Scientific laws of information and their implications—part 1

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The grand theory of atheistic evolution posits that matter and energy alone have given rise to all things, including biological systems. To hold true, this theory must attribute the existence of all information ultimately to the interaction of matter and energy without reference to an intelligent or conscious source. All biological systems depend upon information storage, transfer and interpretation for their operation. Thus the primary phenomenon that the theory of evolution must account for is the origin of biological information. In this article it is argued that fundamental laws of information can be deduced from observations of the nature of information. These fundamental laws exclude the possibility that information, including biological information, can arise purely from matter and energy without reference to an intelligent agent. As such, these laws show that the grand theory of evolution cannot in principle account for the most fundamental biological phenomenon. In addition, the laws here presented give positive ground for attributing the origin of biological information to the conscious, wilful action of a creator. The far-reaching implications of these laws are discussed.

In the communication age *information* has become fundamental to everyday life. However, there is no binding definition of information that is universally agreed upon by practitioners of engineering, information science, biology, linguistics or philosophy.

There have been repeated attempts to grapple with the concept of information. The most sweeping formulation was recently put forward by a philosopher: "The entire universe is information."[1] Here we will set out in a new direction, by seeking a definition of information with which it is possible to formulate laws of nature.

Because information itself is non-material,[2] this would be the first time that a law of nature (scientific law) has been formulated for such a mental entity. We will first establish a universal definition for information; then state the laws themselves; and, finally, we will draw eight comprehensive conclusions.

What is a law of nature?

If statements about the observable world can be consistently and repeatedly confirmed to be universally true, we refer to them as laws of nature. Laws of nature describe events, phenomena and occurrences that consistently and repeatedly take place. They are thus universally valid laws. They can be formulated for *material* entities in physics and chemistry (e.g. energy, momentum, electrical current, chemical reactions). Due to their explanatory power, laws of nature enjoy the highest level of confidence in science. The following attributes exhibited by laws of nature are especially significant:

- *Laws of nature know no exceptions*. This sentence is perhaps the most important one for our purposes. If dealing with a real (not merely supposed) natural law, then it cannot be circumvented or brought down. A law of nature is thus universally valid, and unchanging. Its hallmark is its immutability. A law of nature can, in principle, be refuted—a single contrary example would end its status as a natural law.
- *Laws of nature are unchanging in time*.
- *Laws of nature can tell us whether a process being contemplated is even possible or not*. This is a particularly important application of the laws of nature.
- *Laws of nature exist prior to, and independent of, their discovery and formulation*. They can be identified through research and then precisely formulated. Hypotheses, theories or models are fundamentally different. They are invented by people, not merely formulated by them. In the case of the laws of nature, for physical entities it is often, but not always,[3] possible to find a mathematical formulation in addition to a verbal one. In the case of the laws for non-material entities presented here, the current state of knowledge permits only verbal formulations. Nevertheless, these can be expressed just as strongly, and are just as binding, as all others.
- *Laws of nature can always be successfully applied to unknown situations*. Only thus was the journey to the moon, for example, possible.

When we talk of the laws of nature, we usually mean the laws of physics (e.g. the second law of thermodynamics, the law of gravity, the law of magnetism, the law of nuclear interaction) and the laws of chemistry (e.g. Le Chatelier's Principle of least restraint). All these laws are related exclusively to matter. But to claim that our world can be described solely in terms of material quantities is failing to acknowledge the extent of one's perception. Unfortunately many scientists follow this philosophy of materialism (e.g. Dawkins, Küppers, Eigen[4]), remaining within this self-imposed boundary of insight. But our world also includes non-material concepts such as information, will and consciousness. This article (described more comprehensively in ref. 1) attempts, for the first time, also to formulate laws of nature for non-material quantities. The same scientific procedures used for identifying laws of nature are also used for identifying laws governing non-material entities. Additionally, these laws exhibit the same attributes as listed above for the laws of nature. Therefore they fulfil the same conditions as the laws of nature for material quantities, and possessing, consequently, a similar power of inference. Alex Williams describes this concept as a "revolutionary new understanding of information".[5] In an in-depth personal discussion with Dr Bob Compton (Idaho, U.S.A.), he proposed to name the laws of nature on information the "Scientific Laws of Information (SLI)" in order to distinguish them from the physical laws. This positive suggestion is to be taken seriously since it takes account of the shortcomings of the materialistic view. I have therefore decided to use the term here.

