Consciousness Explained by Daniel Dennett (Chapter Summaries)
Chapter 7, The Evolution of Consciousness

1. Inside The Black Box of Consciousness

Taking a new tack, Dennett suggests that we pause in our external (heterophenomenological) scrutiny of the “black box” of consciousness for a moment, and instead consider how consciousness might have arisen evolutionarily. Since human consciousness is obviously a relatively recent phenomenon (evolutionarily speaking), it must have evolved from prior processes that themselves weren’t actually conscious. The reason an evolutionary line of thought might be profitable for us, is that it is easier to imagine the behavior of a “device” that one “builds” or synthesizes from the inside out, than it is to try and analyze a “black box” and try to figure out what is going on inside.

Up till now we have been taking the behavior or phenomenology of the brain as a given and wondering what hidden mechanisms inside could explain what we observe. Now let’s think about the evolution of brains or nervous systems for doing “this or that” and see if by this we can explain some of the puzzling “behaviors” of our consciousness. Dennett proposes to tell a story, one that is not necessarily complete or scholarly, but in the interests of keeping it short and interesting, more like a hundred word summary of War and Peace. In our particular case- this document is therefore a summary of a summary, so please read Dennett’s book to get even "the hundred word summary of War and Peace."

The story of the origins of consciousness will be analogous to other stories from the evolution of biology, for example the origins of sex. Originally all was asexual reproduction and then slowly by some imaginable series of steps, some of these organisms must have evolved into organisms with gender and eventually into us. How, and even more importantly, why did this happen?

The parallels between the evolution of sex and consciousness are intriguing: there is almost nothing “sexy” (for humans at least) about the sex life of flowers, oysters and other simple forms of life, but we recognize in these apparently “joyless routines of reproduction the foundations and principles of our much more exciting world of sex." In the same way, there is nothing especially "selfy" (as Dennett coins the term) about the primitive precursors of human consciousness, but they lay the foundations for our “particularly human innovations and complications.” Dennett suggests that our conscious minds are the result of three successive evolutionary processes, piled on top of each other, each one successively much more powerful and complicated than it’s predecessor.

2. Early Days (Genesis)

“In the beginning, there were no reasons: there were only causes. Nothing had a purpose, nothing had so much as a function; there was no teleology in the world at all.”

This is because there was nothing that actually had “interests.” But after a while there emerged simple replicators. Though they had no inkling of their interests and it would be proper to say they indeed had no interests, we, looking back from our “god-like” perspective can assign them certain interests by defining them an “interest” in self-replication. Of course their replication didn’t really matter to anyone and really made no difference whether they replicated or not (though perhaps we might be grateful they did replicate), but we can say that if these simple replicators are to survive and replicate in the face of increasing entropy (disorder), their immediate environment must be conducive to replication at least some of the time.

To put it anthropomorphically: if these simple replicators want to replicate they should “hope and strive” to avoid “bad” things and seek “good” things. The “good” for such an entity (by our non-teleological definition) is to, however primitively, avoid it’s dissolution and decomposition. This is the simple replicator’s “point of view” if you will. In this “point of view” there are three kinds of world events: the favorable, the unfavorable and the neutral. Any behavior, even simple chemical causes, of these simple replicators that improves it’s replication, is a reason or interest in our limited sense, however “unself” recognized that behavior might be to the organism itself.

Now as soon as something is in the business of (preserving) self-replication, boundaries start to become important. Simply because if you are preserving your replicating self, you don’t want to waste your energy on preserving the rest of the universe. So you need to draw a line. The replicator becomes, in a word, “selfish”.

