Complexity and Rock Gardening

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I am very honoured and pleased to receive the first International Award from the Japanese Society of Hydrology and Water Resources.

Understanding what is going on around us is equivalent to building models and confronting them with observations. However, we are dealing with the complex world in which variables involved are not known to any comparable degree of detail. What is complexity? Complexity is an idea that is part of our everyday experience. Quite often, in analyzing complexity the very choice of what should be a pertinent variable may well be part of the problem we try to solve.

Two main assumptions are well accepted by system scientists. Complex behaviour, represented by non-linear dynamics is a consequence of (a) the system structure and (b) feedback relationships between system components. Feedback is a characteristic of any system in which the output, or result, affects the input of the system, thus altering its operation. In a well-connected world consequence of our actions at one point may very likely be felt at many other locations in the system domain. Let me use the example of climate variability and change. Increased industrialization of Japan or Canada is usually manifested in the increased emission of harmful gases into the atmosphere. Increased concentration of gases affects the temperature and spatial and temporal precipitation pattern. Therefore consequences of actions in Canada can be felt in Japan and vice versa.

A very interesting result emerging from the modeling of complex systems is the following. If a new activity is launched at a certain time, it will grow and stabilize. If the location is well selected, it may even prevent the success of similar attempts made nearby at a later time. However, if the same activity is launched at a different time, it need not succeed; it may regress to zero and represent a total loss. This illustrates the danger of short-term, narrow planning based on the direct extrapolation of past experience. The principle message of the dynamic modeling is that the adaptive possibility of natural systems is the main source allowing them to survive in the long term, to innovate of themselves, and to produce originality.

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One possible way to increase our understanding of complexity is the transfer of knowledge: between people, between disciplines, and between different time intervals. My personal collaboration with colleagues from Japan is aimed at actively maintaining the transfer of knowledge. During my many visits to Japan I fell in love with Japanese gardens, especially the choice of rocks, their secret placing and variety of shapes that carry special meaning. I also learned how such rock gardens are made. The rock is usually a porous volcanic stone, which is chosen by a rock farmer for its sculptural possibilities. The rock farmer would carefully chisel the rock to open it up in a subtle way. Then the rock farmer would carefully select a spot near the edge of a lake or a river, with moving water, and would plant the rock there to erode in a natural way over a generation, or several generations. The farmer himself, or his son or grandson, would harvest the rock, and incorporate it into the composition of a garden. This sense of connection, of continuity, is an extremely important aspect of complexity. We are all fathers and sons in the same time. We are all rock farmers. I personally hope that one day someone in Japan will harvest the rocks I planted in my professional life. I am already harvesting rocks planted by my Japanese colleagues.

Once more thank you very much for the great honour given to me by your Society.