MUSEUM OF SCIENTIFIC DISCOVERY

The Museum of Scientific Discovery is housed in a shopping mall in Harrisburg, USA, and is of interest because of the comparatively low start-up costs of around $350,000. This is the same order of funding made available through charities to groups in the UK. Since writing this article Ken Gleason has been in Cardiff, Wales, developing exhibits for the Techniquest group.

Like most other interactive science and technology centres, the Museum of Scientific Discovery has many of the exhibits detailed in the Exploratorium's Cookbook. This is a useful article for any group preparing an estimate of the costs of starting up a project. Costs of exhibits are reviewed and – importantly – development and building time.

The incorporation of a science centre in a shopping mall is interesting as this type of shopping facility is now becoming more widespread and may provide suitable premises for start-up projects. We may see the day when property developers automatically set aside an area for such a proposal as a public amenity. Coincidentally, Techniquest was first set up in a shopping area in the centre of Cardiff. Ken Gleason must have had a sense of deja-vu.

Location:	Harrisburg, Pennsylvania, USA
Date opened:	February 1982
Floor area:	1000sq m
Number of exhibits:	56
Number of staff:	8 permanent 100 volunteers
Number of visitors:	70,000p.a.
Opening times:	Tues-Fri 10-6, Sat 10-5, Sun 12-5
Entrance fees:	$2.50 adults $1.75 students under 18 and senior citizens over 64 Free for children under 3 years $1.25 groups of 10 or more registered in advance Membership (1 year free admission plus other benefits) $25 family, $15 individual

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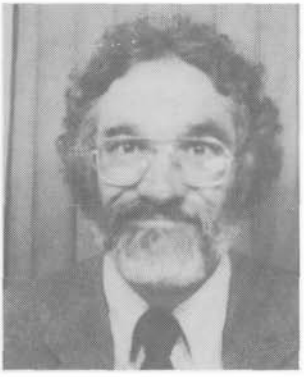
Ken Gleason



Ken Gleason helped open the Museum of Scientific Discovery where he was Exhibits Director and, for a time, Acting Executive Director. In 1986 he began consulting with hands-on museums, including Techniquest in Cardiff where he coordinated the design, construction and presentation of exhibits. He has also done work for the Children's Discovery Museum, the Discovery Centre of the Capital Region, and the Bard College Blum Art Institute. His academic background includes a BA from Harvard University and graduate work in psychology at Washington University.

The Museum is situated on the upper storey of a shopping mall.

The idea for the Museum of Scientific Discovery began in 1977 with a small group of Junior League members who were seeking a worthwhile project that would add life to the Harrisburg Community. (The Junior League is a national US organisation of young women who volunteer their time to work on projects that benefit their local communities.) They all knew the excitement and value of trips to the Franklin Institute and Smithsonian Institution, each of which was a two and a half hour bus trip for Harrisburg area school children. 'Why not have a science centre right here in Harrisburg?' they asked themselves.

Initial work involved the organisation and funding of a Junior League committee, a survey of the school systems, visits and enquiries to established science centres and planning for a pilot project called Sensorama. For one month in 1979, Sensorama was set up in 2000sq ft of space within the lobby of the nearby State Museum of Natural History. The twelve exhibits that comprised Sensorama were intended to be samples of the participatory exhibits that would fill a science centre so that interest could be aroused and evaluated.

Considerable publicity announced Sensorama and it was visited by over 13,000 people, who showed much enthusiasm and led the committee to decide to go ahead with full plans.

By 1980 business and community leaders had been recruited to join with the Junior League committee and form a 24-member board of directors and establish the Museum of Scientific Discovery as a non-profit organisation.

Board members were chosen in part to include representation of various sectors of the community including education, medicine, government, banking, law, business and entertainment. Five basic goals were established:

1 To provide a unique science learning centre
2 To stimulate an interest in science
3 To develop positive feelings about museums
4 To make science education an enjoyable experience
5 To assist in the revitalisation of Pennsylvania's capital city.

The aphorism, 'I hear – I forget; I see – I remember; I do – I understand' was adopted as a motto.

