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NEW CONCEPTS FOR SCIENCE AND TECHNOLOGY MUSEUMS

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Since science museums generally display their exhibits in compartmental arrangements, there are two possible misconceptions imparted to the visitors: (1) there are no unifying principles behind the different natural phenomena; (2) there is a natural boundary separating the natural and social sciences. As a simple remedy, it is proposed that before the exit of every science museum, there should be a room or a space showing some established principles that are able to unify many different phenomena found in nature, with examples taken from both the natural and social sciences. Three such principles are fractals, chaos and active walks.

1 INTRODUCTION

Science museum (or science and technology museum) is an effective medium in helping the public to understand science. In comparison with popular science books[1-3] or TV science programs, museums are limited by their physical locations and large budgets. Yet, when available these museums allow the public to see the real objects, and, apart from admiring the wonders of nature itself, learn the science principles behind some natural phenomena.

In China new science museums appeared rapidly in the last 20 years. In other parts of the world, for example, in Barcelona, Spain, a brand new science museum is under construction. There is no doubt that the importance of science museums is well recognized.

The first step in making a good science museum is to have good exhibits. The next step is to make it partially or completely physically interactive. Almost all science museums stop here. This could create a problem and is most unfortunate; most unfortunate because the problem is easily removable. What is needed is a *new* concept.

2 POSSIBLE MISCONCEPTIONS IMPARTED TO THE VISITORS

The exhibits in all science museums are displayed according to their subject matter, in other words, in compartments. For example, the exhibits may be put into four divisions: the inanimate matters, life, intelligent matters, and civilizations. This classification is according to the hierarchic construction of the material world, as we know it. The world is made of atoms, and, in increasing size, atoms form molecules, molecules form condensed matter—inorganic matters and organic matters. Organic matters form living matters—plants and animals. Animals consist of cells and organs. In particular, we have human bodies. A group of humans form a society, leading to civilizations. Consequently, the four divisions of the exhibits are logical and there is nothing wrong with that. However, science museums with these compartmental exhibits could create two misconceptions for the visitors:

1. The visitor may leave with the impression that science is neatly divided into compartments; that is, there is no unifying themes or principles behind many of those exhibits.

2. Since almost all science museums are limited to natural sciences only, the visitor may go home thinking that there is a natural boundary separating the natural sciences from the social sciences.

The fact that social science should and can only be based on natural science[4-6] is easy to see, but is sometimes overlooked. Social science is about the study of human behaviors and human societies. Humans are (biological) material bodies which, of course, is part of natural science since natural science is about *all* material bodies.

3 A SIMPLE REMEDY

How can these two misconceptions be avoided and corrected? Very simple. Before the exit of every science museum, there should be a room or a space showing some established principles that are able to unify many different phenomena found in nature, with examples taken from both the natural and social sciences. There are three such principles.[7]

1. *Fractals*—the principle of self-similarity. Fractals are everywhere, ranging from the morphology of tree leaves, rock formations, human blood vessels, to the stock market indices and the structure of galaxies.
2. *Chaos*—the common (but not universal) phenomenon that the behavior of many nonlinear systems depends sensitively on their initial conditions. Examples of chaos include leaking faucets, convective liquids, human heart beats, planet motion in the solar system, etc.
3. *Active walks*—a major principle that Mother Nature uses in self-organization. Active walk is a paradigm introduced by the author in 1992 to handle complex systems [7,8]. In an active walk, a particle (the walker) changes a deformable potential—the landscape—as it walks; its next step is influenced by the changed landscape. For example, ants are living active walkers. When an ant moves, it releases chemicals of a certain type and hence changes the spatial distribution of the chemical concentration. It next step is moving towards positions of higher chemical concentration. In this case, the chemical distribution is the deformable landscape.

Active walk has been applied successfully to a number of complex systems coming from the natural and social sciences. Examples include pattern formation in physical, chemical and biological systems such as surface-reaction induced filaments and retinal neurons, the formation of fractal surfaces, anomalous ionic transport in glasses, granular matter, population dynamics, bacteria movements and pattern forming, food foraging of ants, spontaneous formation of human trails, oil recovery, river formation, city growth, economic systems, and, most recently, human history.[4,5,9-11]

4 CONCLUSION

It is gratifying to note that in some science museums in China[12,13] and perhaps elsewhere, some, but not all, of the unifying principles mentioned above have been included in their exhibits. However, unfortunately, there is still no emphasize on the theme that social sciences and natural sciences are an integral whole, and the former is based on the latter, with unifying principles.[4-6]

Lastly, to have the greatest and lasting impact on the visitors, I still think that putting the unifying themes of all natural and social phenomena before the exit of a science museum is the best choice.

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