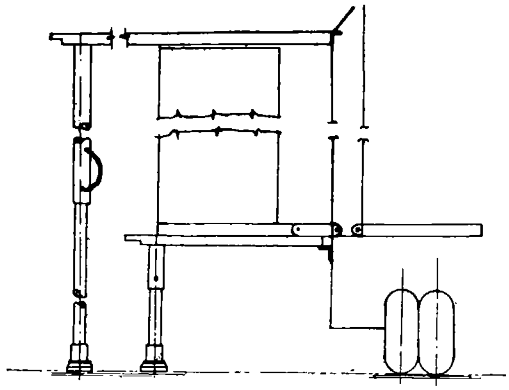


Fig.—51

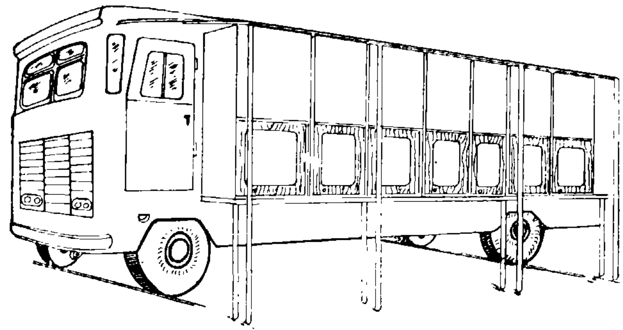


Fig.—54 Perspective view during exhibition.

were also located in the driver's cabin. The design introduced changes in the construction of window shutters for the exhibits facing the exterior of the museobus. The 3 window shutters for 7 windows on each side of the bus—the middle shutter covering 3 windows while the 2 others covered two windows each, were raised to a much greater height in order to facilitate pulling out the exhibit housing windows. These shutters were supported on long props instead of on collapsible brackets (plate XVIII and plate XIX).

The Museobus type III was inaugurated in October 1977 when it started on its journey to rural areas in Maharashtra State.

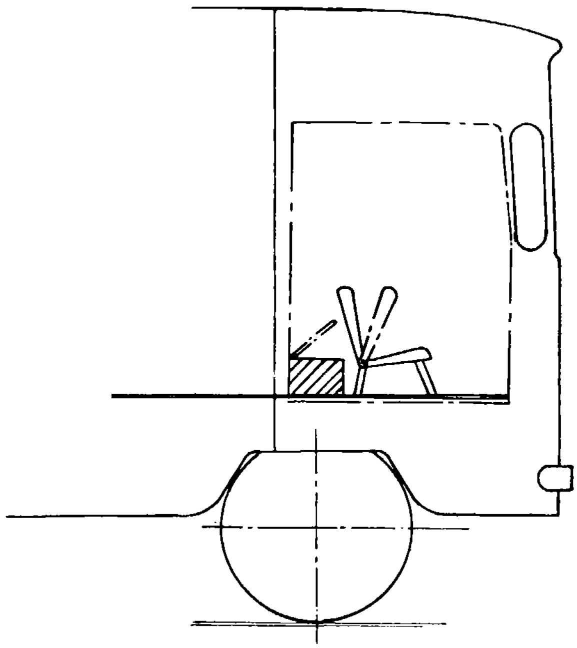


Fig.—55 Elevation showing driver's seat and tool box.

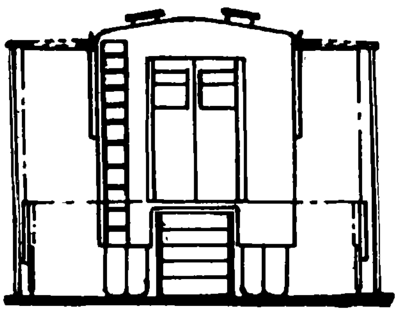
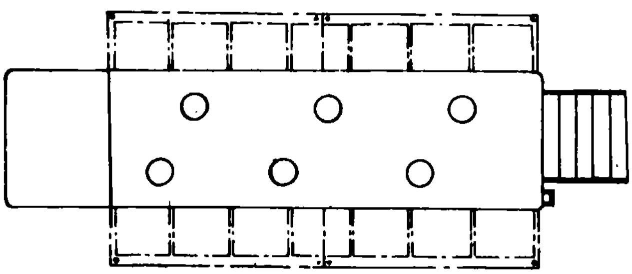


Fig.—52 Sectional rear view.

Fig.—53 Plan



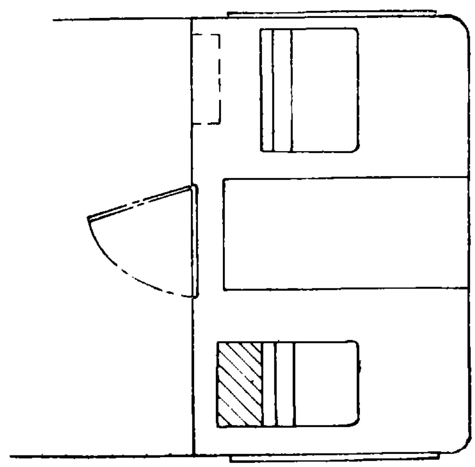


Fig.—56 Plan of Driver's cab with interconnecting door.

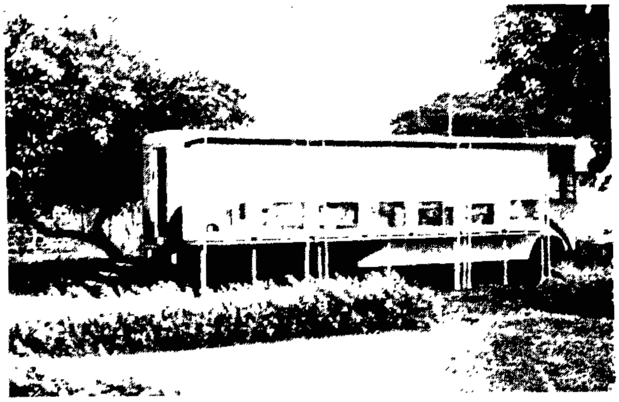


Plate XVIII : Props support pulled out exhibit housings. Window shutters are also supported on long props in Museobus type III.

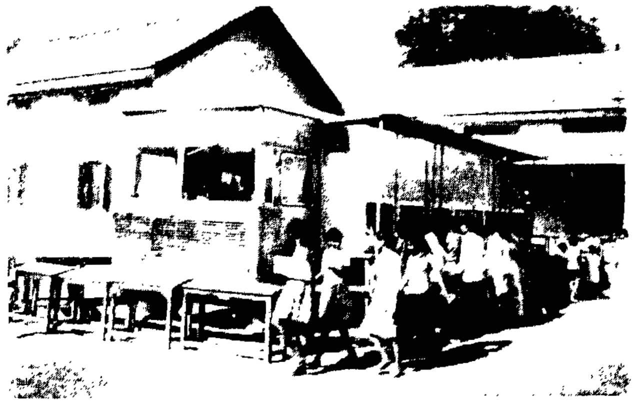


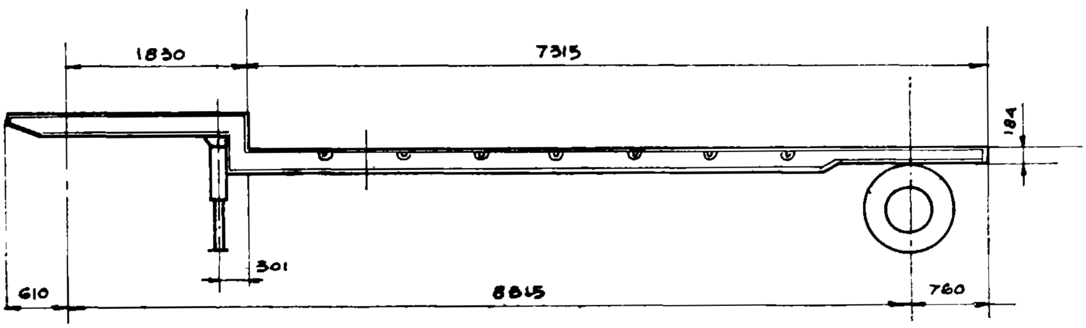
Plate XIX : Students going around Museobus type III, while school desks serve as a useful fencing.

Exhibition trailer and tractor (Type C)

Both the trailer-tractor units Type A & B, operated by the BITM, Calcutta and VITM, Bangalore, still needed improvement in their braking system. Although the tractor had its braking system for front and rear brakes simultaneously operated by a hydraulic master cylinder operation with air servo assistance, the trailer could only be slowed down with the help of the rigid frame of the tow bar attached to the trailer and finally could be parked by pulling the hand brake from the driver's cabin, which operated the mechanical parking brake system of the trailer. If the unit had been speeding when the brake was applied there could be always a chance of the trailer dashing against the tractor. (Of late it is understood the VITM trailer has been fitted with a braking system designed and fabricated at a fairly high cost.) Another drawback of these units had been that they could not be reversed. If it became necessary to reverse the trailer, which was frequently the case after entering a school compound, the practice was to disconnect the trailer from the tractor and manually turn round the former with the help of half a dozen people. This manoeuvre became particularly difficult when the ground was sloping.

R. M. Chakraborty and his co-workers at VITM, Bangalore investigated whether the trailer-truck articulated combination unit used for haulage of goods over long distances could be modified to suit exhibition requirements and succeeded in evolving a suitable design. A 10-ton semi-low-bed trailer manufactured by Mahindra Owen, was selected for conversion into an exhibition trailer (fig. 57 and fig. 58). The trailer was already

Fig.—57 Elevation



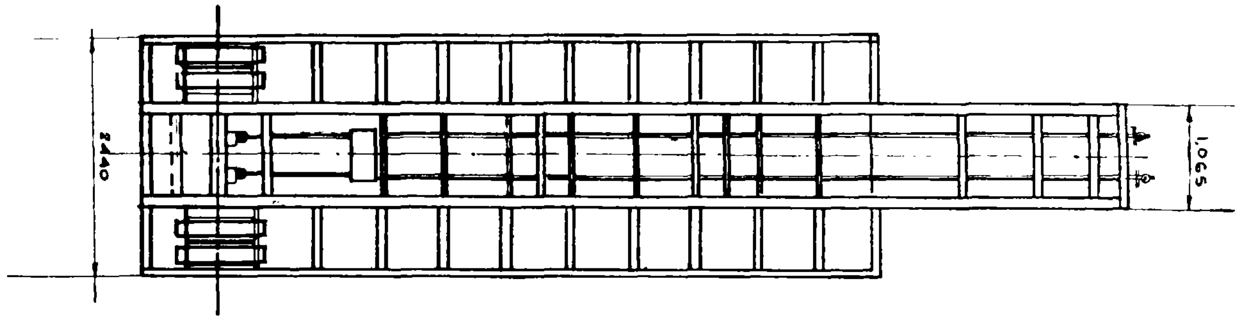


Fig. 58 Plan.

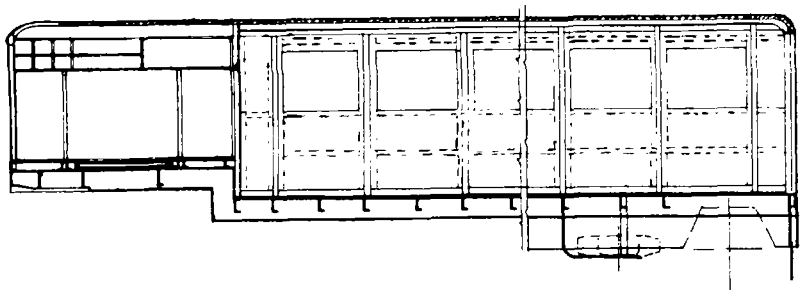


Fig. 59 Sectional elevation.

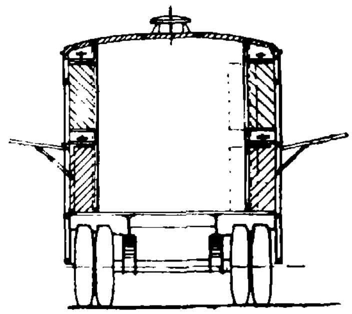


Fig. 60 Sectional rear view.

equipped with a pressure brake system which could be conveniently connected with the braking system of the truck with which it was going to be coupled. The trailer bed had two levels, the bed at the lower level having a length of 7315 mm was utilised for construction of exhibit housings, while the bed at the higher level, having a length of 2440 mm, was utilised for building the storage room for audio-visual equipment, generator, miscellaneous stores and accessories (fig. 59 and fig. 60). The design provided for the construction of 6 nos. of cubicles on each side of the chassis to accommodate 12 nos. of exhibit housings on the upper and lower levels making thereby a total of

Fig. 61 Elevation showing ventilation ducts.

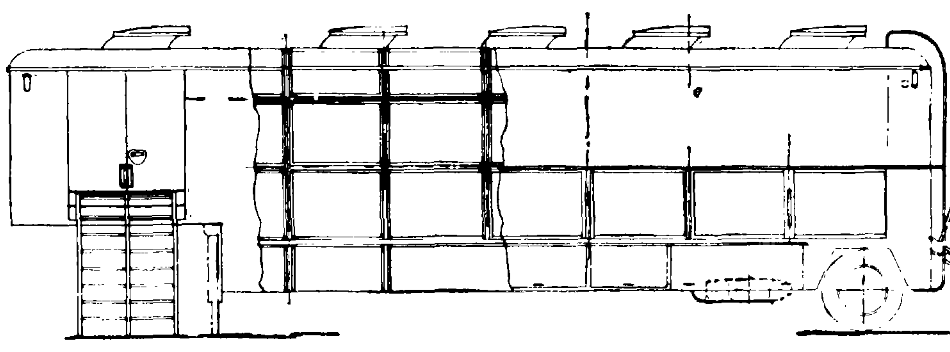
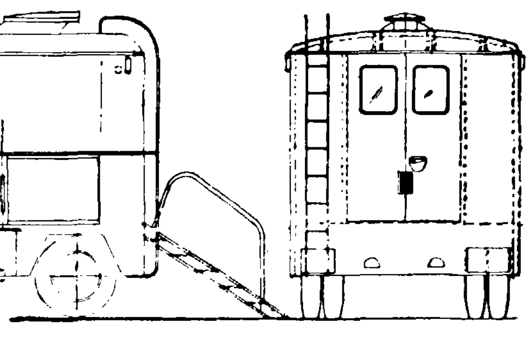


Fig. 62 Rear view.



24 exhibits, of which 12 could be viewed from inside and 12 from outside. In view of the restriction on the height of the finished trailer, the exhibition area had a height of 1996 mm (78"), while the height of the storage area was 1494 mm (59"). Separate entrances were designed for the exhibition area and the store which had their separate pairs of ladders (fig. 61 and fig. 62). The store was carefully designed with separate enclosures for audio-visual equipment and a mobile generator. Slotted angle racks were specially arranged for storing consumable items. Ventilation was provided by 5 nos. overhead domes, streamlined to look like a ship's funnel and those above the exhibition area had forced air 200 mm fans installed inside (fig. 63).

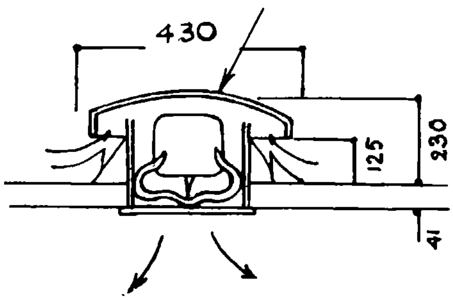


Fig. 63

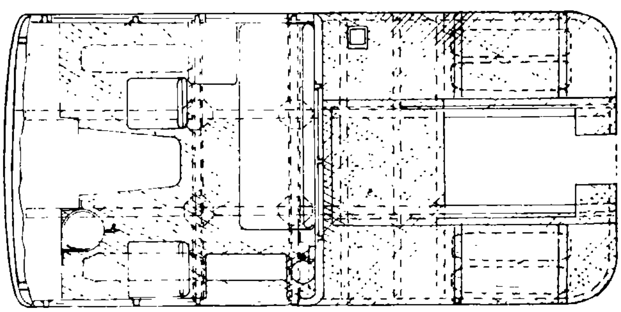


Fig. 64 Plan

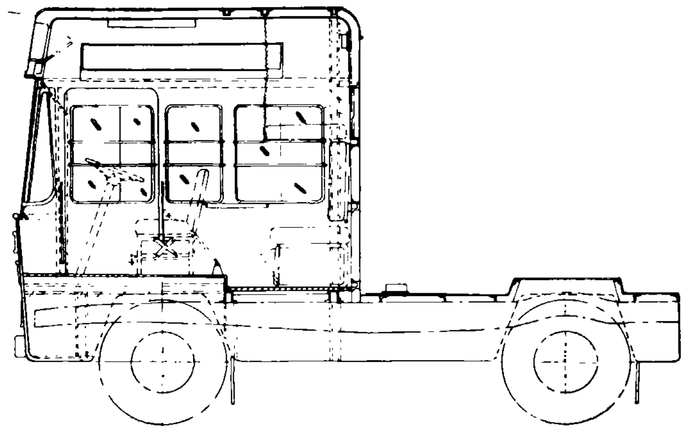
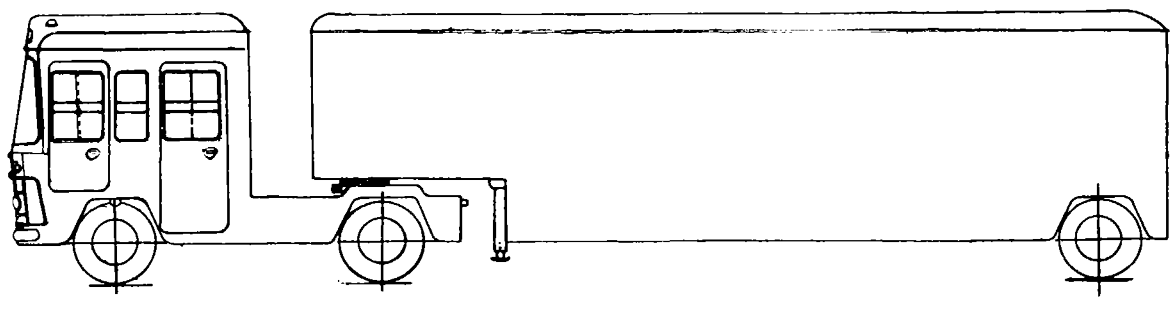


Fig. 65 Sectional elevation showing seating arrangement in driver's cab.

