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A New Biology for A New Century - Carl R. Woese

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INTRODUCTION

Science has become a major part of the modern world and how it works, often stemming from new technological advances combined with an attempt to solve a common human problem. Molecular biology is a perfect mix of these things, striving to solve problems regarding biology specifically. Just as problems were solved by scientific discoveries of the past, it is largely hoped that molecular biology will have the same effect.

THE MOLECULAR ERA IN THE BIGGER PICTURE

The very root of science started with people of the 19th century who questioned how things worked and defined potentially solvable problems. For example, Darwin questioned where humans originated and came up with the theory of evolution, which has since then gained more evidence and become greatly viable information. Advances continued over to the 20th century, where molecular biology has come to change science for the better, helping humans better understand living systems. Without science people would be deemed helpless, especially in the face of various issues, including climate change and air pollution, which humans have started to advance on.

Reductionism versus Reductionism

Whilst empirical reductionism strives to break down biological concepts, fundamentalist reductionism is more of a metaphysical (abstract) concept. Even though these types of reductionism can have clashing conceptual views, it is also clear that both are necessary to the scientific world. For example, empirical reduction resulted in enzymology and the cell's structure, and fundamntalist reductionism has created the Watson-Crick DNA model. Both these ideas are interlocked (they both led to the cell models we see today), thus showing how no complete discoveries could have been made without both types of reductionism.

Synthesis

Since biology viewed through only the eyes of a funamentalist is not complete, it is suggested that the molecular biology era cannot be avoided. Sometimes, seeing things as black and white is not beneficial, needing more colorful and diverse ideologies. Viewing a concept as whole instead of piece by piece could help scientists and others working in the scientific field easily solve problems, instead of making the whole process more difficult than needed.

TOWARDS A NEW REPRESENTATION OF BIOLOGY

The reductionist perception has resulted in scientists having a more closed off view, seeing intelligent things and processes as mechanical and robotic. For example, physics used to have a flattened view of the world, but had grown to encompass more three-dimensional views. In the same way, it is hoped that biology can strive to do the same, gaining more scientists that will look at the big picture, not just as small pieces.

CHANGING THE OVERVIEW

In some ways, organisms and complex processes can be seen as "machines" with abilities to continuously work and renew, but in other

ways they are not. Organisms are greatly reliant on their resilience and homeostasis, qualities that machines do not possess. This implies that scientists who associate with the machine metaphor do not see the whole picture and may miss details that could be captured by seeing organisms for what they are.

SOME PERTINENT HISTORY

A race to see who would first uncover the secret to life (uncover more information about genetic code), would make scientists test te=he bounds of their minds and make them think outside of the box. No simple physical or chemical correlations between amino acids could not be found, but upon closer examinations it was seen that DNA was not just random. The same thing happened with similar ideas, including phylogenetics. Therefore, this is bound to happen again, showing how scientists should be ready to face any scientific problem with open minds and while looking at the whole picture.

THE PANDORA'S BOX OF MICROBIOLOGY

Scientists were stumped by the evolutionary history of bacteria. One issue with the never formally recognized field was its lack of a central concept or focus. This meant that there were very small chances that the problems that this field was created to solve would never really be solved. As this field became more complex after the discovery of prokaryotes, this issue continued to worsen. Without a clear idea of where something is going, everything may begin to crash and fall apart.

The Dismantling of Bacteriology and a Deconstruction of the Procaryote

Microbiologists suggested that prokaryotes had a common ancestor, even with minimal evidence to support this idea. However, some clearly saw this as an attempt to oversimplify and broadly explain cells. Scientists would have to do much more research than that in order to really understand all the more specific processes that a cell undergoes. Even in the future, very extensive research will be needed before a formal and accurate hypothesis can be reached.

Other Guesswork Solutions?

Speculations seem to be quite common in the scientific world, another one being found in the doctrines of Charles Darwin. Darwin attempted to oversimplify science and say that all animals simply came from one common descendant. Much later, more discoveries and microbiology would go on to be a major part of evolution, again showing how science is not always as simple as scientists may have suggested it to be.

CELLULAR EVOLUTION: THE BUMPY ROAD TO WHO KNOWS WHERE

After molecular biology went on to separate and completely ignore the big picture of cells, scientists began to see a much more muddled concept of a cell. Modern molecular biologists have the job of putting everything back together and helping people see how cells work as one big picture. It is important to understand cells as organelles that each perform specific duties, rather than just combinations, which can blur the concepts.

THE DYNAMICS OF CELLULAR EVOLUTION

Recent discoveries regarding the Horizontal Gene Transfer (the transference of genetic information between organisms without sexual interaction) provides new insights of the evolution theory. There are categories within these genes, including specialized cells, normal function cells, and the organizational cells. All these cells are vital for cellular evolution, as well as how the modern cell works.

The Key to Understanding the Character of HGT

Horizontal Gene Transfer is the transfer of genetic information between organisms (no sexual interaction), usually occurring with genes that do

not interact much with the rest of the cell. Loosely connected, and highly modular primitive cellular organization would be subject to HGT and many functions could be introduced without interrupting the loosely defined cellular organization.

From There to Here

Occurring over great periods of time, evolution resulted in different components and pieces of a cell giving into the changes that would help them easily perform their jobs, resulting in the cells that make up organisms today. Nucleic acids were an integral part of the more refined cellular matrix, helping the cell translate. In some theories, RNA was said to have evolved and eventually played a part in the creation of the various organisms of the modern times. This shows how evolution can change things for the better.

An Interesting, if Not Relevant, Aside

Statistical proteins let evolution make the underlying genes have selective values, thus showing how they play an important role in cell evolution and process. The many small parts and proteins all come together and make the cell work the way it does today. Without these small parts, the cell would be nowhere near as functional.

When Is a Tree Not a Tree?

When Horizontal Gene Transfer has too much dominance over the process of evolution, it results in the genomes constantly evolving. These genomes are considered unstable. When they cross the Darwinian threshold, where the HGT has mostly run its course, it is no longer possible to represent it using a tree model.

ONE LAST LOOK

Sciences such as physics and chemistry have both played a huge part in getting biologists to begin abandoning reductionist ideas (looking at

something as small parts) and move on to seeing biological systems as one big picture for a sense of clarity. It is hoped that in the future, scientific questions can be answered while avoiding reductionist ideologies, which can place a barrier in science.