What is information?

Information is not a property of matter!

The American mathematician Norbert Wiener made the oft-cited statement: "Information is information, neither matter nor energy."[6] With this he acknowledged a very significant thing: information is not a material entity. Let me clarify this important property of information with an example. Imagine a sandy stretch of beach. With my finger I write a number of sentences in the sand. The content of the information can be understood. Now I erase the information by smoothing out the sand. Then I write other sentence in the sand. In doing so I am using the same matter as before to display this information. Despite this erasing and rewriting, displaying and destroying varying amounts of information, the mass of the sand did not alter at any time. The information itself is thus *massless*. A similar thought experiment involving the hard drive of a computer quickly leads to the same conclusion.

Norbert Wiener has told us what information is *not*; the question of what information really *is*, then, will be answered in this article.

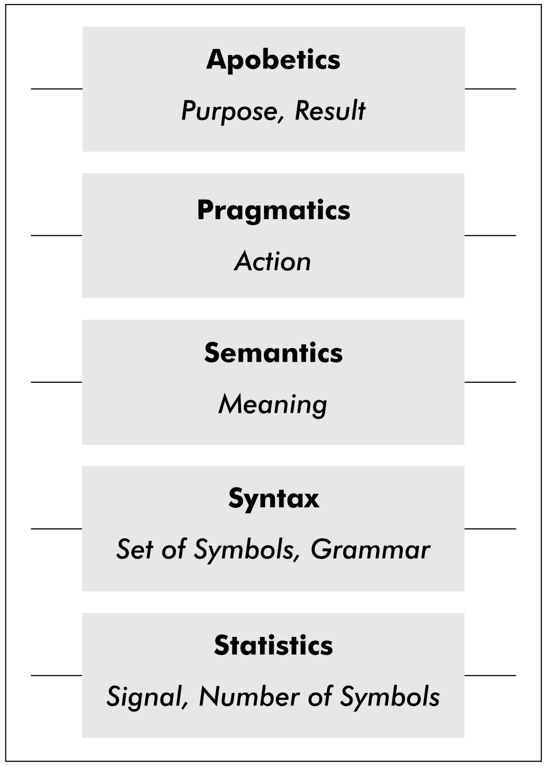

Figure 1. The five levels of information. To fully characterise the concept of information, five aspects must be considered—statistics, syntax, semantics, pragmatics and apobetics. Information is represented (that is, formulated, transmitted, stored) as a language. From a stipulated alphabet, the individual symbols are assembled into words (code). From these words (each word having been assigned a meaning), sentences are formed according to the firmly defined rules of grammar (syntax). These sentences are the bearers of semantic information. Furthermore, the action intended/carried out (pragmatics) and the desired/achieved goal (apobetics) belong of necessity to the concept of information. All our observations confirm that each of the five levels is always pertinent for the sender as well as the receiver.

Because information is a non-material entity, its origin is likewise not explicable by material processes. What causes information to come into existence at all—what is the initiating factor? What causes us to write a letter, a postcard, a note of congratulations, a diary entry or a file note? The most important prerequisite for the construction of information is our own will, or that of the person who assigned the task to us. Information always depends upon the will of a sender who issues the information. Information is not constant; it can be deliberately increased and can be distorted or destroyed (e.g. through disturbances in transmission).

In summary: Information arises only through will (intention and purpose).

A definition of universal information

Technical terms used in science are sometimes also used in everyday language (e.g. energy, information). However, if one wants to formulate laws of nature, then the entities to which they apply must be unambiguous and clear cut. So one always needs to define such entities very precisely. In scientific usage, the meaning of a term is in most cases considerably more narrowly stated than its range of meaning in everyday usage (i.e. it is a subset of). In this way, a definition does more than just assign a meaning; it also acts to contain or restrict that meaning. A good "natural-law" definition is one that enables us to exclude all those domains (realms) in which laws of nature are not applicable. The more clearly one can establish the domain of definition, the more precise (and furthermore certain) the conclusions which can be drawn.

