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Sustainability, polysaccharide science, and bio-economy

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ABSTRACT

At the opening of the 2nd EPNOE conference the role and responsibility of polysaccharide scientists was reflected upon and placed in the context of actual global issues like the transition process towards "sustainable bio-economy". Difficulties in the chain of communication between the different parties involved and towards the wider public was addressed. The need for change in the relations between science and the public and to go beyond the horizon of the specialization was discussed. It was stated that polysaccharide science is one of the key sciences in those transitions.

1. Introduction

At the 2nd EPNOE Polysaccharide conference held in Wageningen, The Netherlands, from August 29 to September 3, 2011, outstanding experts have gathered from all over the world with an established track record in the scientific literature of their works and discoveries. They have the drive to bring the frontiers of polysaccharide science a step further and to learn from each other's latest findings. These scientists explore the frontiers of our knowledge of the world. They are very much aware that polysaccharide science is crucially important for human survival on our planet. This branch of science is interested in our daily intake of carbohydrates and high-fibre products, it is therefore interested in health issues, but it is also interested in polysaccharides as a multifarious source of energy that pertains to many more aspects of our life than food and health alone. Polysaccharides are found in all biological matter around us. It is what provides structure, texture, taste and shelter to (practically) all living organisms. It is no exaggeration to say that polysaccharides such as cellulose, starch, chitin and countless other polymeric sugars in plants, animals or microorganisms sustain existence on our planet.

The chemistry and physics of polysaccharides as well as their biological, medical, or economic aspects have been studied since the early days of our species, long before the word 'polysaccharide' was invented. Discovery of cellulose microfibers enclosed in halite crystals in 250 million old Permian rocks (Griffith, Wilcox, Powers, Nelson, & Baxter, 2008) proofs that polymeric carbohydrates have persisted unchanged in the evolution of life on earth. Whereas there has been hardly any doubt about the relevance of polysaccharides for biology, nowadays we also witness new and unforeseen technological applications. Cellulose, for example, has recently been discovered by outstanding scientists as a smart material. Biomimetic sensors in micro-electronic smart materials based on cellulose and other polysaccharides have been designed and are within reach of commercial production (Kim, Yun, & Ounaiaes, 2006).

Nowadays, the scope of polysaccharide research is very wide (Persin et al., 2011) and there is so much information available in the literature that it is impossible for a scientist to grasp the entire domain and to oversee all the consequences. Most of the innovations and discoveries made today are firmly based upon existing knowledge. Innovations are often based on knowledge from handbooks and long traditions in scientific disciplines. New combinations of information and cross fertilization from different disciplines may lead to significant improvements and breakthrough technologies. Sometimes only new names and new packaging are sufficient for a profitable expanding market.

It is true that many researchers are clustering around the same hot topics and trends that are interesting to laymen (politicians, companies, public, media, etc.) as well. Those who study polysaccharides are operating on the cutting edge of contemporary science: nanotechnology, semi-synthetic biology, bio-economy, bio-refinery, genomics, and information technology all impact on polysaccharide research and vice versa. At the 2nd EPNOE conference in Wageningen, all these and more issues were addressed in the various sessions (Boeriu, van Dam, Schols, Pepping, & Oudshooorn, 2011).

The search for alternative renewable sources for the production of transportation fuel has evoked discussions on the sustainability of biomass use for the production of energy, and use of fertile

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agricultural land for other than food crop production. Facing a huge variety of political and societal dilemmas, scientists play a key role in finding credible solutions when they are investigating feasible alternatives and options for overcoming technical and economic barriers. For example, the discovery of GH61, an enzyme derived from fungi that is capable of degrading cellulose more efficiently to sugars (and hence overcomes the constraints of converting poorly digestible plant matter into ethanol) opens completely new perspectives not only for bio-economy, but for the world as such (Quinlan et al., 2011). The impact of this discovery becomes clear if one realizes that the global generation of cellulose equals 20 times the annual global current oil consumption. As co-author Paul Walton argued (Walton & Davies, 2011): "This discovery opens up a major avenue in the continuing search for environmentally friendly and secure energy. The potential of bioethanol to make a major contribution to sustainable energy really now is a reality. "Such discoveries imply new roles and perspectives for scientists. They have to combine and cluster very disparate sorts of information from many different angles in order to understand and find answers to questions that arise when we speak about global issues like "sustainable bio-economy".

