

# Exploration and Discovery

## Frank Oppenheimer, Exploratorium

Acceptance speech for the AAM Distinguished Service Award - June 21, 1982

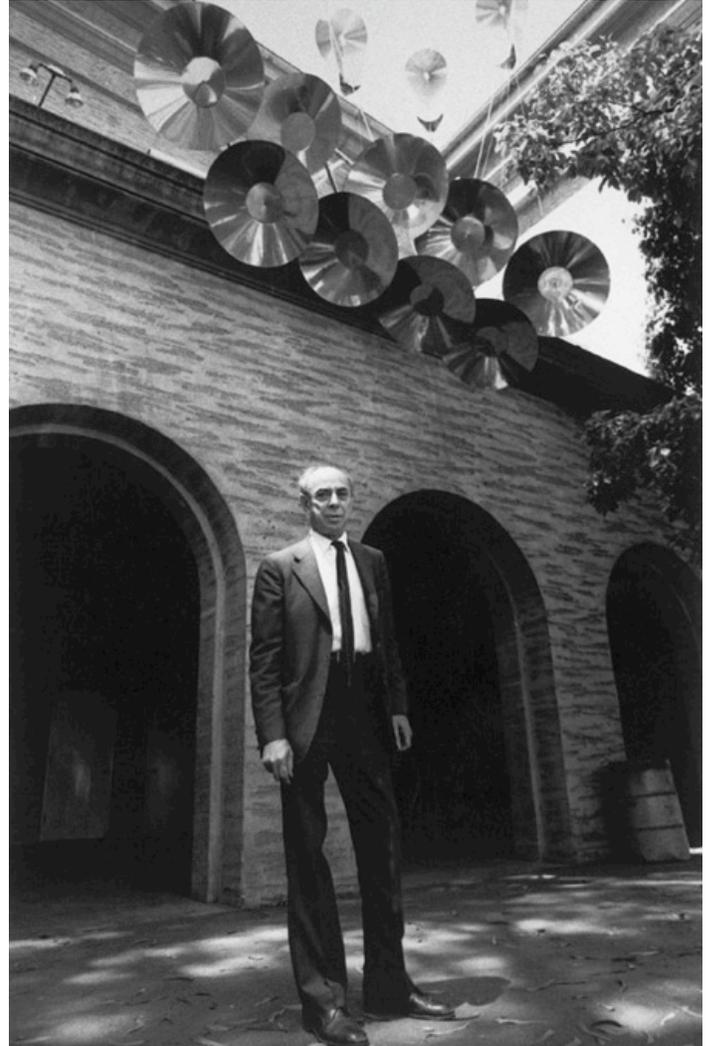
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Thank you very much. I worried about this speech more than any other that I have given and now I am even more worried about it.

I am, of course, extraordinarily honored to receive this distinguished service award from the American Association of Museums. I do want to thank Ken Starr again. It was he who first told me about the award. We have been friends and have become terribly fond of each other over the years so this is a wonderful occasion for me. I am also especially pleased to have an award from AAM because when I first started developing a science museum, there was no organization whatsoever which thought of science centers as part of the museum world. Since we didn't have collections in the normal sense of the word, we weren't eligible to join the AAM. So it seems that this award is not only to me but to the entire field of science centers. I am extremely pleased with that.

Science centers have grown and multiplied rapidly and impressively during the last 10 years and communication between them has become very important. But communication between all museums has been and will continue to be important, and is one of the extraordinary and vital things that the AAM accomplishes.

Although all museums are based on props, most museums and perhaps especially science centers are basically museums of ideas. What we communicate in science centers are ways of thinking about nature or about technology. Such ways of thinking about nature traditionally have been part of the body of our culture. When we study the Greeks and when we look at the religions of ancient people, we invariably study the way people thought of nature in the world around them.



Frank Oppenheimer outside the Exploratorium's front entrance beneath the Aeolean Harp

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Today such thoughts about nature are developed by and come out of science. They are as imaginative and fantastic as they ever were. But what surprises me is the limited role that people now ascribe to science. That which was in the past considered culture, was called natural philosophy, is today denied its place in our culture. People continue to talk of the arts and music as culture but neglect the fact that our view of ourselves, our role in the world and what the world is like, is equally and vitally a part of culture.



