

ABOUT THE PAST AND THE FUTURE

Motto:

“The past is not dead. It's not even past.”

William Faulkner

This year, we are commemorating 10 years since Professor Cristofor Simionescu, the founder of the *Cellulose Chemistry and Technology* journal, passed away to eternal rest. Last year, we celebrated the journal's 50th anniversary [see Editorial – V. I. Popa and I. Spiridon, 50 years of *Cellulose Chemistry and Technology*, *Cellulose Chem. Technol.*, **50** (5-6), 505 (2016)]. We think it is time to answer the following question: How do we see the future? So, we contacted our colleagues from the Advisory Board, in an attempt to find out the answer to this question with regard to our journal. Some of them shared their thoughts on the evolution of the research field and of the journal, and we will try to comment on them further.

THE PURPOSE OF THE JOURNAL

María Cristina Area: *Cellulose Chemistry and Technology* was founded by Professor Cristofor Simionescu. This year marks the tenth anniversary since he passed away to eternal rest. Dr. Simionescu will always be recognized for his contributions to Romanian and international science. Over time, the journal has been growing and improving. Last year, the journal celebrated its 50th anniversary (a special issue was dedicated to this event, **50** (5-6) – Editor's note), and notably, each issue seems to be better than the previous one. It is worth noting the efforts made by its editors to continue making the publication on paper. A valuable aspect is that it is one of the few Open Access journals free for authors and users. *Cellulose Chemistry and Technology* covers the study and exploitation of the industrial applications of carbohydrate polymers in areas such as food, textiles, paper, wood, adhesives, pharmaceuticals, oil field applications and industrial chemistry. Although it has a broad thematic coverage, it is one of the few journals with a tradition in the publication of processes related to lignocellulosic materials, such as pulp production.

Patrick Navard: For the commemoration of the passing away of Professor Cristofor Simionescu and the celebration of the journal's 50th anniversary, I send you my opinion regarding new topics of interest for the next decade. I have first a concern about the discrepancy between the title of the journal and its scope:

The journal Cellulose Chemistry and Technology acts as a medium for the exchange of ideas on all aspects of natural macromolecular compounds, wood and annual plants. It covers the study and exploitation of the industrial applications of natural polymers in areas such as pulp and paper, textiles, wood, adhesives, pharmaceuticals and industrial chemistry.

The point is whether *Cellulose Chemistry and Technology* should only consider cellulose and cellulose based – or derived – topics or if it should also consider other natural polymers. If I look at the subjects of published papers, many other polymers than cellulose are the main object of the studies (lignin, to cite one). Another point is the limitation to chemistry and technology. Many articles are dealing with physics and mechanics, again out of the scope of the title. It means that the scope of the journal is not only cellulose and not only chemistry and technology. This is causing, I think, a prejudice in the sense that many good articles on topics other than cellulose chemistry and technology are probably not submitted to *CCT* because of its title. Would it be wise to change the title?

Editors: When the journal was founded, a subtitle was proposed: *International journal for physics, chemistry and technology of cellulose and lignin*. On different occasions offered by the International Symposia on Cellulose Chemistry and Technology organized in Iasi, we have had the privilege to have members of the Editorial and Advisory Boards among the participants and they proposed to modify the subtitle to *Advances in the Chemistry, Physics and Technology of Polysaccharides and Lignin*, as it is today. Over time, as you know, the scientific preoccupations in the field have changed, especially with the appearance of the concept of biorefining and the interest in other compounds of biomass has increased. At the same time, the problems concerning interferences between natural and synthetic polymers in

biocomposites, applications of biotechnology and environmental protection have become part of the subjects addressed in the journal, as happened to other journals as well. Having in mind that the journal is known by this name, in our opinion, it could be dangerous to change its name, but we can accept to modify the subtitle.

Thomas Heinze: I would propose to find a subtitle that would inform about the aspects (papers) the journal is going to publish. I would not change the journal's name. From my point of view, one important aspect should be Chemistry of Carbohydrates, including not only polysaccharides, but also mono- and oligosaccharides. The carbohydrates and their derivatives are important products, regarding biology and medicine – these studies will be increased in the future and should be included in the journal's scope. Although it is somewhat contradictory to discuss chemistry and technology in the same journal – chemistry is mainly basics and technology concerns applications. Today, most journals deal either with chemistry or with technology. However, I have no good idea how to change that.

František Potucek: A subtitle could be: Advances in the Chemistry and Processing of Lignocellulosic Materials.

Feng Xu: (proposes a subtitle) Cellulose and Lignin Conversion to Biobased Chemicals and Biomaterials.