Unfortunately, scientists are trained to discuss details that are oftentimes difficult to discriminate for outsiders. Despite the fact that scientists nowadays are the most trusted professional group – far more than religious teachers or politicians (Gaskell et al., 2006) – the public understanding of the scientific implications of complex issues such as the relationship between bio-economy and sustainability remains poor. A reason for this might be poor communication skills on behalf of the scientists.

We surmise that public participation in the discussion about bio-economic developments and their impact on sustainability and globalization is essential. Therefore, public awareness needs to be incited at all possible levels. We do not only need to elucidate how polysaccharide science influences our society, but also how it might affect our understanding of popular concepts such as sustainability and globalization. In what follows, we will cautiously present some ideas from the philosophy of science about how we might evoke a truly inter- and extra-disciplinary science in relation to polysaccharides and bio-economy.

It is generally taken for granted that science plays an important role in society. In this sense, there is no lack of self-confidence in various branches of science. The quote by Professor Walton (see above) is a case in point. But see also what we have picked up from the EPNOE-conference website: Polysaccharide-based polymers are offering credible answers to the challenges faced by the world in terms of global sustainability.

"Polysaccharide-based polymers are offering credible answers faced by the world in terms of global sustainability." We submit that not all sciences will make these kind of claims. But whoever speaks about polysaccharides or any other issue related to bio-economy is, at least according to the promulgators of this science, invoked in something grand. Expressions like 'global sustainability' at least suggest something of the sort. But what exactly do we mean by concepts such as 'globalization' or 'sustainability'? And how are scientists involved in polysaccharide research capable of making sense of them?

People interested in bio-economy generally take for granted that Polysaccharide-based polymers are offering credible answers to the challenges faced by the world in terms of global sustainability.

Polysaccharide-based polymers are offering credible answers to the challenges faced by the world in terms of global sustainability.

alternative, more sustainable forms of energy are absolutely necessary for the future of humankind. This seems to be so commonsensical that it is difficult to shed doubt on all of this. Whereas philosophers or social scientists, environmentalists, or business people think about the *ideas* surrounding the theme of sustainability, it seems to us that most participants in polysaccharide research know something about the more *material* aspects behind these *ideas*. It is, after all, in the material world (e.g. plant biomass) that they suspect lies a great promise for the future, even the near future. Not only on the website of the EPNOE-conference, but also in the articles presented there we encountered an unadulterated kind of optimism that infuses and inspires the disparate types of research in the field (Boeriu et al., 2011).

But what about the *idea* of sustainability? What is it exactly that we are talking about when we speak about it as if its significance can be taken for granted? In what follows, we will 'focus on three terms: 'public', 'science', and, indeed, 'sustainability'. Now, this may baffle some of our readers. Why, after all, should we want to talk about 'public' and 'science'? It is our conviction that efforts to implement something called 'sustainability' will only be successful if we all, scientists and non-scientists alike, are capable of bridging the gap between public and science. The good news, as far as we see it, is that this gap can be bridged. It has, as we will argue, not always been there and so we do not need to take it for granted. The bad news, however, is that there are different logics in contemporary society at work that enlarge rather than narrow this baleful gap. But first, we need to talk a bit more about sustainability. Later on, we will address the notion of 'public' in relation to that of 'science'. The overall, somewhat provocative idea that we will try to defend is that sustainability requires a very special, perhaps even new kind of scientist. What are his or her contours? Who is he or she? And what is his or her impact on bio-economy?