Fig. 66 Trailer mounted on the tractor.



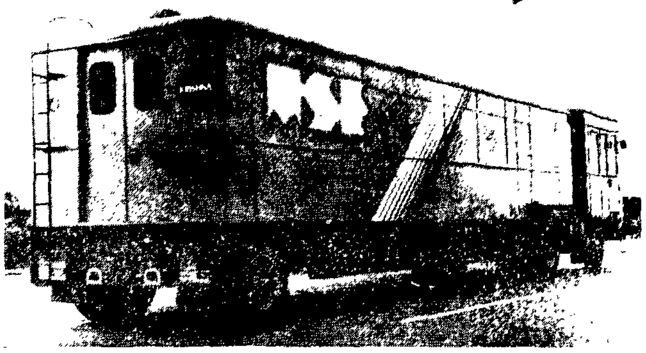


Plate XX : Articulated trailer-tractor on the road.

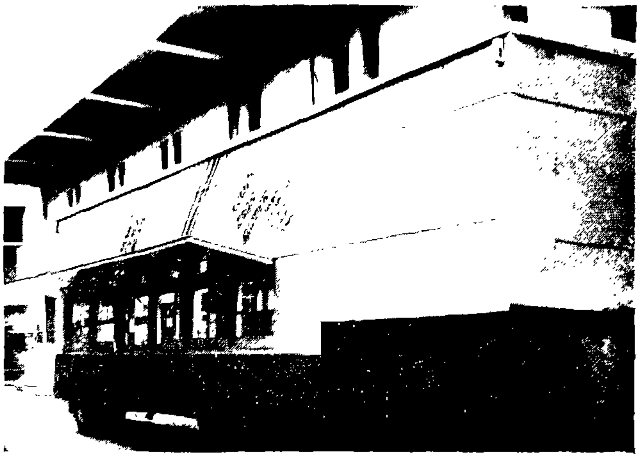


Plate XXI : Articulated trailer-tractor jacked up before exhibition. Storage area is on right.

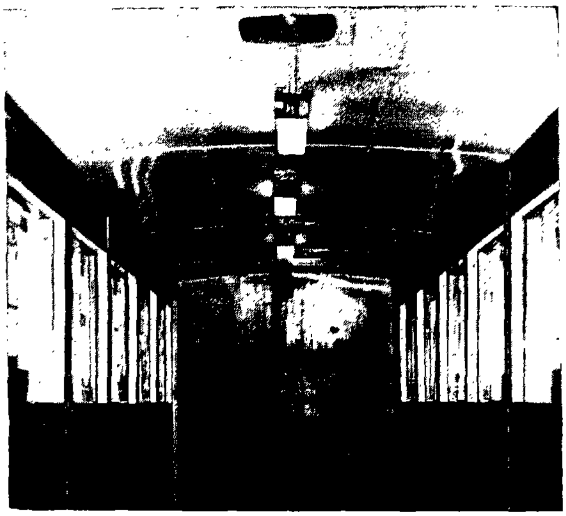


Plate XXII : Interior of type C unit with forced air fans and fluorescent light overhead.

The tractor chosen was a Hindustan J6 120" (3048 mm) wheel base diesel engine truck on the bed of which special arrangement was made for mounting the "fifth wheel" coupling of the Mahindra Owen tractor (fig. 64, fig. 65). At the rear of the driver's seat was designed a foam rubber cushioned seat with a foldable backrest for two more persons to sit. The back rest could be lifted up and hung from chains and the area converted into a two tier sleeper birth. A luggage cabinet was constructed on the upper portion of the driver's cab.

As soon as the articulated trailer-tractor reached (fig. 66 plate XX) the exhibition site, the trailer portion was jacked up and the tractor detached and withdrawn. The jacked up trailer was then ready for the exhibition (plates XXI, XXII, and XXIII). The tractor could thereafter be utilised to bring another trailer to some other exhibition site and thus the same tractor could be utilised for pulling a number of trailers and organising several exhibitions. The trailer-tractor articulated unit was also capable of turning within 330 degrees and could be reversed. Both these features are of great advantage from the operational point of view.

The very fact that six different designs have already been introduced and adapted in mobile exhibition units in the course of a few years, proves that possibilities exist in this field for further research and development.

Plate XXIII : Entrance to articulated trailer-tractor units.

Electrical requirements for exhibition vehicles

Electrical Control Circuits for exhibits

Electrical control circuit for Mobile Science Exhibition (MSE) are usually designed to extend the maximum facility to the visitor in understanding the message conveyed by the exhibit when he presses a simple push button or operates a rotary selector switch. These buttons or switches are affixed to the bottom part of the front frame of the exhibit cabinet. Control circuits and other gadgets required for the operation of the exhibit are placed at the back of the exhibit and are easily approachable by the attending technician. Time delay circuits are sometimes provided when the exhibit has sequential or repetitive operations or operations having movements of long durations. Small motors with reduction gear boxes are widely used in MSE exhibits. All the electrical components, lamps etc. used for control circuits are selected to withstand heavy jerks, heat, voltage fluctuations etc. Complicated circuits are generally avoided, so that repairing of the defective circuit may be done in remote and far away places.

Electrical control circuits using triacs, thyristors, IC'S, etc. are gradually replacing the conventional components like relays or selectors and attending technicians are now being trained to become familiar with the typical faults that may arise in the new system.

Illumination of exhibits

Since the inside length of a standard MSE cabinet is about 39" (990 mm), one 24" long, 20W tube light is usually fixed on the top lid of the cabinet for illumination of the exhibit. The top lid is fixed on hinges and can be easily opened or closed. The tube light is fixed on the front end of the lid, so that the display is uniformly illuminated, eliminating the possibility of formation of shadow due to projections. Other accessories, like choke, starter, p.f. capacitor, etc. are fitted in a specially made compartment on the top of the lid. The tube light remains hidden by the top portion of the front frame and is not visible from outside. The above arrangement is working satisfactorily since it is now possible to replace any defective component without removing the entire cabinet from its enclosure in a MSE bus.

In some exhibits (especially on optics) it may be necessary to switch off the light for illumination, so that the optical phenomenon or translites which are being displayed, may be seen more prominently. In such cases the front push button switch has a normally closed contact, which completes the lamp circuit. With the pressing of the switch, the lamp circuit is disconnected. In working exhibits with large control circuits, relays or precision switches are used to control the lights whenever necessary.

Mains supply connections to the exhibits

MSE exhibits are designed to operate on 230V.50 Hz. single phase supply. When a set of twenty-four exhibits are installed over stands, power supply for each exhibit is provided by the looping method, i.e., loop chords are used to interconnect the exhibits, and at one end mains supply is fed through a master fuse switch. Maximum power consumption in a MSE unit is around 1.5 KW.

In order to set up the entire exhibition within a very short time a special arrangement was evolved so that the loop connections could be made very quickly. Two 2 pin 230V.5 Amp plug sockets are fixed at the two ends of an MSE exhibit on the back side. The plug sockets are interconnected by a thick insulated wire clipped on the bottom board or on the back frame (fig. 67).

The electrical circuit of the particular exhibit, including tube lights, etc. is tapped from any one of the sockets through a fusing circuit. Similarly electrical circuits of other cabinets are interconnected by loop chords, which are usually 1m long thick well-insulated and sheathed flexible wire, with one 2 pin 230V.5 Amp plug top, fitted at each end. Twenty-three such loop chords are required to set up a set of twenty-four exhibits over stands, but two or three extra loop chords are supplied with the unit as a standby measure. In the MSE bus, each exhibit can be individually connected to the power sockets fitted on the side wall of the bus, by using the same loops.

To avoid sudden coming out of the plug sockets by accidental pull or by getting loose, a special spring clamp is fitted to hold the plug top firmly over the base.

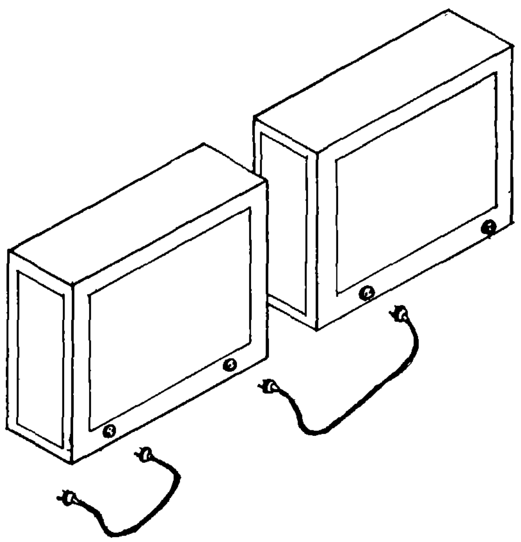


Fig. 67 Connection of plug sockets in M. S. E. exhibits

Electrical distribution circuits inside an MSE bus

Electrical distribution circuits inside the MSE bus are arranged on the basis of the following requirements:

1. Mains supply connection for the exhibits.
2. Mains supply connection for the exhaust and other fans for ventilation.
3. Separate sockets for operating film projectors, battery chargers etc.
4. Change over circuit for operating the electrical circuits from a Petrol/Diesel generating set in non-electrified areas.
5. Over voltage/under voltage protection circuits.
6. Master main switch board, with voltmeter and incoming power supply lines.

In an MSE bus, exhibits are arranged in four rows. Either six or seven exhibits are usually installed in each row. Three power supply boards with four 2 pin 230 V 5 Amp sockets in each board, are fitted on each side wall of the bus, so that four exhibits (two exhibits facing outside and two exhibits facing inside) can be fed from each board. Separate fusing circuits are provided for left and right rows, so that in case of any fault, the defective circuit can be quickly isolated and repaired.

Exhaust fans and other ventilating fans are provided with a separate switch. Some spare plug sockets are provided in a separate power board for operating film projectors, battery chargers, P.A. amplifiers, Radio sets, etc. Two lights connected to the battery circuit of the bus are used, whenever there is a sudden power failure. P.A. amplifiers also work from 12 V bus batteries, so that announcements can be made at any place or when the vehicle is on the move.

Use of Generating Set in non-electrified areas

In the non-electrified areas, power is drawn from a small petrol or diesel generating set. Initially one 1.5 KW petrol generating set was provided with each unit. But some disadvantages, like voltage fluctuation, poor voltage regulation, etc., had caused some problems in running the exhibitions. A special change over circuit had to be installed so that only two rows of exhibits received power at a time. This prevented overloading of the generator, but created difficulty for the visitors. However after the year 1971 small portable 2.5 KW diesel generating sets were procured and put in service with the mobile exhibition units. These generating sets could provide sufficient power for the entire unit and even the film projectors could be used without any difficulty.

Over voltage and under voltage trip circuits

In the rural electrified areas serious voltage fluctuations (sometimes in the order of 20% to 30%) affected the normal working of the exhibits. A special transformer (to be discussed later) with tappings for voltage correction, is used to overcome this problem. In low voltage areas tapping on the transformer is adjusted for a rise in output voltage. Similarly in high voltage areas it is also possible to step down the voltage. Now in order to prevent any mishandling or wrong adjustment of the tappings or sudden rise or fall in supply voltage levels, the over voltage and under voltage trip circuit disconnects the incoming line instantly without causing any damage to the exhibits. The tripping circuit can be switched to 'ON' state, only when the voltage level is set within 10% of the desired value. (This circuit is now being replaced by automatic voltage correction circuits).

Main incoming circuit

Main electrical incoming circuit in a bus is usually provided with a heavy combined isolating switch with fuses. A long PVC or rubber insulated and sheathed flexible wire (usually 50 meters long) capable of handling large current, interconnect the main switch in the bus and the actual supply mains through a transformer. A voltmeter is provided near the main switch, to check the voltage, before the tripping circuit (as discussed earlier) is set to 'ON' state.

Isolating transformer

Since the MSE bus remains isolated from the ground by its pneumatic tyres, any leakage or short from the electrical circuit with the bus body may be of danger to the visitors, who may touch the metallic parts, while operating the switches on the exhibits.

Since earthing of the entire bus body at every exhibition site is not practicable due to various difficulties, some alternative arrangement was thought of, to overcome the problem.

sible to overcome this problem (fig. 68). From the diagram it may be seen that the transformer has two windings. The primary winding has some tappings while the secondary winding is completely isolated from the primary and the metal casing. The whole transformer is fitted inside a well ventilated enclosure. A short lead is provided on the primary side, which prevents the transformer being placed inside the bus by mistake. The transformer is placed near the mains supply socket and the long cable from the bus is directly connected to the secondary.

The transformer is called an isolating transformer since it isolates the incoming and outgoing circuits, while the transformer transfers full power by the normal induction process. Isolating transformers are provided with a voltmeter which is connected across the secondary winding. This helps to adjust the tapping for proper output voltage.

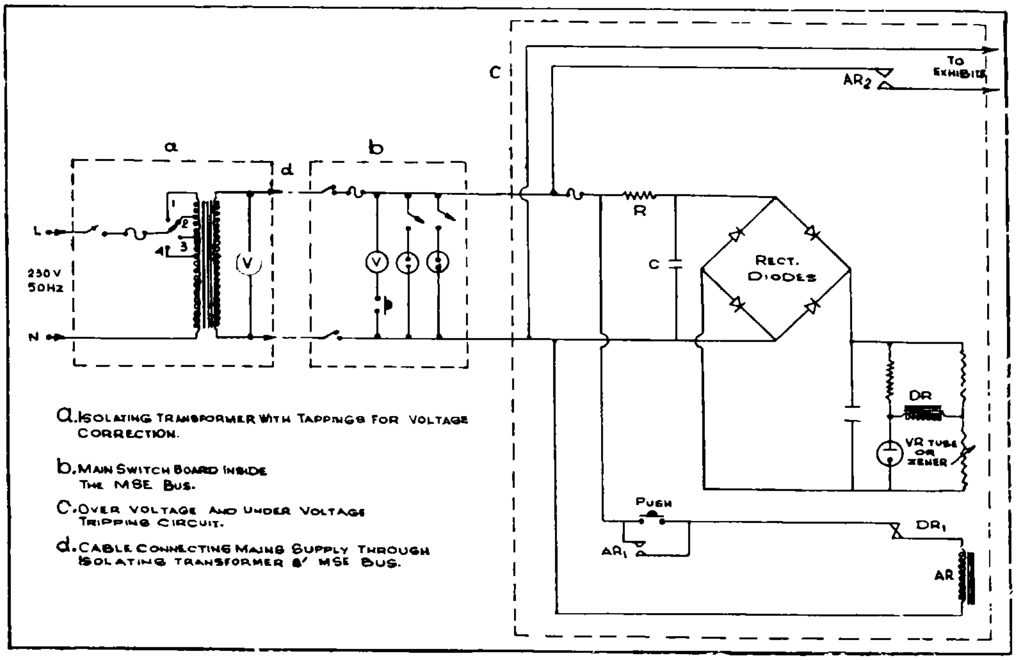


Fig. 68 Circuit diagram of power supply system.

In single phase AC power supply system one of the wires is 'live' with respect to the ground, since the other wire is connected to neutral or ground potential. If the 'live' side of the electrical line accidentally touches the metallic parts of the bus body, then persons standing on the ground may receive electrical shock, if they touch the bus body. Now if both supply lines can be isolated from the ground by some device it becomes pos-

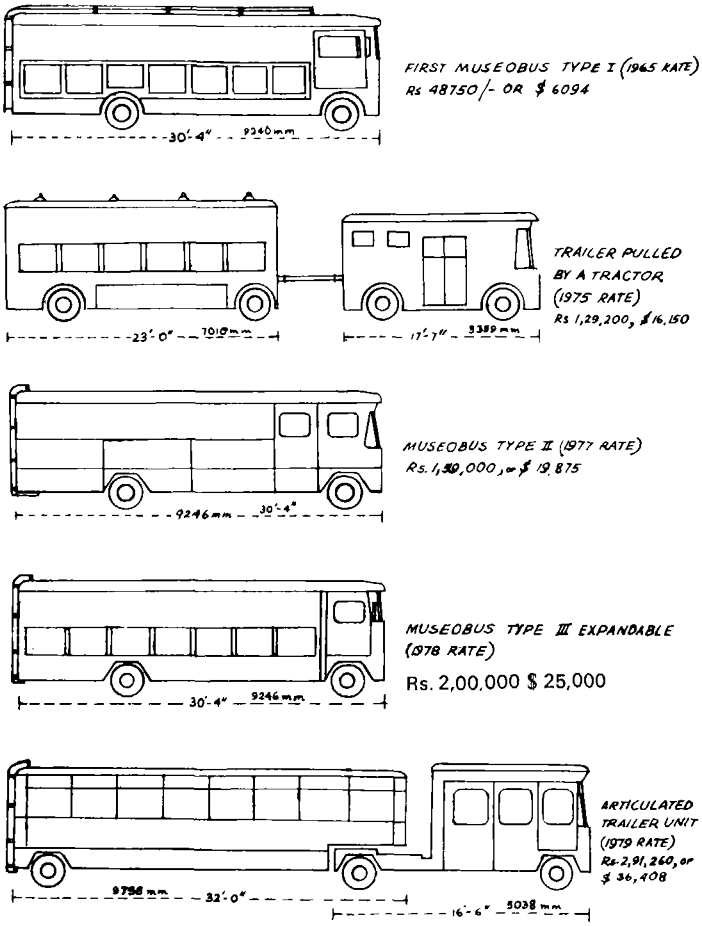
Line voltage can be adjusted by controlling the four position selector switch which selects the tappings on the primary of the isolating transformer. Usually tappings are provided for adjusting line voltages from 170 V to 260 V in four steps to maintain the output voltage at 230 V $\pm$ 10%.

Capacity of power handling of these transformers are generally 1.5 KVA and 2 KVA. Both the types are now in use with MSE units, depending on actual power consumption of the unit.