Obviously this primordial “selfishness” does not have most of the variety and breadth of human selfishness, but this "selfishness" is distinctly different from non-life. A piece of granite can in no sense imaginable, be said have an interest in where it’s boundaries are. Nothing “works” to protect a fracture boundary, no mechanism pushes the boundary back to preserve itself. All things biological have the imperative- “me against the world”. Not just ingestion and excretion , respiration and transpiration but also other processes. Consider the immune system, with it’s millions of different antibodies arrayed in defense of millions of alien intruders. The fundamental problem that the immune system must deal with is: “recognition” of what are “friendly” forces (belonging to the organism) and what are “unfriendly” forces (those seeking it’s dissolution). It is worth pointing out that this “army” of the immune system is an army without generals, without headquarters, or even a description of the “enemy.” The antibodies represent their enemies only in the way a million locks represent the keys that open them.

Several other points are worth noting here:

1. Although evolution depends on history, Mother Nature doesn’t “care” how the organism acquires its prowess, just as long as the job gets done. This has important implications for later in the explanation of consciousness.

2. Because evolution is “blind”, as in "undesigned", there is no way to “foresee” evolutionary or especially phenotypic side-effects. Most genetic evolution is so haphazard from an engineering point of view that, side-effects are plentiful and

sometimes these side–effects have serendipitous effects, especially in combination with other functional systems, that are then effective in dealing with a problem in a new way. As Dennett puts it:

“Multiple functions are not unknown in human engineered artifacts, but they are relatively rare; in nature they are everywhere, as we shall see, one of the reasons theorists have had such a hard time finding plausible designs for consciousness in the brain is that they have tended to think of brain elements as serving just one function each.”

To sum up our primordial facts so far:

1. There are reasons to recognize. (replication itself is a primitive sort of reason)
2. Where there are reasons, there are points of view from which to recognize or evaluate them. (survival of replication, "intentional" or not, implicitly defines a "point of view")
3. Any agent must distinguish “here inside” from “the external world.”
4. All recognition [of boundaries] must ultimately be accomplished by myriad “blind, mechanical” processes.
5. Inside the defended boundary, there need not always be a Higher Executive or General Headquarters.
6. In nature, handsome is as handsome does; origins don’t matter (where a mechanistic process is co-opted from, does not matter so long as it provides a survival advantage)
7. In nature, elements often play multiple functions within the economy of a single organism.

Next Dennett looks at the evolutionary survival value for a new "trick". That is “producing” or more simply, predicting or anticipating (no matter how primitively), the future. There are many ways to survive- an organism can armor itself liked a tree or a clam and “hope for the best” or it can develop methods for getting out of harms way. If you perform this latter strategy, you are an animal, and the question on your mind is always: Now what do I do?

To do this, you need a nervous system, to control your activities through time and space. For navigating through the sea for a suitable home the sea squirt has a rudimentary nervous system. But once rooted, it eats its brain since it is not needed anymore. Brains are anticipation machines. Even the armored clam cannot always stay closed- it snaps shut as a crude but effective harm-anticipator/avoider.

For more primitive organisms, simple withdrawal and approach responses are tied to bad things (recoil) or good things (engulf). How these two classes of events are discriminated, is of course the job of the perceptual system, which at the lowest level may be a simple chemical reaction. Organisms are “wired” for these responses at the some primitive level and these pre-wired circuits are present in subtle and not so subtle ways even in our advanced human brains.

These early nervous system depended on avoiding noxious contacts and seeking out nutritious bits (and mating opportunities once sex had appeared, of course), but this could still be improved upon by short range anticipation processes.

The ducking from looming object response is hard wired in us and other animals. It can be observed in newborn infants and is a gift from all our (human and non-human) ancestors that learned to duck "instinctively" and survive to reproduce We are also hard wired to be sensitive to vertical axes of symmetry. Why? Because this type of visual perceptual pattern usually means another animal is looking at us. Maybe to eat us, so it's better to have an alarm go off that you are being looked at by another animal, as opposed to waiting until you feel its teeth digging into you. Of course, sex adds new dimensions to this type of alarm response too.