2. Sustainability

Nowadays most people consider sustainability to be a virtue, the value of which is often taken for granted. Nevertheless, there are so many definitions of the concept that many people cannot see the wood for the trees. It is therefore a heavily contested notion.

Let us therefore start with the simple and useful distinction that can be made between *sustainability* as a goal and *sustainable development* as a means to achieve that goal (ten Bos & Bevan, 2011). The goal can be formulated as follows: an integrated understanding of the interconnectedness of human activity, including business and enterprise, with all related man-made and natural systems. Sustainable development is, according to the most famous definition formulated by the Brundlandt commission (1987), a whole series of measures and activities that "seek to meet the needs and aspirations of present society without compromising the ability to meet those of future generations".

The concept is etymologically related to the French word *soutenir* which means 'to support' or 'to defend'. The Latin *subtus* means 'under' and *tenire* means 'to hold' or 'to maintain'. There is a link with care: to sustain someone implies that one takes care of him or her. We sustain our infants with love, education, and food. But even though we sustain them in a variety of ways, they do not remain babies. They change and become children, then adolescents, and finally adults. What holds for babies also holds for society. Sustainable societies are not against change.

It is important to stress this, for there used to be a time when business people and politicians were very suspicious about concepts such as sustainability exactly because they were believed to thwart change or progress. In 1976, the German Federal Chancellor Helmut Schmidt, at that time one of the most influential politicians in the world, explicitly warned against the findings of global think tanks such as The Club of Rome (Meadows, Meadows, Randers, & Behrens, 1972). Such institutions, he claimed, merely urge us to get back to a simple life, indeed to the life of Diogenes, the ancient Greek philosopher who made a virtue out of poverty and who spent his life in a tub alongside a river in Athens. Human beings, Schmidt

argued, have not arrived and worked on this planet to live the life of a dog (Sloterdijk, 1982).

Today, there are probably not many people who would embrace Schmidt's cynicism. The message that sustainability should be a central concern for politicians and business people is loud and clear. Yet, it is remarkable how long it has taken before it was finally received. Where do these tenacious doubts about sustainability come from? An answer to this question requires a brief detour through history. Already a long time ago, scientists warned against the deleterious consequences of human enterprise. Georgius Agricola or Georg Bauer, the founding father of geology who lived in the first half of the 16th century, was already well aware that activities such as mining ruined the environment (Mumford, 1934). Not only did it cause deforestation – wood was needed for fuel, the construction of tunnels, or water transport – but also the extermination of "beasts and birds". Agricola's contemporaries, however, were deaf to his premonitions and saw mining as a relatively comfortable way to profit and wealth. It was cheaper and far less risky than sailing the seven seas. Another important legitimation of mining was that it was, like agriculture, considered to be an honest practice. From way back, doing business has been associated with cheating other people. Business practices such as usury and interest were always frowned upon. The idea, however, to directly obtain wealth from the earth rather than from a human being was believed to be commendable since it did not involve deceit and swindle. Mining and agriculture were therefore conceived as morally unproblematic.

In his book, *Technics and civilization* (Mumford, 1934) the American philosopher Lewis Mumford discusses Agricola's ideas at some length. The mine, Mumford claims, is portrayed by Agricola as a completely an-organic and shapeless environment where "the day has been abolished and the rhythm of nature has been broken". All that the miner sees is matter – and matter is either an obstacle to wealth or an opportunity to become wealthy. In such a bleak environment, there is nothing to distract the miner, and hence his work can become focused, even "dogged" and "unremitting". Mumford suggests that the mine can be seen as a model for the conceptual world that not only scientists but also business people and politicians in a capitalistic society entertain. More precisely, economic value was understood as a function of two elements: the quantity of brute work and the scarcity of the product. This completely reductive understanding of value became, according to Mumford, of paramount importance in financial circles as well. Note that Mumford wrote this almost 80 years ago, shortly after the Wall Street stock market crash of 1929.