Patrick Navard: Another aspect is again in the scope: *The journal Cellulose Chemistry and Technology acts as a medium for the exchange of ideas on all aspects of natural macromolecular compounds...* Is it really what characterizes CCT, to act as an exchange medium? My opinion is that CCT is the location where research of good level is published. Of course, as with all journals, this leads to exchanging ideas, but I do not think it is its main characteristic. By the way, I cannot see how “to exchange ideas” could be implemented?

Editors: We agree with this opinion and we will consider changing the Guide for Authors according to the changes produced in recent times in the research fields. Also, we think this could be an opportunity to modify the subtitle of the journal.

František Potůček: If you allow me, I would like to point out another problem regarding the *Cellulose Chemistry and Technology* journal. According to my colleagues from the Czech and Slovak Republics, the time period from the submission of a manuscript to its publishing seems to be too long. If it is possible to shorten this time, while keeping the high quality of the reviewing process, I think that the contributors' interest will increase.

Editors: You're right, this is one of our main problems. At present, our journal is experiencing a huge overload of submitted manuscripts, and unfortunately, not all of them stand up to standards of quality and scientific validity – an issue that is apparently encountered by other high-standing journals as well. Moreover, it is becoming increasingly difficult to find reviewers for this inflow of submitted papers. For this reason, we often ask the members of the AB to recommend us specialists in their research field who can be contacted for this purpose.

THE PAST

Bruno Lönnberg: After the Second World War, researchers and academics at Akademi University were in some way a generation set to rebuild and improve the Finland that had been destroyed by the war, as it was also the case in many other countries. We were proud of our Faculty and its Professors, whom we considered as having special knowledge to share with us. Our courses were evidently combining the best of the chemistry and basic technology, for example, technical chemistry and engineering technology. The schooling was aimed at providing the students with skills that should help them develop the industry. Finland's main industry was the forest industry, including mainly pulping and papermaking, with a share of two thirds of the national export incomes. It was by chance that I joined Varkaus as a diploma worker and after graduation the Tampella Research Center in Inkeroinen. I later joined the Finnish Pulp and Paper Research Institute (KCL) in Espoo led by Professor Waldemar Jensen, who was its president (Waldemar

Jensen was one of the founders of the *Cellulose Chemistry and Technology* journal and a member of its Editorial Board– Editor’s note). My time at KCL still represented a period of strong development in the forest industry.

I joined Åbo Akademi University in 1983 as full professor in pulping technology. Unfortunately, the period from here until 2005 witnessed a rather decreasing trend, although the forest industry was still a major industrial branch. This happened because the international competition was getting stronger and industrialised countries made investments in cheaper countries, hoping for improved economy of their domestic companies. However, this short-time philosophy turned against the domestic companies in the long run. Now, the domestic forest industry is improving again and large capital is invested in common papermaking, but also in new industries that require chemical pulp and pure cellulose for various purposes, such as viscose and materials substituting plastics. Also, Valmeth as recently improved grindstone refining of wood by introducing Galileo diamond surfaces, which represent the so-called single-layer grinding technology. This development was granted the Arne Asplund Award, mainly because the Galileo technology is able to save up to 20-30% energy. Further, the grindstone surface becomes smooth when given a proper stabilising treatment and, accordingly, good fibre length can be achieved. Also, the hard diamond surfaces may be conditioned only once in half a year, which is in clear contrast to the weekly conditioning of current ceramic grindstones. This example indicates that there are still possibilities to develop classic processes in the forest industry as well, provided that there is enough basic knowledge available concerning process mechanisms, as well as practical experience and engineering skills.

From my own field of research and practical experience, I would like to emphasize some important details regarding mechanical pulping and chemical pulping as well. By application of a heat balance over the mechanical wood grinder, one might evaluate wood grinding by plotting data in a diagram for dragging power as a function of compressing power. These powers represent products of force and speed. Such a diagram evidently satisfactorily describes the grinding process, and the groundwood properties, such as pulp freeness and tensile strength, might be evaluated as a function of the compressing power, which seems to reflect grinding sensitivity. Chemical pulping, again, may be improved, for example, by chipping the wood to provide smooth thin chips. It could be followed by impregnation in at least two stages to ensure maximum absorption of pulping chemicals. Moreover, the impregnation may be performed at low temperatures and by application of long times to ensure a complete impregnation with a minimum consumption of chemicals, as primarily they should react with lignins. Such an impregnation would result in high yield pulps and thus provide higher savings. Such an impregnation may be applied in any pulping process, but, in the future, sulphur-free alternatives will also be developed. The IDE concept developed at the University includes three explicit pulping stages: *i.e.* impregnation, delignification and extraction. The concept is designed to produce a high pulp yield and low lignin content at the same time. Moreover, the delignification should be carried out at high temperatures to decompose the lignin effectively and hence provide an easy bleaching with less chemicals. Accordingly, one may also expect pulps close to pure cellulose, which could be applicable for viscose and comparable products. The future chemical pulping process would thus be one affording higher pulp yield and better pulp quality.