Ventilation inside MSE bus

Exhibits of the mobile exhibition units are placed in two types of vehicles. 1) the Museobus and 2) the trailer and tractor. In the Museobus, there is only one passage for entry and exit for the visitors. To lessen stuffy atmosphere inside the bus, one exhaust fan (10" dia axial flow fan) had been placed centrally, while several blowers with rubber blades were fixed on the side panels covering the exhibits. But due to noise, small fans were replaced by 'Cabin' type fans which were placed between the exhibition space and the driver's cab, so that some fresh air could be blown inside. The trailer had two separate passages for entry and exit. Two exhaust fans and two intake fans fitted on its roof were found to be sufficient. A large amount of fresh air could enter the bus, from the two passages. In the Museobus type II three low noise fresh air intake fans have been fitted in the exhibition space. In sultry summer weather, visitors feel more comfortable, when fresh air is blown inside the bus.

CAPITAL EXPENDITURE ON MOBILE MUSEUM VEHICLES



Capital expenditure on mobile units

It will be difficult to compare the cost of different units so far designed and fabricated as the units were commissioned at different periods of time extending from 1966 to 1980 and over the years there had been tremendous escalation of prices. For that reason along with the cost price is also indicated the year of fabrication. The capital expenditure shown in the chart includes the cost of new chassis, construction of the shell, panelling and woodwork, ventilation arrangements, general illumination, painting, decorating and upholstry. It however does not include the cost of cabinets, the exhibits inside the cabinet, installation and individual wiring. Development of new exhibits is a laborious process involving great deal of research and designing, which will be explained in subsequent chapters. For computation of price of exhibits, it will be certainly difficult to estimate the time spent by the curators and exhibition officers in research and design although it is realized that this item should be a part of overhead. For all practical purposes it can be said that for producing 24 exhibits with cabinets it had cost in 1980 about Rs. 70,000 or U.S. dollar 8750.

Chapter VI

EXHIBITS FOR MOBILE EXHIBITIONS

Choosing a theme

Originally when the travelling or mobile science exhibitions were introduced the beneficiaries had been mainly the student community since the exhibitions were held either inside the school rooms or inside the school campus. Hence while choosing an appropriate theme for the exhibition, its relevance to the student community was foremost in the mind of the organizers. In consultation with the Headmasters' Association, the subject of the first exhibition was therefore chosen as "Our familiar electricity", the contents of which were based on the higher secondary school curriculum on "Electricity and Magnetism". It was followed by the second exhibition, entitled "Transformation of Energy". This exhibition portrayed the sun as the primary source of energy and all planets revolving around the sun bound by a force of attraction. It showed that the sun acts as a big pump and evaporates water from the ocean which forms into clouds, and then returns as rain back to the earth. It also showed that flowing water from springs had energy that drives water wheels which turn the grinding wheels, grinding wheat into flour. The analogy is drawn with the dams which in modern times perform similar functions and help in rotating the turbine which in turn rotates a generator and produce electricity. With the help of other operating models was explained how power from nature was harnessed to produce energy and how such energy could be transformed to different uses. A third and a fourth exhibitions were developed on the themes "The science of motion" and "Light and Sight". The last named exhibition explained with 24 attractive demonstrations, the science of optics being a part of the curriculum in physics for the secondary schools in India. The Headmasters' Association at Calcutta and Bangalore had frequent meetings with the science museum authorities and out of such meetings would emerge useful ideas and suggestions that were utilised in developing new themes for exhibition. The result was that whenever the mobile exhibition unit would visit schools, students would simply flock together to attend the exhibition as difficult principles of mechanics, optics, electricity, heat would be explained through interesting experiments.

In course of time the science museums/centres constituted scientific advisory committees with the help of school teachers, college professors, social workers, designers and engineers who could advise on suitable themes having wide impact on the life of the common man.

One such theme was "Water—the fountain of life", which stressed the importance of water in everyday life, and its physical, chemical and biological aspects. The title of some of the exhibits and their short description in the labels will give an idea about the nature of the exhibition.

1. *Water Water Everywhere !*

Life cannot exist without water. 65% of the weight of the human body is only water. As the body utilises water regularly for its activities, constant replenishment of water is absolutely essential.

Percentage of water

Human Body	: 65	Pea Weevil	: 48
Sunflower Seed	: 5	Rat	: 65
Corn Kernel	: 70	Chicken	: 74
Tomato	: 95	Fish	: 67
		Frog	: 78
		Earthworm	: 80

2. *How to utilise stored water ?*

Contrary to popular belief, water is rarely present underground as a pool or stream. Mostly underground water is only in the form of water filling the pores or cracks in the rocks. The top of the zone in which all the rocks are saturated with water is known as the 'water table'. Any well that is dug below the water table is most likely to have water.

3. *Life in a drop of water*

How interesting a drop of pond water may look when it is viewed after being magnified by the "Micro-projector". The floating and drifting creatures and plants are collectively called "Planktons".

4. *Drinking water should be purified*

In the towns and cities the natural water supply is invariably purified to remove impurities and bacteria. Several steps are required for the purification. Firstly, chlorine gas is passed through water to kill bacteria. Thereafter suspended impurities are removed by precipitating them with alum. Finally the water is filtered in large sand and gravel beds and collected in reservoirs for distribution.

5. *Irrigate your field by Siphon*

The Siphon is a bent tube used for continuously transferring water from a higher to a lower level. If the bent tube is initially filled with water, the water will continue to flow down as long as the discharge end of the tube is below the level of water. The Siphon method of irrigation is suitable when water from fields at a higher level cannot be led into a field at a lower level by cutting trenches.

6. *When to use a sprinkler system ?*

Irrigation by sprinkler is well suited for cultivators whose lands are highly undulating and therefore expensive to level. Also, it avoids damage to top soil and there is economy in the use of water. As long as water escapes from the bent nozzle with force, the sprinkler will automatically rotate in an opposite direction.

7. *Know These Living Organisms*

Some of the diseases which are dangerous to life are caused by minute disease carrying organisms known as bacteria. Cholera, which is a deadly disease may originate from unclean water and can be seen when magnified about 1500 times by the microscope.

8. *What is Water*

Water is a simple chemical compound made up of gaseous oxygen and hydrogen. Although normally water is very stable, it can be split into oxygen and hydrogen by passing an electric current through it.

9. *Use Canal System of Irrigation*

Flowing water from rivers can be stored by constructing a dam. When required the water can be fed to the fields by sloping channels for irrigation purposes.

10. *See how Plants Drink Water*

Plants make their own food from soil, water and air. The water is absorbed through the fine root hairs underground and travels upward through the stem. A similar example is the drawing of oil through a wick in a cooking stove, which is known as capillary action.

The exhibition which was inaugurated in Southern India (In Karnataka State) became extremely popular with the common man, and besides students, thousands of villagers used to come from distant places to see and enjoy the exhibition.

Another exhibition theme suggested at the meeting of the Scientific Advisory Committee of VITM, Bangalore was that on "Man must Measure". This exhibition highlighted the importance of 'Measurement' in trade, industry and everyday life. The various units of measurement were also explained. There were 24 exhibits ; a short description of some of the exhibits are as follows :

1. *Rain, Rain, Come Again*

Rainfall in a particular region determines the kind of farming and general weather condition. The rain gauge collects water in a cylindrical container which is poured later into a standard measuring glass. The height of the water indicates the total rainfall in millimeters.

2. *Make Things Level*

The plumbline is a cord with a conical metal weight used commonly by the mason to check during construction whether the wall is vertical. Whether a surface is even is checked by spirit level by bringing the air bubble to the mid-point of a tube.

3. *Is it too Windy ?*

The motion of air parallel to the surface of the earth is called wind. It is always described by its speed and direction. The weather cock indicates the direction of wind, whereas the cup anemometer measures its velocity in kilometers per hour. The average reading of the counter for a period gives the wind velocity during that time.

4. *Telling the Time*

Ancient people used to measure the passing of time by the sand hour glass, the sun-dial, the candle clock and the water clock. The modern time keeping devices such as the Pendulum clock, the Electric clock, and the Automatic clock tell time in seconds, minutes and hours.

5. *What is K.W.H. ?*

The electrical energy consumed by appliances is measured by the Kilowatt hour meter. 1000 watts of power when consumed for 1 hour. becomes one Kilowatt hour. The appliance shown tells how much K.W.H. is consumed.

The Scientific Advisory Committee of BITM, Calcutta suggested a theme on "Agriculture" and advised that the exhibition be held near the offices of the District Agricultural Officers so that they in turn could arrange demonstration of tractors, seed multiplication, soil testing etc. along with the exhibition. The aim of the exhibition was to stress that since food scarcity was increasing along with the growth of population it was essential to raise more crops. Since the available cultivable land was limited it was necessary to adopt improved techniques of cultivation, preservation, pest control, etc. The cultivator thus gets an idea as to how science and technology could improve the output of his land and help to raise his standard of life.

From concept to production of exhibits

The theme of an exhibition is usually chosen after an interaction between the museum's director/ curator and its scientific advisory committee. The interest of the users, the objectives to be preached and the various messages to be conveyed are the guiding factors. Having reached a tentative decision with regard to the theme and after receiving the green signal of the management committee, the curator starts an extensive study of the subject and sets up a small committee of experts to guide him in planning the different exhibits. An exhibition is primarily meant for a certain category of clientele, although it can be seen by one and all. For example, the exhibition on "Agriculture" was mainly for the agriculturists. The exhibition on "Know Mechanisms around you" (displayed by BITM, at Moscow in 1982) is aimed mostly for the technicians and artisans. The curator, in planning the details of the exhibits, takes this factor into consideration and then makes a list of exhibits and prepares their titles and a short description about their contents. Often he has to visit a few rural areas to gain a first hand experience regarding the people to be served and their habits and customs. Although a mobile exhibition unit carries 24 or 28 exhibits, a few more exhibits are kept ready in case of urgent replacements, in case there is damage or when an exhibit does not produce the desired impact. The contents of the exhibits are referred to the expert committee who may suggest improvements or modifications. When the exhibition on "Agriculture" was being planned the expert committee comprised the Vice-Chancellor of the local agriculture university, a professor of agriculture, a representative of the Director of Agriculture, a district agricultural extension officer and other specialists and their suggestions were invaluable. Similarly the expert committee set up for planning an exhibition entitled "Man Must Measure" included representatives of the departments of Meteorology. Weights and Measures, Indian Standards Institution, industrialists, manufacturers and physicists.

After the contents of exhibits are finalised, the Curator produces a rough sketch to give an idea about the exhibit, taking into consideration the functional and scientific aspect fo the exhibit and the limitation with regard to the size of the cabinet. The first concept of the exhibit on the title "Is it too windy" which is a part of the theme "Man Must Measure" is shown in fig. 69.

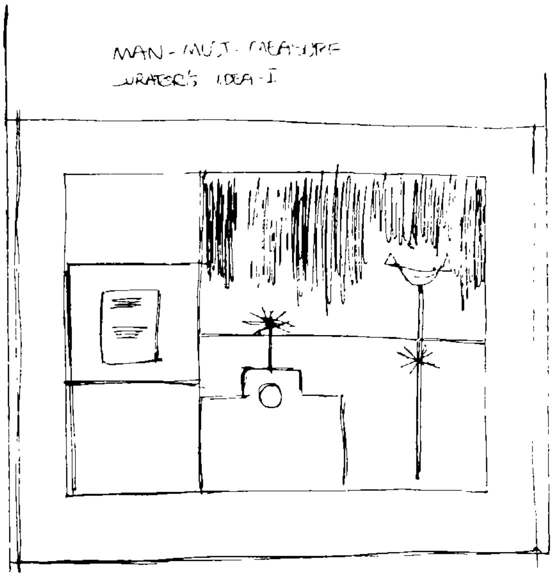


Fig. 69

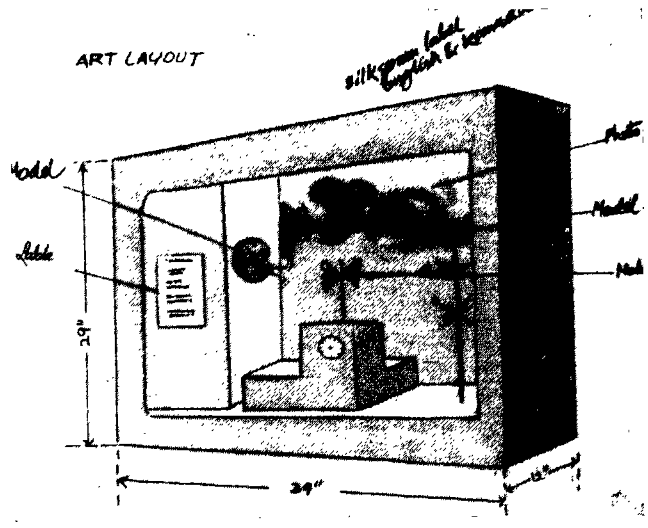


Plate XXIV : Graphics prepared before fabrication of exhibit "Is it too Windy".

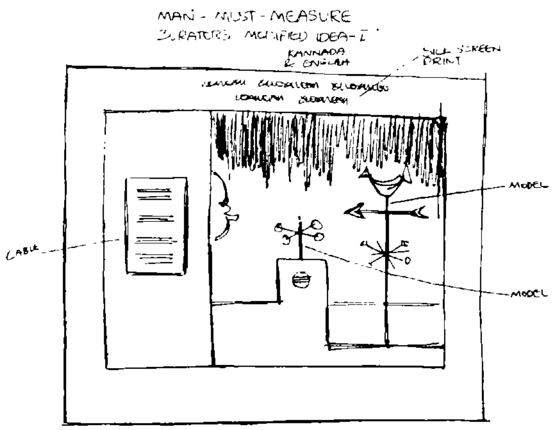


Fig. 70

This concept is placed in a departmental meeting convened by the curator with the Exhibition Officer and his colleagues in the Art & Modelling studio, and the curator presents his idea about the exhibit and its functional aspect and invites interactions. A more realistic and practical concept is thereafter evolved and a modified sketch is prepared (fig. 70). The studio starts work on this modified sketch and prepares a graphics with colour layout (plate XXIV). A card board dummy is thereafter made based on the graphics in 1: 5 scale. The entire production staff, consisting of the mechanical engineer, the electrical engineer,

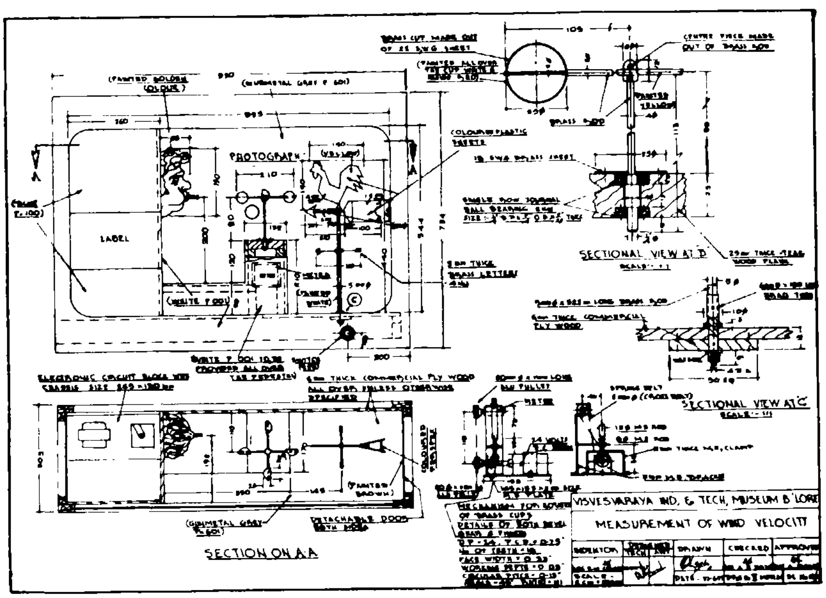


Plate XXV : Engineering drawing.

the Exhibition Officer and the artists and modellers meet together, along with the Curator to scrutinise the dummy and make suggestions or modifications from their own standpoints and the exhibit is cleared for fabrication. The next step consists in preparing a complete engineering drawing (plate XXV). On the basis of the drawing the exhibit is produced either in the museum's workshop or contracted to a firm of model makers. The fabricated exhibit entitled "Is it too windy" is now ready to be fitted in the mobile unit (plate XXVI). The function of this particular exhibit is to portray how a weather cock indicates the wind direction and how an anemometer measures the speed of the wind. To simulate stormy weather, a gush of air comes out of the nozzle as soon as the push button is pressed and as much realism is introduced as possible by painting a background of stormy sky. A great deal of attention is given to the finished exhibit so as to make it very colourful and simple; in this way it would appeal more to the layman. The mechanical parts are made rugged so as to withstand jerks and jolts and the electrical circuits are made as simple as possible for easy repair and maintenance. To reduce the weight of the exhibit plywood is used in construction in place of sized wood. When it is desired to construct a topographical model, for example, a hilly terrain or a canal, instead of plaster of paris, fibre glass is used to reduce weight and also to make the model water-proof. Where water or any other fluid is used in demonstration, the liquid is invariably pumped out to prevent spillage during transit and stored in cans and poured in the proper place at the time of exhibition.

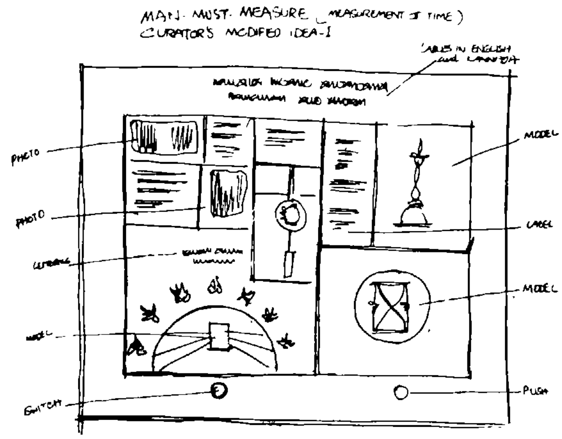


Plate XXVII

The development of another exhibit entitled "Telling the time" described in page 70, is shown through the various steps of (a) curator's idea, (b) curator's modified idea, (c) graphics (d) engineering drawing and (e) finalised exhibit (plate XXVII, XXVIII, XXIX, XXX and XXXI).