Example—energy: In everyday language we use the word *energy* in a wide range of meanings and situations. If someone does something with great diligence, persistence and focused intensity, we might say he "applies his whole energy" to the task. But the same word is used in physics to refer to a natural law, the law of energy. In such a context, it becomes necessary to substantially narrow the range of meaning. Thus physics defines energy as the capacity to do work, which is *force x distance*.[7] An additional degree of precision is added by specifying that the force must be calculated in the direction of the distance. With this, one has come to an unambiguous definition and has simultaneously left behind all other meanings in common usage.

The same must now be done for the concept of information. We have to say, very clearly, what information is in our natural-law sense. We need criteria in order to be able unequivocally to determine if an unknown system belongs within the domain of our definition or not. The following definition permits a secure allocation in all cases:

Information is always present when all the following five hierarchical levels are observed in a system: statistics, syntax, semantics, pragmatics and apobetics.

If this applies to a system in question, then we can be certain that the system falls within the domain of our definition of information. It therefore follows that for this system all four laws of nature about information will apply.

The five levels of universal information (figure 1)

1. *Statistics.* In considering a book, a computer program or the genome of a human being we can ask the following questions: How many letters, numbers and words does the entire text consist of? How many individual letters of the alphabet (e.g. a, b, c … z for the Roman alphabet, or G, C, A and T for the DNA alphabet) are utilized? What is the frequency of occurrence of certain letters and words? To answer such questions it is irrelevant whether the text contains anything meaningful, is pure nonsense, or just randomly ordered sequences of symbols or words. Such investigations do not concern themselves with the content; they involve purely statistical aspects. All of this belongs to the first and thus bottom level of information: the level of statistics. The statistics level can be seen as the bridge between the material and the non-material world. (This is the level on which Claude E. Shannon developed his well-known mathematical concept of information.[8])
2. *Syntax.* If we look at a text in any particular language, we see that only certain combinations of letters form permissible words of that particular language. This is determined by a pre-existing, wilful, convention. All other conceivable combinations do not belong to that language's vocabulary. Syntax encompasses all of the structural characteristics of the way information is represented. This second level involves only the symbol system itself (the code) and the rules by which symbols and chains of symbols are combined (grammar, vocabulary). This is independent of any particular interpretation of the code.
3. *Semantics.* Sequences of symbols and syntactic rules form the necessary pre-conditions for the representation of information. But the critical issue concerning information transmission is not the particular code chosen, nor the size, number or form of the letters—nor even the method of transmission. It is, rather, the semantics (Greek: *semantikós* = significant meaning), i.e. the message it contains—the proposition, the sense, the meaning.
4. Information itself is never the actual object or act, neither is it a relationship (event or idea), but encoded symbols merely represent that which is discussed. Symbols of extremely different nature play a substitutionary role with regard to the reality or a system of thought. Information is always an abstract representation of something quite different. For example, the symbols in today's newspaper represent an event that happened yesterday; this event is not contemporaneous; moreover, it might have happened in another country and is not at all present where and when the information is transmitted. The genetic words in a DNA molecule represent the specific amino acids that will be used at a later stage for synthesis of protein molecules. The symbols of figure 2 represent what happened on Creation Day 1 (Genesis 1:1–5).
5. *Pragmatics.* Information invites action. In this context it is irrelevant whether the receiver of information acts in the manner desired by the sender of the information, or reacts in the opposite way, or doesn't do anything at all. Every transmission of information is nevertheless associated with the expectation, from the side of the sender, of generating a particular result or effect on the receiver. Even the shortest advertising slogan for a washing powder is intended to result in the receiver carrying out the *action* of purchasing this particular brand in preference to others. We have thus reached a completely new level at which information operates, which we call pragmatics (Greek *pragma* = action, doing). The sender is also involved in *action* to further his desired outcome (more sales/profit), e.g. designing the best message (semantics) and transmitting it as widely as possible in newspapers, TV, etc.
6. *Apobetics.* We have already recognized that for any given information the sender is pursuing a goal. We have now reached the last and highest level at which information operates: namely, apobetics (the aspect of information concerned with the goal, the result itself). In linguistic analogy to the previous descriptions the author has here introduced the term "apobetics" (from the Greek *apobeinon* = result, consequence). The outcome on the receiver's side is predicated upon the goal demanded/desired by the sender—that is, the plan or conception. The apobetics aspect of information is the most important of the five levels because it concerns the question of the outcome intended by the sender.

