

Museums, Teaching and Learning

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For the people who have learned how to use them, most museums, certainly most major museums, have always been centers in the way that they have provided a great variety of patterns that people use for either teaching or learning. But somehow, until about 15 years ago, the potential of museums as adjunctive resources to other forms of learning have been neglected in the popular mind and even in the image that museums have had of themselves. It is not completely clear to me how this neglect came about perhaps some of it had to do with the media that led many innovative people to devote their attention to film, radio and television. A large part of the neglect, I think, had to do with the extraordinary preoccupation of both school and college teaching faculty with the notion of certification. Educational opportunities which did not provide any way of certifying the students or of evaluating their performance were relegated to a different domain and were not considered part of the overall process of public education. This preoccupation with certification has been, in fact, a very deadly one. It has produced generations of teachers who teach what they are supposed to teach rather than what they know and want to teach. Even university faculties sit around and talk about "what-should-the-students-know" rather than what it is that each of them would like to tell the students. In the lower levels of schooling, the preoccupation with certification has done even more damage. In any event, since museums do not certify, and the watching of television shows is not graded, or going to libraries cannot be supervised, all of these adjunctive resources for public education have been neglected. Concomitant with this neglect, schools have become more and more disappointing. They have taken on, and jealously guarded, the total job of education while having at the same time had to cope with



Frank Oppenheimer looking through one of the prisms on the "Prism Tree"

an ever more complicated society and an increasingly mobile population. They have unfortunately failed abysmally. So museums, whether they are called a center or an exploratorium or a museum, must be perceived in a broader light; It is therefore fitting that we are talking about their role. Museums serve as centers in many different ways. They have their permanent exhibit collections and changing special ones. In addition, most of them produce written materials that include not only the labels which accompany the exhibits but also many other documents. At the Exploratorium, we have produced essays about the ideas related to our props as well as catalogues, books and magazines. Museums also create many visuals, including posters, reproductions, postcards, films and television programs. Almost every museum conducts classes and encourages classes that are taught by non-staff people but which are held in the museum. In addition, they arrange public lectures and provide tours, explainers, demonstrators and docents. They hold concerts, dance performances, panel discussions and sponsor conferences and

meetings. Many museums furthermore have programs in which they take samples of their wares out to the schools or community organizations. Every museum is a place to which people in the community can bring their wares, their ideas, and their events, thereby creatively contributing to the museum programs or exhibitions. Museums are places where the staff, as well as the public, can make many discoveries, sometimes through systematic research, and always through forms of investigation that are required in creating their exhibit or their written material.

The Exploratorium is a relatively young museum. It has been in existence only 11 years and yet has become such a center for all manner of diverse activities. I am both flabbergasted and inspired by the richness of the educational endeavors that center around a museum's activities and props.

Yet I do not believe that this richness can arise automatically. None of the projects, exhibits or written material or visuals or lectures or classes that we have engaged in were easy to do. They all required much new thought and discussion, together with long hours of experimentation and effort, and usually, a good chunk of money as well. Frequently museums are not as good as they can be because these kind of activities have not been taken seriously enough by the administrators or because the people who have been engaged in them have not been those who enjoy and have experience in teaching or who thrive on learning. Good teaching whether in a museum or in a school can never happen without a lot of thought and planning. Furthermore, teaching requires a continual refreshment. Last year's lecture notes, for example, invariably require re-understanding and reorganizing of the subject matter in order to be useful this year. To some extent a "bad name" has become associated with the popular conception of museums because many of them have been stagnant. When I first told people that I was going to start a science museum in San Francisco, many of them turned up their noses at the notion of another museum. It was partly in response to this reaction that we invented



The empty Palace of Fine Arts in 1968

the word "Exploratorium" because what we had in mind would be a place for exploration, both for our staff and for our visitors. But in reality, it is essentially a mistake to make distinctions between exploratoriums, science centers, museums or discovery places. The science centers that have been springing up during the past ten years throughout this country and throughout the world should think of themselves as very much allied with other museums, including art museums, natural history museums, history museums, and also those that involve archaeology, anthropology or live animals and plants.

The creation of involving exhibits does not necessarily imply that one must be able to touch or activate exhibits. Although when exhibits are "participatory" the initiation may happen more readily because many people are drawn into paying attention by touching, changing and activating the exhibits. But even then the resultant learning is highly dependent on the attitudes and past experiences that the visitors bring to the museum. I want therefore to talk about the learning which can take place in museums by telling of some of my own experiences that are characteristic of different kinds of museum learning.