Perhaps, one might understand the call for sustainability as an incentive to get out of this conceptual mine. Whether this can be done within the context of capitalism remains a moot issue, but as Mumford himself indicates, "genuine value lies in the power to sustain or to enrich life: a glass bead may be more valuable than a diamond, a deal table more valuable aesthetically than the most tortuously carved one, and the juice of a lemon may be more valuable on a long ocean voyage than hundred pounds of meat without it." The point here is that the value of something lies directly in its life function, not in its origin, rarity, originality, or even in the work done by human agents.

Crucial for the wide-spread acceptance of the concept 'sustainability' has been the fact that nowadays even economists seem to have embraced it. For a long time, they have been captive in Mumford's conceptual mine: humanity's purpose in the world was the relentless pursuit of wealth. The most efficient way to become wealthy was to externalise costs to the environment. It was therefore tacitly assumed that the plundering and ravaging of the world could be beneficial for society. Today, many economists warn against the true costs of this way of thinking. Economics has put a value on climate change and sustainability takes on an *economic* meaning. Where once economists blissfully ignored the environment because it did not make any economic sense, now the environmental changes confront us with the economic reality that the market itself may not be sustainable. Take, for example, the debate on waste disposal. As the British economist Paul Seabright (2004) makes clear, prosperous people have always tended to export their waste to less prosperous people all over the world. Today, the debate is very topical when it comes, for example, to the exportation of nuclear waste to African countries. These kind of practices have been considered to be very profitable. But Seabright points out that exporting pollution will not work anymore in a world were citizens become increasingly aware of what is being inflicted upon them. There may be fewer and fewer places where our waste can be safely ignored.

So, it is safe to say that sustainability has become fashionable. Today, many companies at least pay lip-service to it. Yet, there is something strangely rankling and unnerving about the popularity of the concept. We should never forget that a concept as such cannot make the world a better place. Indeed, behind the lip-service paid to it, there has been and there still is a lot of sluggishness and reluctance to change existent practices. For example, Exxon-Mobile's chairman en CEO Ray Tillerson has repeatedly argued that his company, the biggest oil-company in the world, is not going to embark on the search for alternative energy. As late as May 2009, he has assured that the fossil fuels still have the future: depletion of the world's resources will not ensue earlier than in the next century. Exxon-Mobil's CEO considers himself to be a realist and has always believed that shareholders are principally uninterested in the search for alternative and sustainable fuels. It is simply not a competitive market. One of Exxon-Mobil's competitors, SHELL, has clearly opted for a different kind of attitude towards the issue of alternative fuels. On the occasion of his retirement, SHELL's former CEO Jeroen van der Veer again claimed that the search for alternative fuels was inevitable: "Alternative energies will come. We are absolutely convinced", he proudly claimed (van der Veer, 2009). But like Tillerson, van der Veer immediately warns us against unrealistic expectations. First of all, the alternative energies will not be very cheap and affordability of energy is for most people in the world a crucially important issue. Second, even if we will become less reliant on non-sustainable fuels – today, they supply about 90% of the total energy – and are capable of reducing it to about 70%, then we will not use *less* of it basically because the need for energy will, according to Van der Veer, have doubled by the year 2050. This sort of business realism has undoubtedly impacted Shell's later decision to stop, as a consequence of the economic crisis, investing in alternative forms of energy.

The point of these digressions into the world of business is very simple: scientists thinking about the possibility of alternative energy should also think about strategies that will convince a certain kind of public, be it the business tycoons of the oil industry or the ordinary man in the street who is, after all, a consumer. So, let us turn now to the concept of the public.