In his outstanding articles "Inheritance of biological information"[5], Alex Williams has explained this five-level concept by applying it to biological information. Using the last four of the five levels, we developed an unambiguous definition of information: namely an encoded, symbolically represented message conveying expected action and intended purpose. We term any entity meeting the requirements of this definition as "universal information" (UI).

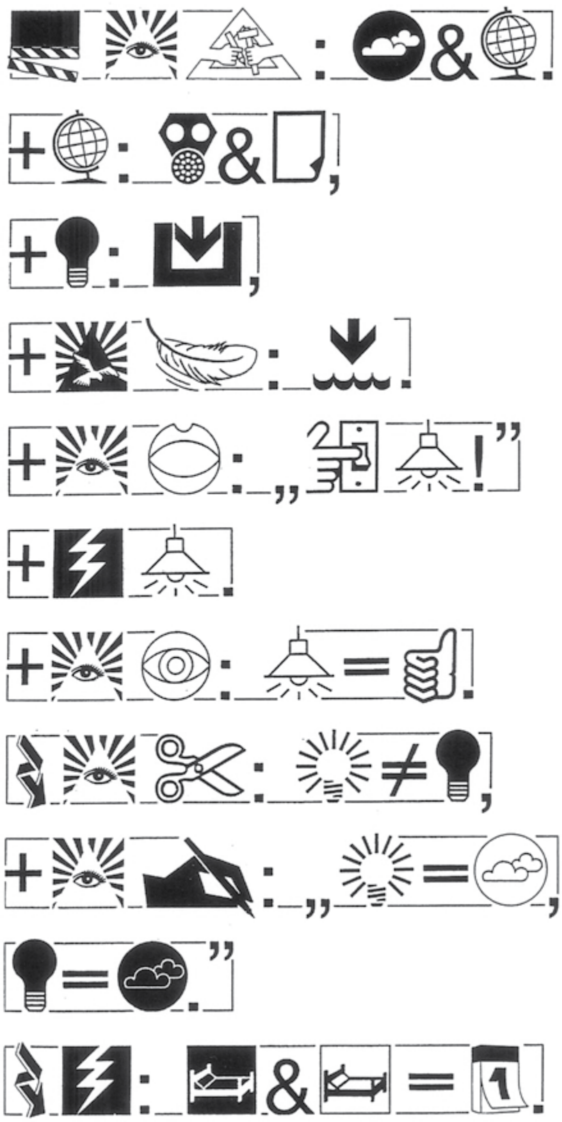

Figure 2. The first five verses of Genesis 1 written in a special code.

Scientific laws of information (SLI)

In the following we will describe the four most important laws of nature about information.[9]

SLI-1[10]

> *A material entity cannot generate a non-material entity*

In our common experience we observe that an apple tree bears apples, a pear tree yields pears, and a thistle brings forth thistle seeds. Similarly, horses give birth to foals, cows to calves and women to human babies. Likewise, we can observe that something which is itself solely material never creates anything non-material. The universally observable finding of SLI–1 can now be couched in somewhat more specialized form by arriving at SLI–2.

SLI-2

> *Universal information is a non-material fundamental entity*

The materialistic worldview has widely infiltrated the natural sciences such that it has become the ruling paradigm. However, this is an unjustified dogma. The reality in which we live is divisible into two fundamentally distinguishable realms: namely, the material and the non-material. Matter involves mass, which is weighable in a gravitational field. In contrast, all non-material entities (e.g. information, consciousness, intelligence and will) are massless and thus have zero weight. Information is always based on an idea; it is thus also massless and does not arise from physical or chemical processes. Information is also not correlated with matter in the same way as energy, momentum or electricity is. However, information is stored, transmitted and expressed through matter and energy.

