

A review of *The Information: a history, a theory, a flood* by James Gleick,  
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We often hear that the fluttering wings of a butterfly in the Amazon might create ripples that lead to a hurricane in the Atlantic. Without debating the degree of truth in that statement, I suggest that an idea with a quiet beginning can create a major shift in understanding. One such example is the birth of Jesus in Bethlehem.

*The Information* asserts that the publication of *A Mathematical Theory of Communication* by Claude Shannon in the *Bell System Technical Journal* in 1948 is the focal point of such a shift in worldview. That article introduced a radically new definition of “information.” The worldview that resulted sees information as the fundamental organizing principle and mechanism for the universe and even for the immaterial world.

Shannon defined information as an entropy function that describes the information in a message as the "surprise" value in receiving that particular message from among a set of potential (but not necessarily equally likely) messages. If there are  $n$  potential messages, with message  $i$  having probability of selection  $p_i$ , then the average information in the system is

$$H = - \sum_{i=1}^n p_i \log_2(p_i)$$

Note that this definition omits any sense meaning. Shannon wrote:

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages.

The origin of the base 2 logarithm in the definition is Shannon's notion that the fundamental unit of information is the *bit*.

Gleick builds up to Shannon's ideas by tracing older systems for encoding messages: African talking drums, the development of writing (also resulting in a fundamental shift in worldview), Morse code, the development of the first dictionaries, Charles Babbage's pre-computers, symbolic logic, and cryptography. He discusses the historical setting and contemporary influences on Shannon (including discussions with Alan Turing). After a description of

Shannon's work, Gleick takes a deeper look at the slippery notion of "entropy" and its origins in the sciences.

Gleick then looks at some ways that Shannon's notions of information percolated into other disciplines. This includes biology (genetic codes and DNA being understood as information and information transmission mechanisms), the realm of ideas (memes), and information as a way to grapple with understanding randomness. He continues with a look at how information theory ideas are found in quantum mechanics. The final chapters look at the internet and information overload.

I found the book to be very enjoyable. It is written for a general (but educated) audience. I intend to use it in a course on the interplay between science, technology, and society with a group of honors students. Each chapter is full of intriguing ideas that are sure to generate lively discussion.

Nevertheless, when discussing how Shannon's ideas have migrated into the present, the book suffers from a critical omission. Gleick discusses in detail Shannon's definition of information and also (in sufficient depth) the details of a Turing machine. He mentions that a Turing machine is capable of performing any computation that any current or future computer can accomplish. What Gleick does not mention is the assertion by McCulloch and Pitts that a neural net has the same computing power as a Turing machine. (The assertion actually required some modification to the neural net model many years later in order to validate the assertion.)

Here is the missing connection (which *is* made in *How we became posthuman* by Katherine Hayes): Turing machines are models of computers and neural nets are models of human brains. Both can be seen as equally-expressive examples of "information processors." Since information in this new worldview is all about pattern and probabilities, information can exist independently of a particular (or any) physical medium. So from some perspectives there is no fundamental difference between humans and sophisticated machines. We should someday be able to download our brains onto a computer once we know how to faithfully copy the pattern. We should also be able to create machines (perhaps in human shape as androids) that are capable of being our peers or our superiors.

Within a worldview that assumes information is the basic organizing principle of the universe, this is all quite natural (but highly reductionistic). We just need to understand the various codes and learn how to do the translations from one encoding to another.

You might think it is unlikely that the idea in the previous two paragraphs would be given credence by serious people. However, some very intelligent people are actively promoting this view. Among them, Hans Moravec (<http://www.primitivism.com/reductionism.htm>) and Ray Kurtzweil ([http://en.wikipedia.org/wiki/The\\_Singularity\\_Is\\_Near](http://en.wikipedia.org/wiki/The_Singularity_Is_Near)). Both have solid credentials in computer science. Some writers who have taken exception to these ideas are Jaron Lanier ([http://www.edge.org/3rd\\_culture/lanier/lanier\\_index.html](http://www.edge.org/3rd_culture/lanier/lanier_index.html)) who has equally credible credentials in computer science, and Katherine Hayles, who discusses the "information processor" idea in depth and presents some arguments against this view (in particular the high degree of reductionism).

There are several ways in which the purported equality of humans and machines fails.

1. This assertion neglects real differences between humans and machines. Much of who we are as people is determined not just by our logical thinking but also by our emotions. And our emotions are intimately tied to our hormone systems. In fact, much of who we are is deeply connected to our gender. If I were to move my brain into silicon, would I really be the same person? I would assert that I would not.
2. Much of our intelligence and our identity resides in our body. (There are experiments that indicate that when we touch a hot object, our arm moves faster than a nerve signal could travel to the brain and return as an impulse to move the arm.) Any attempt to download our brains into something that is not a body is doomed to failure. In fact, the Biblical record indicates that even in heaven we will have bodies. People like Hans Morovek are seeking the opposite of what God intends.
3. This assertion carries an implicit assumption that there is no creator. Humans are assumed to be a product of a material universe and as such are machines built upon biological mechanisms. Most readers of this review would reject this assumption in favor of a loving God who created the universe and also created people to be in relationship with him.
4. This desire to gain immortality by moving our consciousness to computers or to artificial bodies or through genetic manipulation is extremely selfish. If this were to become possible, only a wealthy elite would be able to initially avail themselves of the opportunity. Those who completed the process would then have extended time to gain more power and wealth and would not need to cede their positions to later generations. This would dramatically increase the social and economic inequities in the world. God has forcefully stated that such behavior is unacceptable. It is not possible to gain immortality by means outside of God's gracious provision through Christ. Such attempts are rooted in the essence of sin: willfully removing ourselves from dependence on God and setting ourselves up as self-sufficient entities.

As educated followers of Christ who wish to understand and speak to our generation, it is useful to understand this new worldview. *The Information* is a good introduction (from a secular perspective). The book is worthy of our attention.