CHAPTER 10: Life's Own Code

JOHNNSEN AND SCHRÖDINGER:

- In 1910 **Willhelm Johannsen**, a Danish botanist, invented the word **gene** to correct common misconceptions about **heredity**.
- The most common misconception was that "personal qualities" are transmitted from parent to progeny.
    - "The personal qualities of any individual organism do not at all cause the qualities of the offspring; but the qualities of both ancestor and descendent are in quite the same manner determined by the nature of the 'sexual substances'- i.e, the gametes- from which they have developed" (Johannsen).
- "Gene" was simply a new terminology at this point an it didn't matter that nobody (including Johannsen) understood what a gene actually was.
- **Gregor Mendel**'s research on green and yellow peas showed that a gene does exist.
    - "Colors and other traits vary depending on many factors, such as temperature and soil content, but *something* is preserved whole; it does not blend or diffuse; it must be quantized" (Mendel).
- When physicist **Erwin Schrödinger** investigated the gene, he had trouble conceptualizing how such a tiny speck could contain the entire code-script that determines the complex development of an organism.
    - To solve this he used an example from telegraphy: morse code.
        - Two signs (dot and dash) could be used in well-ordered groups to generate all human language.
        - Genes must also employ a **code**.
        - "The miniature code should precisely correspond with a highly complicated and specified plan of development and should somehow contain the means to put it into action" (Schrödinger).
- **QUESTION**: What is the value in understanding human's genetic code? Are there any drawbacks?

QUASTLER:

- In the 1940s, molecular biology started to study information **storage** and **transfer**.
- Information was regarded as the concept needed to discuss and measure complexity, order, organization and specificity in biology.
    - Biologists could count in terms of "**bits**".
- **Henry Quastler** applied information theory to biology and psychology. He estimated that an amino acid has the information content of a **written word** and a protein molecule has the information content of a paragraph.
- His colleague referred to a **chromosomal thread** as a "linear coded tape of information".
    - The entire thread is a "message" that can be broken down into **subunits** (paragraphs, words, etc).
- A researcher at Quastler's symposium estimated that there were 10 13 bits in a single bacterium.
- Quastler wanted to measure organism's in terms of "hypothetical **instructions** to build an organism".

    - This brought him to genes.
    - He determined that the **genome** was the whole set of instructions (or rather the "catologue").
    - "The essential complexity of a single cell and of a whole man are both not more than 1012 nor less than 105 bits; this is an extremely coarse estimate, but it is better than no estimate at all" (Quastler).
- **QUESTION**: Quastler used analogies to written word to understand amino acids. Is it possible to understand new mediums without referencing/applying old mediums?

WATSON AND CRICK:

- The scientific community reached the consensus that genes were likely **proteins** made of long **chains** of **amino acids** thanks to a letter written by **James Watson** and **Francis Crick.**
- Watson and Crick found **deoxyribonucleic acid** (DNA) in the nucleus of every plant, animal and phage cell.
- These molecules could not be seen, but X-ray diffractions revealed their subunits.
    - Each nucleotide contained a "**base**".
        - There were four bases (A, C, G, and T) in predictable proportions.
            - These had to be the letters of the code.
- They later discovered that DNA consists of two long sequences of bases, coiled together to form a **double helix.**
    - "Unzipped" each strand can act as a **template** for **replication**.
    - In each chain the sequences of bases was irregular.
        - "It follows that in a long molecule many different permutations are possible" (Watson).
            - Many **permutations**= many possible messages.
        - "It therefore seems likely that the precise sequence of the base is the code which carries the genetical information" (Watson).
- DNA molecule is unique because the information it bears is its **only function**.
    - Thus, the ability to **decipher** the code is important.
- **QUESTION**: Are all mediums like DNA in the sense that their only purpose is to deliver a message?

GAMOW:

- **George Gamow** was an originator of the Big Bang Theory as well as a cosmotologist, this set him apart from all the biologists involved as he was more interested in DNA as a code rather then in the biological aspect behind it.
- **RNA** the single stranded relative of DNA was also apart of this encoding process taking on the role of the messenger. Due to this Gamow and all those involved with him saw the encoding as a mathematical issue, something derived from coding**.**
    - They as such used **combinatorics** and **information theory** to try and solve the issue
- So it became a problem that needed to be solved, How does one get from the bases of DNA to the many known amino acids.

- This idea opened up an entirely new perspective, that DNA could possibly be as simple as a code rather than an advanced biological entity.
- A further perspective shift happened when the Tie Club realized the DNA issue wasnt just about **DNA storage** but also about **DNA transfer**. The realization that DNA was also manufacturing proteins rather than just replicating itself. Due to this Biologists were able to see the situation clearly since the message was defined.
- Gamow ended up not being able to solve genetic code, this was due to the fact that genetic coding was much less neat than he had theorized.
    - Amino acids could correspond to one, two, four or six codons.
    - Codons could also be stop or start signals or even redundant.
- After discovering the innerworkings of genetic code, science would move forward to attempt to understand the gene.
- **QUESTION:** Why is it important to see mediums from new perspectives? How could the bias we carry with us effect the way we look at mediums and perceive messages?
-

DAWKINS:

- In this attempt to understand what a **gene** was and what made up genes it caused for a worlds of molecular biology and evolutionary biology to overlap.
- This combination of two sciences was important as neither side could move forward in understanding the issue without the help of the other.
- However, it wasn't until a comment made by a young **Richard Dawkins** that progress being made.
- Similar to the issue of genetic code Dawkins also believed them to be looking at the issue of the gene from the wrong perspective.
- He believed that making organisms the center point was the wrong idea. That its not the organisms that are using the DNA for anything. Its the DNA that existed well before we did, and its always been genes that have been **programming** us to preserve them.
    - Even stating that its genes that are the units of natural selection rather than the organisms.
- The ideas that Dawkins brought changed the way in which scientists understood the gene. Bringing forth the idea that "*X is just a Y's way of making another Y*" (pg.303). That we were just gene colonies interesting in protecting genes and producing more genes.
- It wasn't just the idea of the gene that was changed, our concept of Altruism made alot more sense. All the times in which animals did things that put themselves at risk or attempted to feed the pack, where all situations in which genes were achieving their goal of keeping the most amount of genes protected. The confusing concept of altruism made a lot more sense when one considered that gene colonies were trying to create future gene colonies.
- This gene perspective helped biologists, since they were able to put into perspective that the genes in our **genome** were only a fraction of the whole that made up us. That we host this ecosystem of genes, bacteria, microbes as a whole.
- Dawkins also pitched the idea that there are genes for everything, reading, altruism that possibly people couldn't do certain things because they didn't have the genes for it using the example of dyslexia. He stated that the genes know nothing of the concepts like the concept of altruism and reading, but that they allow us to do such things.
- **QUESTION**: How could the reshaping of things we understood, help us understand situations better as a whole?