The empty Palace of Fine Arts before the Exploratorium moved in.

The other thing that surprises me is the distinction that is made between the culture and transmitting the culture through education. Museums are thought of as cultural institutions and not as educational institutions. But I do not see any essential difference between the two descriptions. To me, the whole point of education is to transmit the culture, and museums can play an increasingly important role in this process. Therefore, they are basically educational institutions. It is a mistake to think that preserving the culture is distinct from transmitting it through education. So that what Ken said about the Exploratorium, I think, is true of all museums, whether they like to admit it or not, curators are educators.

I've always been a very avid museum goer. I grew up in New York City with the Metropolitan Museum and the American Museum of Natural History and my family was peripherally involved in the beginning of the Museum of Modern Art. But my first official contact with the museum world occurred during the summer of 1966 when I was invited to present a paper at a conference in Burlington, Vermont, that was sponsored by the Office of Education and the

Smithsonian Institution. The proceedings of this conference were written up in a fine book edited by Eric Larabee. It was an exhilarating conference at which I made friends with many, many people who have remained friends more or less continually during these past 16 years.

I would like to talk about two broad topics in response to being presented with this award. I want especially to talk about the remarkable extent to which other museums have influenced and shaped what has happened in developing the Exploratorium. But first, I want to discuss my own feelings about the general topic of exploration. One of the people that I met at the Burlington Conference was Albert Parr. I went to see him at the Museum of Natural History and he subsequently visited me at the Palace of Fine Arts in San Francisco. At that time I was merely hoping that we would get permission to use the building, yet he was most encouraging. He urged me to publish the introduction of my initial proposal for the Exploratorium. This introduction, "[A Rationale for a Science Museum](#)", presented the idea of using human perception as a starting point for exhibitry.



The beautiful exterior of the Palace of Fine Arts

Perception has provided a starting point for us. But from that start we have been able to go as far as we wish in both the sciences and the arts. Perception is basic, of course, to both. Dr. Parr was entranced by the Palace of Fine Arts building, and he was full of ideas for things that we could do within it. He felt we should not put up any walls. We were hoping to build a theater within the building, but he said that we should attach it to the outer curve of the building and should not obscure the wonderful 1000 foot long, 120 degree arc of space within the building. Unfortunately, we were unable to change the outside of the building to accommodate his suggestion. He remarked that it would be fine if the museums had more exhibits outside rather than inside. For example, he suggested that the whale in the American Museum hall should instead be in

Central Park Lake. But, alas, this suggestion to us has also been unrealized largely because a determined band of vandals, in the early morning hours of the weekends, push over everything in sight - even 1,000 pound concrete statues. Although I would still like to be able to take that part of his advice, we have not been able to afford to keep the exterior area secure.

Dr. Parr seemed to me such a wise, thoughtful and encouraging person that I feel very humble at being presented with the same award that the AAM presented to him. I cannot envision myself as living up to his stature. During his visit to San Francisco, he told me a fine story about his youth. He lived in a small town which, I believe, was outside of Stockholm. At the age of 10 or 12 he would be asked by his parents to go into the city to buy a variety of supplies for the family. He would ride the train, get off at the industrial edge of the city, go by factories and then wander around one kind of market or another encountering all manner of people. He remembered these expeditions as being full of adventure and richness as well as creating for him a sense of self-reliance. He compared his experiences with those of suburban children, who nowadays must be chauffeured everywhere, and who have neither responsibilities for long-distance wandering on behalf of their households nor intriguing opportunities for exploring on their own.

Even city children are probably now much less free to wander around than they were fifty years ago. For the most part, both children and adults have few opportunities for exploration. They usually know ahead of time where they are going and why they are going there. They rarely just wander on the off-chance that they might find something interesting. Television has amplified this lack of interest in wandering; when children are bored they don't go out trying to find something, they don't wander around, they don't look for new things, they merely turn a knob and watch the tube. As a consequence, the whole tradition of exploration is being lost for entire generations.

It is, therefore, more important than ever that museums assume the responsibility for providing the opportunities for exploration that are lacking for both city and suburban dwellers. It would be fine indeed if they would, but it will take a bit of doing to do so properly. If museums are too unstructured, too unmanageable, people get lost and simply want to get back to home base. On the other hand, if they are too rigid, too structured or too channeled, then there are no possibilities for individual choice or discovery.