An important point Dennett makes, that is crucial for understanding human brain functions, is that there is always a tradeoff between "truth and accuracy" and "speed and economy" in perceptual or anticipatory brain processes. This vertical symmetry detection is one example of an "orienting" response which has been interpreted as a sort of "all hands on deck" alarm for the brain. That is, "we just got an alarm from a crude and specialized harm avoidance circuit, so take us out of auto-pilot and let's do a sensor scan and see what's out there."

Now these brief episodes of brain process interruption and heightened activity are not themselves episodes of human-style "conscious awareness" (as people redundantly say). But they probably are precursors in the evolution of our human/primate conscious states.

Once this "all hands on deck" alarm circuit existed, it cost little or nothing to keep it turned on all or most of the time (though I myself wonder if this extra duty cycle time is involved in the increased need for sleep of mammals). So regular vigilance could evolve to regular scanning or exploration, and hence a new strategy evolved: gathering information for information's own sake. But this new brain process of gathering information was itself cobbled out of existing systems and this evolutionary history has left its emotional and affective overtones on our consciousness (as cognitive science has discovered in the mammal brain). That is, the innate links of informing states to withdrawal and engulfment, avoidance and reinforcement were not thrown away, but only attenuated and re-directed.

The dorsal/ventral division of these brain process labors were developed further in the primates into the celebrated right-hemisphere/left hemisphere specializations: the global right brain and the analytic left brain.

3. Evolution in Brains and The Baldwin Effect

Now a completely new "trick" that Dennett discusses next is the idea that some phenotypic (observable genetically produced variation in an individual) innovations in the brain are not entirely hard-wired, but are a more flexible and "programmable" type of brain processes. In addition to the hard-wired "duck when something is looming overhead" response we also have cyclical responses like grow more hair when cold and the waking/sleeping cycles. But sometimes an organism needs to respond to more unpredictable and unknown problems, and so an organism that can re-design it's "software" wiring is at an advantage. We might call such design changes "development" or just "learning."

How can brains learn? One way, that does not require us to invoke miracles, is something related to a process of evolutionary natural selection but occurring within the individual (phenotype). For many years, the most popular explanation was B.F. Skinner's "behaviorism" involving "operant conditioning", but today the emphasis is on various theories that move evolution inside the brain. To avoid a major discussion of these various theories (by the way, that could and are being tested in huge computer simulations) let's just say for our purposes that the brain is capable of reorganizing itself by selecting various brain "structures" or "connections" that control or influence behaviors, and the selection itself is accomplished by a mechanical "weeding-out" process that is genetically part of the nervous system. Not only is this an advantage over organisms that cannot "re-wire" themselves, it also speeds up the process of evolution through a phenomenon known as the "Baldwin" effect.

Think of the Baldwin effect in this way: let's say a group of individuals in a species have some considerable variation in the way that they are hard-wired up. One possible way that some of them could (in principle) be wired up has a strong competitive advantage. But a slight difference in the wiring from this particular advantageous state means an individual has no competitive advantage. However thanks to some limited ability to re-wire themselves, some of the individuals can "stumble" upon the particular hard-wiring that has the competitive advantage. Those animals that start out genetically closer (in terms of mathematical connection possibilities) to the hard-wired "good trick" have a competitive advantage without waiting for evolution to randomly re-hard-wire their brains. The next generation will have even more individuals with hard-wiring closer (and therefore easier to learn) to the "Good Trick."

4. Plasticity in the Human Brain: Setting the Stage

So now, besides the famous four F's (fight, flee, feed, or mate) we now have some new informational gathering and learning processes that are ready to deal with the eternal animal question of "What to think about next?" But as Dennett likes to point out, like the immune system with no centralized command, we don't need to assume that there is a captain on board just because someone yelled "all hands on deck."

Many models have been invoked to explain the organized activity of this situation, but what we now have to further explain is more than just the vigilant, short attention span, and even long term nest-building/dam-building subroutines. We have to imagine a more human "stream of consciousness" on which human civilization apparently depends.