Additional visits to other centres were conducted and lists of their most successful participatory exhibits were made, contacts were established and advice was sought.

Committees were formed on the following subjects: Fi-

nance, Exhibits, Development (fund-raising), Building, Personnel, Planning, Nominating, Programmes and Publicity. This was a 'working board' in which members put in long hours of work on their committees. Nearly all board members helped with fund raising.

The primary fund raising method was to have one or two board members meet a prospective donor to describe plans and ask for a three year pledge. A portable rear screen slide projection system was used extensively in these meetings. Most contacts were initiated by references from people who knew the individuals and could recommend the museum project. None of the original funds came from government grants. Over $350,000 was pledged during 1981 from a large number of donors (approximately a hundred) giving $500 to $5,000 amounts. There were only a few pledges in the $10,000 or more range.

Staffing

The first paid member of staff was hired in early 1981 as a part-time secretary for the fund-raising chairman. In May 1981 the Executive Director was chosen after months of searching. He (Roger Smith) was a very enthusiastic and creative high school science teacher who had been a board member. The part time secretary then worked for him primarily. The President of the Board of Directors (Beverley Spitzer) worked virtually full time from the spring of 1981 until the museum opened in February 1982. In late 1981 the Director persuaded an old friend of his (Ken Gleason) to work for three or four months to help with the design and construction of exhibits. This person became the Exhibits Director and the second full time staff member. Numerous other people were enlisted to help start the museum, some as volunteers and some under contract. They included the following:

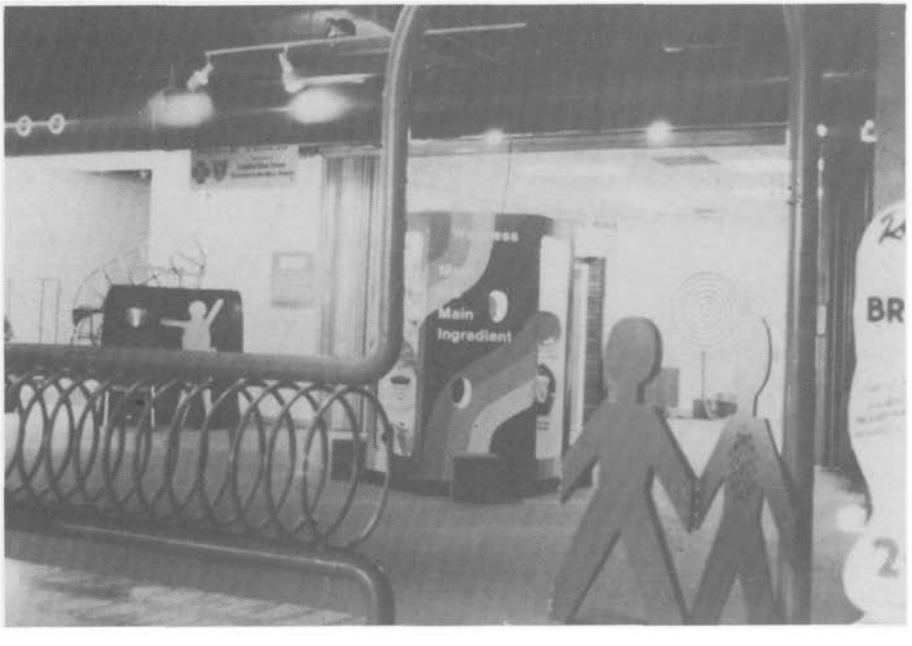
Accountant
Architect
Builder
Carpenter
Computer Programmer
Computer Technician
Craftsmen
Fundraisers
Graphic Artist
Insurance Agents
Management Consultant
Materials Suppliers:
- timber
- electrical parts
- electronic parts
- graphics supplies
- hardware
- surplus parts
- office supplies

Plumber
Printer

Many locations within the city were considered for housing the science centre. Space in an existing structure was sought since the construction of a totally new building would have been much too expensive. The candidates included old school houses, a fire station, an empty hotel and shop premises.