Maria Cristina Area: The pulp and paper industry can be classified as a traditional industry. For example, the kraft process is 150 years old. Most modern pulping processes, such as APMP, and the TCF and ECF bleaching systems are already 30 years old. They have been optimized, but few innovative processes have passed the experimental scale. Nevertheless, the crisis generated by globalization and the massification of electronic media, the increasingly restrictive environmental legislation and consumer pressure, as well as the shift of production towards areas of fast-growing species, forced the incorporation of the concept of biorefinery as a way of increasing competitiveness from diversification.

THE FUTURE

Lucian Lucia: As Faulkner stated, the past is not even past. It is so with cellulose. This long standing and noble biopolymer has found a way to become relevant to every generation. *CCT* is poised to continue to cement and advance it as the feedstock of yesterday, today, and the future. A collaborative network of science, engineering, and technology efforts is the next significant step toward valorizing and improving the

state and use of cellulose. We can no longer be sequestered in our own silos; the time for transdisciplinary and multidisciplinary work is now.

Patrick Navard: Regarding new areas, I considered the scope of the journal, not its title. Five areas will, in my opinion, emerge or be strengthened in the next years, touching upon biobased polymers: (1) The interplay between biology and material science; (2) The in-depth study of the possibility to use new sources of biomass for applications; (3) The challenges posed by the circular economy concept, in particular, by the fact that there will be a push to use local biomass resources, which challenges the possibility to build large production units; (4) The need to use all by-products of agriculture and agro-industry (it is somewhat related to the point above); (5) 3-D printing, in particular, using biomass-based molten polymers and solutions.

Marguerite Rinaudo: I can see a development of natural polymers in new materials (blends, composites, new processes to transform them), taking into account the economy of the process and safety of the transformation (less use of chemicals and polluting agents) to prepare new materials. The interest in polymers resides now in biomedical applications. This is the evolution I can see in the field of polymers and, why not, in natural polymers from a general point of view. Congratulations for your efforts regarding the journal.

Stefan Willför: I think the research directions pursued by the journal already involve most of the areas I find most promising, *i.e.* using polysaccharides and lignin in high-value applications in biomedicine, sensors and diagnostics, as well as new types of biocomposites for various applications. Especially, 3D bioprinting using natural biopolymers will be an area of growing interest. Although a lot has been published in recent years on fractionation technology, I still see it as a direction to keep. Another issue is that an open access online version of the journal would definitely help with the impact.

Emmanuel Koukios: In my opinion, there are three levels of action corresponding to the journal's title terms:

1. *Cellulose*: continue, deepen and strengthen the good tradition, also carefully extend it to ligno/cellulosic biomass, cell-wall phenolics and other components, oligomers and other intermediate products *etc.*
2. *Chemistry*: Extend from cellulose chemistry to other molecular sciences of cellulose (see previous point), first of the chemical family, then physics, biology, even mathematics of production, conversion and final use stages.
3. *Technology*: Extend from the chemical technology approach to the broader technological spectrum of the utilisation of cellulose (see above 1), based on a broad scientific basis (see above 2). This extension has two dimensions:
 - 3.1. High-tech: Link to info-, bio- and nano-technologies;
 - 3.2. Integrated: Include work on important non-technical utilisation aspects, such as economics, environment, education, art *etc.*

Hiroshi Kamitakahara: Research directions could be extended as follows: other polysaccharides can be included as one of the topics of this journal; biorefinery is an appropriate keyword for new decades; cellulose nanofibers and nanocrystals are of great interest in the field of cellulose science. Manuscripts focusing on such topics should be welcome.

Maria Cristina Area: In the future, research will focus on the development of innovative paper products, or new compounds and materials from the chemical compounds that make up fibrous resources. In line with this, the key is to provide new functionality to paper or to use fiber components for other uses. Innovative products include intelligent materials, such as new textile fibers, functional packaging, bioplastics, and inputs for the food and pharmaceutical industries, among others. The development of new packaging and 3D printing with bioplastics are among the most promising. These are the areas that will surely appear more assiduously in the journal.