Exploring, like doing basic research, is often fruitless. Nothing comes of it. But also like basic research, as distinct from applied or directed research, exploring enables one to divert attention from preconceived paths and to deviate from the original path to go after some intriguing lead: a fragrance or a sight or smell or an interesting street or a cave or even a hole in the ground or a sudden open meadow encountered in the woods or a patch of flowers that leads one off the trail. Often it is precisely as a result of initially aimless exploration that one does become intensely directed and intensely preoccupied. Painters often carry a sketchpad on their wanderings. Durer became absorbed in the sketching of hands, Chagall with horses, mules and donkeys pulling wagons. Albers became preoccupied with squares. I, as a physicist, became absorbed with the origin of cosmic rays in an accidental way. I was invited to go to the University of Minnesota in the late 40's because General Mills was learning how to make huge helium-filled balloons that would carry a large payload 20 miles up into the atmosphere.

We thought they would provide an opportunity to study nuclear physics by studying the impact of the cosmic rays that are found at high altitudes since very large high-energy accelerators did not exist at that time. We developed an elaborate apparatus for this purpose, but at the last minute we also attached a stack of photographic plates to the balloon. When these came down, we discovered that these photographic plates showed, not just the expected tracks of hydrogen nuclei, but also very dark, wide



Frank Oppenheimer (right) adjusting a cosmic ray experiment lifted aloft by balloon

tracks of the nuclei of all elements. This discovery opened up a whole new field of study. Although that discovery was made in 1948, the people who were in our group at the University of Minnesota and the University of Rochester are still, 44 years later, tracking down the discovery that was made simply because we added those photographic plates to supplement the main instrument of the experiment. It was really an exploration that paid off in an unexpected way.

It is those things that are found through one's own exploration that often tend to seem particularly one's own. This proprietary interest can exist even if it turns out that other people have made the same discovery. The things that people discover on their own in a museum usually lead them to bring back their friends, children or parents. It is those things that they remember most and tell about and go back to see over and over again even 50 years after finding them.

Whenever we move exhibits to new locations in the Exploratorium, many visitors frantically ask us, "Where is this...what happened to...?" They had come back specifically to show somebody an exhibit that they had discovered during a previous visit. It is exploration that leads to the discovery of unexpected novelty, and it is invariably such unexpected novelty that really moves science and technology into

new frontiers of understanding. Without the introduction of novelty and discovery, problems could not be solved. Discovery, however, is made not just through science and technology but, equally and importantly, through the explorations of art. It is the artists who perceive and communicate how people react to their environment and it is often through their discoveries that we change our behavior and our feelings, including our attitudes toward life and toward all of nature. Personal discovery, whether it occurs through art, through science or just by wandering around the city or the country or a museum, brings far-reaching satisfaction and personal consequences that are vastly greater than knowledge which is just handed to you or told to you.

But even though we can appreciate the role of discovery and its importance in museums, it is never an easy task to provide it. There is no way of achieving a universally applicable balance between, on the one hand, the amount of guidance that is required to insure that people are not discouraged and, on the other hand, the amount of freedom needed to permit the kind of exploration that can give people the full satisfaction of discovery. Each situation, each subject takes a specifically appropriate adjustment of this essential balance.

The balance that we have tried to achieve in the Exploratorium between unfettered exploration and detailed guidance is still constantly being adjusted. We may try this, we try that, and we decide that people need a little more guidance and we make a change, and then discover that people are being too regimented in the way they look at the exhibits. But the balance that we eventually adopt is undoubtedly largely a matter of taste and an expression of personality. I therefore think it is quite legitimate that different museums adopt different solutions to these problems. For the solutions are most human when they are reflections of some individual's attitude towards the entire process and purpose of learning. It is such attitudes, rather than specific 'objective evaluations' that ultimately must determine the balance between guidance and exploration. Regrettably, many of the people who talk about

the discovery method of teaching are really talking about the arranging of a lesson or an experiment so that students discover what they are supposed to discover. I don't think that is exploration. In order for exploration to take place, there has to be a built-in richness that makes it possible for people to find things that even the staff (or the teachers) didn't know about when they conceived the exhibit or the lesson. We find that the very process of fabricating an exhibit is full of discovery and that even after an exhibit has been out on the floor for a month or even a year, we discover new things in it. It also is especially remarkable and wonderful that our visitors keep discovering things that we haven't yet discovered and tell us about them. The fullest aspect of discovery, whether in a painting or in a diorama or in a science experiment, occurs when each separate piece of the museum is so rich that it has components that nobody knew were there when it was first set out. It is not enough that the museum as a whole be a place to find novelty.