My earliest recollection of a museum exhibit that affected me was the armor display at the Metropolitan Museum of Art. I was in elementary school at the time and we were studying the knights of yore. The opportunity to

see those beautiful and ornamented steel vestments enabled me to realize their scale, to appreciate their articulation and to imagine how strange it must have felt to be inside of one of them. I became much more in touch with what we were studying in school. The armor stimulated my imagination and even induced me to make a coat of mail by using several dozens of the kind of key-ring pot scouring pads that were in vogue at that time. This kind of reinforcement by museums can be extremely important. In the Exploratorium we can clearly observe that our exhibits or our graphics become much more meaningful to visitors when they remind people of things they have been studying in another environment than when they have to struggle to connect our exhibits with other experiences. It is obvious, yet often overlooked, that the more that different learning environments can be connected with each other and the more that people can bring experiences with them that bear on the experiences in a new place, the better the total learning will be. But at the outset we were not nearly as aware of this need as we have now become. Yet even with this awareness, we still find it very difficult to satisfy the needs of a diverse audience.

The armor at the Metropolitan was not touchable, and it was not even demonstrated and yet it was nevertheless very involving. It managed to vividly stimulate my imagination. Years later, I remember looking at the gold jewelry from ancient Egypt in the same museum and found myself wondering how that jewelry came to be. Did the women who wore it, order it? Did merchants offer it to their queens, or was it a gift from some lover? There were no answers, but the questionings that I myself invented made me much more aware of the threads that connected that ancient culture with my own. A different kind of insight can develop while standing in front of a statue or a painting. For example, a few years ago, while looking at Clifford Still's paintings at the San Francisco Museum of Modern Art, I became fascinated with the jagged forms that Still left as shadows between broad areas of the painting. It occurred to me that there must have been some reason that he allowed those

jagged spaces to remain. When I tried to imagine where in nature such shapes occur and whence they were derived, I managed to picture overlapping shadows of people, or alternatively, the spaces between leaves of a tree, or the brushes of pine needles, or the splatter of a dark liquid on the pavement. This exercise enabled me to see more clearly than ever how deeply abstract painting could be related to nature, because there is a kind of universality to certain shapes that occur over and over again in seemingly unrelated aspects of nature.



A different kind of museum experience occurred for me at Burlington, Vermont, in a room full of decoy ducks. I had never imagined that there could be such variations in the ducks and that the art of carving them could have been such a major preoccupation. It was truly an enchanting exhibit and experience, telling me about making decoys, about the ducks themselves and also indirectly about the nature of museums. In museums repetition, and multiplicity of examples, whether of painting, decoy ducks, or the interference of light, can be provided more wonderfully than by any other medium including lectures or even books or films.

I have also used museums to learn about a subject in a very systematic way. Shortly after I graduated from college, I worked in the physics department at the university in Florence and every Thursday afternoon, for about six months, went to the Uffizi Gallery. I learned and memorized the names of the painters and their styles, starting with the pre-Giotto Byzantine painters and continuing through the Titians and Tintoretts. I tried to understand the changes that were taking place. In my mind Giotto represented the pinnacle of early Italian

art which in many ways deteriorated as the painters became more skillful. I realized from observing the progressions in Italian art the kind of things that happen in an art or a craft as people use their increased skill to elaborate and embellish. Years later I realized that a similar entrapment by technique and technology also happens to physicists (as well as to three star generals).

Jackie, my wife, and I engaged in a similar form of systematic learning when we lived, for a year, a couple of blocks away from the British Museum in London. We studied the Chinese porcelains there. We learned the names and epochs of the dynasties, and were able, by the end of our stay, to test ourselves on the recognition of the various patterns and textures in the Chinese plates and bowls, an ability that we enjoyed but never had a chance to use. It was during that same year that I visited the science and technology museum in South Kensington. It reminded me of the fine beginnings and the subsequent demise of a science museum in New York City that occurred while I was in high school. I realized what a scandal it was that there were so few and so few good ones in the United States. This realization managed to really alter the rest of my life and therefore represented still another kind of learning that can happen because of museums.