The distinction between material and non-material entities

Necessary Condition (NC): That a non-material entity must be massless (*NC*: $m = 0$) is indeed a necessary condition, but it is not sufficient to assign it as non-material. To be precise, the "sufficient condition" must also be met.

Sufficient Condition (SC): An observed entity can be judged to be "non-material" if it has *no* physical or chemical correlation with matter. This is always the case if the following four conditions are met:

- *SC1: The entity has no physical or chemical interaction with matter.*
- *SC2: The entity is not a property of matter.*
- *SC3: The entity does originate in pure matter.*
- *SC4: The entity is not correlated with matter.*

Photons are massless particles and they are a good contrast to the SC because they do interact with matter and can originate from and be correlated with matter.

Information always depends on an idea; it is massless and does not originate from a physical or chemical process.[11] The necessary condition (NC: m = 0) and also all four sufficient conditions (SC1 to SC4) are also fulfilled, and therefore universal information is a non-material entity. The fact that it requires matter for storage and transportation does not turn it into matter. Thus we can state:

Universal Information is a non-material entity because it fulfils both necessary conditions:

1. it is massless; and,
2. it is neither physically nor chemically correlated with matter.

Occasionally it is claimed that it is a physical (and thereby a material) entity. But as presented under SLI-1, information is clearly a non-material entity.

There is another very powerful justification for stating that information cannot be a physical quantity. The SI System of units has seven base units: mass, length, electric current, temperature, amount of substance, luminous intensity and time. All physical quantities can be expressed in terms of one of these base units (e.g. area = length x length) or by a combination (by multiplication or division) of several base units (e.g. momentum = mass x length / time). This is not possible in the case of information and therefore information is not a physical magnitude!

SLI-3

> *Universal information cannot be created by statistical processes*

The grand theory of evolution would gain some empirical support if it could be demonstrated, in a real experiment, that information could arise from matter left to itself without the addition of intelligence. Despite the most intensive worldwide efforts this has never been observed. To date, evolutionary theoreticians have only been able to offer computer simulations that depend upon principles of design and the operation of pre-determined information. These simulations do not correspond to reality because the theoreticians smuggle their own information into the simulations.

SLI-4

> *Universal information can only be produced by an intelligent sender*

The question here is: What is an intelligent sender? Several attributes are required to define an intelligent sender.

Definition D1: An intelligent sender as mentioned in SLI-4

- is conscious
- has a will of its own[12]
- is creative
- thinks autonomously
- acts purposefully

SLI-4 is a very general law from which several more specific laws may be derived. We know the Maxwell equations from physics. They describe, in a brilliant generalization, the relationship between changing electric and magnetic fields. But for most practical applications these equations are far too complex and cumbersome and for this reason we use more specific formulations, such as Ohm's Law, Coulomb's Law or the induction law. Similarly, in the following section we will present four more specific formulations of SLI-4 (SLI-4a to 4d) that are easier to use for our practical conclusions.

SLI-4a

> *Every code is based upon a mutual agreement between sender and receiver*

The essential characteristic of a code symbol (character) is that it was at one point in time *freely defined*. The set of symbols so created represents all allowed symbols (by definition). They are structured in such a way as to fulfil, as well as possible, their designated purpose (e.g. a script for the blind such as Braille must be sufficiently palpable; musical symbols must be able to describe the duration and pitch of the notes; chemical symbols must be able to designate all the elements). An observed signal may give the impression that it is composed of symbols, but if it can be shown that the signal is a physical or chemical property of the system then the fundamental "free mutual agreement" attribute is missing and the signal is not a symbol according to our definition.[13]

SLI-4b

> *There is no new universal information without an intelligent sender*

The process of the formation of new information (as opposed to simply copied information) always depends upon intelligence and free will. A sequence of characters are selected from an available, freely defined set of symbols such that the resulting string of characters represents (all five levels of) information. Since this cannot be achieved by a random process, there must always be an intelligent sender. One important aspect of this is the application of will, so that we may also say: *Information cannot be created without a will.*