Our closest relative is the chimp and genetically he is closer to us than he is to the gorilla or orangutan, but it is important to remember that the chimp's ancestors and our ancestors once had similar brains almost four million years ago. Our brains didn't grow to be four times larger until several millions years after the lines split, in spite of the fact that our ancestors were bipedal 3.5 million years ago. This growth in brain size started and finished about 150,000 years ago- BEFORE the development of language, cooking and agriculture. Everything that we tend to think of as "human" was produced by software programming (as opposed to hard-wiring) and occurred only in the last 10,000 years- a blink in the eye of evolution. All the former selection pressures from the environment have been overwhelmed by the "learning" abilities of the "plastic wiring minded" primate and especially, human brain.

Now Dennett moves on to how animals and humans "represent" various things in brains. Consider the following:

1. the position of the body and it's limbs
2. a spot of red light
3. a degree of hunger
4. a degree of thirst
5. the smell of a fine old red burgundy
6. the smell of a fine old red burgundy AS the smell of Chambertin 1971
7. Paris
8. Atlantis
9. the square root of the largest prime number less than 20
10. the concept of a nickel plated combination corkscrew and staple remover

Although we can imagine that an adult human brain could represent all the items, we'd have to admit that items 6-10 are beyond the reach of all other animal brains, though even humans will require considerable training or adjustment before being able to represent them.

How does the brain represent these different things, thirst versus hunger for example or Paris versus Atlantis? As we have discussed, some categories are hard-wired, others are software programmed. How do we do this? It is not known exactly, but probably by a process of generation and selection of patterns of neural activity in the cerebral cortex. That brain mass, that in humans has completely overgrown and now covers the older animal brain underneath. With this evolution apparently, humans have evolved the genetic "Good Trick" of a system of hard-wired "learning" circuits for re-programming the cerebral cortex. That is, we use our brain not just to learn, but to learn to learn better, and to learn to learn to learn better (ad infinitum).

5. The Invention of Good and Bad Habits of Autostimulation

Consider this hypothetical "just so" story in the history of early man, when language or proto-language was just beginning to develop. First, it should be obvious that these early hominids used vocal sounds like our primate cousins and were probably able to discriminate them on the basis of who was uttering them and who was hearing them. And that they utilized information on what the parties might believe or want (though the jury on primate deception abilities is still out). For example, “hominid Alf wouldn’t bother trying to get hominid Bob to believe there was no food in the cave (by grunting “nofoodhere”) if Alf believed that Bob already knew there was food in the cave. And if Bob thought Alf wanted to deceive him, Bob would be apt to view Alf’s vocalization with cautious skepticism.”

Ok, so we might imagine that one of these hominids was in a situation that required assistance and it might “ask for help” or “ask for information.” The other hominids might be able to utter other vocalizations that could possibly help the first hominid out of it’s rut or trap or problem or whatever. The point being, that at some point in the development of language, some interrogative vocalization (we humans still change pitch when it’s a question sentence) could produce a answering vocalization providing information of what the other assisting hominid “knew”. This hypothesis does not assume, that by itself these utterances had evolutionary survival benefit, but it is possible that enough of this behavior and it’s success in sharing of information was witnessed by the other hominids to spread and become established in the hominid community.

Here is where it gets interesting: now imagine one fine day a hominid “mistakenly” asks for help and no other hominid is within earshot- except of course itself! When the hominid heard its own request, the stimulation provoked the same other-helping utterance that the request from another would normally have caused. To the creature's delight- it answered its own question!

This simplistic thought experiment is solely to justify the claim that some information in one part of the brain (in one specialized perception circuit for example), might be useful to another part of the brain (in a different specialized circuit) and that the connection between the “mouth brain” and the “ear brain” provides a sort of software “link” or software connection between the two systems.