There are some museums that I know that defy any exploration. I would say, for example, that New York's Guggenheim Museum (which was designed by an architect and not a museum person) provides an example of such a place. Visitors cannot in any way change the order in which they see the pictures, and if they want to bring somebody back to show them a particular picture, they have to start at the top and go by all the other pictures. Two of the exhibits in the Smithsonian History and Technology Museum provide, for me, an excellent example of the difference between ample and overly limited opportunities to explore. "We The People" has all kinds of wonderful things to discover. It has political buttons, banners, speeches, photographs and costumes telling about all manner of moving, impressive or terrible things that people have said or done in our history. These things are tucked away and yet easily found. Thematically, however, the exhibit is highly organized. "A Nation of Nations," on the other hand, provides virtually nothing to discover. As one walks by it, one gets the message that we are a nation of nations very clearly and

beautifully. There are intriguing illustrative objects to look at. But one does not come away from it with any particular new feeling about the subject, and not even with much detail that one remembers. It is just an elaborate reinforcement of something that one really knew already but that is retold in a very picturesque way.

Allowing for the possibilities for exploring does not mean that a museum has to be disorganized either physically or conceptually. It does, however, mean that there has to be a lot which people can readily miss, so that discovery becomes something of a surprise, a triumph, not so much of personal achievement as of personal satisfaction. It is the kind of satisfaction that invariably leads me to tell someone about the experience.

Opportunities for discovery do not require the kind of interactive experiments that we have in the Exploratorium. They can also derive from very static exhibits.

I admire the dioramas in the Denver Museum of Natural History so very much. I keep finding new things in them - a lizard here or an arrowhead there or a high-altitude heliotrope hidden behind some grass. In a recent visit there, the people around me were constantly pointing out to each other, "Oh, look! Over there behind that rock." The dioramas reproduce the sense of discovery that occurs when one is really out in the woods or wandering around in the high country.

Of course, a particularly fine thing for me about those Colorado dioramas is that they represent something familiar to me. I had been in that kind of country. This effect is a quite general one: I have become ever more aware that the exhibits which mean the most to our visitors are those that they can connect with their past experience. But such connections are difficult to establish since each visitor has had a very different range of experiences. Yet one has to keep trying to do so through graphics and through an appropriate juxtaposition of exhibits in the hope that at least some piece of the



The "Blue Sky" exhibit where one learns that sunsets are red because air scatters blue light.



The diffraction of a point light source into fans of light by passing the light through a piece of sheer cloth.

museum meshes with a piece of the visitor's past life.

Museum experiences most certainly can influence the way in which people perceive their subsequent experiences. We hope, for example, that when visitors who have been to the Exploratorium subsequently see a rainbow or look at the blue sky or see strange shafts of light when they squint, remember the Exploratorium and say to themselves. "Aha! What I am seeing is like the exhibits in the Exploratorium, like the bending of light in Glass Beads or the scattering of light by the cylinder of gelatin in Blue Sky or the diffraction of light around my eyelashes in the Diffraction exhibit. I saw those exhibits on the mezzanine of the Exploratorium."

In concluding, I want to talk about the many influences that have shaped the Exploratorium. Certainly my past experiences with teaching and curriculum development had a major influence on the Exploratorium. However, many other factors have been equally important. During 1965 I spent a year in London on a Guggenheim Fellowship as well as an appointment at University College. My wife and I frequently went to the science center in South Kensington, where we became aware of the lack of such facilities in this country.

