Organic Mathematics for Integral Biomathics and the Reformation of Science

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Leslie Lamport's paper "How to write a proof." (1993) and later its 2011 sequel are computer science classics. The major idea behind Lamport's approach, and his own logic, TLA(+) (Temporal Logic of Actions) was to describe a method, an algorithm, for writing precise, concise and easily comprehensible structured proofs. The school of thought representing this instructive organization of mathematical knowledge for new scholars entering a field was later known as "Organic Mathematics". William C. Hoffman's last paper entitled "Mathematics for Biomathics" written just before his passing away (2013) made the next corner point that motivated this journey.

The goal of this contribution is to find out which is the best instructive and comprehensible way to restructure and optimize the basic and advanced study material in mathematics for graduate students both in mathematics and the life sciences in order to adequately address biological problems and find their solutions. More specifically, the goal is to obtain a new[1] science of biology that uses both the available and the discoverable possibilities of mathematics in a sophisticated and systemic way. I personally find David Hestenes' approach to unify knowledge in mathematical physics very appealing. He has been developing it in a series of lectures for over 20 years now; his talks can be found on YouTube. Hestenes' book "Space-Time Algebra" was like a revelation to me, both as research manual and a comprehensive pedagogical reference. His method being a shortcut pathway through a series of formalisms on geometric calculus[2] has found fruitful grounds not only in physics today, but also in computer graphics and the engineering disciplines. There are number of mathematicians who think and work this way. I wish we could have a similar kind of mathematical construct and methodology for biology and the life sciences. Perhaps Hestenes' ontology can be used as a good example to start from. Yet, other approaches to restructuring knowledge in mathematics to make it amenable to biologists are also welcome.

What is central to this goal of adapting and developing mathematical modelling is the key to relating mathematics with biology. The answers will be different for different questions and different areas of biology. For instance, topology is directly relevant to DNA and RNA and to protein folding. We can ask for a broader list of possible relationships between a given mathematical field and other areas in biology. Analogously, we can start with a biological field and ask with widely open mind – what mathematics may be relevant here? Or we start from both ends simultaneously and look for a match iteratively. The answers may not be immediately as obvious as they were for the case of DNA. Yet, setting goals leads the outcome. Thus, *Organic Mathematics for Integral Biomathics* may become a way of rethinking science and its role in a very different post-COVID-19 world.

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[1] The genuinely new in this new science of biology is filing the gaps of knowledge in a systematic way, as they currently do in medicine, using e.g. computational analytics on data from multiple sources. In the way that physicians try to make a more precise diagnosis about a tumor by combining e.g. histological and radiological imaging data, as well as molecular data, we can try integrating diverse formal mathematical methods using modern computational means like AI/ML. New formalisms are usually invented by mathematicians themselves; it is their own imagination to create new algebras, geometries, calculi, etc. and combinations thereof. But has someone tried to use machine intelligence for discovering gaps, analogies, synergies and anomalies between mathematical and computational formalisms, conjectures, axioms and theorems, as we do from crawling data? How did Mendeleyev come to the idea to place the chemical elements on specific places in a table?

[2] from the antiquity (Euclid, Diophantes) to present day, through the classical works of Descartes, Wessel and Gauss, the 19th century formalisms of Hamilton, Grassmann, Cayley, Clifford, Gibbs and Ricci, and the 20th century breakthroughs of Cartan, Pauli and Dirac, incl. his own (Hestenes) insights.

The intention behind this project is to prepare a curriculum for the post-COVID-19 generation of students, as well as for other scholars who wish to participate in the reconstruction and reformation of science in which models and methods are mapped more precisely and systematically to the observed phenomena and questions as in the case with relating mathematics and biology. Why is this reconstruction and reform necessary? It is not that there is something wrong with science, if it cannot instantly handle a problem. This is also not because science is something that can solve all problems of humanity. This is *because* of the dominating mode of "channelled", industrialised, micromanaged and for-profit science which has been artificially imposed and intensified during the past 30 years following the fall of the Iron Curtain. It is also because twenty biomedical companies with thousands of employees, seventy nations doing research and billions of dollars were not enough to solve the problem which humanity has been facing for over a year now and the clinical vaccine trials were extended into the real population following unprepared emergency executive decisions. In contrast, the virologist Maurice Hilleman who beat the 1957 flu pandemic, produced a vaccine and had people immunized in four months. The quest for a COVID-19 remedy which began like a Sunday excursion, moving later into something like alchemy with the randomly testing this and that approach, could end up as a disaster and total failure of our entire civilization. Despite our advanced technology, it appears that we do not have control over the situation and are unable to develop biological defence that would help us survive as a species on this planet. What if scientists around the world are not able to provide an effective vaccine against the SARS-CoV-2 virus? Will then death and devastation cover our known Earth? If this happens, people will begin asking why do we care about science at all? Of course, asking this is a complete misconception about the nature of science. Today we acknowledge that there is no instant solution to the virus problem. That is not an indictment of our present science. it is just a fact resulting from its *overmanagement*[3], from *human greed, ignorance, stupidity and arrogance*.

Science has never been based on the search of power and the ownership of knowledge for the privileged. **It is absolutely essential that everyone understands that science is about *being curious, honest and creative in the face of the unknown*.** Only with that understanding new solutions can and will emerge at whatever pace they need. That's what science is supposed to be. But that does not guarantee a solution. Applied research deals with solving practical problems in everyday life. Yet, fundamental research should remain what it is at its core: to support human curiosity and the desire to understand the world at the deepest level. From this quest has come and will come all the solutions to practical problems of which we are capable. Let's go back to the roots we have lost.

[3] What happens is that the administrations try to control scientists through financial rewards and punishments. Managers are allowed to dominate, choosing what areas to fund, which professors to hire, etc. They are most successful not at organising and advising science, but at funding themselves, raising their high salaries much higher and justifying these by cutting costs, getting rid of pesky scientists who want autonomy, etc. Corruption is another typical social phenomenon and disease for large research organisations. It can be compared to a candida infection related to sugar intake. Above a certain threshold it becomes a pandemic that overtakes the entire body bringing injustice and suffering. Therefore, scientists should not feel chased to work on principles like "Publish or perish" and keep deadlines on projects e.g. like managers do, because their creativity is lost. This is what I am trying to practice consistently at all circumstances. If I don't have something to say, I don't publish and prefer to think, read and learn! Where did all these measurements and performance criteria in science come from? From industry and production, of course. Everything should be put under control and set under competition conditions. Then we wonder why cohorts of researchers in large pharmaceutic companies cannot deliver fast results with the SARS-CoV-2 vaccine. Yes, it is a difficult task indeed, but also there is something else. Scientists are chased to compete and defend corporate assets and values, not to cooperate. They are forced to keep their results secret and even lie to confuse and mislead their competitors, without regard for what this may cost in precious time and human lives! What a damned world are we living in? These concerns about the management of science and the autonomy and responsibility of scientists at research institutions and companies are part of the broader issue of how we defend our genuine democracy and freedom.