Plate XXVI : Final exhibit made ready for the travelling unit.

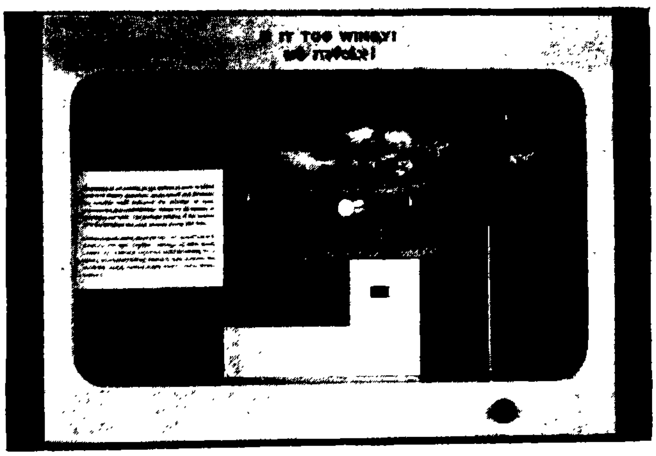
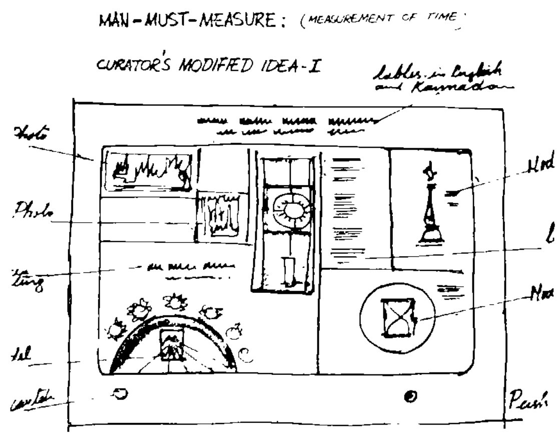


Plate XXVIII



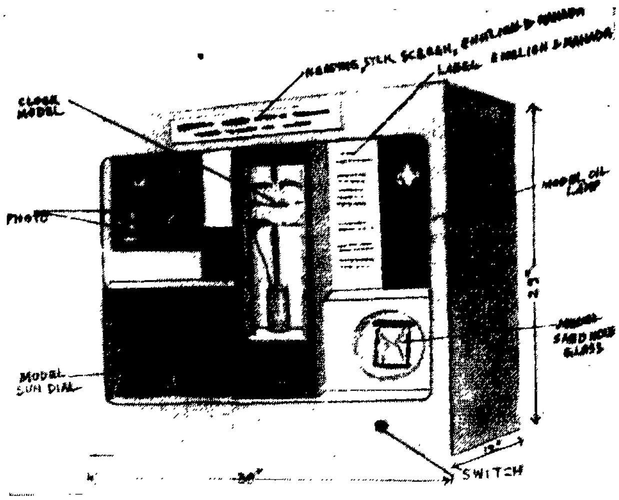
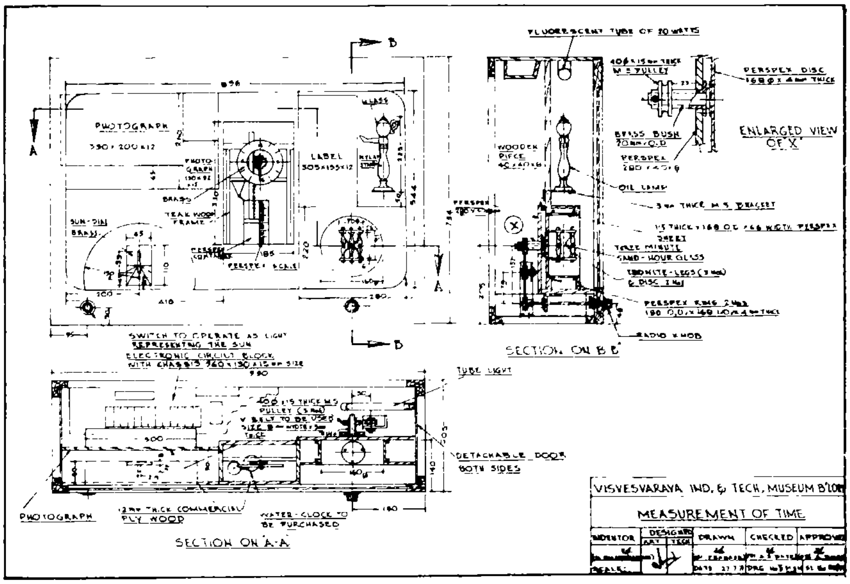


Plate XXIX : Graphics prepared before fabrication of exhibit "Telling the time".

Plate XXX : Engineering drawing.



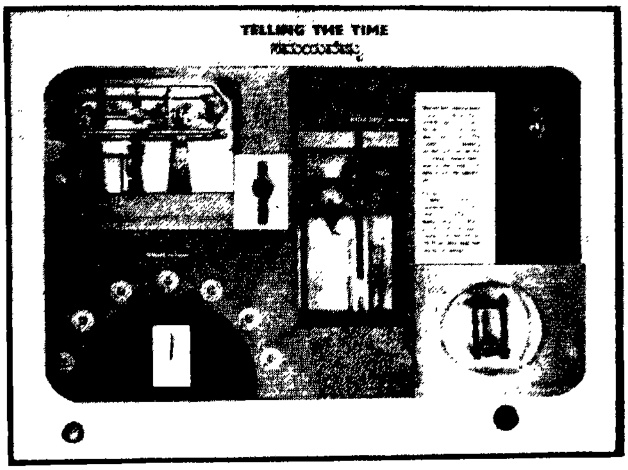
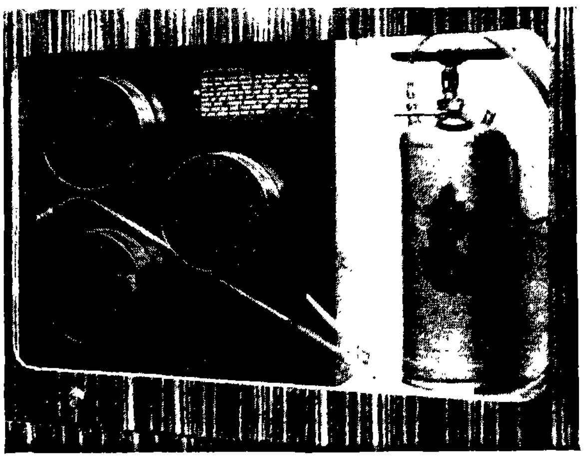


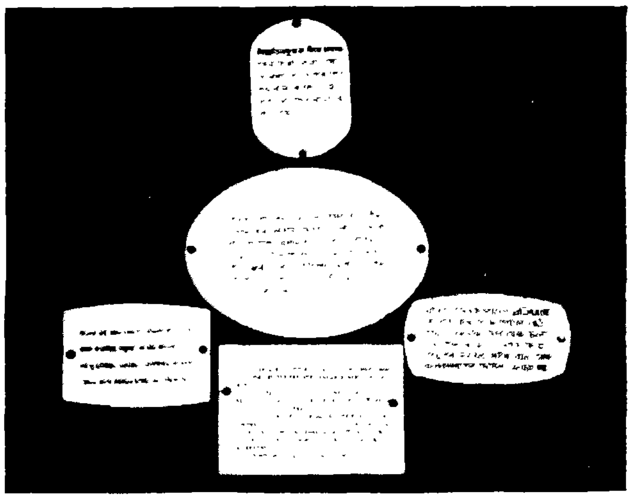
Plate XXXI : Final exhibit made ready for the travelling unit.

Labels for Exhibits

The preparation of descriptive labels for portable type of exhibits used in travelling or mobile exhibitions needs special mention. An exhibit displayed in a permanent museum has its title, its description and its mode of operation (if it is a working model) written on the background panel or on the cabinet frame. The written matter is of a permanent nature, inscribed by means of silk screen or type setting or by the artist's brush. The labels for portable exhibits are made differently. As the mobile exhibition unit travels through different states of India, having their individual languages, the labels are always written in a number of languages on small detachable masonite or plywood boards to be screwed at fixed positions of the exhibit housing (plate XXXII). These boards are of square, rectangular or oval shape (plate XXXIII), and a complete set of captions for all 24 or 28 exhibits in different languages of the operating zone are kept with the team. As soon as the state boundary is crossed and a separate language zone approaches, the team members get busy in replacing the labels already fixed, with another set written in the appropriate language.



Plate—XXXII : Labels written on detachable boards to be screwed on later.



Plate—XXXIII : Boards in different languages of the zone, are kept ready in proper size.

Chapter VII

DYNAMICS OF OPERATION

Introduction

Organising an exhibition for the urban and rural population in a developing country such as India, presents unique problems which are seldom faced in a developed country in the West. In a developing country science exhibitions are always treated as a social obligation of the museum/centre organizing the exhibition so that not only the venue, the itinerary and the timings are to be decided by the organizer but also the role of exhibitor is played by the same institution at the exhibition site—the receiving institution only offering facilities for stationing the van and offering co-operation in sending visitors. The sites where exhibitions can be held require selection. These should be easily approachable from the highway, should be wide enough for the movement of a heavy transport vehicle and the surface of the road strong enough to bear the weight of the vehicle. The sites have to be in a central area of the town or village so that village people and school students can easily reach them. An open area is normally required for stationing the van—an area which is big enough for regulating crowds, surrounded by fencing or boundary walls so as to provide safety. From experience it has been found that usually schools in urban and rural areas can meet most of these requirements. The schools have usually play grounds which are ideal for the exhibition and the walls round the campus offer protection to the vehicle and its expensive exhibits and equipment. Another advantage in locating the van inside the school campus is that the students get an opportunity to visit the exhibition usually during school hours and on returning home they will persuade their parents and relations to visit the exhibition in the evening. In India, in rural area during festival times, one comes across village fairs, cattle shows, carnivals, krishimelas (agricultural fairs), where hundreds and thousands of villagers congregate and people from adjoining villages also participate. Such sites are ideal locations for science exhibitions on topics relating to social science and hygiene. The other alternative sites are open grounds near the office of the Sub-divisional officers or Block Development Officers, who are the state officials in charge of the sub-division or block (the smallest unit in the state hierarchy). A mobile science exhibition on "Agriculture" was organised in a similar location in West Bengal, where the support of the District Agriculture Officer was also mobilised in organizing actual demonstrations on application of fertilizers, pesticides etc. The campuses of district museums, district libraries, town halls are also suitable for locating exhibition vans as these are well frequented places.

Selection of operational Zones

A successful handling of the mobile exhibition project will require the establishment of a headquarters organisation from where control can be exercised on the operation of the exhibition unit, the programming of schedules, the servicing of exhibits, the routine maintenance of vehicles, the periodic replacement of crew members, the sending of emergency relief, and finally disbursement of funds and their accounting. It is for this reason the headquarters has to be set up in one of the various established science museums/centres in India. India is a vast country covering an area of 3,267,500 sq.km. the distance between the north and the south extremities measures 3220 km. and that between the east and west measures 2977 km. It will not be practical to set up one central organization anywhere in India which can serve as the operational headquarters, rather it will be desirable to ensure that at no stage the exhibition unit is more than 500 km. away from its base. This ideal system could not be achieved so far due to lack of an adequate number of science museums/centres (fig. 70A). As matters stand at present, the BITM, Calcutta, is responsible for the operation of the mobile unit in the eastern and northeastern part of India, comprising the states of Bihar, Orissa, West Bengal, Assam, Meghalaya, Nagaland, Tripura, Mizoram, Arunachal and Manipur (fig. 71). The VITM, Bangalore, which is located in the South of India, can handle the mobile unit in the 4 southern states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (fig. 72), while the NSC, Bombay, which is located in the west coast of India, has taken charge of the exhibition unit in the states of Maharashtra and Gujarat (fig. 73). A large part of northern India, comprising the states of Madhya Pradesh, Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Rajasthan, Jammu and Kashmir are yet to be covered. In course of time, when a new science centre at New Delhi will be established, it might be possible to run mobile science exhibition programme for some zones of the nothern states. But to implement fully the Zonal system of operation a few more science museums/centres would have to be set up, which could serve as zonal headquarters for the exhibition units.

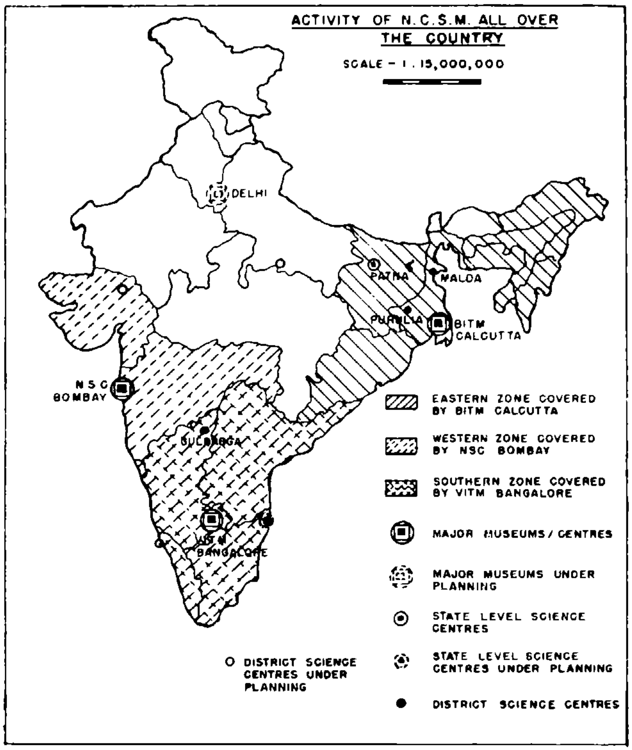
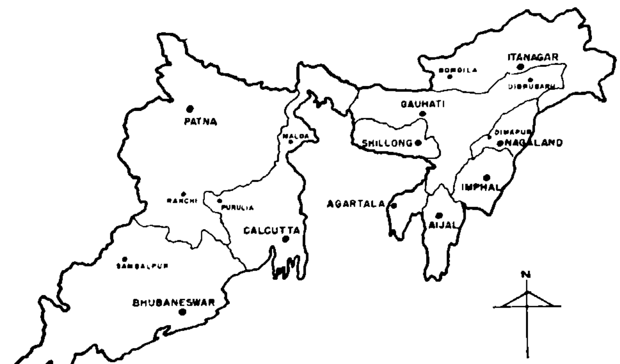


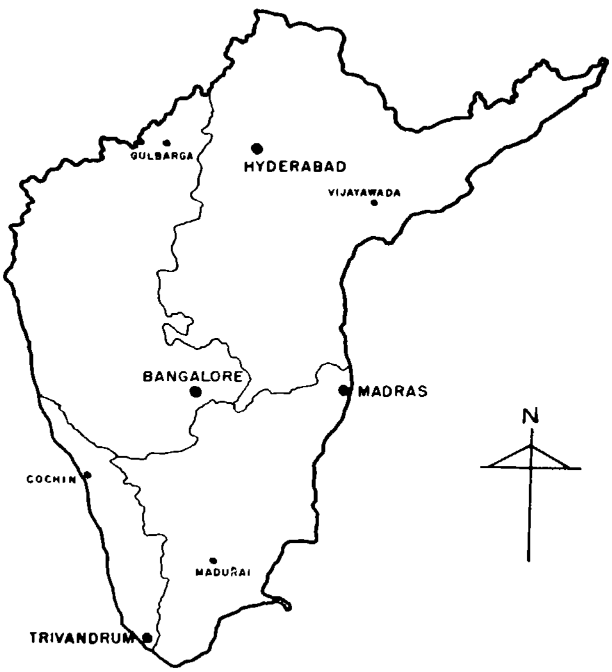
Fig. 70A

Fig. 71

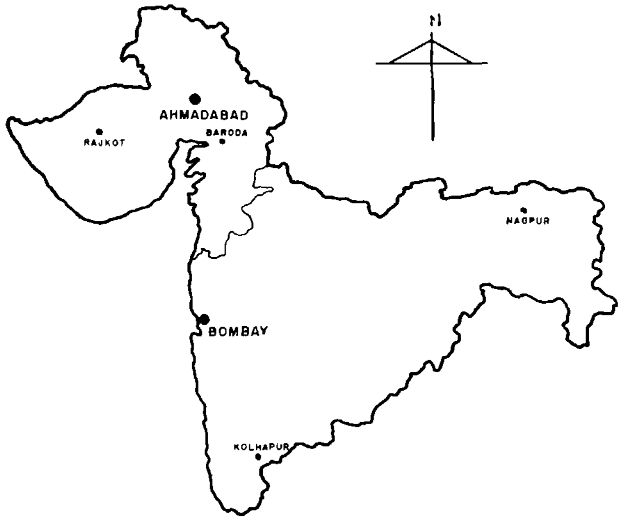


ZONE OF OPERATION OF MSE FROM BITM-CALCUTTA

Fig. 72



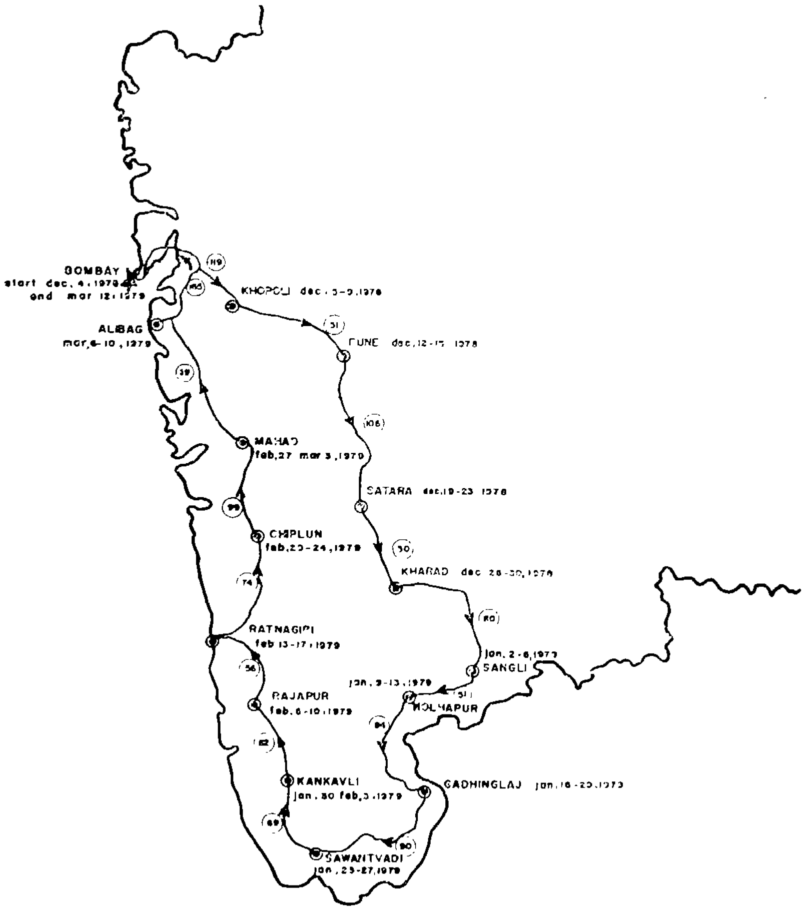
ZONE OF OPERATION OF MSE FROM VITM, BANGALORE