Thanks to the Baldwin effect, this type of "autostimulation" could rapidly be refined into, at first and obviously, simply “talking to oneself.” But more importantly it could provide an internal mechanism for considering information, even though by unconscious brain speed standards, this process was enormously slow and inefficient. How this type of inter-brain communication might work in practice, is painfully exposed with experiments on patients with the corpus callosum severed, so that the right and left brains no longer communicate directly or at least internally. See the text for fascinating examples.

Talking to one self is just part of this “Good Trick”- drawing pictures in one’s head is yet another. Many variations and mechanisms can be imagined that all helped move more and more of our brain processes into the area of “software.” Finally it is interesting to note that once a large fractionn of a population has learned the “Good Trick” due to Baldwin type effects, the evolutionary pressure for moving these processes into the genome is extinguished or at least greatly diminished.

6. The Third Evolutionary Process: Memes and Cultural Evolution

Here Dennett discusses the evolution of culture as not only an innovator of consciousness, but in noting the amazing rapidity with which language is learned by children, he also means to claim that the human genotype must "include many adaptations that are specifically in place to enhance language acquisition." However, given the Baldwin effect, this development is somewhat unsurprising, even though it is almost an instant in evolutionary time.

Once human brains are built along these lines for rapid learning, it is not surprising that certain "tricks" or more broadly, certain "entities" can survive and reproduce in this evolutionarily new and unique brain "software friendly" environment. Dennett re-introduces this newest "replicator" to emerge on our planet- Richard Dawkins' famous or infamous "meme" replicator. For those unfamiliar with this term (itself a "meme"), this new replicator consists of, roughly, ideas. "Not the 'simple ideas' of Locke and Hume (the idea of red, or the idea of round or hot or cold), but the sort of complex ideas that form themselves into distinct memorable units- such as the ideas of:

1. wheel
2. wearing clothes
3. vendetta
4. right triangle
5. alphabet
6. calendar
7. the Odyssey
8. calculus
9. chess
10. perspective drawing
11. evolution by natural selection
12. impressionism
13. "Greensleeves"
14. deconstructionism

Intuitively these are more or less identifiable cultural units, but note that we can say something more precise about how we draw the boundaries- about why D-F#-A isn't a cultural unit, and the theme from the slow movement of Beethoven's Seventh Symphony is: the units are the smallest elements that replicate themselves with reliability and fecundity."

In the Selfish Gene (not a book about a gene for selfishness by the way), Dawkins urges the reader to consider the idea of meme evolution literally, not just as an analogy to biological or "genic" evolution. Of course mathematically, the theory of evolution is not specific to just biological entities, and has been applied with success to many non-biological self-organizing or self-replicating processes, so there is a certain appeal to this idea.

However, it must be admitted: this new way of thinking has extremely unsettling implications for many people- just as an "chicken is an egg's way of making another egg", so a "scholar is just a library's way of making another library."

If you are turned off by the idea that your brain might merely be a "dung heap in which the larvae of other people's ideas renew themselves, before sending out copies of themselves in an informational Diaspora", you are not alone, says Dennett. After all, who's in charge, according to this idea- we or our memes?

There is, says Dennett, no simple answer to this question which speaks to the very confusions that surround the idea of a "self." This is because human consciousness is a product not only of natural selection, but also of cultural and language evolution as well (see Helen Keller's quote from the beginning of chapter 8). The fact that meme replication (by itself), just as for genes, is not necessarily "for the good of anything" is a simple fact of the mathematics of replication. Replicators that flourish, like genes, are only good at… replicating! The important point being that there is no necessary connection between a meme's replicative powers and it's "fitness" from its own point of view. This observation, in my view, partially explains brain entities like, for example, folk lore, intuitions, superstition, religion and urban legends. These are not necessarily ideas that are "fit" in any sense, they just replicate very readily in the "fertile" and swollen cerebral cortex of the human mind.

