



Bio Based Press

Reconnect with nature through innovation

Waltzing with nature

A manifesto

The pressure is mounting to change our lifestyle. We humans have not taken good care of nature. Global heating, plastic littering everywhere, insect decline, nutritional diseases because of bad diets and risks of pandemics like the corona crisis. But unexpected friends come to our rescue: modern science and technology. With innovations that take up and copy nature's strength and do not act against her. Waltzing with nature. Like in a dance. A new lifestyle.

At face value, technology seems just an instrument for comfort and luxury: motor car, washing machine, refrigerator, central heating. But technology can also solve *real* problems and fundamentally change society: antibiotics, the computer, the green revolution that saved the world from starvation.

Technology can also be the instrument to tackle our new urgent problems. Innovations in the service of a new balance between nature, culture and the economy. Solar and wind power, modern biotechnological-chemical industry, precision agriculture and artificial intelligence. Our recent insights into nature will greatly help us fulfilling this task. *We learn to imitate nature instead of putting a break on it.* We look into nature's processes in order to discover how smart she is. In agriculture and horticulture, we use less and less poison but redress nature using devices of her own. Industry increasingly makes use of natural processes, that require little energy and leave hardly any waste. Using solar and wind power is moving with nature. A new lifestyle emerges, in harmony with her. This is a revolution, and we witness just the beginning.



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Fifty years ago, the Limits to Growth report issued a strong warning for disaster through pollution and food shortages. Now solar energy is in full development; chemical industry cleans up its business fast and world food production is at a sufficient level to feed a growing global population. Mankind has taken to heart the warning. We can now do the same with global warming, plastic pollution, resistance to pesticides and herbicides and unexpected threats to public health. But faster. And in symbiosis with nature.

Our new technologies need support and recognition; from public opinion and through government support. *Our mentality should change and our lifestyle; and our structures as well.* Incumbent interests that maintain that 'things are not as bad as they look like' should be put on hold. *Scientific research, the source of new technologies, should come to the forefront.* And all this together: from more and better fundamental research to innovations and investments, and to regulation that protects them. For regulation without new technologies is without any joy: driving less, using less plastics. And technologies without new regulation are toothless.

It is exciting to shape this new relationship with nature. A relationship in which mankind doesn't have the upper hand; but in which we accept to be a partner in this system that transcends us. *We can do so in our private lives through more respect for nature.* And we can pave the way for these new technologies, inspired by nature and above all in cooperation with her. We can do the right thing.

We are convinced that mankind can overcome its new problems. With intelligence, confidence and adaptability. And by waltzing with nature: showing more respect for our eternal partner.

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Explanation

Technological developments come in waves. Economists know this. According to them, periods of economic growth, the so-called Kondratieff waves, correspond to the rise of a new technology. The last wave was propelled by ICT. Now we are heading for an era in which biology and biochemistry constitute the peak of technological developments. The 'life sciences' are coming – the knowledge of living nature in all its aspects. The importance of these scientific branches isn't generally known yet. They will assist us in solving major problems. *Nature is unbelievably rich and full of technology. In its processes, we can discover how to do it: obtain results without causing problems.*

We aren't technological optimists. Our message isn't: technology will solve all problems. As if the climate will cool down all by itself and as if we will also come up with some smart solutions on plastic waste. Our message is: we can solve our present mega problems, if we respect living nature and take care of it, and take into consideration its laws.

Examples of new technologies

Life sciences come in many forms.

Biological control

In tomato greenhouses, horticulturalists use more and more biological control and less and less poison. They release the vermin's natural enemies into the greenhouse. In doing so, they control common tomato diseases like the tomato mosaic virus, mildew, botrytis and fusarium. We can control plant diseases with poison. But sooner or later (and often sooner), resistance will pop up. Vermin will become resistant to the pesticide; we will have to use ever increasing amounts of it, or change to yet another poison. Biological control is the alternative, in regular agriculture as well. In doing so, we use techniques that nature itself selected in its long evolutionary process. It will keep on selecting such mechanisms, for the evolution keeps going on.

Biological production

From times immemorial, mankind has produced beer and wine making good use of microorganisms. We used bacteria in 'green manuring' with legumes; for these host bacteria in their root tubers that fix atmospheric nitrogen and process it into nutrients. This is a trick we humans can only perform in large chemical factories, using a lot of energy. In the well-known Haber-Bosch process, a major

breakthrough a century ago. And although nature's process for nitrogen capture is very cumbersome, this still holds the key for the world's future food production.

Nature holds many more promises. One company produces bricks from just sand, chalk and water, with a bacterium. Another one cleans up polluted soils using microorganisms. Yet other companies harvests new materials (PHAs) from bacteria. We keep making new discoveries. Science in these areas has just scratched the surface.