Finally arrangements were made in the summer of 1981 for a 10,000sq ft space in a brand new shopping mall and office centre that happened to have been built as part of the plan for renewing the old and decaying inner city. The space was intended for a restaurant but a renter had not been found and the interior had not been finished. It seemed a perfect place for the Museum of Scientific Discovery.

An architect was engaged to draw up plans and put out bids to contractors. The Director and President of the Board were heavily involved in developing the final plan and in working with the architect and contractor as work was in progress during the latter part of 1981. Of the 10,000sq ft, approximately 8000 was used for exhibit space, 1000 for an auditorium with 'kitchen' attached and 500 each for offices



The entrance to the museum is bright and sets the mood of the exhibition. The shop is by the entrance and the staff also keep an eye on the exhibits.

and gift shop. There was also another 1000sq ft in the basement for combined storage and workshop.

It had been decided that the 'look' of the museum would consist of clean lines and 'finished' quality. Interior walls were built of plasterboard painted white. The concrete floor was carpeted in broad stripes of grey and brown shades – donated by a local carpet manufacturer. This has been a great help in controlling the noise of one or two hundred children visiting at one time. (Noise can become a problem when you are sharing a building with other tenants and when offices are adjacent to the exhibition space.)

We liked having the offices near the exhibits for the contact it provided with the public and for the inhibiting effect it had on vandalism, which has been very low. Not only are the staff nearby to watch over exhibits but they are within easy reach for getting help with an exhibit or reporting a malfunction. We also attribute low vandalism to the small size of the exhibit space, our promptness in repairing broken exhibits and the accessibility to the exhibits which conveys an expectation of good treatment. The negative side of having the offices close by was the difficulty for office workers to

Giving lectures is part of the activity of the museum and an area has been set aside for this purpose. The museum also runs courses and camps.

concentrate on work while so near to the noise of the visitors and the exhibits.

The ceiling was criss-crossed with air ducts, pipes and wires. It was painted black as the least expensive way of finishing it. Suspended track lighting also helped reduce the overhead chaos to shadows while it permitted some areas to be kept relatively dark to facilitate light-based exhibits such as strobe lights on piano strings. The idea of painting each pipe duct with bright colours was briefly considered but the expense made that impractical. The auditorium and office were provided with suspended ceilings and bright illumination. This helped with the appearance and with the sound control. It was thought that suspended ceilings could be added to the exhibition area at a future date if the funds and the need arose. So far no-one has felt the need, though it would brighten the space (which might, or might not, be desirable) and provide some sound insulation from the air-conditioning machinery overhead.

A Newtonian telescope, of the type often made by amateurs, is demonstrated. The museum relies greatly on volunteers to demonstrate exhibits, as do most science centres in the US.

The exhibits

The original 34 exhibits were chosen after board committees had visited existing science centres and identified their most popular and interesting exhibits.

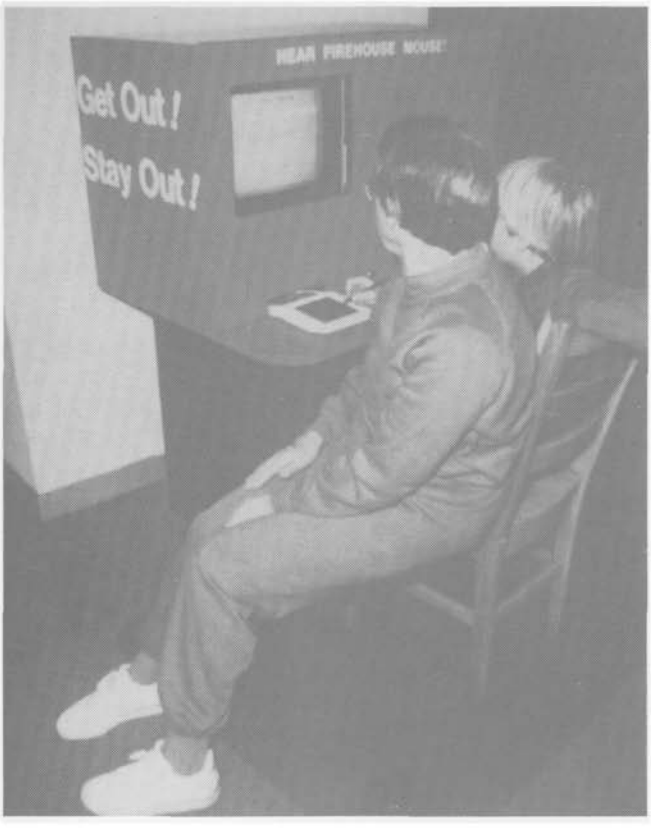
Themes of perception, communication and physics were used to group exhibits, but not rigidly and not without exceptions. The exhibit's budget of $50,000 and feasibility of construction were also used to narrow the list. Construction strategy combined professional and volunteer labour in carpentry, electronics, computer programming and graphics. Some construction was done in the museum workshop and some at outside shops. The Exploratorium 'Cookbook, Volumes I & II' was very helpful when choosing and constructing many of the exhibits. It is considered a compliment to copy another centre's exhibits and that is what we did, with some modifications to fit the look of our museum or to adapt to available parts or to make improvements. We wanted to have sure winners with which to open and establish the museum rather than experiment with many new and untested designs.

