rate from our rejection of the imposition of individual biases on other scholars; we continue to believe that disciplines capture generalities and that information science should not reject any valid research on information and should attempt to embrace all forms of information.

4. A Process

Information is always informative about something, being a component of the output or result of the process. This "aboutness" or representation is the result of a process or function producing the representation of the input, which might, in turn, be the output of another function and represent its input, and so forth. Consider a common process such as cooking. Baking a cake begins with ingredients and a set of instructions, either written, spoken, or in the mind of the cook. Following the instructions, the cook transforms the ingredients into a sloppy mess which, after an appropriate amount of baking, results in a cake, if one is careful and perhaps lucky.

Examining the cake provides information about both the process and the original ingredients, assuming that the cake may be examined without the act of observation changing the cake. The choice of high quality ingredients or the addition of a special flavoring will affect the outcome, ideally in a beneficial way. Varying the process, such as the amount of time in the oven or the temperature at which the cake is baked, also changes the final product, and an examination of the final product provides information about the process used as well as about the ingredients. Note that the information will seldom allow one to fully reconstruct the producing process and its input, and any prior knowledge about the process or its input will aid in the reconstruction. The cooking process changes one set of ingredients, one set of materials, into another set of materials: The cake. The change from one set of materials to the cake provides information about the original materials, and the baking process. We may speak of the cooking process as carrying information about the original materials.

A cook cannot move backwards from a cooked cake to regenerate the original ingredients; baking is almost always an irreversible process. Processes may be totally reversible, allowing the process to move backwards from the final state to the initial state. Reversible processes are such that no information is unrecoverable (lost) during the operation of this process; thus, given the output, one can still move back to the input. A simple reversible process is one that increments the input by one and returns the incremented value. One can always take the output and, knowing the nature of the process, move backward to the unique input that produced the output. On the other hand, non-reversible processes may lose information as they operate. Given the output of a non-reversible process, one cannot always tell which input produced the output. The square function that produces the number 4, for example, could take +2 or −2 as its *argument*, what it takes as input; knowing the result does not provide all the information needed to determine the input to the function. Information about the sign of the original number is lost when squaring occurs, making the reversal of the process not possible for all cases. Similarly, if the reader is told that the sum of two numbers is 7, it is impossible to determine whether the two initial numbers were 6 and 1, 4 and 3, or some other combination. One can imagine a reversible variant of this function that produces the sum and one of the original numbers. One can always move from these two outputs back to the original values.

Other types of processes produce information. An interesting phenomena is found at the quantum level in physics. Consider two particles that are produced from a single process such that they are moving in opposite directions. Many pairs of particles produced from a single creating process will each have a characteristic which does not "take on" a value (for either particle) until this value is observed or measured by instrumentation. Because these particles (will) have opposite characteristic values, measuring the value of one of the particles causes or forces the other particle, no matter at what distance, to take on the opposite value for the characteristic. A measuring process here makes information appear or become available; we try to avoid saying that information was "created" by the measuring process. The measuring process takes the particles that are valueless in regards to the characteristic as input and produces particles that have values.

All processes produce information: Making cakes and measuring characteristics of sub-atomic particles, physical processes and processes commonly understood as non-physical, describable and indescribable processes. An understanding of the information produced by processes requires some understanding of the nature of a process. Processes may be complex, or they may be simple and easily described and studied. All produce information about the input and the process. The author believes that all processes can be described, given enough time and resources. However, even if some processes cannot be described it is still useful to recognize the output of the process as "about" the process itself and the input. Furthermore, the notion of information as the values in the output of a process is helpful in understanding information phenomenon.

Processes consistent with assumptions defined by mathematicians may be defined as mathematical functions, such as those obtained by pressing mathematical operator keys on a calculator. These functions take one or more *arguments* as input and *return* a single value. Each input will produce the same given output each time a deterministic function is used, acting mechanically, always giving the same output from a given input. The process of addition, being deterministic and given common mathematical assumptions, will always produce 5 from inputs 2 and 3. Consider the *increment* function, which returns the value one more than the amount as-