ZONE OF OPERATION OF MSE FROM NSC - BOMBAY

Fig. 73

Fig. 74



Programming a time schedule

The important criterion for programming a time schedule for exhibitions, consists in selecting sites off a single route not too much away from a highway and not too far apart. Unlike trucks carrying goods, the exhibition vehicle while moving over village roads can hardly exceed 40 kms per hour beyond which there is a risk of damaging the exhibits and other interior installations. It will therefore be safe in observing a speed limit and choosing sites which are between 40 to 100 km of one another, so that normally 2 to 3 hours time would be required in moving from one site to the next. For a successful programming it is also desirable to know the climatic conditions of the area so that gruelling heat and excessive monsoon could be avoided. Throughout India the months of April, May and June are hot summer months, when hardly any person will volunteer to visit an outdoor exhibition during the day time. Moreover, it is during this period that the schools observe a two months' summer vacation and the school premises and campuses will be closed to one and all. The monsoon breaks out in North East India in the later part of May and by early June there will be heavy downpours in both the western sector and the eastern sector of India. Southern India has another monsoon in October and November which is sometimes quite heavy. As a general rule, a suitable exhibition season in India will be from the middle of October to the end of November, and from the middle of December to the end of April and finally from July to September (in zones where the rainfall is not heavy). The optimum duration of an exhibition in a particular year is therefore, between 8 to 9 months, the remaining period of the year can be utilised in attending to repair and maintenance of the vehicle and exhibits.

Although school compounds are considered most ideal for exhibition purposes, the school auhtorities are normally reluctant to permit the exhibition to continue beyond 3 days as the exhibition usually draws crowds and thereby studies are likely to be disrupted. It is for this reason that the exhibition schedules in schools are usually limited to 3 days, and since the schools are closed on Sundays, exhibitions are also not held on Sundays. The usual practice is therefore to start the shifting of the exhibition van on the mornings of Mondays and Thursdays and conclude the shifting in the course of the forenoon. A tentative exhibition schedule sheet is always prepared showing exhibition sites, distances between consecutive sites, and the dates of exhibition at each site. The final route map of an exhibition in Southern Maharashtra arranged from December 4, 1978 to March 12, 1979 is shown in fig. 74 and the extract from the above exhibition schedule is reproduced below.

Team for mobile unit

For organizing and operating a mobile exhibition programme, a composite team is required for handling different activities and responsibilities, and it is to the interest of the circulating agency to manage this affair with the minimum strength of staff. Firstly an experienced truck driver-cum-mechanic is required for driving the exhibition van and for attending to sudden breakdowns of the van, since facilities for repair and maintenance of trucks may not be available in the urban and rural areas. Secondly, exhibits installed in the mobile van are mostly of the participatory type and their working mechanisms will involve mechanical, electrical, and electro-mechanical systems with relays and electronic circuits; as such a skilled mechanic for handling repairs of models and exhibits is required. Thirdly, scientific and technological exhibits require demonstration and explanation for which an experienced museum guide or demonstrator is necessary, who should have the experience of working in a science museum or exhibition. The team should also have an attendant, who can look after the security of the exhibition and can assist the mechanic in taking out exhibit cabinets for the purpose of repair and re-installation. Occasionally he can also work as a helper to the truck driver for attending to flat tyres and breakdowns of the van. The minimum strength of the team can therefore be 4 persons, consisting of a truck driver, a skilled mechanic a guide lecturer and an attendant. This number is quite in contrast to that engaged by the mobile museum programme of the Children's Museum in Nashville, U.S.A. where two persons, a curator and a guide-driver completed a team. An unusual team had been the one driver-curator, who took to the road in a 45 foot tractor trailer

FINAL PROGRAMME OF EXHIBITION SCHEME

Period December 4, 1978—March 12, 1979

Sl. No.	*Institution, Postal Address, Telegraph Office, Telephone No. and Police Station*	*Distance from previous halt*	*Period of exhibition*	*Electricity Yes/No.*	*Whether confirmed Yes/No.*	*Remarks*
1.	Janata Vidhyalaya, Khopoli, Khalapur, District Kulaba P.S. Khopoli Ph : 220 Pin : 410203	119 Km	Dec 5-9, 1978	Yes	Yes	Exhibition days every Tuesday—Saturday. Sunday—Rest
2.	Loyala High School, Pune, P.S. Chautrshringi T.O. : N.C.L. Poona-8-Pin 411 008 Tel : 56699/53384	51 Km	Dec 12-16, 1978	Yes	Yes	Monday—Movement & settling of exhibition at new site.
3.	Annasaheb Kalyani Vidyalay, Camp : Satara Ph. 2981 Pin : 415001 P.O. Satara City	106 Km	Dec 19-23, 1978	Yes	Yes	Film Show every exhibition day at 7 p.m.
4.	Tilak High School, Karad District Satara Pin : 415 110 P.S. Karad, T.O. Karad	50 Km	Dec 26-30, 1978	Yes	Yes	Exhibition hours 12 noon to 4 P.M.
5.	City High School, Sangli P.S. Sangli, T.O. Sangli Ph : 3298 Pin : 416416	80 Km	Jan 2-6, 1979	Yes	Yes	Period and Timings of exhibiton are changed, sometimes to meet, the requirements of schools.

unit, called Art Mobile I, organised by the Virginia Museum in the U.S. in 1953. One of the members of the team has to take up the duties of the team leader and it is invariably the guide-lecturer who is called upon to shoulder this responsibility. The team leader has to perform a number of duties, he is responsible for giving adequate publicity, he has to write reports, distribute funds, maintain accounts, ensure prompt maintenance of the vehicle, and exhibits and finally regulate overall discipline. In other words the success or failure of the exhibition depends on the team leader. Once the exhibition unit leaves headquarters, the only link between the exhibition unit, the receiving agency and the sponsoring museum/centre, is the team leader. Often he has to take a decision regarding changing the exhibition site without reference to headquarters, if he finds that the van cannot approach a particular receiving institution or when the receiving institution at the last moment declines to receive the exhibition.

In a hot and humid climate, where the living conditions in rural and urban areas are far from ideal, replacement of staff members at periodic intervals is undertaken as a matter of routine to maintain proper efficiency. Replacement of personnel is usually done in places which are directly connected by railway so that the despatch of personnel from headquarters and their return to headquarters become easy. The team leader is rotated every 5 to 6 weeks, while other members are usually replaced every 6 to 10 weeks. Since the team leader has numerous duties and responsibilities, one team leader has to formally transfer his charge to the other in a prescribed form.

Publicizing exhibitions

Every exhibition needs extensive publicity for its success and the mobile exhibition is no exception. It may sound strange to a reader, but it is no exaggeration to state that hardly any other communication is possible between a rural school and the sponsoring museum/centre other than through the media of the post. Urban and rural schools do not possess a telephone and the nearest one may be situated in the village post office. Timely sending of enquiries and correspondence is therefore essential for finalizing programmes. The headquarters after preparing the tentative exhibition schedule, forwards the same to the District Inspector of Schools or the District Education Officer (D.I. S./D.E.O.), who usually wields jurisdiction over a group of schools, with a request to approve the programme, if required, after necessary additions and alterations. The D.I.S/D.E.O. is also requested to sign a circular addressed to schools under his jurisdiction and to return the same to the organizers. On receiving approval, the museum/centre approaches the schools directly enclosing the signed circular of the D.I.S./D.E.O. together with a booklet on the exhibition and also forwarding a folder to collect some important informations about the institution, its location, road conditions, availability of power, etc. It is only after all such information is compiled that the final itinerary is prepared which is usually 4 weeks before the departure schedule.

Although the exhibition van is situated in one particular school, the neighbourhood schools are informed directly by the organizers to take advantage of the exhibition which is being held in that area. In this way the mobile exhibition unit tries to serve the entire town or village, as the case may be.

After completing all advance publicity measures, the exhibition unit proceeds on its tour and any publicity thereafter becomes the sole responsibility of the team leader. The team leader, immediately on arrival at the destination proceeds with his publicity efforts for the exhibition. This is not a very small task, as giving publicity in an urban and rural area would require personal visits from place to place using the local transport, which is either the pedalled bicycle-rickshaw, or in big towns the power-driven cycle rickshaw (also known as scooter). The team leader visits neighbouring market places, clubs and community centres, to make announcements. Sometimes he uses a portable P.A. system while he moves about, thereby attracting the attention of crowds or he may even distribute hand bills. Where the exhibition unit comprises a trailer and a tractor, the tractor could be detached and effectively used for all such publicity drives.

The strength of the exhibition team is too meagre to handle large crowds of visitors, particularly because the van is stationed in the midst of an open space, and the crowd has to be guided through temporary barriers erected for this purpose. From experience it has been found out that students of the receiving institution are always willing to act as volunteer guides. It is useful to utilise students as volunteers because the students take additional interest in learning more about the exhibits, in handling the switching and crank mechanisms, and in taking a position of authority in regulating visitors. Also, because of the involvement of the local boys and girls, the exhibition becomes more lively and better organized.

Unlike exhibitions in metropolitan cities, the media of the T.V. for publicity purpose is not available for the mobile exhibition. But wherever there is a local newspaper or a radio station nearby, their co-operation is always forthcoming and in such a situation adequate publicity is received by the mobile exhibition. Using advertisement slide in the local cinema houses has also been found useful. Another publicity as well as educational drive is done with the help of the units' sound-film projector. Every exhibition van carries with it a 16 mm. sound film projector, a projection screen, a set of loud speakers and a reasonable stock of films of educational and scientific value, borrowed either from the museum's own film library or loaned from the state government's publicity department. As soon as the shutters are drawn in the exhibition and evening sets in, the team leader arranges a film show in the open air. The audience, consisting of children and elders of the locality, assembles immediately, sits down under the open canopy of the sky and enjoys the film show. They learn a great deal about various topics of scientific and technological interest or about industrial development of the country. No additional publicity is required for the film show since the speakers attached to the projector can pierce the stillness of the evening air for miles around, and can immediately draw the attention of the local inhabitants.

Publications and educational materials

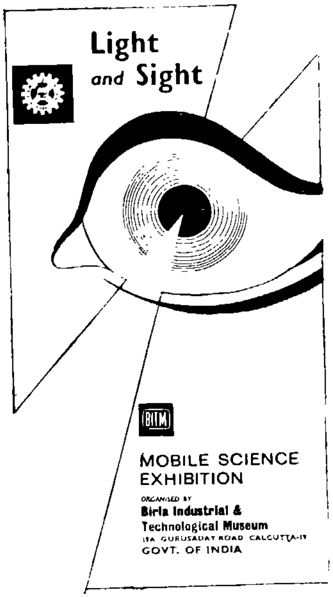
The educational aspect of the mobile exhibitions should never be overlooked. Every exhibibition has its own message to tell, which is narrated by the various exhibits. Unless the contents and the functions of the exhibits are fully explained to the visitors, the purpose of the mobile science exhibition will not be fulfilled. The school teacher or the village elder or the Block Development Officer needs a clear idea of the exhibition and its objective so that they, in turn, can influence others to visit the exhibition, and also brief the visitors in advance about what they are to expect. School students, and junior college students, should also know in advance how the exhibition is going to be relevant to their studies. It is for this reason that illustrated pamphlets on the theme of the exhibition are invariably brought out by the organizers as soon as a new series of exhibits is ready. The graphics are as important as the contents of the booklet. These booklets are sent in advance to the receiving institutions, so that the teachers and others responsible for sending visitors, can acquaint themselves with the nature of the exhibits in advance. India is a country where different languages are spoken in different zones and therefore the booklets are published in the language of the zone where the exhibition is going to be held. Sometimes in the course of a single tour, the van has to cross several states having their separate languages and hence the same booklet is published in different languages. Many different types of booklets have so far been published— some bilingually, some others in one single local language, etc. A booklet on "Light and Sight", in which the contents are in English but the captions to the illustrations are written in Bengali is reproduced in the next page. Such booklets are not intended to serve as a guide to all the exhibits, but they indicate the contents of the exhibition and have the purpose of arousing the curiosity and interest of the visitors by means of attractive illustrations so that they may feel tempted to visit the exhibition. It has also been noticed that too much narration without any illustration or graphic, has an adverse effect on the students, instead of helping them in their understanding.

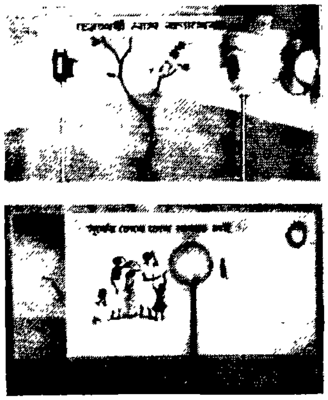
Manual of instructions, periodic reports and monitoring system

With the development of mobile science exhibitions for carrying the messages of science and technology, as a regular programme of the science museums/centres, it became necessary for the headquarters to formulate from time to time various executive orders, instructions and numerous "do's and don'ts" for the guidance of team leaders, truck drivers and mechanics.

In course of time all such instructions, etc. have been compiled and this has been published by BITM Calcutta in the form of an "Instruction Manual", a part of which is reproduced in appendix I. The manual is essential because it contains the guidelines for operating a mobile exhibition unit. For example, it contains a list of tools, accessories and spare parts required for the unit,

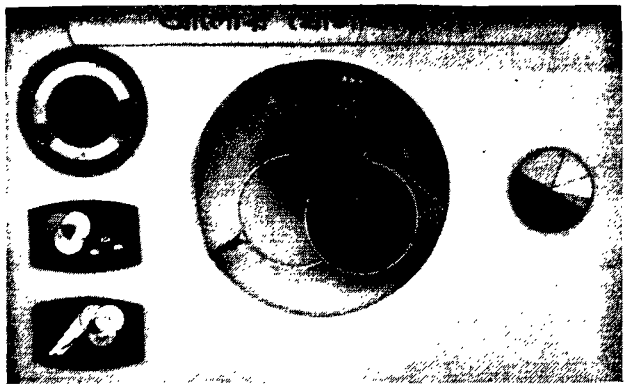
Excerpts from the booklet "Light and Sight"





Top — Eye and Camera

Bottom — Sun burn



Mixing of Colours

Light, eyes and brain work together for sight. We can't see if any one of the three goes wrong. All the 24 working models of this exhibition tell this story.

The exhibition starts with "world of colours". Man and birds can see seven colours in sunlight while dogs and cats can see only grey. To bees there is only one colour—blue. A series of exhibits shows how sunlight can be split into seven colours by a prism, why a rainbow appears on the sky and how colours can be mixed. Then comes the model showing the properties of ultraviolet rays.

An eye is basically a camera. This is explained by two interesting models. Persistence of vision and the principles of movie films are explained with the help of models. Several amusing exhibits show how a brain can misinterpret what an eye has seen.

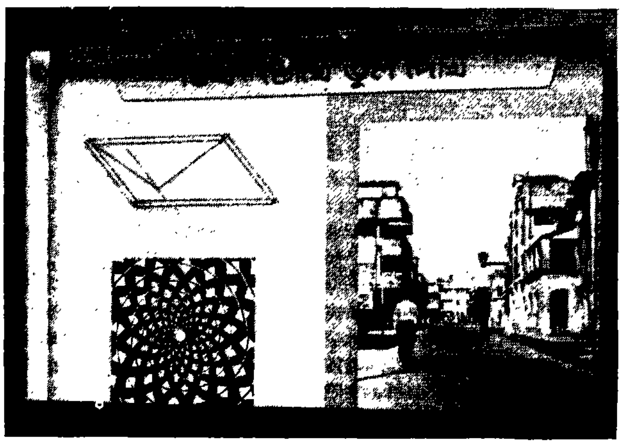
Reflection by different types of mirrors and refraction by lenses are shown in details. A useful model clearly explains why man becomes blind by trying to see the solar eclipse with bare eyes.

A series of exhibits shows how spectacles help us in removing the defects of eyes for seeing far and near objects, how a minute particle is seen through microscopes and how a distant object becomes clear through a telescope.

Two exhibits are most popular in this unit. One shows a turning wheel appearing to be stationary or rotating otherway round when a stroboscopic light falls on it. The other exhibit explains why the sound of thunder is heard much later than the lightning is seen.

"Light and Sight"—an interesting exhibition for school students and common people.

Spectacles



Optical illusion

without which the team may land in difficulty while attending to routine maintenance and breakdowns. It also contains procedure for organizing the exhibition at sites and for maintaining records, preparation of reports, accounting of cash and stores, etc. The manual is all the more important because the personnel of the unit have sometimes to be replaced all of a sudden, due to illness etc. and a newcomer gets hardly any time to receive briefing at headquarters and has necessarily to fall back upon some manual for taking independent and on-the-spot decisions. Also the manual helps in maintaining uniformity in all actions and duties to be performed by whosoever is called upon to undertake the mobile exhibition work. The Virginia Museum of Fine Arts, Richmond, U.S.A., one of the pioneers in mobile exhibitions, devised a number of forms and instruction leaflets with regard to their Artmobile programme and some of these were extremely practical and useful.