3. Public

Let us face it right away: a large portion of the population in modern societies do not understand the basics of science and consequently cannot grasp the social or environmental impact of scientific discoveries. In other words, there is a gap between science and the public. The business tycoons mentioned above are not an exception to the rule. Not too long ago, the Dutch minister of Law, Fred Teeven, did not mince words when he openly admitted that he was not interested in science but just in what the public was thinking. There are many of these examples: 'counter-factual' politics, that is to say, a politics which flatly denies what many scientists would agree is a *matter of fact* is very dominant. *Politicians do not*

need to listen to what scientists argue. We will not say too much about this here, but we can safely assume that science has two major tasks these days. On the one hand, it should try to advance our knowledge – and conferences like that in Wageningen are doing just that. On the other hand, it should try to bridge the distance between science and public. In other words, science needs to be communicated, not only to the public as we generally understand it, but also to people working in adjacent or even altogether different domains. The reason for this is that no specialization whatsoever can solve the problem of sustainability. We desperately need people who are capable of bridging gaps between different types of research and ultimately of bridging the gap to the public.

Now, these ideas may touch a sore spot. Of old, the notion of an increasing gap between public and science is related to an understanding that science is progressing whereas societies are not. The French philosopher and historian of chemistry Bernadette-Bensaude Vincent puts it as follows: "When it is assumed that the advancement of science is natural and a necessary process that nothing – no human intervention – can stop, then nothing can prevent the increasing gulf between the professional scientists in charge of the production of knowledge and the public that consumes the products of knowledge" (Bensaude-Vincent, 2001). But she also points out that this gap or gulf is a relatively recent phenomenon. There was a time, she argues, when public interest in science was widespread and closely related to amateur practices of science. These amateurs considered themselves and were considered as members of the 'republic of science'. Among the 'citizens' of this republic were not only scientists themselves, but also politicians, entrepreneurs, and philosophers. Science, its promulgators argued, is like the sun: everybody in the republic should come closer to it and experience its warmth and enlightenment. Until far in the 19th century the public considered science to be amusing, interesting, fun, recreational, entertaining, but also critical, enlightened, and indispensable for society. People in the republic did not question its relevance for society. People like the Dutch minister of Law whom we just quoted were unheard of.

All this is not to claim that everybody in France or elsewhere was involved in science. Indeed, this would be an absurd claim given, for example, the illiteracy at that time. But we can safely assume that there was a continuity between public and science. Somehow this continuity has vanished. How did that happen? How did the gap come into being?

We are talking a very complex phenomenon here. Bensaude-Vincent, who is considered to be one the most renowned experts on the history of chemistry, points out that the 19th and 20th century has seen many efforts to popularize or, as skeptics would have it, 'vulgarize' science. In fact, people came to accept that there was a proper science and a popular science. Such a distinction is no longer considered to be tenable. Today, "any non-professional practice of science that is not shaped an constrained by the current norms and regulations of the academic community is labeled a pseudo-science. There is no alternative science. Science is unique." So, these days, we have the scientists who hold the monopoly of the truth and the "numerous, anonymous, or amorphous mass" forming something called the public who are then considered no longer to be seriously interested in science, or at least no longer to be expecting enlightenment by it. This is, of course, a deplorable state of affairs. In the republic of science, everyone understood that science is deeply rooted in common-sense, in what we experience on a daily basis. Part of why this has become unacceptable is related to the rise of a particular kind of physics that was no longer understandable by common sense and that communicated in a new kind of very complex mathematical language. Relativity theory or quantum mechanics are mind-boggling for most of us – which is, of course, not a reason to dismiss it – and they have no doubt contributed to the gulf between science and the public that we are bemoaning here. But times have changed, the prestige of physics has declined somewhat, and today we see the rise of a new kind of science, generally alluded to with adjectives such as 'biological' or 'environmental'. As Bensaude-Vincent points out, this might bring about a "deep transformation in the relations between science and the public". Indeed, the new sciences may render this very gap between public and science obsolete.

But what does that mean for the practitioners of this science?