The original exhibits were:

Bernoulli Blower
Bicycle Gyro
Binocular Vision
Catenary Arch
Cheshire Cat
Colour Computers
Coloured Shadows
Discovery Room
Distorted Room
Echo Tube
Flying Mirror
Gravity Tower
Gravity Wall
Heave Ho (Block and Tackle)
Impossible Triangle
Infinity Mirror
Iris in Action
Larger than Life
Lissajous Patterns
Magic Faces
Morse Code
Periscope
Piano Strobe
Puzzles and Paradoxes
Seeing is Deceiving
Shadow Box
Sinclair Computers (2)
Strobe Fountain
Talking on Air
Video Phones
Wave Machine
Whisper Dish

Several important considerations were kept in mind during the design and construction of exhibits for Harrisburg. One was that the knowledge of visitors would vary greatly and that the exhibits must be prepared to engage both extremes. Those with a minimum knowledge of science seemed to be in the majority.

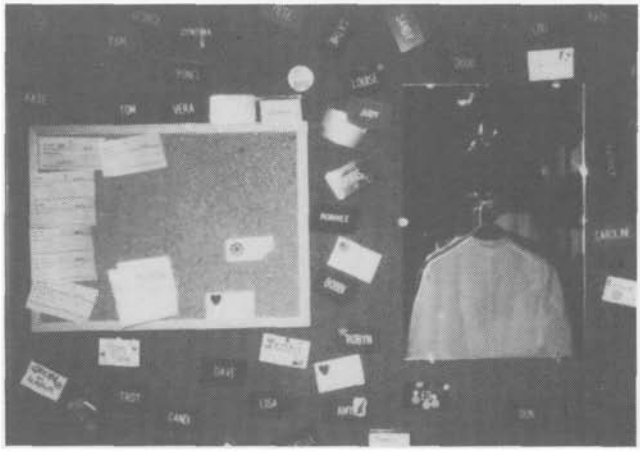
Another was that the experience of understanding an



'Fire House Mouse' is a computer-based exhibit which teaches children about reaching safety in the event of a fire in the home. Children key in details about their house and receive a printout.

exhibit is rewarding in itself, while confusion is frustrating. Thus we strove for clarity in how to operate and observe an exhibit. We kept age groups in mind realising that some exhibits would have broad appeal while others would be more for either adults or children. We wanted visitors to invest some time at exhibits so wherever it was appropriate we included chairs. Multiple chairs encouraged sharing an exhibit, while just having chairs was 'visitor friendly'. We sought to use standard and easily available components in the exhibits wherever possible, rather than custom-made or difficult to obtain items. When successful at this, and we often were not, expenses and maintenance procurement problems could be reduced.

Maintenance was a high priority for us because we were committed to minimising "out of order" signs in the museum. We felt they gave a poor impression of the museum and possibly even stimulated vandalism. Prototyping and



Volunteers are made to feel at home in the museum. This is the board with all the name tags in the volunteers room.

testing of exhibits, a highly desirable practice, was more practical when standard and inexpensive components were used. Safety, attractiveness and sturdiness were, of course, primary considerations at all times.