There were only a handful of them in 1965 and most cities and states had none. In fact, Colorado, where I had lived for 20 years, had none. The Science Center in Kensington had a room in the basement with many exhibits for children which they could change and play with. The entire museum seemed to me a marvel, and it kindled my interest in science museums even though most of the exhibits were historical or static. But the children's portion emphasized how important it is to be able to say, "what would happen IF ..."

People who are well-grounded and initiated in art can look at a painting and understand how different the composition would have been if some small line had been omitted or a color changed ever so slightly, or they can appreciate why the artist painted different versions of a particular scene. In short, they can understand the effect, the impact, of a change. In a museum of ancient culture the initiated visitor can recreate history through the artifacts and the statues. In the science museums, however, we take great pains to induce visitors to ask themselves the question, "what if?", and then to enable them to find some answer to their questioning.

My interest in science museums was rekindled by the science museum in London. They have a wonderful collection of optics and great models of ships from all ages and all lands. Their exhibit on paper chromatography challenged me to determine how much I could learn about chromatography from the exhibit. The exhibit did not help much, but it did lead me to go to a library to learn about the subject.



Herschel's prism at the Science Museum in South Kensington, UK

We also visited the Palais de la Decouverte in Paris where they had many college student demonstrators. These students remained in the area in between their demonstrations and answered questions about the exhibits. This feature of the Palais suggested our Explainer Program to me. We modified the idea by using paid high school students. We were able to do so because San Francisco has a program in which students can go to school in the morning and work in the afternoon.



An orange-jacketed explainer demonstrates the "String Squirter" to a visiting family.

The Explainer Program satisfied a goal that I had been unable to achieve satisfactorily in a classroom. It enabled us to have a workable program in which the process of teaching facilitates learning. Everybody admits that they learn more when they start teaching than they did in courses. These high school students are learning constantly in formal and informal sessions and at the same time, often the same afternoon, they have an opportunity to teach others what they have learned.



Exploratorium teacher Paul Doherty works with science teachers on a density experiment.

I spent a week at the Munich Museum. I was impressed by their program in which teachers came to the museum in the fall before school opened for a protracted session and had a complete training on the use and the contents of the museum. We have been able to adapt that idea in our museum through our School-in-the-Exploratorium (SITE) program, which develops teacher training workshops. I learned many things in the Munich Museum. Everything was so well-crafted there that I think they must have been made by elves in the basement. Yet I noticed that one man had come up out of the subterranean shop and was using one of the exhibits, a fancy milling machine, to do something he couldn't do in the basement. It was so nice to watch him that I think that incident first suggested to me our policy of having the Exploratorium machine and carpentry shops open to public view.

But I also learned some negative things there. The Munich Museum presents physics in a series of rooms, and the material in each room



The Exploratorium's shops are on the exhibit floor visible to the visiting public.

corresponds identically to a chapter of a standard physics text; one room on mechanics, one on optics, one on light, etc. I realized more than ever that a great virtue of a museum lies in its ability to unify things rather than to separate them. In a course that meets every Monday, Wednesday and Friday, one is forced to present the material in a linear fashion. The over-compartmentalization of the physics in the Munich Museum made me much more aware of the great potential for presenting a unifying overview that constitutes a special characteristic of museums.

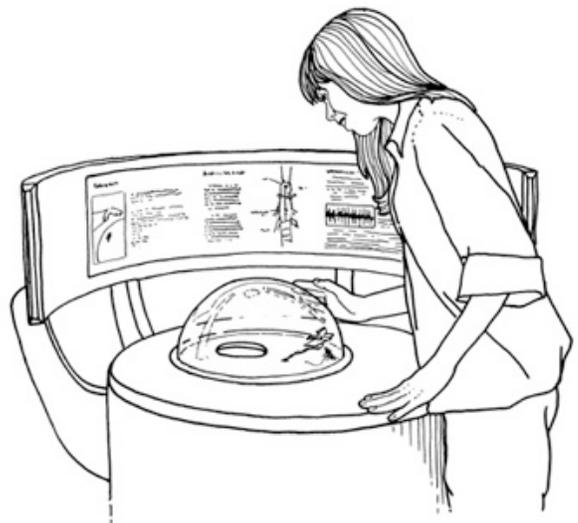
In the American Museum of Natural History exhibits on culture, I realized another very special property of museums. They have multiple examples of cultures from different islands and different continents; yet each culture is shown with a richness of detail; each has its pots, its weaving, its tools and its housing. Each one is different, yet through the multiple examples, one begins to abstract and to discover the common elements, the true meaning of a culture. In the Exploratorium we have therefore tried to do just that. We do not, for example, have just one exhibit on refraction, one on interference and one on the polarized light. An entire small section is developed for each kind of behavior, displaying six or eight examples of each topic in a variety of contexts.