4. Different roles for scientist

We have seen that in the discussions about sustainability, scientists have always played an important role. Problems that are oftentimes associated with sustainability – climate change, CO_2-emissions, bio-safety and biohazard, or environmental pollution – were first addressed by experts with a scientific background. It were biologists, physicists, or geologists who first addressed the deleterious consequences of human enterprise (UNEP, IPCC, 1988). In contemporary democracies, these experts are supposed to enlighten not only the general public but, more specifically, politicians, enterprise, and colleagues who are operating in different research areas. However, we have also seen that there are many difficulties here: the chain of communication between the different parties involved is hardly ever clear. Public and politicians do not always wish to hear expert messages about the current state of the world. Moreover, many of the experts themselves do not seem to agree about particular developments. The French philosopher and mathematician Michel Serres has complained about the tendency among scientists to find shelter in specified territories to which others cannot have access (Serres, 2010). There is, he claims, a deafness among scientists with different specialisms, something which he closely links to contemporary academic rules.

If we take a look at the EPNOE-conference in Wageningen, we typically see scientists discussing all sorts of progress in their research areas. Each expert knows very much about his or her own interest field, perhaps also about some adjacent domains. But generally, experts do not dare to venture too far from their own field of specialization. A good scientist is absolutely certain about his or her findings and about what he or she contributes to the field. He or she can defend certain ideas on the basis of sound arguments. But what happens when he or she ventures into different but relevant research fields that are required to obtain answers that cannot be found in one's privileged field of research? Or what is happening when one can only fund research by embarking on fashionable or trendy topics such as nanotechnology? We hope and trust that conferences such as EPNOE 2011 make possible to go beyond the horizon of the specialization. We hope that strategic alliances and networks have been forged. But also hope for individual scientists who know how to be loyal to the traditions of their own research field while simultaneously being capable of looking further than this tradition as such. Polysaccharide expertise deals with distinct disciplines like bio-organic chemistry for the synthesis and analysis of nanostructures; biotechnology for the study of the specific nature and the genetics of enzymes such as GH61; biomaterials science for all sorts of materials and their properties. The polysaccharide science involves most important disciplines of biology, medicine, physics and chemistry and are including for example food chemistry and immunology, rheology or hydrology. But we need, simply put, people who can think out of the box. And we need people who can 'sell' their ideas to broader audiences.

Partly due to the societal developments we have just depicted, people no longer rely on experts as far as their lives are concerned. They have good and bad reasons for this. A good reason is that scientists have, of course, been complicit in creating the problems we have now. Science has a long-standing and rather scary tradition of

being involved with industry, indeed, of making the kind of industry possible that incites people on the planet to live more and more '*un*sustainably'. Unfortunately, they have not always acted with integrity. The famous 1974 Asilomar conference on biotechnology, where scientists chose to take into account public fears about developments in biotechnology, stands as an exception to the rule (Berg, Baltimore, Brenner, Roblin, & Singer, 1975). By and large, the public still has hardly any voice in the debate. This is not to say that this public is not on the mind of successful scientists. Take, for example, the world famous Dutch virologist Ab Osterhaus. In his country, he has been a man who has persistently warned against the dangers of a pandemic. He repeatedly tried to persuade politicians that they should develop or purchase vaccines on a massive scale. He became a well-known scientist held in high esteem by the public. Yet, his authority received a blow when it turned out that he not only held several positions on advisory boards for the medical industry but also had shares in quite a few of the companies involved.

These kinds of conflicts of interest have haunted scientific experts for a long time. How objective is it what they say? How reliable are their research programs? The problem is that scientists have, in spite of some of the counter-factual tendencies described above, always been capable of relating to industries or powerful politicians, but hardly ever to the public. Scientists are, in other words, often involved in social situations that do not always make a concern for the public weal an easy option. Moreover, there seems to be a certain antagonism between science and democracy. To put it straightforwardly, is there a way in which the public can control the kind of expert knowledge that people like Osterhaus have? Admiration can easily transform into distrust. Scientists that are working in cutting edge areas – and we certainly think that not only virologists but also polysaccharide scientists belong to them – should not take public trust for granted.