SLI-4c

> *Every information transmission chain can be traced back to an intelligent sender*[14]

It is useful to distinguish here between the *original* and the *intermediate* sender. We mean by the original sender the author of the information, and he must *always* be an individual equipped with intelligence and a will. If, after the original sender, there follows a machine-aided chain consisting of several links, the last link in the chain might be mistaken for the originator of the message. Since this link is only *apparently* the sender, we call this the *intermediate* sender (but it is not the *original* one!).

The original sender is often not visible: in many cases the author of the information is *not* or *no longer* visible. It is not in contradiction to the requirement of observability when the author of historical documents is *no longer* visible—in such a case he *was,* however, observable once upon a time. Sometimes the information received has been carried via several intermediate links. Here, too, there must have been an intelligent author at the beginning of the chain. Take the example of a car radio: we receive audible information from the loud speakers, but these are not the actual source; neither is the transmission tower that also belongs to the transmission chain. An author (an intelligent originator) who created the information is at the head of the chain. In general we can say that there is an intelligent author at the beginning of every information transmission chain.

The actual (intermediate) sender may not be an individual: we could gain the impression that, in systems with machine-aided intermediate links, that the last observed member is the sender:

- The user of a car auto-wash can only trace the wash program back to the computer—but the computer is only the *intermediate* sender; the *original* sender (the programmer) is nowhere to be seen.
- The internet-surfer sees all kinds of information on his screen, but his home computer is not the original sender, but rather someone who is perhaps at other end of the world has thought out the information and put it on the internet.
- It is by no means different in the case of the DNA molecule. The genetic information is read off a material substrate, but this substrate is not the *original* sender*;* rather, it is only the *intermediate* sender.

It may seem obvious that the last member of the chain is the sender because it seems to be the only discernible possibility. But it is never the case in a system with machine-aided intermediate links that the last member is the original sender (= author of the information)—it is an intermediate sender. This intermediate sender may not be an individual, but rather only part of a machine that was created by an intelligence. Individuals can pass on information they have received and in so doing act as intermediate senders. However, they are in actuality only intermediate senders if they do not modify the information. If an intermediate changes the information, he may then be considered the original sender of a new piece of information.

Even in the special case where the information was not transmitted via intermediaries, the author may remain invisible. We find in Egyptian tombs or on the obelisks numerous hieroglyphic texts, but the authors are nowhere to be found. No one would conclude that there had been no author.

SLI-4d

> *Attributing meaning to a set of symbols is an intellectual process requiring intelligence*

We have now defined the five levels (statistics, syntax, semantics, pragmatics and apobetics) at which universal information operates. Using SLI-4d we can make the following general observation: these five aspects are relevant for both the sender and the receiver.

Origin of information: SLI-4d describes our experience of how any information comes into being. Firstly, we draw on a set of symbols (characters) that have been defined according to SLI-4a. Then we use one symbol after another from the set to create units of information (e.g. words, sentences). This is not a random process, but requires the application of intelligence. The sender has knowledge of the language he is using and he knows which symbols he needs in order to create his intended meaning. Furthermore, the connection between any given symbol and meaning is not originally determined by laws of physics or energy. For example, there is nothing physically about the three letters "d, o, g" that necessarily originally caused it to be associated with man's much loved pet. The fact that there are other words for "dog" in other languages demonstrates that the association between a word and its meaning is mental rather than physical/energetic. In other words, the original generation of information is an intellectual process.

Finally, we make three remarks that have fundamental significance:

Remark R1: Technical and biological machines can store, transmit, decode and translate information without understanding the meaning and purpose.

Remark R2: Information is the non-material basis for all technological systems and for all biological systems.

There are numerous systems that do not possess their own intelligence but nevertheless can transfer or store information or steer processes. Some such systems are inanimate (e.g. networked computers, process controls in a chemical factory, automatic production lines, car auto-wash, robots); others are animate (e.g. cell processes controlled by information, bee waggle dance).