The authorities at headquarters have to devise ways for checking the activities of the unit. Datas are to be collected for monitoring the performance. For this purpose, the team leader is required to submit a weekly report of the performance in the prescribed form. This report gives indication about the suitability of the exhibition site, the public response to it, records of breakdowns and thefts, if any, defects developed in the exhibit and equipment, etc. The reports are analysed at the headquarters and any organizational defects are later on rectified. Indications are also received as to whether any particular exhibit or equipment developed frequent defects and therefore would require complete renovation or even redesigning. These weekly reports also help in preparation of various statistics such as, the visitor attendance, the number of schools participating, the number of exhibitions held, the road milage covered in the course of the tour etc.

The other checks and balances comprise, collecting from the head of the institution where the exhibition is being held, his confidential comments on the overall performance of the exhibition and of its team members. This report is sent by the institution directly to the organizing museum/centre. From a study of the comment it is also possible to ascertain the amount of interest taken by the institution and whether it would be interested in receiving another exhibition in future on some other theme. The organizing museum also exercises direct supervision occasionally by deputing the curator who has taken part in developing the theme of the exhibition, to make on the spot visits to a few exhibition sites. Apart from the fact that these visits will keep the exhibition team on the alert, such visits would help in assessing the impact of the exhibition on the local people, and in finding out the extent of co-operation received from the local authorities in making the exhibition a success.

Breakdowns, repairs and maintenance

The M.S.E. unit consisting of the vehicle, the exhibits and sundry equipment such as film projector or portable power generator, are serviced at headquarters before and after each tour. There is always heavy wear and tear of the vehicle, because it is exposed all the time to the vagaries of strong sun and rain and requires a new coat of paint every year. It is also not unusual to discover that the body of the van is scribbled with names of the village children who sometimes feel a strong inclination to sign their names on the bus body as a permanent record. Regarding breakdowns, it is not unusual to receive a frantic telephonic call or cable from the team leader from hundreds of kilometres away, requesting immediate help from headquarters to attend to a major breakdown of the vehicle or series of exhibits which cannot be handled by the truck driver, the mechanic or by the garage in the locality. In such cases, headquarters must be ready to despatch a service vehicle with more experienced staff to attend to the breakdowns, or to tow the exhibition van to the nearest district repairing centre.

With regard to exhibits, minor breakdowns are more frequent and as a matter of routine, the team mechanic attends to the maintenance of the exhibits everyday, either before or after the exhibition hours, since a broken down exhibit is a source of great disappointment to the young visitors. From the weekly report submitted by the team leader, headquarters can easily find out if any particular exhibit is remaining out of order for a long time and whether it needs the attention of a more experienced model maker from headquarters. The instruction manual also specially draws the attention of the various members of the team to their specific role with regard to proper maintenance of the exhibits, the projector, generator or transformer and to various safety and precautionary measures.

Operating budget

The expenses for operating the mobile science exhibition programme in rural areas extending over a vast area in India, has so far been fully met out of the budget of three existing science museums/centres. Occasionally in the past, organisers of industrial exhibitions or fairs in some important urban centre have offered to meet the fuel bill when the unit was taken to these sites, but such cases have been few. A substantial part of the operating cost goes towards meeting the salaries and allowances of the 4 member team and their per diem expenses while on tour outside headquarters. Assuming that the exhibition unit stays away for about 8 to 9 months a year travelling and assuming that the services of the team members can be utilised the rest of the year in the general upkeep of the science museum/centre, the expenses on the personnel is more than 57% of the total budget. The other expenses are on fuel (petrol or diesel as the case may be) and on maintenance and repair of the vehicles and exhibits. An approximate break up of the total budget for a single unit for different items can be specified as follows, based on 1980 prices :

1. Staff salaries, perquisites and per diem expenses	Rs.	40,000/-	($ 5000)
2. Fuel	Rs.	12,000/-	($ 1500)
3. Repair and maintenance of vehicle	Rs.	10,000/-	($ 1250)
4. Repair and maintenance of exhibits	Rs.	5,000/-	($ 625)
5. Publications, publicity efforts and incidentals	Rs.	3,000/-	($ 375)
	Rs.	70,000/-	($ 8750)

On the assumption that annually a single unit can visit about 40 institutions and is seen by more than 110,000 visitors, the total expenditure seems fully justified. It is, however, doubtful if the operating budget could be reduced at all, rather it is likely to go up further because salaries and fuel are going to cost more and more in future.

Chapter VIII

EVALUATING EXHIBITIONS

Soon after the introduction of mobile science exhibitions at Calcutta in 1966, the "cult" of mobile exhibition spread far and wide in India because people from all sections of society felt that mobile exhibitions were appreciated and accepted by the rural folk and by the dwellers of small towns and that through the medium of mobile exhibition science and technology could be easily disseminated and the common man could be made "science conscious". This impression was rightly gathered by visits to those areas where science exhibitions were being held and where hundreds of people were found standing in queue to enter the exhibition vehicle. The museum authorities were also receiving feed backs from the heads of academic institutions where the exhibitions had been held, in the form of confidential comments about the science exhibition and promising future facilities in case exhibitions with other themes would visit such institutions. Curators from the science museum who were deputed to make surprise inspections of the unit at far away places, also came back with satisfactory reports about visitors participation. The visitor statistics compiled with the help of the daily records prepared by the travelling team also showed encouraging figures. The statistics compiled by B.I.T.M. Calcutta for the Eastern Region of India and by V.I.T.M. Bangalore for the Southern Region of India were as follows.

Eastern Region

Year	*Total No. of themes*	*No. of exhibitions*	*Total visitors*
1974	3	115	285,358
1975	4	129	211,916
1976	9	192	783,365*
1977	7	150	323,784*
1978	5	174	237,447
April 1979— March '80	5	88	218,871

Southern Region

1974	3	33	67,320
1975	2	108	147,280*
1976	4	192	335,347
1977	3	167	321,862
1978	2	128	162,328
April 1979 to March '80	2	161	207,004

* denotes that the visit of mobile exhibitions coincided with important fairs in one or two occasions.

Modern administrators, who are charged with the task of allotting funds for the science museums and the mobile exhibitions, like to be convinced now-a-days not only about the popularity of the exhibitions but also about their effectiveness. They argue, and quite logically, that people can also just walk in the exhibition for the sake of curiosity, rather than anything else, and so figures do not prove active participation. Surveys should therefore be undertaken to find out how useful these exhibitions are, their impact on society and whether the impact is commensurate with the inputs. After all, there are many competing media in this field, such as cinema, radio and T.V., all seeking funds. Planning a suitable survey, analysing the results and coming to a satisfactory conclusion are fairly difficult exercises, as also expensive and time consuming, and hence museums avoid a survey and evaluation if they can. Surveys are also necessary to know the type of people visiting the exhibition, their age, sex, educational background and other interests, as this information has bearing on choosing proper themes for exhibitions and selecting sites. Much has been written on the subject of visitor surveys and it may not be necessary to dilate upon the subject from a theoretical aspect.

At a workshop held in Washington D.C., on November 17-18, 1977 there was considerable discussion about the appropriateness of evaluations of travelling exhibitions. Everyone agreed that although evaluation was difficult, nevertheless travelling and mobile exhibitions should be evaluated just as exhibits in a museum gallery are evaluated. Dr. Watson Laetsch aptly remarked at this meeting that exhibits should be tested like new products, "otherwise, how do you know if the exhibit objectives were reached, or what the public obtained from the exhibit ? Sometimes, you learn something quite different from what the designers had in mind". A note of caution was, however, given by Mr. Drabik : "Evaluation studies do not measure the total experience and transfer later in life, ... instead of measuring what concepts are retained, the studies should be concerned with what percepts and insights result".

After the commissioning of three mobile science exhibition units at Calcutta, G. S. Das and S. K. Ghose undertook a survey of the programmes initiated by B.I.T.M., Calcutta, and also on the visitors' reaction to certain typical exhibits, so that on the basis of the result of the survey, any deficiency of planning and programming could be corrected. The project was sponsored and financially supported by ICOM. Two of the exhibition units were touring at that time the nothern districts of West Bengal and some areas in the adjoining state of Bihar. The survey was conducted by random sampling of visitors and was based on structured questionnaires. In order to prevent the questionnaire from becoming inconveniently lengthy, thereby causing annoyance to visitors, a single visitor was questioned for one questionnaire only. Out of the 5 questionnaires framed 3 were meant for mobile units. The number of visitors interviewed for mobile units was as follows :

Q 1	Q 2	Q 3	Total
400	250	100	750

Important excerpts from the report are reproduced below. Questionnaire 1 dealt with the characteristic and behaviour of visitors, such as their age, sex, education, motivation, etc. and the analysis percentagewise revealed the following :

Sex	*Age*	*Education*
Male—60	Below 10—38	Illiterate—0
Female—40	10 to 21—45	Upto Class VIII—46
	22 to 50—17	Class IX to XI—51
	Above 50—nil	College level—3
		Beyond—Nil

Motivation

Fun	— 10
Knowledge	— 84
Recreation	— 6
Not interested	— Nil
Uncertain	— Nil

The 2nd questionnaire dealt with the mass media habits of visitors. This was done to find out the most effective media through which the museum/mobile unit could be publicized to the visitors. An interesting analysis percentagewise was as follows :

Frequency of reading Newspapers		*Frequency of visiting cinemas* (so that reaction to advertisement slides can be found out) No. of films seen in a *month*	
Rarely	— 3	Rarely	— 24
Once a week	— 10	Once	— 32
Several times a week	— 27	Upto 4	— 25
Daily	— 60	More than 4	— 19

Interest in radio advertisements

Finds Interest	— 67
So so	— 24
Not interested	— 9

Questionnaire 3 was intended to identify the most interesting exhibits from the visitors point of view, so that the reason of their popularity could be analysed from the result of this survey. The survey was undertaken while the mobile unit was carrying 24 exhibits on "Water—the fountain of life". All exhibits were temporarily numbered prominently and visitors while coming out of the vehicle were requested to suggest five interesting exhibits by numbers on the questionnaire form. This made them go round the exhibition once again and review the exhibits.

Code No.	Name of the exhibits	% of the visitors
18	What does a water drop look like?	80
19	Why wait for rain ? Use canal system of irrigation	80
22	How does steam work ?	60
14	Electricity from water power	60
1	Water without asking	60
23	Do you know how plants drink water?	50
17	The endless water cycle	50
12	When do you use a sprinkler for your field ?	50
3	Centrifugal Pump	50
5	How to irrigate your field with a siphon?	30

The top position in this list was captured by an electronic exhibit. It displayed slowly dripping water seen against stroboscopic light, but it did not succeed in scoring 100%. Out of 24 exhibits, 10 exhibits had been mentioned by 50% visitors. This indicated that the exhibits in this unit were mutually comparable in importance.

As a result of the surveys made some of the conclusions reached were that: 1) Adults were heavily under-represented in mobile units, and therefore it was necessary that occasionally exhibitions be held in places other than schools to bring in more adult visitors, 2) museum's publicity in connection with mobile exhibitions was completely ineffective; intense and advance publicity was needed, and 3) the best method of local publicity for mobile exhibitions was announcement by public address system in the locality, in addition to hand-bills and posters.

Follow up actions were initiated in subsequent years to correct some of the abovementioned deficiencies. For example, when the exhibition on "Agriculture" was inaugurated in July 1979, it was taken to many of the public places in the rural areas to enable the adult cultivators to participate in the exhibition and benefit from it.

The filled up questionnaires from heads of institutions where exhibitions are held, are also analysed regularly. A number of interesting comments have been received in reply to one of the museum's questionnaires which stated: "Please suggest improvements you feel necessary for conducting such exhibitions". Some of the replies were "The mobile exhibition should consist of at least two units with more models"; "The exhibition may be held twice every year and the number of items may be increased"; "There should be more exhibits of an improved nature for the students of the higher secondary classes (XI and XII)"; "The different stalls of the exhibition presuppose some sort of basic knowledge of scientific theories. To be of more practical use to the students, they should cover elementary aspects of science"; "Before opening of the exhibition every day arrangement for a group lecture, to make the visitors aware of the value of the science exhibition, usefulness of intensive study of modern science, present condition of science, etc., should be arranged"; "Before starting a film show, a synopsis of the contents of the show should be given by a lecture on the microphone". Many of the suggestions were quite useful and most have been acted upon by the museum authorities.

The visitor survey is a continuing affair and it is desirable that it be done periodically, at least every five years. After the last useful survey in 1971, a number of years have passed by and during this period some follow up actions must have already been initiated by the museum authorities. A fresh survey at this stage, particularly to find out whether adult participation has increased and whether there has been an impact of science and technology on the rural population could be profitably undertaken.

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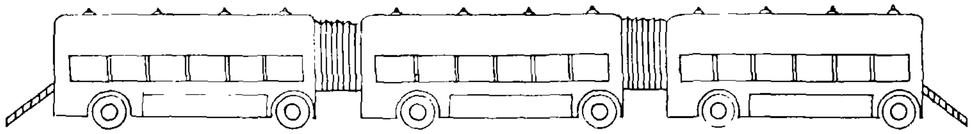
Chapter IX

CONCLUSIONS AND RECOMMENDATIONS

The mobile science exhibition programme which was launched from Calcutta in December 1966, attracted attention from all corners of India, and was gradually introduced in Southern India and then in Western India where again the programme proved popular. The Indian Museum, Calcutta, and the National Museum, New Delhi, adopted the mobile programme for spreading art and culture to adjoining small towns and rural areas. Bangladesh also recently introduced mobile exhibition for carrying cultural objects, having partially adopted the design introduced by the BITM, Calcutta. The success of the mobile science exhibition attracted the attention of a British firm who had approached BITM, Calcutta, a few years ago for the relevant designs and drawings, evidently the firm must have received enquiries from some countries desirous of introducing the mobile science programme. Thailand has already embarked on a mobile science exhibition and the Republic of Korea has decided on such a programme. It would have been much easier for other countries to adopt this programme had there been adequate publicity outside India about the usefulness and effectiveness of mobile science exhibitions and had there been readily available a suitable technical manual or handbook with relevant details.

Although a lot of experimentation has been done since 1966, still there is plenty of scope to improve the existing exhibition units. It is felt that educational activities, such as organising hobby centres, not only for students, but also for adults could be undertaken simultaneously with mobile science exhibitions. The number of exhibits could also be increased. A number of institutions which have been visited by the exhibition units have already remarked in their reports that the number of exhibits on view is inadequate. If it is possible to take one exhibition trailer to a rural site, they argue, why should it not be possible to take one or two more, and form a bigger exhibition area (fig. 76), and why should not the exhition be continued for a week, instead of three days at a place ? There are some countries in Asia where rivers and canals form the artery of

Fig. 76



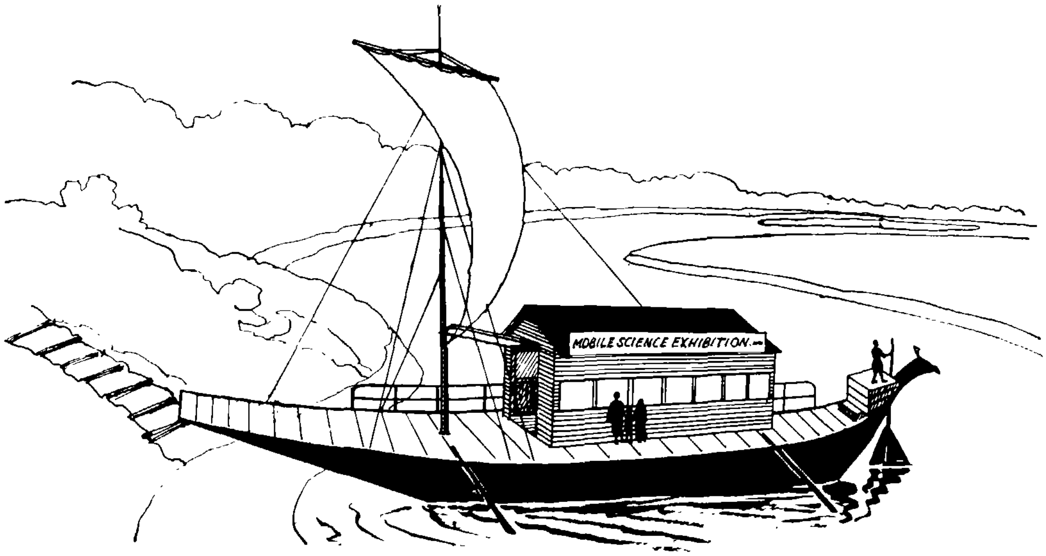


Fig. 77

transport, and rural people can only be reached through rivercraft. To serve such people, researchers might conceive of a mobile exhibition system on boats (fig. 77). Over the years, many countries have built up an extensive network of railways, stretching from one corner of the country to the other. This vast network has seldom been put into use other than for passenger and goods transport. Perhaps railway carriages could be converted into science and technology museums and be carried to different railway stations, and stationed at sidings for viewing by the public. A few years ago, the Indian railways carried an exhibition of engineering goods used in railways, which were in short supply in the country and the exhibition drew the attention of Indian manufacturers the problem of shortage, so that they could start manufacturing the same indigenously. The outcome of this exhibition was quite satisfactory. Similar efforts could be made in carrying exhibitions to highlight the achievements of science and technology in improving the living conditions of the urban and rural population (fig. 78), so that a large number of people could benefit. Periodically more attention should also be given to the creation of new designs in the field of mobile science exhibitions to correct the deficiencies noticed in the earlier designs. Due to lack of adequate finance and scientific expertise, although there is plenty of scope for research in this field, not much could be done.