After repeatedly visiting and studying the South Kensington Museum, I traveled to look at other science museums. In Munich I saw one lone machinist who had come upstairs to use a very fine large milling machine that was supposedly only on display. He had plugged it in just for his own purposes of making an exhibit part. That museum experience led me to the realization that machines and carpentry shops usually provide the most genuine technology that occurs in a science museum, a thought which then led to having our Exploratorium machine shop in full public view. At the Palais de la Decouverte in Paris, I watched young demonstrators and realized that they were using teaching as a part of their learning since many of the demonstrators were college students, a realization which later led to



A high-school Explainer helping a visitor with the "Bicycle Wheel Gyro"

instituting an Explainers Program for high school students at the Exploratorium. A visit to the California Academy of Sciences made me aware that a charm of an aquarium was due to the fact that the fish, although not touchable, are always in motion. Therefore, as much as is practical in a science museum, one should have moving devices that the visitors can stop and then control manually to see how they work rather than static demonstrations that the visitor activates.

There is today, especially among some science museum people, a tendency to discount some of the traditional museum techniques. In fact, I myself have argued that the techniques of television and film for portraying, for example, the African Veldt or of Cousteau in the sea, had made obsolete the traditional dioramas. But I recently visited the Denver Natural History Museum and found their dioramas so very, very wonderful. I felt as though I were up in the high country or wandering through fall aspen trees. But even more important, each diorama was full of things to discover: a lizard, a bird's nest, a clump of columbine. I and my companion could spend ten or fifteen minutes finding such things and pointing them out to each other, a kind of activity that is utterly impossible with television.

I mention these kind of learnings to emphasize that museums can be used in such a great

variety of ways, not only for what the designers had in mind, but also for other very specific kinds of learning. My initial interest in learning about museums and museum pedagogy occurred before I had the faintest inkling that I might become concerned with starting a science museum myself. These few examples of some of the different kind of things that can happen are indeed far from exhaustive even in my own experiences. In each instance that I have described I extended my knowledge or thinking by connecting aspects of a museum with previous experiences, with my fantasy world, or with things that were happening in school.

Most of the processes described above were more or less solitary adventures. But the most common form of learning in museums comes about when people go there with friends or relatives and teach each other. Recently I was taken by a friend to the Dumbarton Oaks Museum of pre-Columbian Art in Washington, D.C. I had not even known of the existence of that place, but my friend was a great enthusiast and very knowledgeable of pre-Columbian art in both Peru and Mexico. She used the exquisite exhibits to tell me much about the meaning of the artifacts and about their origin, age and the various people represented. She became very much my teacher, although eventually it became a time of discovery for both of us, and we would point things out to each other. Later, the same day, we went to the National Gallery and looked at the Italian and Spanish paintings. There I was initially the expert and the teacher, and in this instance as well, eventually teacher and pupil begin to change place through observations and conversations.

I have given these examples to show that even for me, museum learning can assume many different forms; for others their uses extend even further. I have also told of ways in which one can become involved with the objects in museums even without touching them. Certainly, although the Exploratorium is one of the most wonderfully participatory environments imaginable, I nevertheless want to emphasize that it is important not to be too

doctrinaire about "hands-on". The important requirement is that museum pedagogy be taken seriously. In most of the places that I have been, the curators could have done more than they have, yet I was pleased, for example, to see in the Philadelphia Museum of Art, a room in which there were four hunting still life paintings with pheasants and other objects laid out on the table. A sign asked: "Three of these paintings were done in one century and the fourth in a different century; can you tell which one was done in the different century?" I looked at the painting a little harder than I might otherwise have done because of their sign. By reading the answer that they provided I saw even more about the paintings than I had discovered all by myself. In most instances, I find that the labels in both art museums and science museums are too minimal. I was pleased to observe that the National Gallery now has a box in each room with a ream of single sheet discussions about the paintings in that room. One can pick up such a paper and wander around with it. Certainly there must be many techniques suitable for every type of museum which could greatly improve their pedagogy. But even as they are, I find that museums can be extraordinarily fine places for learning, for tying together things that have been learned and for providing an intuitive or experiential background which promotes and facilitates subsequent learning. I have also found that working at, or more accurately living at, the Exploratorium I observe a most rewarding and unexpected array of ways in which the place provides opportunities for teaching and learning.

A large number of the children that come to the Exploratorium on field trips bring either their friends or their families back at some time. When they do, it is a delight to watch and overhear them serving as guides, as they select one exhibit after another that they obviously have remembered from their school visit. When high school or college students who are taking a course in science come to the Exploratorium with their friends or parents, they also invariably use the Exploratorium to become the teachers of their companions. Parents are likewise able to use their special