We can assist nature in helping us. Fertilizer? Useful, but we can do better. We can coat crop seeds with a bacterium; this spreads into the plant, lending to all cells the ability to produce nutrients from the air. Fertilizer use can go down by half. And the soil produces much more. We have discovered that it is a treasure of useful organisms. They produce almost everything plants need. Soil moulds keep plants healthy and assist them in finding nutrients. They even help them to communicate with each other; we can now view a forest as one huge organism. In nature, everything and all living organisms are interconnected. Holism instead of reductionism. We should start thinking like a natural being.

Bionics (also called biomimicry)

Whoever has seen a gecko walk along a wall, or even on a ceiling, must have wondered how the little animal can do this. The electron microscope has solved this problem. The gecko's paws are covered with millions of tiny hairs. These attach to the wall with forces that only operate on the micro level. Technicians have now copied this miracle. They have constructed devices that can crawl on the inside walls of industrial boilers, looking for micro cracks. Much cheaper and more efficient than constructing a scaffolding and send technicians upwards, mounted with flashlights. And 'gecko' grabs can lift objects like displays and mount them.

Bionics copies nature's techniques. Cutting, sticking, moving, purifying, stitching, cleaning, drag reduction – nature offers us a plethora of solutions. Bionics makes use of the 'biological intelligence' that nature has acquired in 3.8 billion years – as long as there is life on earth. Nature has selected productive techniques and separated them from the unproductive ones. And we can now tap into that intelligence – free of charge. Bionics comes up with surprising solutions, often quite different from existing human technology. Bionics too, has just scratched the surface.

Biochemistry

Some time ago, synthetic antibiotics were brown and bitter; they had to be firmly encapsulated. Nowadays they are small, white and tasteless. The difference is biochemistry: they are produced much more purely, with help of enzymes, nature's little helpers. And with a much smaller footprint: from less resources with less energy use, and without producing toxic waste.

Biochemistry studies living nature's processes and applies them. Processes in living organisms like digestion and energy supply. These are governed by enzymes, proteins with very specific functions. We can use those enzymes for similar industrial processes. That will produce pure substances. Biochemistry has many useful applications. Like tests, for instance for cancer or pregnancy. Looking for the causes of conditions, and finding possible remedies. Studying the process of digestion, and discovering ways in which it can go wrong. Finding the interplay between a fertile soil and a healthy crop.

Biotechnology

At present, artemisinin is the best antimalarial medicine. It is produced by the artemisinin plant (small wormwood). But we now also produce it from microorganisms. Much more efficiently. We introduced the gene responsible for medicines production into those microorganisms.

We have mastered the art of transferring genes from one organism to another. Those genes then still have the properties of their own and continue for instance to produce a medicine; often with a much higher yield. We can also transfer parts of those genes, DNA fragments. With much the same effect. Industry produces many medicines along this pathway. But there are many more opportunities. Industry can produce new and special materials, polymers with useful properties. Chemicals from biobased resources; they can substitute petrochemical substances (and do so with much less energy use and toxic waste production). Pathways for processing difficult resources like wood.

There is much fear for biotechnology, and resistance towards it. Opponents tell us that this technique is 'unnatural'. But it is not well-known that genetic modification takes place within nature as well, even on a major scale. In particular micro-organisms, viruses, phages, bacteria, moulds etc. etc. exchange genetic material all the time. It is the motor behind evolution. Just consider changes in the corona viruses. In living nature, organisms continuously change DNA fragments, and exchange them as well. Within one species, and also among different species.

This happens with all living organisms. The cassava, a tropical root crop, has become edible at a certain point in its evolution: it absorbed a DNA fragment from the bacterium *Agrobacter*. And surprisingly, a few percent of our human DNA is of viral origin. We can only surmise that distant ancestors have put a viral infection to good use by incorporating some viral DNA. Biotechnology is the science of copying such natural mechanisms. It is a technology like all others, it can be used for the better and for the worse. If used for the better, biotechnology is a major addition to our technological toolbox. An opportunity to restore the equilibrium with the Earth, because we use mechanisms from living nature.

Food technology

Modern technology will allow the food industry to drive back waste in the entire food chain; and improve our health as well. Our knowledge of the microbiome

in our guts and of our digestion has expanded a lot. Modern food technology will enable us to produce excellent and healthy products. But too often, everything in the food chain is geared towards low prices. We will do a great favour to ourselves, and to nature, if we change this.

More life sciences

New applications pop up all the time.

- Science develops *artificial organs* like kidneys (that could substitute dialysis equipment) and pancreases (that might spare diabetes patients the plight of having to inject insulin).
- *Stem cells* are non-specialized cells that can develop into any kind of cell required by the organism. They are at the basis of *stem cell therapy*, that could treat conditions like diabetes, liver conditions and leukaemia.
- *Tests* that would allow doctors to determine if a medicine will work on a given patient. Some cancer medicines are effective just on some patients and not on others; it would be extremely helpful if we could determine to which category a certain patient would belong.