Hiroshi Kamitakahara: (1) Editorial systems, such as Scholar One *etc.*, will increase the convenience for manuscript submission. Such an editorial system would promote the reviewers' fast reviewing; (2) Conference papers would be published in the journal after undergoing a peer-review process. This effort might increase the quality of the papers; (3) The journal should come closer to some international academic societies, for example, EPNOE (European Polysaccharide Network of Excellence) to enhance its quality. This might be challenging.

Editors: Some years ago, a research program led by Professor Simionescu pursued to identify new sources of biomass to produce biofuels and bioproducts and the concept of "complex processing of phytomass" was proposed [C. I. Simionescu, V. Rusan and V. I. Popa, Options concerning phytomass valorification, *Cellulose Chem. Technol.*, **21**(1), 3 (1987)]. After 1990, this concept was named "biorefining" and, at present, it is developed in research and development programs [(V. I. Popa, Biorefining and pulp and paper industry, *Celuloza si Hartie*, **61**(1), 3 (2014); V. I. Popa, in "Pulp Production and Processing: From Papermaking to High-Tech Products", edited by V. I. Popa, Smithers Rapra, 2013, Chapter 1: Biorefining and pulp and paper industry, pp. 1-28]. It is expected that, in the near future, this procedure will be able to recover all the compounds existing in biomass, including lignin [V. I. Popa, Lignin and sustainable development, *Cellulose Chem. Technol.*, **41** (9-10), 591 (2007)]. Therefore, we appreciate that "valorizing lignin is an imperative for ensuring the viability of biorefinery".

Claudia Crestini and Dimitris S. Argyropoulos: Government and funding agencies these days increasingly emphasize issues of Circular Economy, Sustainability, Green Chemistry and overall our society's independence from fossil based resources. The term "Biorefinery" emerges as our community's inherent relevance to these imperative societal thrusts. During the past decade, indisputably intense research and industrial efforts have been in effect promoting first and second generation biofuels [and bioproducts – Editor's note]. The economic realities that emerge, however, impose serious challenges, beyond inherent technical limitations. Namely, in the absence of government subsidies, second generation biofuels, such as ethanol, and even biodiesel, are currently uneconomical because of enormous market competitive forces from petrochemical sources. Logically, one arrives at the conclusion that as long as the price of oil remains low, these constraints can only become more acute. One major contribution, our research and technical community can make to this predicament is to offer competitive value-added products from the side-streams that emerge from the production of biofuels. This is perhaps, the most likely scenario that may ensure the survival and the economic viability of future biorefineries. In this respect, it is undeniable that our science can be pivotal in defining the development of future technologies. In the recent past, literature accounts show an above average activity in the area dealing with lignin utilization, emphasizing the renewed interest in using lignin streams to replace aromatic streams of petrochemical origin. The remaining obstacles are technical, economic and cultural. Technically, lignin poses significant challenges in terms of structural definition and variability. For example, the precise structure of even the simplest softwood kraft lignin still remains elusive, with possible recent efforts being an exemption. Furthermore, any lignin streams proposed to be integrated in a process as feedstocks need to be first refined. This refining needs to be aimed at imparting to them a set of consistent specifications, such as molecular weights, functional groups *etc.* This could be reminiscent of the early days of crude oil utilization, where refining operations made possible to arrive at a multitude of products from a crude mixture, with the emergence of a myriad of applications for it today. Recent pioneering efforts on fractional precipitation of kraft lignin have paved the way and have shaped our thinking in this direction with "lignin fractionation" papers appearing with increased frequency, during the past two years. In our view, amongst the most significant areas of research and technology developments with promising tangible profitable industrial outlets for technical lignins are efforts centered around lignin based carbon fibers. Carbon fiber based composites offer versatile strong and light weight solutions to the automotive and the aviation industries. The markets for carbon fiber reinforced composites are currently seeing an exponential growth. Actually, this growth offers projections that in the very near future, the fossil-based poly(acrylonitrile) raw material for carbon fibers will not be enough to meet these growing demands. Lignin based carbon fibers could be a means to alleviate the possible scarcity of this valuable resource. It is imperative, however, that novel chemistries and technologies be developed to offer such materials composed solely of technical lignins in the absence of synthetic polymer supports, a common