knowledge or expertise to teach their children and talk about things to which the children probably would not pay attention were it not for their captivation by and delight in the demonstrations and props in the Exploratorium. Sometimes the effects are overdone. I have observed mothers who would not let their children touch an exhibit until they had read out loud every bit of the graphics. On one occasion a father who, when his child came running to him with: "Hey dad, come look at this," said to the boy, "You're disgusting, I brought you here because I know about this stuff and I want to show it to you, not the other way around!" Continually, in the Exploratorium, one sees and overhears people explaining, often somewhat unorthodoxly, things to their friends, wives, husbands or children. Classroom teachers, of course, also use the Exploratorium as a part of their teaching. Many of them prepare worksheets or ask the students to find specific exhibits and to describe how they work. A college instructor wrote a laboratory manual during his sabbatical that enabled him to use the Exploratorium exhibits as a laboratory for his intersession courses for teachers. A sixth grade instructor allowed his gifted student class to undertake a spring semester project that consisted of making a film at the Exploratorium. Many college and university faculty either send their students to the Exploratorium or bring them there on specially arranged tours that provide an overview of their course work on, for example, visual perception, optics or neurophysiology. One architecture professor assigned his students a task of designing a pleasant sitting area for the

Exploratorium. A theology professor brought students there to learn about and to write a paper on the implications of perceptual foibles on philosophy. People have used the exhibits in the Exploratorium in the process of writing a book or of making films or television shows. A group that concentrates on teaching sensorially handicapped children arranged several classes at the Exploratorium for the parents of these children. A dozen or so exhibits illustrating, for example, reverse distance cues or delayed speech effects were selected for study so that the parents could get some feeling for the frustrations that their children were experiencing. In addition to our exhibits, we have demonstrations and talks. Our artists-in-residents talk about their work not only to our staff members but to many of our visitors and to local artists. Dr. Tom Humphrey, after he left the Exploratorium, taught classes at the Exploratorium for the College of Mann and for the Art Institute and for the Art Academy which fulfilled the science requirement for those schools. Our staff members have, on a number of occasions, taught courses for college, junior high or high school. We have an ongoing program of teacher workshops for elementary school instruction. The Sigma Psi at San Francisco State University organized a weekend during which a dozen faculty researchers set up some of their apparatus and arranged booths that enabled them to show their data and to explain to our visiting public what their research was all about.

Last year for a period of six months, six different groups of doctors, nurses and technicians set up collections of medical instrumentation and equipment in the Exploratorium. Each subject remained on display for a month. The doctors, technicians and practitioners were on hand during weekends to explain the basic medicine and the medical instrumentation and also to answer questions. In this instance also, the Exploratorium provided an opportunity for professionals to become teachers of the general public. Many of the exhibits that we have on display were commissioned from the people who came to us with an idea or a

device. These commissions also enable people to learn while working at the Exploratorium and to discover how to translate their ideas and knowledge into instructive exhibits. In addition, people from distant universities and museums come and spend time at the Exploratorium teaching us about what they are doing, and learning what we are up to. Historians of science, from Stanford and Berkeley, have written materials for us and planned some of the exhibits. Journalists have become our writers. K.C. Cole, for example, has written for us catalogues that are virtually short textbooks on light and vision and other matters. She too has become a teacher.

In short, one of the most important roles that the Exploratorium has assumed is that of providing rewarding and important opportunities for all manner of people, from the general populace, from the professions and from other kinds of institutions to become teachers as well as learners. I am convinced that what I observe to be happening at the Exploratorium is typical of what happens or what can happen at all manner of museums and centers. But these opportunities for teaching and learning do not necessarily just happen. They require an openness on the part of the staff to the needs and ideas of other people and other groups as well as a continuing devotion to the improvement of one's own pedagogy through exhibit development, through written and graphic material, through films, books, lectures, through what is sold in the store, and importantly through the spirit of the operation and organization of the exhibits. All of these matters have to be carefully thought out and arranged. It is wrong, therefore to talk about the museums as providing "informal" education. Much of what they do must be formalized and disciplined. A museum does, it is true, provide the props and materials that can enable all kinds of people and groups to manage their own education, whether formal or casual. And a museum, unlike a school is not, as I mentioned at the outset, concerned with certification. Nobody either gets a degree or a black mark as a result of a museum visit, and nobody really keeps track of each individual in

the sense that he or she is kept track of in school. But museums do provide most splendid and rewarding opportunities for teaching and learning. But if the museums together with all other educational media, the libraries, television, magazines and books, are really going to join forces to promote public education, then I think it is more important than ever that the role of certification not be as dominant in the overall notion of public education as it has come to be. If the learning is done by the learner for learning itself and the teaching by the teacher is done for the satisfaction of communicating what they know and love, then it will be possible to develop a really expanded view of public education that includes not only the classroom but also the conglomerate of adjunctive learning and teaching resources that we are in the process of creating.