The essential point for our understanding of consciousness is that from the human genome point of view, some memes are beneficial, like intestinal bacteria, while some are parasites that provide no major advantage to human genetic replication. But there is no doubt that in general, our "meme-immunological systems" are better than chance average of choosing memes that tend to "help us." The exceptions to this tendency are interesting, however we should note that the eventual replicative success of what we can amusingly call the "meme meme" (the idea of meme evolution through selection) is strictly independent of its epistemological virtue; it might spread in spite of its perniciousness, or go extinct in spite of its virtue.

In fact, each of our minds has a limited capacity for memes, hence there is considerable competition between memes in the brain, and this is one major selective force in meme selection. But this partly depends on the meme's ability to restructure the mind to make it a better and more suitable habitat for similar and compatible memes. For instance the "conspiracy meme" also contains the meme for "explaining why there is no evidence of a conspiracy- because the conspiracy is so powerful." Which is similar to how the "faith" meme also contains the meme that "faith in spite of a lack of evidence is more pure and pious." But Dennett warns us not to fall into the fallacy of "memes vs. us." There is no doubt, in the basement of our minds, there exists a tension between the biological imperative of gene and the imperatives of the memes, but to say we side with one or the other, is to deny the power of this symbiosis between brain and culture, through gene and meme.

In summary, all three evolutionary forces, genetic evolution, phenotypic plasticity and memetic evolution have contributed to the "design" of human consciousness and at each turn, at increasing rates of speed. Through genetic engineering and neuroscientific engineering, the promise (and peril) of a fourth "evolutionary" force is already before us.

7. The Memes of Consciousness: The Virtual machine to be Installed

"Human consciousness is itself a huge complex of memes (or more exactly, meme-effects in brains) that can be best understood as the operation of a 'von Neumannesque' virtual machine implemented in the parallel architecture of a brain that was not designed for any such activities. The powers of this virtual machine vastly enhance the underlying powers of the organic hardware on which it runs, but at the same time many of its most curious features, and especially its limitations, can be explained as the byproducts of the kludges that make possible this curious but effective reuse of an existing organ for novel purposes."

Thus Dennett presents his model for software parallel processing in the "virtual machine" of the mind. Like modern computers with hard wired processing, but with lots of memory to store programs for almost any imaginable purpose, the human mind at birth is hard-wired and ready to go, but blank so far as "software" is concerned. But the difference between von Neumann brains and our brains is that the von Neumann brains process data in a totally serial fashion, while our brains apparently use hundreds or thousands of parallel processes to perceive and interpret the world. This fact is often cited as a reason why A.I. or artificial intelligence is not possible, even in principle.

On the other hand, the striking similarity between computers and our conscious minds (that we have access to) is that both von Neumann style computers and human "consciousness" or minds, use serial processing. In other words, just as the computer considers instructions one at a time, so our minds seem to consider ideas in a serial "stream of consciousness."

Now one interesting thing that Alan Turing demonstrated is that it is mathematically and completely possible (though possibly inefficiently speed wise) to model any possible parallel processing machine using a von Neumann type architecture by a clever connection process called "knitting" (see text for details), but what we are interested in, for our understanding of consciousness, is the opposite problem: how does one model the serial "stream of consciousness using a "parallel" computational architecture?

Dennett suggests the following: "Conscious human minds are more-or-less serial virtual machines implemented- inefficiently- on the parallel hardware that evolution has provided for us. " But he continues: "What counts as the 'program' when we talk of a virtual machine running on the brain's parallel hardware? What matters is that there is lots of adjustable plasticity that can take on myriad different microhabits and thereby take on different macrohabits. In the case of the von Neumann machine, this is accomplished by hundreds of thousands of zeros and ones (bits), divided up into 'words' of 8, 16, 32 or 64 bits, depending on the machine. The words are separately stored in registers in the memory and accessed a word at a time in the instruction register. In the case of the parallel [brain] machine, it is accomplished, we can surmise, by thousands or millions or billions of connection-strength settings between neurons, which all together in concert give the underlying hardware a new set of macrohabits, a new set of conditional regularities of behavior."