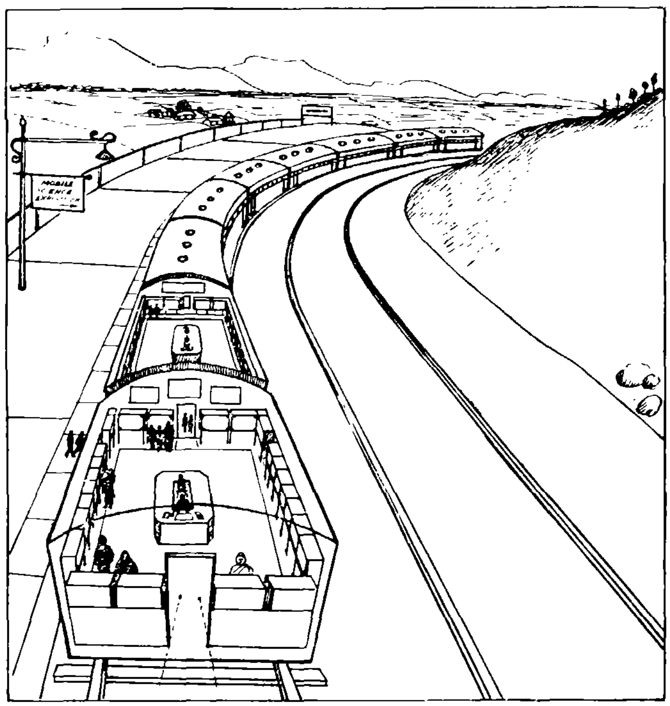


Fig. 78

It is not enough to produce only new designs of mobile exhibition units. Inadequacy of science and technology exhibits would also stand in the way of introducing such programmes throughout the developing countries. This aspect has been stressed in earlier international meetings. An exhibition theme suitable in one part of the world may not also be suitable in another part of the world, unless the theme deals with pure science. Technology will be different in different countries, particularly in developing countries, where "appropriate technology" is in demand. Themes and contents of exhibits having socio-economic implications and impacts, have to be selected in consultation with the concerned countries, where exhibitions are going to be held. Special agencies have therefore to be set up for selection of appropriate themes for exhibitions, for design of exhibits and their production.

Since mobile science exhibitions are now attracting international attention, and since making them successful on a wider scale would require pooling of resources and expertise on an international level, UNESCO can play a very important role in this field. The following recommendations are therefore made to UNESCO for consideration :

1. UNESCO may consider the setting up of a "Design Research Centre for mobile science exhibition units", where better and more efficient design could be developed for different modes of transport, to cater to the needs of developing countries. The Centre may also undertake the preparation of designs of portable exhibits and their production, and for this purpose establish contact with developing countries to ascertain their specific requirements and needs.

2. UNESCO may revive its previous project of travelling science exhibitions, with certain modifications, and expand the previous level of their programme. Standardization of exhibits is essential, as also their portability, in order to make the programme a success. UNESCO may consider whether such a programme could be linked with mobile science exhibition programmes.

3. A technical handbook or manual be published by UNESCO, which may help other developing countries to adopt this system for their own use. Initially the handbook may be published in English, for use by developing countries in Asia and by some countries in Africa. Translation in French and Spanish may also be considered at a future date for use by developing countries in Latin America and Northern Africa.

Appendix I

INSTRUCTION MANUAL FOR RUNNING AND MAINTENANCE OF MOBILE SCIENCE EXHIBITION

BIRLA INDUSTRIAL & TECHNOLOGICAL MUSEUM

1. Duties

1.1 The leader of the team will be in over-all charge of the Unit and shall be responsible for its proper functioning, movement, etc., in accordance with the enclosed programme (MSE/8). He will demonstrate the exhibits to the public, train the local students for demonstrations, supervise the work of all members of the team, and keep exhibits and equipment in working condition. It will be his responsibility to see that all office orders relating to the Mobile Science Exhibition are strictly adhered to and all instructions contained in this manual are complied with.

1.2 It shall be the duty of other members of the team to follow the leader's instructions as may be given by him for proper and efficient running of the unit and custody of the Museum's property.

1.3 The leader of the team and the mechanic must devote at least two hours every day to the repair and checking up of exhibits. A diary showing a daily account of work must be maintained for preparing the weekly report (MSE/12).

1.4 The primary duty of the mechanic will be the repair of exhibits and the operation of the projector, generator, transformer, etc. If, at any time, many exhibits become out of order the mechanic should be relieved during exhibition hours and deputed to repair work 7 hours a day. Daily account of work in such cases should be recorded in the weekly report (MSE/12). The mechanic should also clean the exhibits and even the vehicle, if instructed by the leader of the team to do so.

1.5 The Driver and the Khalasi must devote at least two hours every day to the checking and cleaning of the vehicle. This will include the interior of the vehicle, Driver's cabin, outside body, all exhibits and glass covers, the wheels and mudguards, bus engine, portable generator and any other thing which the leader of the team will think proper. The leader will ensure that everything connected to this unit is thoroughly cleaned every day.

1.6 During the hours of exhibition all members of the team will watch for the protection of the unit and operate models whenever necessary, unless otherwise instructed by the leader.

2. Movement & Routes

2.1 The members of the team are required to move with the unit from place to place, as per programme, and stay at the exhibition site at the outstation unless in any particular case it is otherwise decided beforehand. Even in case of urgency not foreseen, no staff should move otherwise, or leave the exhibition site without prior permission of the leader of the team, who is expected to exercise judicious discretion in the matter. A record of all such events should be maintained and forwarded to this office in the weekly report (MSE/12).

2.2 Where the leader of the team himself wants to stay away from the unit for any special reason, he *must* obtain prior permission from the office.

2.3 In case the road condition/school compound, etc. are unsuitable for touring and/or holding exhibitions, this *must* be reported in the weekly report for future guidance. The team leader may choose an alternate site when exhibition cannot be held according to the approved programme and report the same to HQ, with reasons.

3. Duty hours

3.1 All members of the staff will work 7 hours a day (4 hours for exhibition, 1 hour for film show and 2 hours for repair and maintenance work) and *no overtime work would be allowed without prior approval of the Senior Curator.*

3.2 In electrified areas the exhibition will be held for 4 hours at a stretch every day. In non-electrified areas where our portable generator has to be run, the exhibition may be held in two spells of 2 hours each with a recess of at least 1 hour in between. This recess is necessary for cooling the portable generators.

3.3 In addition to the exhibition, films will be projected every evening for 1 hour.

3.4 On reaching a particular site as per programme the Team Leader should contact local authorities, who are concerned with the holding of the exhibition, and try to fix up the exhibition hours in such a manner that the evening film show immediately follows the exhibition.

3.5 The Team Leader will fix up 7 hours of duty at a stretch and without any break in between. Whenever any recess has to be provided between 2 spells of exhibitions or between exhibition and film show, such period of recess may be utilized for repair and maintenance work. A few typical examples are given below for the guidance of the Team Leader:

3.5.1 Repair and maintenance—12 noon to 2.00 p.m.
Exhibition—2 p.m. to 6 p.m.
Film show—6 p.m. to 7 p.m.

3.5.2 Repair and maintenance work—12 noon to 1 p.m.
Exhibition—1 p.m. to 3 p.m.
Recess (repair and maintenance)—3 p.m. to 4 p.m.
Exhibition—4 p.m. to 6 p.m.
Film show—6 p.m. to 7 p.m.

3.5.3 Exhibition—12 noon to 4 p.m.
Repair and maintenance—4 p.m. to 6 p.m.
Film show—6 p.m. to 7 p.m.

3.6 On the day of shiftings, only the Driver will be considered on duty during driving. For other members of the Team, duty may start sometime after the arrival at the exhibition site. The Driver may be given off for driving time during exhibition hours so as to make his duty 7 hours on that day.

4. Exhibition

4.1 The leader of the team should try to recruit about 10 students at every place as volunteers. These students will be trained before the exhibition starts so that they can demonstrate and guard the exhibits. The leader of the team will normally supervise their work.

5. Accounting

5.1 Three days before the departure from Headquarters the leader should draw directly from the cash suitable cash advance, for the purchase of petrol, diesel, mobil, etc. and also to meet other incidental expenses. A proper account of the expenditure incurred should be maintained and a statement of accounts, duly supported by sub-vouchers, should be sent to the office for recoupment as and when considered necessary. The leader should maintain a *cash register* for proper accounting, and should learn from S.O. how to maintain such a register before he leaves the H.Q.

5.2 The leader of the team should maintain a running account of petrol, diesel and mobil used in the vehicle and generator. He should regularly check and countersign the log books for the vehicle (to be maintained by the Driver) and the generator (to be maintained by the Mechanic).

5.3 Three days before the unit leaves H.Q., the leader should take over charge of the entire unit, including vehicle, exhibits, equipment, tools, spare parts and records from the main stores. This should be accomplished in form MSE/17 (not reproduced), which will be filled in two copies—one copy to be taken by the team leader and the other copy to be retained by the Store Supervisor in a file.

5.4 The leader should make entries in blue slips (repair and maintenance report), for all stores consumed during his tour and hand over those blue slips to Store Supervisor on the day of his return to H.Q. He should also bring back all unserviceable stores with him and return them to the Stores. The Store Supervisor will arrange for making entries in job cards from blue slips.

5.5 At the time of transfer of charge outside H.Q., the two leaders (the relieved and the reliever) will fill in the form MSE/17 in three copies. One copy is for the reliever and two copies for the relieved. The relieved leader will retain one for his personal record and submit the other copy to Stores Supervisor on the day of his return to H.Q. The relieved leader will have to account for all discrepancies to the Stores Supervisor.

5.6 The leader will maintain under his personal care and responsibility an 'Inventory Register' for all exhibits and equipment in the unit which he will hand over to his reliever. The reliever will check all exhibits and equipment with this register and note all discrepancies in form MSE/17 at the time of the transfer of charge.

5.7 Tools for vehicles will be issued, directly to drivers and will remain under the drivers' custody. Such stores will be transferred in site from one driver to the other in form MSE/22 (not reproduced) and will be accounted for by drivers in the manner laid down in 5.5.

6. Records and reports

6.1 The leader should maintain the following records and hand them over to his reliever :

6.1.1 Inventory Register for exhibits and equipment.

6.1.2 Log Book for the vehicle (to be filled in by the Driver).

6.1.3 Log Book for the portable generator (to be filled in by the Mechanic).

6.1.4 Cash Register.

6.1.5 File for duplicates of weekly reports.

6.1.6 Record of tools and spare parts in form MSE/17.

6.2 The leader of the team will mail (preferably under certificate of posting) a weekly report each Monday in form MSE/12 and maintain a *file for duplicates* of all weekly reports.

6.3 The leader should hand over a Headmaster's report form (MSE/13) to the head of the host school/exhibition site on the last day of the exhibition and request him to fill in the form *confidentially* and send it direct to the museum. He should not personally collect it.

7. Security

7.1 The leader of the team will contact the nearest police station for posting guards during exhibition hours and at night. In case no assistance is available from the police station the Headmaster or the local authorities should be requested to arrange for guards.

7.2 Any case of theft, loss, damage of properties, etc. during the tour should be forthwith reported to the office with as much details as may be available at the time of submission of the report. *In case of theft the local police authorities should also be informed* and the no. of diary entry etc. should be reported to the office in the weekly report.

7.3 In case of local disturbances (civil disorder, riot, strike, natural calamity, etc.) the leader will immediately move the unit to a proper place of safety, viz., police stations or other protected areas and contact the H. Q. at the earliest by phone, failing which he may send the Khalasi with a letter to report to H.Q.

8. Safety and Precautions

8.1 The leader should ensure that the vehicle is *never* run from sun-set to sun-rise unless otherwise instructed in writing. He should also strictly adhere to the *maximum speed* of 30 km/h for trailers and 40 km/h for the bus. Any violation of these instructions will be viewed seriously by the office.

8.2 Before connecting the unit to the nearest electric supply the leader of the team must ensure that the isolating transformer is connected properly and *placed as near as possible* to the electric point of the school and *not* near the bus. This is absolutely essential for avoiding accidents due to leakage.

8.3 He is also directed to check up the terminal voltage every time before the unit is switched on. He will also keep watch on seeing that the voltage of the transformer is suitably adjusted in response to fluctuation of line voltage. He should learn this from the electrician before departure.

8.4 He should see that the generator, whenever necessary, is connected only to half of the unit at a time and watch the terminal voltage from time to time.

8.5 The leader will be held responsible for any damage done to the exhibits or to persons by his failure to observe fluctuation in the voltage in time or due to wrong connection and/or installation of transformer.

8.6 He should learn from caretaker use of fire extinguishers before departure.

9. The leader of the team *must* hand over the charge of the unit (or submit the MSE/17 form to indicate that he has already handed over the charge to his reliever outside the H.Q.), including all blue slips, vouchers and stores to Store Supervisor and refund the balance of cash to the Cashier on the *day of his return* to H.Q. (or next working day, if he returns after office hours).

10. All members of the team, including the team leader, *must* submit their TA adjustment claims *within 3 days* of their return.

11. *The leader of the team should read all the above instructions thoroughly and explain the relevant portions to other members of the team. He should ensure that all the members of the team work accordingly. In case of any lapses the leader will be held responsible.*

Sample form

1. MSE/2 : Initial/Revised Tentative Programme

MSE Unit No : Period : Area :

Sl. No.	Name of School, Postal address, Telegraph office & Police Station	Distance from previous halt	Period of exhibition	Two alternative schools, Postal address, Telegraph office	Distance from previous halt	Remarks

2. MSE/8 : Final programme

Sample form

Final Programme for MSE Unit : Area : Period :

Sl. No.	Name of School, Postal address, Telegraph office & Police Station	Distance from previous halt	Period of exhibition	Electricity Yes/No	Confirmed Yes/No	Remarks

Sample form

3. **MSE/18 : Exhibition Register**

Unit No. :———— Subject :———————— Vehicle :———— Area :———— Period :————

Sl. No.	Institution and address	Period of exhibition	Head of the Institution	Report MSE/13 Yes/No	Mile-meter reading on arrival	Distance from the last halt	No. of visitors Students	Others	Security Yes/No	*Remarks* Mention any problem regarding road condition/ school compound, etc. and suggest alternate site.

MSE/12

Weekly Report form for MSE Team Leaders

Period of Exhibition : From To

Unit No. : Unit Name :

1. Site Data :

1.1 Address (Full)

1.2 Telegraph Office Police Station Phone

1.3 Name of the Head of the Institution :

1.4 Mention if the road or site has to be avoided in future (state reasons) :

1.5 Was the Exhibition held inside Institution compound ? If not, why ?

1.6 Can you suggest alternate site in the area ?

2. Visitor Data :

2.1 Names of important persons of the locality who visited the exhibition :

2.2 Approximate number of visitors (including 2.3)

General public : Students : Teachers :

2.3 Neighbouring schools who sent students to see the exhibition :

Name of the School *Date of visit* *Number of students*

3. Exhibition Data :

3.1 Periods of exhibition (mention when portable generator was run) :

Date *From (Hours)* *To (Hours)*

3.2 Any trouble for which the exhibition was suspended for some time :

Nature of the trouble *How many hours suspended*

3.3 Film show (mention when portable generator was run) :

Date & time *Name of the film* *No. of visitors*

4. Security :

4.1 Assistance received from the Police Station for security : Check Yes/No

4.2 Assistance received from school for security : Yes/No

4.3 Any damage or theft of property :

Name *Quantity* *Date when occurred*

4.4 Has the theft been reported to the Police Station : Yes/No—If yes

Name of the P.S. *Date when reported* *Diary No.*

5. Materials :

5.1 Materials which need to be sent :

Name *Quantity* *Exact purpose* *Date when needed*

5.2 Materials indented before and now received :

Name *Quantity* *Date when received*

6. Cash at hand : Rs.

6.1 Do you need money immediately ?

7. Milometer reading on arrival at the site (State reasons if it exceeds mileage shown in the programme).

8. Diary of the Mechanic showing the details of repair work done by him day-to-day (use opposite page if necessary).

Date *Name of exhibits and nature of defects* *Time of working*

9. Diary of work of the Driver :
Date *Hours employed in driving* *Hours employed in cleaning* *Hours of attendance in exhibition*

10. List of defects arising in exhibits, projector, generator, vehicle, etc. which could not be attended to during the period (use opp. page if necessary).

11. Dairy of the Attendant :

Date *Hours employed in cleaning* *Hours of attendance in exhibition*

Signature of Mechanic with date *Signature of Driver with date*

12. Any other remark including confidential notes :

Signature of the Team Leader with date

Sample form MSE/7

No. Date :

From : The Senior Curator

To : The Headmaster/Headmistress/Principal,

Sub : **Mobile Science Exhibition**

Sir/Madam,

This museum, functioning under the Government of India, has been holding Mobile Science Exhibitions in rural schools since 1965. The exhibition unit is entirely mounted on a bus, containing working models which are highly educative. The mobile units hold exhibitions in West Bengal, Bihar, Orissa, Assam and Hill States.

The details and dates of the exhibition are given in the enclosed proforma. If you are interested in holding this exhibition in your school, you are requested to fill in the proforma and send it to this museum at the latest by——————————so that your school can be accommodated in the final programme.

Please check up whether the bus (the size given in the proforma) will be able to enter into your premises through the gate, if any.

Yours faithfully,

Section Officer

Enclo : A lesson through fun
&
Descriptive folder on the unit

Sample form MSE/9

No. BM Date :

From : The Senior Curator

To : The Headmaster/Headmistress/Principal

Sub : **Mobile Science Exhibition during**...............

Dear Sir/Madam,

In reply to your recent request we hereby confirm that the Mobile Science Exhibition will be held in your premises as per programme attached.

You are requested to kindly arrange for the following :

(i) a clean open space in front of your school for placing our exhibition bus of approx. size 54' (L) × 9' (W) × 11½' (H).
(ii) provision for 230 volts 50 cycles A.C. electric supply near the exhibition site, wherever electric supply is available.
(iii) a small room in a nearby place for the use of our staff for keeping costly equipment.
(iv) night guard or suitable safety arrangements for the bus and the exhibition.
(v) about 12 science students to act as volunteers in this exhibition.