practice so far in the literature. On a fundamental front, research activity needs to be focused, in general, on polyphenolic biopolymers from wood, such as lignin and even tannins [or other polyphenolic compounds–Editor’s note]. Fundamental aspects of such research imply a deeper insight in their structural elucidation by the use of advanced NMR and of the methods of organic polymer chemistry and analysis. A very relevant issue, as emerged from our recent overall understanding at this point in time, is the elucidation of their supramolecular and Pi stacking behaviour both *in vivo* and in isolated products and fractions. This is fundamental in relation to creating an in-depth understanding and tailoring their interactions with surfaces, solvents and materials. The control of the hydrophobic/hydrophilic properties of lignins and tannins paves the way to a number of applications in the polymer and composites field that need to be further explored. A salient issue of vital significance that may offer tremendous advances to the cause of lignin is that of consistent, reliable, reproducible and facile technical lignin characterization methodology development. While some advances have been made in this area, contributing vital functional group information for technical lignins, the area of molecular weight determination remains in need for further development, and unification by a well-defined and generally accepted experimental protocol. It is important to outline here that our society and our industry (pulp and paper, and the emerging biorefineries) need to start considering lignin as a valuable resource and not as a waste by-product. This latter consideration imposes a framework of inferiority to lignin that is always coupled with relatively low financial margins. Such an approach is doomed to failure at the onset, if this attitude does not radically change. The issue of lignin utilization rests in the hands of funding agencies, academics, lignin producers and users. Consistent, meaningful and non-partisan funding sources for academic and pilot research need to be improved, while academics need to become acutely aware of the difference between Innovation and Invention. In other words, academics need to gain confidence and work closely with lignin producers and the user sector to ensure the transition from idea to application becomes seamless. Finally, lignin producers need to adopt a more entrepreneurial spirit. They need to create an open dialog with the innovators and catalyze thinking at identifying target applications and markets. They need to adopt a cross-business attitude, work closely with them on front-end market research to identify market economics, market dominance considerations and potential regulatory barriers or opportunities. They need to be able to converse and convincingly connect with the chemical and allied industries that they can provide a reliable feedstock for their use. This can only occur if the lignin producers show a serious commitment to such an endeavour that will require a major cultural shift. The new paradigm is that they no longer treat lignin as a secondary by-product, but treat it with the respect accorded to a valuable chemical feedstock.

Emmanuel Koukios:

SHAPING THE FUTURE OF THE CCT JOURNAL – A MANIFESTO

Strengthen, Deepen and Extend!

- I. **A KEY BIORESOURCE:** Today, in a period of high demand of sustainable biobased solutions, *lignocellulosic biomass* represents the main available non-fossil resource for conversion to fuels, chemicals and other high value-added products. (It plays a key role in the implementation of circular economy concepts–added by Angeles Blanco)
- II. **CATALYSING INNOVATION:** Better understanding of the structure and properties of *lignocellulosic feedstocks* has a significant impact on the growth of innovation in several critical fields, *e.g.*, new materials, green chemistry, soil and the environment.
- III. **JOURNAL TITLE:** *Maintaining* the original title of the Journal, on the one hand, signifies the continuity of its publication and capitalizes on its achievements, on the other hand, implies covering a great part of the knowledge basis of the whole field concerned.
- IV. **JOURNAL SUBTITLE:** A small change is proposed in order to express the extension of the range of scientific and technological fields to be covered by the Journal, through the use of the “*Science and Technology*” expression familiar to policy-makers.
- V. **SCOPE & THEMATIC AREAS:** To be revised as follows: *The CCT journal acts as a forum for the presentation and discussion of high quality research findings on all aspects of natural*

macromolecular compounds, wood and annual plants. It covers the whole spectrum of (fundamental–added by Angeles Blanco) industrial applications of natural polymers in areas such as pulp and paper, textiles, wood, adhesives, pharmaceuticals, industrial chemistry, new materials, biofuels, biochemicals, biorefineries, and the related circular bioeconomy.

- VI. SPEEDING-UP PUBLICATION: High quality research papers can be attracted by fast publication regimes. The key to this is speeding up the *review process*, without sacrificing its role and value. This can be achieved by recruiting more reviewers.
- VII. OPEN ACCESS: This important characteristic of modern scientific publication media could also promote the reputation of the Journal in conjunction with the rising quality of its papers, therefore *CCT* should lead the way towards *full openness*.
- VIII. SPECIAL ISSUES: The above proposed richer thematic range of the Journal could be served by the *well-prepared* publication of Special Issues on selected topics, such as 3D printing applications, complex biorefineries, and circular bioeconomy of lignins.
- IX. ADVISORY BOARD: The role of the Advisory Board in implementing the actions prescribed in the present Manifesto is *critical*. Its members can contribute to the attraction of high-quality papers, recruiting new reviewers, running special issues *etc.*
- X. ELECTRONIC PLATFORM: Last but not least, all the above and more – *e.g.* other publications, organization of events, networking – could not become possible without the design, operation and maintenance of a *user-friendly*, flexible web-based platform.

*Based on the “About the past and the future” campaign
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