But how do the "instructions" get loaded? Here Dennett says, the analogy to hard-wired computers breaks down. "While it is probably true that each particular connection-strength setting between neurons in the brain has a determinate effect on the resulting behavior of the surrounding network, there is no reason whatever to think that two different brains would have the 'same system' of interconnections."

So why use the analogy of computers to understand the brain? Because many puzzling aspects of consciousness get "illuminating explanations on the hypothesis that human consciousness (1) is too recent an innovation to be hard-wired into the innate machinery, (2) is largely a product of cultural evolution, and (3) its successful installation is determined by myriad microsettings in the plasticity of the brain, which means that its functionally important features are very likely to be invisible to neuroanatomical scrutiny in spite of the extreme salience of the effects. Just as no computer scientists would attempt to understand the different strengths and weaknesses of WordStar versus WordPerfect [word processing programs] by building up from information about the differences in voltage patterns in the [computer] memory, so no cognitive scientists should expect to make sense of human consciousness simply by building up from the neuroanatomy."

And besides, Dennett says, "(4) the idea of the user illusion of a virtual machine is tantalizingly suggestive: If consciousness is a great virtual machine, who is the user, for whom the user illusion works? I grant that it looks suspiciously as if we are drifting inexorably back to a internal Cartesian Self, sitting at the cortical workstation and reacting to the user illusion of the software running there, but there are, as we shall see, some ways of escaping that dreadful denouement."

The question once again is: how does various parallel processes get serialized in our "stream of consciousness." Dennett believes that partly from the demands on the brain from meme produced social interaction, language (including talking to one's self) and even writing and diagramming, the brain has been forced to "off-load" these tasks into the external environment as political/social structures, speech acts and writing and drawings. In the course of childhood development, these organized and partially pretested sets of habits create an architecture that includes, among other topics to be discussed in chapter 9, "serial chaining", in which first one "thing" and then another "thing" takes place in (roughly) the same "place" in our "stream of consciousness." Sort of how von Neumann computers use "CPU time slicing" to multi-task multiple programs running on a single processor computer. This stream of events is entrained by a host of learned habits, of which talking-to-oneself is a prime example.

But what's the good of all this, Dennett asks? The answer is: it may be that capacities for self exhortation and self-reminding are a prerequisite for the kinds of complicate and elaborate long term self-control, without which, agriculture, building projects and other civilized and civilizing activities could not be organized.

Be that as it may, it is still difficult to see how these myriad process can vie for dominance in our minds without chaos. Chapter 9 will deal with some of these difficulties. In the meantime, it is useful to consider the analogy of virtual machines from computer science for a perspective on human consciousness. Computers were originally just supposed to be number crunchers, but now their computational powers are utilized in almost every imaginable way from video games to fluid dynamical simulation to word processing to digital illustration to natural language interpretation. Where are the digital bits in all this computer magic? Our brains weren't originally designed for word processing either, but now a significant portion of the brain is utilized for speech production and comprehension. We can also ask: Where are the neurons in all this brain magic?

So what does this have to do with consciousness! A computer is not conscious after all! How can implementing any architecture on any hardware produce a "Joycean" "stream of consciousness" in my brain? Dennett gives a short, and at this point for many, unsatisfactory answer: "The von Neumann machine, by being wired up from the outset that way, with maximally efficient informational links, didn't have to become the object of its own elaborate perceptual systems. The workings of the Joycean machine, on the other hand, are just as "visible" and "audible" to it as any of the things in the external world that it is designed to perceive- for the simple reason that they would have much of the same perceptual machinery focussed on them [from other individual minds]."

Crazy, maybe. But Dennett will attempt to show in the next two chapters, how this could be true, using language as a internal/external brain modifier.

By John Donovan