An infected cell can produce thousands of infectious virus particles (black dots) that are then released from the cell surface, as shown in this electron micrograph of the new coronavirus, nCov-2019. EM: John Nicholls, Leo Poon and Malik Peiris/The University of Hong Kong

Viruses and Evolution – Viruses
First? A Personal Perspective
Karin Moelling,1,2* and Felix Broecker,3
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“The discovery of exoplanets within putative habitable zones revolutionized astrobiology in recent years. It stimulated interest in the question about the origin of life and its evolution. Here, we discuss what the roles of viruses might have been at the beginning of life and during evolution. Viruses are the most abundant biological entities on Earth. They are present everywhere, in our surrounding, the oceans, the soil and in every living being. Retroviruses contributed to about half of our genomic sequences and to the evolution of the mammalian placenta. Contemporary viruses reflect evolution ranging from the RNA world to the DNA-protein world. How far back can we trace their contribution? Earliest replicating and evolving entities are the ribozymes or viroids fulfilling several criteria of life. RNA can perform many aspects of life and influences our gene expression until today. The simplest structures with non-protein-coding information may represent models of life built on structural, not genetic information. Viruses today are obligatory parasites depending on host cells. Examples of how an independent lifestyle might have been lost include mitochondria, chloroplasts, Rickettsia and others, which used to be autonomous bacteria and became intracellular parasites or endosymbionts, thereby losing most of their genes. Even in vitro the loss of genes can be recapitulated all the way from coding to non-coding RNA. Furthermore, the giant viruses may indicate that there is no sharp border between living and non-living entities but an evolutionary continuum. ..."
Editorial for Progress in Biophysics and Molecular Biology

**Origin of life and of DNA code** Denis Noble

“At present, no-one knows the answers to these questions. And that is the reason why we should keep an open mind about the possibilities, even if we find some of them extremely improbable”.

“In this issue of Progress in Biophysics and Molecular Biology, we publish two further articles (Steele et al., 2019; Mitra, 2019) that deal with the issue of where life may have originated and, by implication, the origin of the triplet code. These issues are both controversial and important.

The controversial nature of the subject is illustrated by the fact that this journal has also previously published two commentary articles by Keith Baverstock, (2018), a member of the editorial board, and by Karin Moelling, (2018). Both are viewpoints from authors who are very critical of the idea that life may have originated somewhere other than our planet. The problem here is that, however one looks at the issues, we are dealing with what seem to be very improbable events, whether they occurred here or elsewhere in the universe. As such, and without further evidence, they are inevitably controversial.

Yet, we may eventually know some of the answers. As we explore the possibilities of life on other planets or moons in the solar system we are getting closer to what, when it happens, will be momentous discoveries. If we find organisms elsewhere than our own planet we may be able to answer the following questions:

1. Metabolism first theories. Must life require a DNA database? DNA itself is a highly improbable molecule in the form in which we find it in organisms like ourselves with 3 billion or more base pairs. So much so that, when a cell copies its DNA the initial error rate of around 1 in 10^4 would leave hundreds of thousands of errors in a human genome. No organism of any substantial degree of complexity could survive such an error rate. It requires extensive mis-copy error correction (Rivera-Mulia and Gilbert 2016; Ganai and Johansson, 2016) to eventually reduce the error rate to more like 1 in 10^10 base pairs, i.e. less than one error in a complete genome). This extreme accuracy in copying is a function of cells, not of DNA alone, and it is fundamental to the functional integrity of organisms (Noble, 2018). ...”
As a teacher, Lynn Margulis was dedicated to biology making sense. Life, whatever its complete definition, included the cell and metabolism. Therefore, viruses could not be considered as living or organisms. Viruses could not be symbionts because symbionts are differing organisms. As Lynn, the teacher, points out to Dr. Robert Siegel who brings up viruses during the Homage to Darwin debate, “It’s all definitional.” She did not disagree with Dr. Stephen Bell’s view that viruses should be considered as “near life.” There is a telling exchange between Margulis and Bell over her model extant organism, Thermoplasma, in the first merger of the Serial Endosymbiosis Theory (SET). It’s an example of Margulis’s conservative and skeptical open-mindedness that contrasts sharply with certaintists, such as Dawkins.