What can be done? The role of science and scientists, some commentators argue, has to change. Karin Backstränd, a Swedish political theorist and environmentalist, has identified three interrelated problems with science as it is currently practiced: (a) it lacks public trust; (b) it has deteriorated into specialist self-indulgence; and (c) it is not properly controlled and governed (Backstränd, 2003). To gain back public trust, it is crucially important that science is willing to revamp itself. One of the major things to be done for scientists is to cope with complexity, and the only way to do that is to start thinking about how to get out of the specialist box into which they have been coerced by contemporary academic organization. The new kind of "civic" science about which Backstränd muses is transparent, interdisciplinary, and accessible.

Bruno Latour, a French philosopher of science, has similar ideas (Latour, 2004). He argues that science should activate rather than paralyze public and politics, since these are the only forces in the contemporary world that enable action. Latour's criticism is tough. He argues that in our society, science functions as a kind of "*curare*" – the paralyzing poison used by indigenous people in South America – basically because it is still hooked on methodological rigor and pseudo-objectivity. The problem with this is that *the world does not need more objectivity but more concern.* Latour therefore proposes to make a distinction between "*matters of fact*" and "*matters of concern*" and he claims that for a very long time science has only taken interest in the former. The point of the distinction is that many discussions related to sustainability do not have the clear-cut objective status that indisputable facts have. Global warming, climate change, the human genome, CO_2-emissions, and cloned animals or otherwise genetically modified organisms are all examples. They are capable of agitating people even before they start to understand the consequences. Nobody seems to remain unaffected. They are therefore not only a concern for scientists, but also for bureaucrats, managers, pressure groups, politicians, and citizens as well. They are a public concern. And the discussion is badly served if scientists, basing themselves on rigidity and objectivity, remain aloof and distanced. *Matters of concern* show us that old distinctions such as fact/value, objective/subjective or nature/culture are not as clear-cut as previously supposed.

This implies that science is no longer an isolated domain. Serres argues that for a very long time scientists have tried to impose their findings on us more or less in the way that the judge imposes his or her verdict on a criminal. But the scientist has lost his/her privileged position: s/he should constantly legitimate his/her knowledge, which is no longer taken for granted. The time of apodictic truths is over. Everyone is once more involved in science these days. It has become part of ordinary life and does not stand outside of it.

This may not be to the liking of the initiated few who still hope to gain something out of the specialist territories they have so carefully constructed for themselves, but Serres wagers on what he refers to as "a house of laicism", where people dwell who accept science as a part of their lives and who would not accept any privileges for people who claim to know what others do not know. Serres aims for what he sees as a de-sacralization of science: it should be done everywhere, it should be part of our lives. In a sense, it should become so taken for granted in our lives that we do not even realize that we are doing science. Think about a simple question: what makes a good swimmer? Answer: you can only swim if you forget how to swim. In other words, you will very likely not be a good swimmer if you think about how to proceed in water. Analogously, you can only speak a language if you forget what you are in fact doing when speaking it. In the way that swimming or language can be in us, as a forgotten presence, science should be in all of us.

We can perhaps make these ideas a bit clearer by referring to a famous story by Edgar Allen Poe. In his *The Purloined Letter* (1845), the police are simply unable to retrieve the letter because they work too systematically and methodically. System and method have always been the hallmarks of science. The same holds for jargon and aloofness. We are not against method or jargon, but there should be more. In a society where *matters of concern* have become more important than maters of fact, we cannot allow science to dwell in a quasi-sacred domain. That is, citizens and politicians cannot choose to ignore what is going on in the live sciences, or in bio-economy. Analogously, scientists cannot choose to ignore what the public desires and wants. Finally, the entire discussion on sustainability gains much more force if we start to think about new roles for science in our society. The earlier we start to ponder these questions, the better it is. We believe that polysaccharide science is one of the key sciences in the transitions we have described. It ought to find access to the broader public and provide answers to public worries.

We think this can be done. We think that one day polysaccharide science will become a public good.

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