It is important to recognize that biological information differs from humanly generated information in three essential ways:

- In living systems we find the highest known information density.[15]
- The programs in living systems obviously exhibit an extremely high degree of sophistication. No scientist can explain the program that produces an insect that looks like a withered leaf. No biologist understands the secret of an orchid blossom that is formed and coloured like a female wasp … and smells like one, too. We are able to think, feel, desire, believe and hope. We can handle a complex thing such as language, but we are aeons away from understanding the information control process that develop the brain in the embryo. Biological information displays a sophistication that is unparalleled in human information.
- No matter how ingenious human inventions and programs may be, it is always possible for others to understand the underlying ideas. For example, during

World War II, the English succeeded, after considerable effort, in understanding completely the German "Enigma" coding machine which had fallen into their hands. From then on it was possible to decode German radio messages. However, most of the ingenious ideas and programs we find in living organisms are hardly, or at best only partly, understood by us at all. To make an exact replica is impossible.

Remark R3: The storage and transmission of information requires a material medium.

Imagine a piece of information written on a blackboard. Now wipe the board with a duster. The information has vanished, even though all the particles of chalk are still present. The chalk in this case was the necessary material medium but the information was represented by the *particular arrangement* of the particles. And this arrangement did not come about by chance—it had a mental origin. The same information could have been stored/transmitted in Indian smoke signals through the arrangement of puffs of smoke, or in a computer's memory through magnetized domains. One could even line up an array of massive rocks into a Morse code pattern. So, clearly, the *amount* or *type* of matter upon which the information resides is not the issue. Even though information requires a material substrate for storage/transmission, information is not a property of matter. In the same way, the information in living things resides on the DNA molecule. But it is no more an inherent property of the physics and chemistry of DNA than the blackboard's message was an intrinsic property of chalk.

Conclusion

All these four laws of nature about information have arisen from observations in the real world. None of them has been falsified by way of an observable process or experiment.

The grand theory of atheistic evolution must attribute the origin of all information ultimately to the interaction of matter and energy, without reference to an intelligent or conscious source. A central claim of atheistic evolution must therefore be that the macro-evolutionary processes that generate biological information are fundamentally different from all other known information-generating processes. However, the natural laws described here apply equally in animate and inanimate systems and demonstrate this claim to be both false and absurd.

Acknowledgments

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7. Energy can exist in various forms (e.g. mechanical, electrical, magnetic, thermal). These are, however, equivalent to each other and are thus expressible in the same units (e.g. Joules).
8. Gitt, ref. 1b, pp. 170–180.
9. Gitt, ref. 1b, pp. 131–150.
10. We abbreviate the individual laws of nature about information to SLI.
11. Information can direct, steer, control and optimize the running of material processes. These processes are carried out by programs that are freely thought out and designed. They are not based on physical or chemical correlations between matter and information. In contrast, there is a definite chemical correlation between hydrogen and oxygen that under certain circumstances will combine to produce water.
12. "Will" here does not meant a decision that a computer makes following a particular algorithm; rather; it signifies a personified will that is able to reach a free and arbitrary decision that cannot be predicted in advance.
13. By contrast, the triplet code carried on DNA can easily be shown to meet the criterion of being freely chosen in the sense of being arbitrary. In other words, there is no physical/chemical reason why the biomachinery of cells has to assign to the triplet GAC, for instance, the meaning of the amino acid "leucine". In fact, in some yeast species it is translated as "serine"? This underscores the point—since the code is not the inevitable outcome of the physics and chemistry of the system, it was at some prior time freely chosen.
14. *Intelligent Source* always refers to an individual who is equipped with a will and consciousness. It is not in contradiction to SLI-4c if the author of the information cannot always be specifically identified, but, rather, sometimes only identified generally, as in the following examples: texts in Egyptian Pharaoh's tombs (Egyptians), historical documents (unknown author), secret radio messages (the military), computer viruses in the internet (criminals), graffiti (graffiti artists), information in biological systems (creator).
15. Gitt, ref. 1b, pp. 311–313.

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