BELL: I think we would have to view, because, without doubt, a cellular organism, and we are the descendants of that cellular organism, although the continuity, if you like, as the DNA sequence, all of our components have been changed and [UNINTELLIGIBLE]. Where I take issue with some of Lynn's suggestions are in the nature of the fusion event that gave rise to the eukaryotes, we have, for example, they have thermoplasma, I think you used. That, I think, is probably the wrong archaeon to pick. I mentioned, in my talk, about crenarchaea, and the euryarchaea, the two lineages. Thermoplasma is a euryarchaeon, that lacks all these features that the crenarchaea have, that are clearly eukaryotic-like in nature. So, I would suggest that, although the fusion idea, I agree with, totally, your choice of [OVERLAPPING VOICES] --

MARGULIS: And the sulfur, too. The sulfur, temperature.

BELL: Right.

MARGULIS: So, you would say, we don’t have it yet, what?

BELL: Well, there are plenty of hyperthermo-like crenarchaea that are self-utilizing. So, we could use one of those, instead. And then you would have [OVERLAPPING VOICES]
multiple origins. You would have ESCRT machinery. You would have replication [license?] and all the various components that are eukaryotic-like.

Lynn Margulis not only listened to Bell, she *heard* him. She listened to Bell’s presentation multiple times from the recording of the debate and did her own reading until she understood Bell’s points.

Quoted from [Commentary on Homage to Darwin debate](#). "The first casualty of the Homage to Darwin debate may well have been Woese’s Three Domains, a taxonomy claimed to be representative of all of life’s history, past and present. The 3-Domain concept is based on complete measurement of several hundred linear sequences of nucleotides, in the small subunit ribosomal RNA, a long chain required for protein synthesis and transfer universally present in all living cells at all times. This measurable nucleotide base-pair RNA sequence is taken as representative of any whole organism. Partial phylogenies are intrinsically limited. The study of evolution must consider full phylogenies that consider the full range of available data of physiology, development, life history and genetics. Stephen Bell, Oxford Professor of Microbiology and a biochemist, describes the Domain of the so-called Archaea as composed of two unique groups of bacteria, the Crenarchaea (mostly high-temperature dwelling sulfuroacidophils) and the Euryarchaea (aerobic halophils and methanogens). Some references divide the Archaea include more subdomains (e.g., Korarchaeota) (Garritty 2005). These Crenarchaea and Euryarchaea are not monophyletic with respect to ESCRT (endosomal sorting complex required for transport) “machinery” for DNA replication. The ESCRT “machinery” of the Crenarchaea thermosulfuroacidophils is more closely related to that of eukaryotes than to Euryarchaea. A second casualty of Bell’s presentation was the neo-darwinist belief that evolution maps exclusively to bifurcating trees. Bell and his group along with many others in the scientific literature conclude that the “tree of life” is the incorrect topology. Bell’s discoveries are better explained by James Lake’s “ring of life” model that recognizes symbiogenetic mergers of organisms rather than bifurcation of branches from a single common ancestor. Bell endorsed the idea that the novel DNA replication system of the Crenarchaea resulted from another merger. He hypothesizes that a prokaryotic microbe dubbed the Last Universal Common Ancestor (LUCA) had a virus integrate into its DNA at the origin of replication. With its own “replication machinery” impaired, LUCA used the viral genes and proteins for its DNA replication. This cell became the first of the Crenarchaeal lineage. Bell thinks this scenario is “sweet” and goes on to say that there is even some evidence for the
Mitochondria incorporated the genes of a bacteriophage, a virus that replicates inside a bacterium, for its replication. Bell describes that the common bacterium, *Bacillus cereus* contains a bacteriophage as a component of its own genes that codes for Archaeal and Eukaryotic proteins. Bell’s examples signal the occurrence of widespread genetic transfer between very distantly related taxa. Archaeal genomes have been shown to contain integrated viral nucleic acid sequences that define the start sets for cell DNA replication. Bell’s conclusion is that viral mergers may well have “sculpted” the replication machinery of life. These mergers show that genes move across taxa. This makes the topology of life a net or web, not a tree.”