Development of exhibits

A selection of exhibits at the Museum of Scientific Discovery is described in the following paragraphs:

Larger than Life: This consists of six microfiche viewers with samples of natural objects such as bird feathers and hair from different animals permanently attached to the slides. They have the effect of small projecting microscopes.

The idea for this exhibit came from the low priced availability of the viewers at a government surplus warehouse. It was conceived as an inexpensive and easy way to permit microscopic observations by the visitor. The slides were prepared by a local school science teacher. The viewers were set upon two leftover industrial show counters that had been donated. A central column for graphics display was designed by the Museum Director, built out of particle board by a volunteer and covered with carpeting by the professionals who installed carpeting on the museum floors.

The exhibit was well used, though not a raging favourite. It was removed after a couple of years because of the high cost and relatively short life of the viewer bulbs and because the bulb sockets began to break and were not easy to replace. Limited exhibit space problems also created the need for retirement candidates.

The approximate costs were: 6 Microfiche viewers, $100;

Central column, $70; Show counter refurbishment, $80; Slide items, $25; Replacement bulbs (six months' supply) $100; Executive Director's time, 25 hours. Total $375 plus 25 hours.

Lissajous: Lissajous figures are curves traced out by a point simultaneously undergoing two simple harmonic motions (sine waves) in perpendicular directions. This exhibit was inspired by one at the Exploratorium and developed out of a discussion between the Executive Director and a volunteer technician. It is believed to be unique in combining two waveform generators.

It consists of four Heathkit brand electronic components (oscilloscope, two audio waveform generators and a signal tracer) that were assembled by the volunteer. The generators' sine wave outputs were independently applied to the horizontal and vertical inputs of the oscilloscope and also to the signal tracer used as an audio amplifier. On the oscilloscope, Lissajous patterns were formed by the interaction of the two waveforms whose frequency could be adjusted by the visitor. A varying audio signal could be heard on the signal tracer speaker. The housing was designed by the Exhibits Director

Visitors use basic electronic test equipment to generate Lissajous patterns. Construction methods for all the exhibits are kept plain and simple.

(who also installed the equipment) and built by a professional carpenter. It was a plastic laminate over particle board with a Plexiglas front that permitted all the equipment to be viewed. Extensions to the two frequency control knobs extended out through the Plexiglas. The exhibit gave the visitor some experience with an oscilloscope and demonstrated Lissajous patterns. It was a well-used exhibit that was interesting to most and intriguing to some.

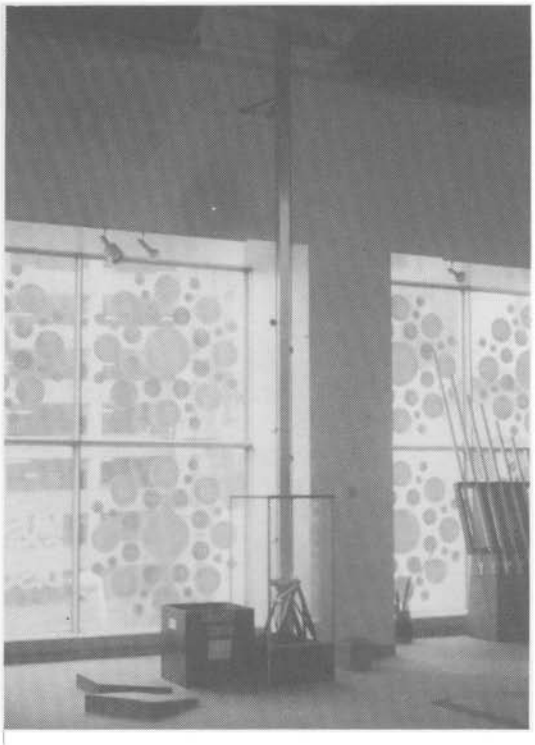
The approximate costs were: Oscilloscope $250; Audio generators $50 each; Signal generator $50; Housing $300; Chair $50; Exhibit Director's time, 35 hours. Total $700 plus 35 hours.