Let's not burden nature anymore

If we should use these techniques, we would not burden nature anymore with toxic substances and waste. Not with plastic and not with CO₂. We would process nature with natural techniques, We would be waltzing with nature.

But all natural processes form part of a cycle. Nature can process all substances that it produces. We should learn to think as a natural being. The snake should be able to digest its own venom, if it eats the animal it just killed. The snake should also have access to a spare venom, in case prey animals should become immune. It should be able to innovate, develop new techniques. Innovation doesn't just belong to the human realm; nature itself innovates all the time. But along pathways that we should learn to know better. In this way, we could adapt to nature, instead of the other way around.

Often, we have already found the solution

We know for a while already how to tackle climate change. Renewable energy (solar, wind and water) will win, together with efficient energy use. This is because solar and wind energies become cheaper all the time. In particular in the case of solar energy we can predict that prices will keep falling for some time to come. But then, we need a new kind of electric grid. A grid that can be fed from the capillaries; a grid that will still deliver even in misty and calm weather. That innovative change needs to step up, we still stick to business-as-usual. We need to change this, for otherwise we will run into difficulties.



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The problem of plastic waste teaches us a lesson. We should not just have an eye on the direct use of a plastic object but on the entire chain. In designing plastics, we have never considered the tail of the process, the events that occur after discarding the object. We never considered recycling to be of decisive importance. We still don't. Here, we need proper innovation; both in collection schemes and in processing. Not a problem but a proper challenge.

Maybe resistance is our biggest problem – the phenomenon that vermin can become resistant to our methods of control. We will have to take a better look at the way in which nature deals with this problem. We don't know enough about this yet.

The new industry

Fifty years ago, chemical industry heavily polluted the environment. It emitted dangerous substances and produced toxic waste. The new 'green' chemical industry is quite different, it uses biotechnology in its processes. Energy consumption is low. As is waste production; any waste produced is much less toxic than it used to be. This industry produces new substances, new materials, often with better properties.

This industry doesn't use fossil fuels as its feedstock, but renewable resources. Recycled materials or CO₂. And notably agricultural products. At present often sugar, for the time being this is in plenty supply. In the future predominantly agricultural waste like straw; or lignin, the wood component that always was difficult to process. This industry is smaller and does not entail major risks. It can be constructed near the feedstock supplier: the farmer. In the future, the countryside will not just supply food, but chemicals and materials as well. This biotechnological industry will change the face of the world. It will kindle new life into rural economies.

Good food for mega cities

Agricultural production is on the rise, in almost all countries. Precision agriculture is the key to this. Its secret is inspection of the crop. Treatment of the crop just insofar it is required. With precise interventions that have few side effects, as few as possible. Organic agriculture can also use many of these techniques. Mankind now produces enough bulk products like wheat, potatoes and tapioca; the world will probably be able to feed the 10 billion people of 2050. Although we need to change our diets. Not eat meat on a daily basis anymore.

But we also need fresh vegetables. We need to produce them as closely to the consumers as possible. In greenhouses, we have perfected the art of precision agriculture. We can construct greenhouses in derelict buildings, on roofs, in the middle of cities or in industrial areas. We adapt lighting to the crop. Developers can now supply complete installations to their customers, with seeds, substrates, manuals for growing the crop and guidelines for the treatment of vermin and infections. In this way, we can supply fresh vegetables to even the biggest cities of the world.

Priority to research

The corona crisis shows us how much more we know than before on the subject of pandemics; but also how much we don't know yet. Fortunately, there is more appreciation for good research now. Let's use this momentum for clearing the way for scientific research. In all its manifestations, starting with extra funding for fundamental research. And new pathways for innovations and smart investments. Doing this, we will run into many ethical dilemmas: cloning, stem cell research, application of genetic techniques on human beings. We should take care to stay in balance with nature at an international level, up to the centres of decision making.

Again: waltzing with nature

We human beings are intricately connected with nature. We are part of it with our bodies and through our environment. That makes us vulnerable – for pandemics, for natural reactions like resistance. But it is our strength as well. We can become partners, like in a waltz.

Creating a flower garden where insects thrive. Less control of harmful nature and better promotion of useful nature. Not wasting energy. Asking ourselves if our waste will be harmful to nature.

Promote innovations that reinforce nature. Taking care of the wealth of new scientific discoveries, looking after their proper application. Support and promote renewable energy. Develop pesticides and herbicides that cause less damage to nature; clearing the way for natural techniques of pest control. Prevent governments and companies to put a brake on such policies.

With this new energy we will be able to move mountains. With intelligence and confidence, and with more respect for our eternal partner, living nature.