At this point in putting together this newsletter, Professor Dr. Robert Siegel who has taught virology since 1983, and currently teaches a course entitled *The Human Virosphere* at Stanford University.

“I need to take a much closer look at the linked article - looks fascinating.

Meanwhile here are some distracted musings...
In terms of the short newsletter write up, I might nuance things a bit differently. While viruses have clearly played an important role in the evolutionary history of life from prebiotic times to the present, I think there is compelling evidence that most of the current viruses that plague humans are not degenerate cells that have lost function, but rather fortuitous collaborations of small numbers of genes that have gained function. Notable exceptions might be pox viruses and possible giant viruses.

Also while viruses are among a vast array of obligate intracellular parasites from viroid to worms, they have a number of features that distinguish them from cellular life. In this sense, large viruses have more in common with minute viruses than with cells, even though their coding capacity is much closer to that of the simplest cells like Mycoplasma.

In terms of the role that viruses have played, at least one role is quite compatible with the ideas of Margulis - the role of viruses in moving blocks of genetic material between vastly disparate branches of the tree of life.

No doubt I will have much more coherent thoughts on this after I study the Moelling and Broecker article.”
Covid-19 shows us how to save the planet. Skies are blue and Indians can see the Himalayas for the first time in decades. The Planet of the Humans has ground to a halt thanks to the Gaian regulation of a global pandemic. By contrast, our “green technologies” extract more energy and resources than they replace. Have the 1% all gotten their Covid-19 vaccinations? Are they leaving it to Covid-19 to reduce the population of “essential workers?”

Ancestor of all animals identified  “A team led by UC Riverside geologists has discovered the first ancestor on the family tree that contains most familiar animals today, including humans. The tiny, wormlike creature, named Ikaria wariootia, is the earliest bilaterian, or organism with a front and back, two symmetrical sides, and openings at either end connected by a gut. The earliest multicellular organisms, such as sponges and algal mats, had variable shapes. Collectively known as the Ediacaran Biota, this group contains the oldest fossils of complex, multicellular organisms. The earliest multicellular organisms, such as sponges and algal mats, had variable shapes. Collectively known as the Ediacaran Biota, this group contains the oldest fossils of complex, multicellular organisms. However, most of these are not directly related to animals around today, including lily pad-shaped creatures known as Dickinsonia that lack basic features of most animals, such as a mouth or gut.”

‘Pachamama’ (Mother Nature) painting by Andres Zevallos, 2002
Photo; Richard Wilkie

Artist’s rendering of Ikaria wariootia. Credit: Sohail Wasif/UCR
Viral evolution
Primordial cellular origins and late adaptation to parasitism
Arshan Nas, Kyung Mo Kim, and Gustavo Caetano-Anollés

“Explaining the origin of viruses remains an important challenge for evolutionary biology. Previous explanatory frameworks described viruses as founders of cellular life, as parasitic reductive products of ancient cellular organisms or as escapees of modern genomes. Each of these frameworks endow viruses with distinct molecular, cellular, dynamic and emergent properties that carry broad and important implications for many disciplines, including biology, ecology and epidemiology. In a recent genome-wide structural phylogenomic analysis, we have shown that large-to-medium-sized viruses coevolved with cellular ancestors and have chosen the evolutionary reductive route. Here we interpret these results and provide a parsimonious hypothesis for the origin of viruses that is supported by molecular data and objective evolutionary bioinformatic approaches. Results suggest two important phases in the evolution of viruses: (1) origin from primordial cells and coexistence with cellular ancestors and (2) prolonged pressure of genome reduction and relatively late adaptation to the parasitic lifestyle once virions and diversified cellular life took over the planet. Under this evolutionary model, existing cellular parasites and enhance the diversity of the world’s virosphere.