Gravity Tower The Gravity Tower is a unique exhibit that involves rubber balls being carried up a 20ft tower by a crank mechanism on the floor. The balls are released to bounce sequentially on three stone blocks into a cloth funnel that guides them back to the crank mechanism. The regularity of the bounce sequence when the blocks are aligned correctly illustrates the dependability of the law of gravity.

The Gravity Tower was conceived by the Executive Director who was fascinated by falling and bouncing objects. A similar exhibit in the Franklin Institute that released ball bearings onto a single surface influenced the conception. The Executive Director and Exhibits Director experimented with many types of balls before setting on rubber squash balls. A volunteer was given charge of the actual design and construction and he turned the project over to a local machine and tool shop owner who actually did the whole job. A number of modifications were made by the Exhibits Director and a volunteer after the installations of the tower. These included:

1 Enlargement of the funnel and lining it with cloth to absorb the final bounce energy.
2 Adding a magnetic clutch to the crank to permit slippage when a ball got jammed.
3 Building a new and sturdier guard to protect visitors from the chain and gear mechanisms.
4 Obtaining larger surfaced stone blocks to compensate for the variations in bounce due to ball irregularities. The stone blocks were cut and donated by a local memorial headstone company and the balls were donated by a manufacturer in the state.

The exhibit has been very successful as it is fun, interesting



The Gravity Tower. Squash balls are lifted to the top of the tower and allowed to drop, bouncing sequentially on three stone blocks. Although not interactive, the exhibit generates a great feeling of anticipation as a ball nears the top.

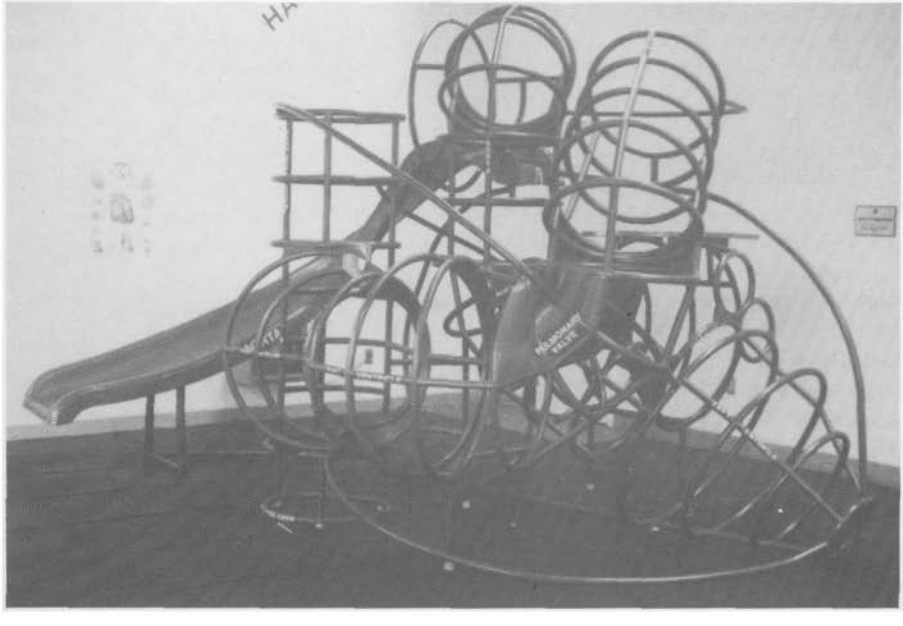
and does show gravitational regularity although the bounce of the balls from this height is not always the same, due to slight spinning, air currents and imperfections in the balls. While this dilutes the message about gravity, it makes a dramatic contribution by adding suspense.

The approximate costs were: Tower $2000; Modification parts $100; Executive director's time, 40 hours; Exhibit Director's time, 40 hours. Total $2100 plus 80 hours.