On arrival of our unit please fix up suitable exhibition hours, not exceeding four hours a day in consultation with our team leader. Where there is no electric supply, the exhibition will be run in two spells of two hours each with a recess of at least one hour in between—this being necessary for our portable genertaor. *Please note that there will be no exhibition on Sundays.*

In case the vehicle cannot enter into your premises or the exhibition can not be held in your school for any specific reason our Team Leader will exercise his discretion for the choice of an alternate site. You are requested to please help him in this respect.

All students of nearby schools and common people of the surrounding localities may be invited to visit the exhibition.

Thanking you for your interest and co-operation,

Yours faithfully,

Section Officer

Encl : Programme

N.B. The exhibition dates may be deferred in case of unpredictable difficulties

(The head of the institution where the mobile science exhibition is held is requested to kindly fill in the report and send it to the museum confidentially in the enclosed envelope. This report is very useful in improving our programmes.)

1. Name of the School : ____________________

2. Full address with
Telephone No. (if any) and Telegraph office : ____________________

3. Period of exhibition : Date : _____/ _____/ _____
Hours : _____/ _____/ _____

4. Was any such similar programme arranged in your school previously ? If so when ? ____________________

5. Please give your comments about its usefulness : ____________________

6. Please suggest improvements you feel necessary for conducting such exhibitions : ____________________

7. Was the duration of exhibitions at your institute quite sufficient ? ____________________

8. Are you interested in having another mobile exhibition in future in your institute ? ____________________

9. Please comment on the work of our staff : ____________________

For official use only

Unit No...

Signature of the head of the institution with seal

LIST OF ASIAN SCIENCE MUSEUMS/CENTRES

Bangladesh

MUSEUM OF SCIENCE AND TECHNOLOGY,
Road No. 6, Dhanmundi, Dacca.

India

HEALTH MUSEUM,
Public Gardens, Hyderabad-500004
HEALTH MUSEUM, BARODA.
SHRIKRISHNA SCIENCE CENTRE,
West Gandhi Maidan,
Patna-800001
AIR-FORCE MUSEUM, PALAM,
New Delhi-110 010
RAIL TRANSPORT MUSEUM,
Chanakyapuri,
New Delhi.
VIKRAM SARABHAI COMMUNITY SCIENCE CENTRE,
Navrangpura,
Ahmedabad-380 009
VISVESVARAYA INDUSTRIAL & TECHNOLOGICAL MESEUM
Kasturba Road, Bangalore-560001
GULBARGA SCIENCE CENTRE,
Gulbarga.
NEHRU SCIENCE CENTRE,
Dr. E. Moses Road, Bombay-400 018
NEHRU PLANETARIUM,
Dr. Annie Besant Road, Bombay-400 018
MAHATMA PHULE VASTU SANGRAHALAYA,
Ghole Road, Poona-411004
BIRLA MUSEUM, Pilani, Dist. Jhunjhunu-333031
CENTRAL INDUSTRIAL MUSEUM,
Mount Road, Madras.
CHILDREN'S MUSEUM, MOTILAL NEHRU MARG,
Lucknow.
JUTE MUSEUM,
JUTE TECHNOLOGICAL RESEARCH LABORATORIES,
Indian Council of Agricultural Research,
12, Regent Park, Calcutta-700 040
PURULIA SCIENCE CENTRE,
Purulia, West Bengal.
NEHRU CHILDREN'S MUSEUM,
4/1, Chowringhee Road,
Calcutta-700 020
INSTITUTE OF PORT MANAGEMENT (MODEL ROOM),
New Traffic Building (2nd Floor),
40, Circular Garden Reach Road,
Calcutta.
INDUSTRIAL SAFETY MUSEUM OF REGIONAL
LABOUR INSTITUTE,
Lake Town, Calcutta-700 055
BIRLA INDUSTRIAL & TECHNOLOGICAL MUSEUM,
19A, Gurusaday Road, Calcutta-700 019
BIRLA PLANETARIUM,
96, Chowringhee Road,
Calcutta.

Japan

Asahikawa Youth Science Museum
(Asakikawa-shi Seishonen Kagakukan)
Tokiwa Parku, Asahikawa-shi,
HOKKAIDO
KUSHIRO MUNICIPAL MUSEUM
(Kushiro-shiritsu Kyodo Hakubutsukan)
10-35, Tsurugadai-2, Kushiro-shi,
HOKKAIDO
MURORAN YOUTH SCIENCE MUSEUM
(Muroran Seishonen Kagakukan)
2-1, Hon-cho 2, Muroran-shi,
HOKKAIDO
Tobacco and Salt Museum
(Tabako-to Shio-no Hakubutsukan)
16-8, Jinnan-1, Shibuya-ku,
TOKYO
COMMUNICATION MUSEUM
(Teishin Hakubutsukan)
3-1, Otemachi-2, Chiyoda-ku,
TOKYO
INDUSTRIAL SAFETY TECHNICAL MUSEUM
(Sangyo Anzen Gijutsukan)
35-1, Shiba-5, Minato-ku,
TOKYO
OTARU YOUTH SCIENCE MUSEUM
(Otaru-shi Seishonen Kagakugijutsukan)
9-1, Midori-1, Otaru-shi,
Hokkaido
TOMAKOMAI YOUTH SCIENCE MUSEUM
(Tomakomai-shi Seishonen Center)
1-12, Asahicho-3, Tomakomai-shi,
HOKKAIDO
MINERAL INDUSTRY MUSEUM,
AKITA UNIVERSITY
(Akita Daigaku Kozangakubu Fuzoku Kogyo Hakubutsukan)
28-2, Osawa, Tegata, Akita-shi,
AKITA
YAMAGATA PREFECTURAL MUSEUM
(Yamagata-kenritsu Hakubutsukan)
1-8, Kajo-machi, Yamagata-shi,
YAMAGATA
METAL MUSEUM
(Nihon Kinzoku Gakkai Fuzoku Kinzoku Hakubutsukah)
Aoba, Aramaki, Sendai-shi,
MIYAGI
SENDAI MUNICIPAL SCIENCE MUSEUM
(Sendai-shi Kagakukan)
1-2, Ichibancho-2, Sendai-shi,
MIYAGI
OKAYA MUNICIPAL RAW-SILK MUSEUM
(Okaya Sanshi Hakubutsukan)
1-39, Honcho-4, Okaya-shi,
NAGANO

MUSEUM OF FIBER,
TOKYO UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
(Tokyo Noko Daigaku Kogakubu Fuzoku Seni Hakubutsukan)
24-16, Nakacho-2,
Koganei-shi, TOKYO

NATIONAL SCIENCE MUSEUM
(Kokuritsu Kagaku Hakubutsukan)
7-20, Ueno Park, Taito-ku,
TOKYO

NHK BROADCASTING MUSEUM
(NHK Hoso Hakubutsukan)
10, Shiba Atagocho-1, Minatoku,
TOKYO

SCIENCE MUSEUM, JAPAN SCIENCE FOUNDATION
(Kagaku Gijutsukan)
2-1, Kitanomaru Park, Chiyodaku,
TOKYO

TELECOMMUNICATION SCIENCE HALL OF N.T.T.
(Denki Tsushin Kagakultan)
2-2, Otemachi-2, Chiyoda-ku,
TOKYO

TRANSPORTATION MUSEUM
(Kotsu Hakubutsukan)
25, Kanda Sudacho-1,
Chiyoda-ku, TOKYO

ASTRONOMY MUSEUM,
GOTO PLANETARIUM
(Tenmon Hakubutsukan, Goto Planetarium)
21-12, Shibuya-2, Shibuyaku, TOKYO

CAMERA MUSEUM
(Camera Hakubutsukan)
21-20, Nishiazabu-3,
Minato-ku, TOKYO

TOSHIBA SCIENCE HALL
(Toshiba Kagakukan)
1, Toshibacho, Komukai,
Saiwai-ku,
Hiratsuka-shi, KANAGAWA

OSAKA ELECTRIC SCIENCE MUSEUM
(Osaka-shiritsu Denki-kagakukan)
1-6, Nishinagahorikita-dori, Nishi-ku, OSAKA

HUMAN SCIENCE MUSEUM,
TOKAI UNIVERSITY
(Tokai Daigaku Jintaikagaku Hakubutsukan)
2407, Miho, Shimizu-shi,
SHIZUOKA

MARINE SCIENCE MUSEUM,
TAKAI UNIVERSITY
(Tokai Daigaku Kaiyokagaku Hakubutsukan)
2389, Miho, Shimizu-shi,
SHIZUOKA

NAGOYA MUNICIPAL SCIENCE MUSEUM
(Shiritsu Nagoya Nagakukan)
17-22, Sakae-2, Naka-ku, Nagoya-shi,
AICHI

GIFU CITY JUNIOR SCIENCE CENTER
(Gifu-shi Shonen Kagaku Center)
3456-21, Hachigatsubo, Honjo,
Gifu-shi, GIFU

NAITO MUSEUM OF PHARMACEUTICAL
SCIENCE AND INDUSTRY
(Naito Kinan Kusuri Hakubutsukan)
C/o. Eizai Kawashima Campus,
Kawashima-cho, Hashima-Gun, GIFU

KYOTO MUNICIPAL YOUTH SCIENCE CENTER
(Kyoto-shi Seishonen Kagaku Center)
13, Fukakusa Ikenouchi-cho,
Fushimi-ku KYOTO

MODERN TRANSPORTATION MUSEUM
(Kotsu Kagakukan)
11-10, Namiyoke-3,
Minato-ku, OSAKA

KAGAWA PREFECTURAL SCIENCE MUSEUM
(Kagawa-ken Shizen Kagakukan)
1901-2, Kizawa, Okoshimachi,
Sakaide-shi, KAGAWA

AKASHI MUNICIPAL PLANETARIUM
(Akashi-shiritsu Tenmon Kagakukan)
2-6, Hitomaru-cho, Akashi-shi,
HYOGO

KOBE INTERNATIONAL PORT AND HARBOR MUSEUM
(Kobe Kokusai Kowan Hakubutsukan)
8, Hatobacho, Ikutaku, Kobe-shi, HYOGO

MT. IKOMA SPACE SCIENCE MUSEUM
(Ikomayama Uchu Kagakukan)
2312-1, Nabatakecho,
Ikoma-shi, NARA

OKAYAMA ASTRONOMY MUSEUM
(Okayama Tenmon Hakubutsukan)
Chikurinji, Kamogatacho,
Asakuchi-gun, OKAYAMA

JAPANESE STEEL MEMORIAL HALL
(Wako Kinehkan)
881, Yasugimachi, Yasugi-shi,
SHIMANE

UBE MUNICIPAL COAL MUSEUM
(Sekitan Kinenkan)
Tokiwa Park, Okiube, Ube-shi,
YAMAGUCHI

YAMAGUCHI PREFECTURAL MUSEUM
(Yamaguchi-Kenritsu Yamaguchi Hakubutsukan)
8-2, Kasugacho, Yamaguchi-shi
YAMAGUCHI

NAGASAKI CHILDREN'S SCIENCE MUSEUM
(Nagasaki-shi Jido Kagakukan)
1-37, Ouramachi,
Nagasaki-shi NAGASAKI

KUMAMOTO MUNICIPAL MUSEUM
(Kumamoto-shiritsu Kumamoto Hakubutsukan)
3-2, Kokyocho, Kumamoto-shi,
KUMAMOTO

TOYAMA SCIENCE MUSEUM
(Toyama-shi Kagaku Bunka Center)
1-19, Nishinakanomachi,
Toyama-shi,
Toyama

KAGOSHIMA PREFECTURAL CULTURAL CENTER
(Kagoshima-ken Bunka Center)
3, Yamashitacho, Kagoshima-shi,
KAGOSHIMA

TOYOHASHI MUSEUM OF NATURAL RESOURCES
(Toyohashi-shi Chikashigenkan)
19-16, Hiuchizaka, Oiwacho,
Toyohashi-shi, AICHI

Korea

NATIONAL SCIENCE MUSEUM
2, Waryong-Dong, Chongno-Ku
Seoul
BUSAN CHILDREN'S CENTER,
Bumil-Dong, Busan Jin-Ku,
Busan
CHUNG-BUG PROVINCE STUDENT SCIENCE CENTER,
Sachangdong, Chung Ju City.
JEON-BUG PROVINCE STUDENT SCIENCE CENTER,
1 dong. Limu Chun Ju City.
KYUNG-PUK PROVINCE STUDENT SCIENCE CENTER
111, Sangeukdong, Buk-Ku,
Daeku City.
KYUNG-NAM PROVINCE STUDENT SCIENCE CENTER,
Chasan dong, Masan City
SEOUL CHILDREN'S CENTER,
3-39, Neung-Dong, Seongdong-Ku
Seoul
KYUNG-GI PROVINCE STUDENT SCIENCE CENTER,
2, dong, Hyojo, Chuncheon City,
Kangwon do.
CHUNG-NAM PROVINCE STUDENT SCIENCE CENTER
448, Daehungdoug, Jung-Ku,
Dae Jun City
JEON-NAM PROVINCE STUDENT SCIENCE CENTER
143, Dongmyong-dong, Dong-Ku
KwungJu City
CHEJU PROVINCE STUDENT SCIENCE CENTER,
Cheju City, Chejudo
KANGWON PROVINCE STUDENT SCIENCE CENTER
2, dong, Hyojo, Chuncheon City,
Kangwon do

Pakistan

NATIONAL MUSEUM OF SCIENCE & TECHNOLOGY
Lahore 31.

Philippines

TUKLASANG AGHAM NG PILIPINAS
Philippines Textile Institute Building
Beinnan, Jaging
Metro Manilla

Singapore

SINGAPORE SCIENCE CENTRE
Science Centre Road,
Singapore 2260
MARITIME MUSEUM
Sentosa
Singapore 0208

Thailand

SCIENCE MUSEUM
Centre for Educational Museums
928 Sukhumit Road,
Bangkok 11.

LIST OF SCIENCE CLUBS IN INDIA

Tamilnadu

The Association for the Promotion of Science Education
95-A, R. K. Mutt Road,
Raja Annamaliapuram
Madras-600 028

Karnataka

The Bangalore Science Forum
National College Building
Bangalore-560 004

Bihar

Vigyan Parishad
High School Siwan
Dist. Nawda, Bihar

Rohini Science Club
13 H. B. Road
Chuna-Bhutta
Kokar, Ranchi-834 001

Bhabha Science Club
High School Amaswan
P.O. Bansgopal
Dist. Nawada

School Science Club
Langta Bab High School
Mirjagunj, Giridih

Nagaland

Science Club
C/o. Science Club
Kohima-797 001

Orissa

Youth Science Centre
Rourkela
Orissa

Tripura

Kishore Vigyan Chakra
Agartala
Tripura

West Bengal

Acharya Prafulla Chandra Ray Silpa O Bijnan Bhavan
11B, Shyama Prasad Mukherjee Road,
Calcutta-700 025

Acharya Satyen Bose Vijnan Samiti
C/o. Bantul Mahakali High School,
P.O. Bantul
Dist. Howrah

Alpha Science Club
1, Ghanendra Deb Road,
Majilpur
P.O. Jayanagar Majilpur
Dist. 24-Parganas

Antaral Bijyan Gosthi
1, Abinash Banerjee Lane
Sibpur, Howrah-711 102

Anusandhani Bijnan Sangha
C27 East Rajapur
Calcutta-700 032

Asokenagar Bijnan Sangstha
686/1, Asokenagar,
P.O. Asokenagar,
Dist. 24-Parganas

Bangiya Bijnan Parishad
P23 Raja Rajkrishna Street
Calcutta 700 006

Bankura Science & Technological Club
P.O. Durlavpur
Dist. Bankura

Bankura Students' Science Centre
Bara Kalitala
P.O. & Dist. Bankura

Barasat Science Club
C/o. Shyamal Gan
Sivananda Palli
P.O. Barasat
Dist. 24-Parganas

Bijnan O Sanskriti Parishad
P.O. Serampore
Dist. Hooghly

Bijnan Parishad
College Para
P.O. Katwa
Dist. Burdwan

Bijnan Tirtha
130 Dewanji Road, Bally
Howrah 711 201

Burdwan Newton Science Club
17, Nalinaksha Bose Road
P.O. & Dist. Burdwan

Chinsurah Science Club
Shyambabu's Ghat Lane
Dist. Hooghly

Dum Dum Bijnan Sangha
45A, Motijheel Avenue,
Calcutta-700 054

Garalgacha Science Club
P.O. & Vill.—Garalgacha
Dist. Hooghly

Gobardanga Renaissance Institute
P.O. Khantura, Dist. 24-Parganas

Jagadish Chandra Bose Science Club
Naikuri Thakurdas Institute
P.O. & Vill.—Naikuri, Dist. Midnapore

Kolaghat Science Hobby Centre
P.O. Kolaghat, Dist Midnapore

Media Bijnan Asar
C/o. Chhatra Kalyan Samiti
P.O. Media (via Khantura)
Dist. 24-Parganas

North Howrah Science Association
74, Sitanath Bose Lane, Salkia
Howrah 711 106

Pioneers Group
1, Sarat Chatterjee Road
P.O. Nabagram, Dist. Hooghly

Satyen Bose Bijnan Samity
C/o. Ramnagar N.B.P.C. High School
P.O. & Vill. Ramnagar, Dist. Hooghly

Science Association of Baranagar
C.P. Estate, Qtr. No. N/28
Calcutta 700 056

Science Association of Bengal
104 Diamond Harbour Road
Calcutta-700 008

Scientific Society of Students
Charu Chandra Pal Road,
P.O. Jhorehat, Howrah 711 302

Singur Science
P.O. Singur, Dist. Hooghly

South Calcutta Science Club
4, K. K. Majumder Road,
Calcutta-700 075

Taherpur Bijnan Parishad
C/o. Air Voice, P O. Taherpur
Dist. Nadia

Young Scientists Association
11 B. T. Road, Calcutta 700 056

Yuba Bijnan Sangstha
P.O. Khantura
Gobardanga
Dist. 24-Parganas

• The science clubs in India run into hundreds. Since most of them are non-registered body and since there is no central apex organization having any link with the science clubs, a detailed list cannot be obtained. The list given above has been verified by BITM, Calcutta, and already 30 science clubs and block science centres are associated with them