There are many things that we have not been able to do as well as others have done. Both

Franklin Institute and the Philadelphia Art Museum have the great virtue of displaying the old along with the new. I wish we could do so in the Exploratorium but we do not have access to the older material. Perhaps more sharing would be possible in this regard, for it can be extremely nice in all museums to show the continuity of history as well as the continuity of concepts.

Many, many museums, from our very beginning, have been extraordinarily helpful to the Exploratorium. When I first started, I distributed our initial proposal widely. I sent one to Charles Blitzer at the Smithsonian, who I had met at the Burlington conference. An assistant of his, Diana Hamilton, got interested in it and wrote me that she thought it was most promising. So we met and she became our "agent" in Washington, with a modest retainer. She discovered for us the exhibit at the Corcoran Annex called Cybernetic Serendipity, which had been put together by the Institute for Contemporary Arts in London. She very wisely thought it would be a good beginning for our Exploratorium. So we talked with Renato Danise at the Corcoran Annex and he persuaded ICA in London to let us have it. He also looked into commercial transportation and found that it was much too expensive for us. So the Corcoran staff loaded Cybernetic Serendipity into a rental truck, drove it to San Francisco, and even helped us set it up. It was indeed a most important beginning for our place for it really set the stage for the kind of work we wanted to do because it combined perception, art, technology and science in a wonderful way. We still have some of its exhibit pieces that we purchased when the exhibit was disbursed 18 months later. (We originally had permission to show it for only six weeks.)

The idea of using sketches of our exhibits in our exhibit catalog/textbooks came from an effort of the Toronto Museum. The National Gallery of Arts has boxes of printed sheets which explain all the exhibits in each room. We are contemplating something similar by having a series of laminated sheets in several areas of the Exploratorium together with a pay copying machine.



There are innumerable aspects of other museums that have influenced the Exploratorium. The art museum in Copenhagen has the wildest disarray of plaster casts stored, partially on display and partially helter-skelter in the basement of the museum that is open to the public. It is wonderful to see the bowels of a museum and to realize that a museum can be partly a hock shop and partly a Gumps window.

There is a small house in the museum near Burlington, Vermont that contains nothing but decoy ducks. There is no text, no book or no film that could so effectively communicate the spirit, the sense of craftsmanship or the variety of ingenuity that has gone into the creation of decoy ducks as does that little section of a museum. It taught me a great lesson more effectively than any of the places that I have seen. It is there that I first appreciated how museums can enable people to find the essence of things through an enchanting multiplicity of examples. The San Francisco Steinhart Aquarium taught me another lesson. The fish there are captivating in part because they are always in motion. Science centers, on the other hand, tend to have static exhibits that are set in motion by the visitors. In the Exploratorium, a sizable fraction of the exhibits are continually in motion unless they are stopped or put under manual control by some action of the visitor.

The influences that have shaped the Exploratorium have come not only from other museums but also from the staff, from artists and scientists in universities, as well as from industries and research labs and from visitors who stop to talk with us or who write to us.

The Exploratorium is also a composite of things that I have used in my previous teaching and curriculum development projects, and from my associates in the academic community. The development of a mutual respect and a sense of common objective between the academic world and the museum world seems to me an extraordinarily important thing to cultivate even more determinedly than it has been in the past. Much of what I think of as our success has come from contacts with people in the

academic world, but our success has also enabled people in the academic world to respect science centers and to see that they can enjoy them and use them effectively. It is, I think, extremely important that these various worlds be put together.

My experience with the many influences that shaped the Exploratorium have made me ever more aware of the important role that museum societies like AAM and ASTC play in helping museums improve themselves. The more that museum members can afford, through the auspices of these societies, to move around and see what others are doing, the richer and better our profession will be.

I thank you again for this award.