Heart Jungle Gym: The Heart Jungle Gym was created two years after the museum opened but it is an interesting example so it is included here. The inspiration began with a device consisting of a line of 2ft diameter steel hoops, spaced about six inches apart, that formed an 8ft long tube across the entrance to the museum. While it was designed by the remodelling architect merely as a barrier, it was observed that small children wanted to (and did) climb through it. It had a magnetic appeal to the kids that the Executive Director and Exhibits Director observed and wanted to exploit. During a discussion between them as to how they could come up with

The Heart Jungle Gym (below) allows children to crawl through the parts of a heart in the same sequence as the flow of blood in a real heart.

The inspiration came from watching children crawl through the tubular entrance feature (right), which was never intended as an exhibit.



a new exhibit utilising this appeal the idea of a heart-shaped jungle gym arose. The Exhibits Director designed it by making models out of wire and tubing. In the third and most refined version, the tubing pieces were made with a limited number of mostly standardised pieces and the model became the plan for the exhibit. A local company that fabricated such things as steel railings and fire escapes was willing to build the 9ft tall jungle gym using the model as a plan. A local car dealership donated the painting of a slide that was attached to represent the aorta where the blood left the heart to go off to the rest of the body. After many consultations between the Exhibits Director and the craftsmen the job was done. It was moved into the museum in sections, reassembled and painted there by the Exhibits Director and volunteers. Lettering to indicate the different parts of the heart were added by a graphic artist and playground rubber pads were placed underneath it for safety. The Heart has been very successful. The magnetic attraction worked in the Heart and a natural pathway takes the visitor through the heart in the same sequence as the blood would flow, including a stop on a pink lung-shaped platform representing the lungs. The exhibit is attractive, fun, educational, sturdy and safe.

The approximate costs were: Fabrication $8000; Paint and lettering $300; Rubber pads $1800; Exhibit Director's time, 200 hours. Total $10,100 plus 200 hours.

Wave Machine: This machine models wave motion as a 10ft long string of metal rods move on a central spine in a visually pleasing way. The idea for this exhibit grew from the availability of two sets of lecture demonstration apparatus from the telephone company. The two sets were combined to make an extra long wave machine. The rods were painted white for better close-up viewing. A method for activation by visitors was devised. An enclosure and stand was constructed by a professional carpenter. The idea was conceived by the Executive Director, the adaptation of the apparatus was engineered and built by the Exhibits Director and a volunteer. The exhibit was very striking in the wave motion it displayed and quite popular. The visitor could see the variations in wave motion determined by the impulse given and the change in 'medium' modelled by the machine. Considerable maintenance problems arose due to the delicate mechanism getting much more use in the museum than in occasional demonstrations. A series of slipping clutches was devised between the visitor and the mechanism which eventually got the maintenance problems under control. The

results were always judged to be worth the trouble.

The approximate costs were: Housing and enclosure $600; Adaptation parts $30; Exhibit Director's time, 50 hours. Total $630 plus 50 hours.

Shadow Box: The Shadow Box was seen at the Exploratorium. It is a shaded room, 10ft by 10ft in which one wall is phosphorescent while the opposite wall has an electronic flash that casts shadows of visitors on the wall. The wall glows, except where the shadows were, for 30 seconds or so. The flash is manually triggered using a four second delay so that the person triggering it has time to get into position in front of the wall. The timer circuitry was designed and built by an electronics technician. The flash housing and installation of the timers was done by the Exhibits Director. Inexpensive photo flash units were originally used but were replaced by a stronger and much longer lasting unit specially built and donated by a company that makes warning lights for antenna towers. The original wall was plasterboard covered with two coats of phosphorescent paint. It was later replaced with ¾in plywood covered with a phosphorescent film that was protected with ⅛in sheets of Plexiglas. This work was done by volunteers and the Exhibits Director. The exhibit demonstrated how the flash light could freeze motion and how the phosphorescent material could be caused to glow and then decay in brightness. It is an extremely popular exhibit with all visitors and especially with young people who like to freeze their shadows while they are jumping off the ground (hence the need for a reinforced wall).

The approximate costs were: Phosphorescent film $250; Wall and Plexiglas $250; Timers $400; Electronic flash $2000 (donated); Flash housing parts $15; Exhibit Director's time, 45 hours. Total $915 plus 45 hours.