The Virus Problem
Viruses are intriguing biological entities that are borderline between inanimate and living matter. They have RNA- or DNA-based genomes with single- and double-stranded nucleic acids, but lack functional translation machinery responsible for protein synthesis, including ribosomes, and their own metabolism. Consequently, they require a host to replicate and spread as viral particles (virions) in large numbers populating the...”
Origin Of Life: $10 Million Prize at the Royal Society

Where did life come from? Where did the genetic code come from? The Evolution 2.0 Prize offers $10 million to the first person to self-organise chemicals into code.

Wealthy investors are offering a $10m prize to the first scientific team that can create a genetic code from simple chemicals — reproducing the unknown process that led billions of years ago to DNA as the vehicle for transmitting information in life on Earth. The Evolution 2.0 prize is an initiative by Perry Marshall, an online marketing entrepreneur based in Chicago. It will be judged by prominent scientists, including George Church, genetics professor at Harvard university, and Denis Noble, the Oxford university biologist who was the first to model the human heart on a computer…

*Clive Cookson, “Entrepreneurs offer $10m prize for cracking mystery of DNA” at Financial Times*

The entire $10 million will go only to a “patentable” coding system, with the sponsors of the prize as partners with the winner in commercialization.”

“The origins of PPE. The look was created by Charles de Lorme to protect doctors from poisoned air. *Virus* is a Latin term for poison.
To friends and colleagues of the biosphere,

While the coronavirus is upon us and causing much profound concern and anguish around the world, we must also keep in front of us that the “viruses” called human-caused climate change and the relentless assaults on Nature continue — even in recent months (and years) before the virus “arrived” — to be substantially ignored and even exacerbated, especially here in the United States. But of course, there are many exceptions wherein an earth-centered ethic emerges and raises us up and onward…. Here below are a few of those recent good-news stories you may have missed. Sending you all good vibes...Keep safe/careful, and let’s too keep our eyes on the prize — a prioritized, healthier, and sustainable biosphere.

Doug/Global Ecology Education Initiative/UMass-Boston School for the Environment

• In a crucial and stunning victory, a proposed oil drilling project by Peru Petro Company in the Peruvian Amazon, which threatened to damage the vast rainforest ecosystem, indigenous peoples, and the biodiverse flora and fauna there, has been halted. After much organizing and citizen support, an indigenous coalition — the Regional Organization of Indigenous People of the East (ORPIO) went to court, presented their case, and the judge ruled recently that the drilling cannot go forward. (As reported by Living on Earth and Reuters News Service)

• The Rainforest Action Network (RAN) announced a major victory in the urgent fight to stop the continuing removal of biodiverse tropical rainforest by megacorporations establishing vast monoculture forests of palm trees for palm oil production. After 6 years of intensive grassroots campaigning, protests, letters, a major palm oil producer and user, PepsiCo, has agreed to a new policy and actions to address the destruction of rainforests, the abuse of workers, and the exploitation of communities. PepsiCo’s new commitments as demanded by RAN and many others are critically important in saving the most endangered species in the world, including Sumatran orangutans, tigers, rhinos and elephants and reducing the continued removal of wild rainforest ecosystems. Palm oil (often under hidden label names such as etyl palmitate, palmate, palm kernel oil, glycerol) is used by most consumers, often not realizing that our continued use of products which contain it make us a contributor to the continued critical loss of tropical forest. It
is found in many cereals, most soaps, cleaning agents, skippy peanut butter, cadbury chocolate, many margarines, shampoos, conditioners, ritz crackers, etc. In most cases the palm is not even an essential ingredient.

• A quality palm oil-free sustainable soap now available is a simple and sensible way each of us can begin to get out of being an enabler of tropical rainforest destruction through palm oil plantation development. With the emphasis on handwashing, mandatory in today's virus crisis, this is an excellent time to make one of the recommended lifestyle/product changes listed in the personal news green deal advocacy article I wrote in the 2019 GEEI Calling Home issue (https://dpzook.wixsite.com/gecallinghome2019). While the soap costs a few dollars more, each bar definitely lasts longer and there are some available deals now. Check out the Hand-in-Hand sustainable soap web site: https://mailchi.mp/handinhandsoap/international-womens-day-2707283?e=b4b32ba3cf.”

These tiny 'guardians' are helping protect the world's forests