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ATG: Joris, can you tell us about your career and what led you to your current position as Director of Special Projects at Digital Science? What are your main responsibilities?

JVR: I have enjoyed working in scholarly communications for over 20 years, many of them spent working at **Elsevier** where I led product development and innovation teams. Then, three years ago, I took a leap and co-founded **Peerwith**, a platform for author services that received investment from **Digital Science**.

In 2017, I joined **Digital Science** as Director of Special Projects. In my current role, I am researching and implementing new technologies in scholarly communication. A highlight from my first year at **Digital Science** was authoring the report "Blockchain for Research." I am currently responsible for leading an initiative to improve the peer review process through blockchain technology together with **Springer Nature**, **Cambridge University Press** and **ORCID**, amongst others.

ATG: What inspired your fascination with blockchain technology and its possible role in scholarly communication and academic publishing?

JVR: I find blockchain truly fascinating. The more I learned about blockchain technology, having been introduced to it through bitcoin, the more I realized its potential value to research and scholarly communication. There are many challenges in scholarly communication — a lack of reproducibility of research results, limited and outdated metrics, challenges in peer review, and overall a lack of openness and transparency, to name but a few. At least in theory, all of these challenges could finally be overcome by applying blockchain technology.

ATG: Many of us in the world of scholarly communication do not fully understand blockchain technology. Can you provide a clear definition that will make the concept of blockchain technology accessible to the average publisher, vendor, and librarian?

JVR: In the broadest sense, blockchain is the technology that allows us to create a revolutionary new type of datastore, namely one without a curator, or central owner. With traditional technology, a curator role is required to ensure the quality and integrity of the data; with blockchain, however, this core role is replaced by technology through things like consensus algorithms and cryptography. This then allows us to create financial ledgers without a central authority, as is the case with bitcoin, but also data stores containing scientific data without a central authority owning or controlling that data.

ATG: How do these consensus algorithms and the cryptography that you mention work

their magic? How do they mitigate the need for a central authority while at the same time assure quality control of the data? In short, how does technology replace curation?

JVR: When we talk about quality in this context, we're not talking about whether the data is good or bad, but more about its trustworthiness. How can we make sure that data that is added to the blockchain is trustworthy when there's no central gatekeeper? And that the data is not tampered with? This is achieved in several ways; let me take you through some examples.

Firstly, we can ensure that whoever adds new data (or a "block") to the blockchain acts in good faith. This is what the "proof of work" and the "proof of stake" protocols achieve. Let's use Bitcoin as an example. In order to add a block, a complex mathematical problem must be solved. The first to solve the problem is allowed to add the block and "wins" bitcoins. Given that the act of solving said problem requires processing power and time, this "proof of work" prevents people from spamming the blockchain with proposed blocks. "Proof of stake" works on a different principle. Only people that have a certain stake in the blockchain (for example, own cryptocurrencies) can add new blocks as these people have a proven interest in keeping the blockchain intact.

Secondly, new blocks can only be added to the blockchain by consensus. If multiple computers (or "nodes") that host the data verify that the data is accurate, the blockchain is updated with new information. In the case of Bitcoin, this happens every ten minutes.

Another example of how data quality is ensured without a central gatekeeper is through hashing. Hashing generates a unique value from the data using a mathematical function. This value is unique to the data, and always the same length regardless of the size of the

data, but the data cannot be decoded from this hash. Every time a block is added, a hash is created from the entire blockchain. Tampering with the data would lead to the generation of another hash, which is immediately spotted by the system.

Each of these methods further increases the quality control of data, without the need for curation.

ATG: You've been quoted as saying that Blockchain technology could "change the role publishers play in the scholarly ecosystem." That's a pretty big claim. How might blockchain have such a dramatic impact?

JVR: I stand by the idea that blockchain can have a fundamental impact on publishers and scholarly communication. In fact, there are potential benefits across three levels:

First, through the application of this technology we could introduce a token system for researchers. Tokens could be provided to an individual when they complete certain activities, for example peer reviewing an article, or sharing datasets. These tokens could then be used to access or purchase other services or content, or even pay for article processing fees. Through this tokenization, an economy around scientific activities could be created, solving some of the current pressing issues around incentivization and recognition.

Second, through blockchain we could manage digital rights much more efficiently. With our current technologies, rights, permissions and royalties are difficult to manage, and we often rely on expensive processes and third parties to manage them. Through blockchain, these could be managed automatically.

Third, blockchain would help us to create datastores of scientific content that are decentralized, which would mean they do not have a single, let alone a commercial, owner. It would then be possible to create a single, global and complete datastore of scientific information, containing not just research data but also information around pre-publication scientific activities. This would make research more reproducible, transparent and also allow us to develop metrics that are more representative of scientific activities. Creating a datastore of all scientific activities with the current technology implies that we need a central owner and gatekeeper — but it is very hard, if not impossible, to find such a gatekeeper that would be willing, able and trusted enough by the entire academic community to play that role. Given blockchain's decentralized nature, it would dispense with the need for such a role entirely. As a result, we could create a single, complete datastore of scientific data and activi-

ties that would make science more transparent, reproducible and recognizable.

ATG: You've mentioned that blockchain offers a new business model for journal publishing above and beyond the current subscription and OA models. Can you describe what that new model looks like? What are its specific advantages?

JVR: Currently, making micropayments on the internet is an expensive and cumbersome experience. This means that publishers rely on business models based on advertising revenue, which is challenging, or subscription models that lead to paywalls, which are very unpopular. In academic publishing we additionally have OA (author pays) models, but after a few decades we have to conclude that this model has not been universally adopted as some had predicted. And OA has left us with another set of problems, such as predatory publishing and challenges for authors from developing countries to get published.

Business models based on micropayments using blockchain technology might be an interesting alternative — users pay as they read, which can be considered more fair, transparent and therefore acceptable for everyone compared to current models.

ATG: We know that you have been involved in a non-profit peer review initiative that utilizes blockchain technology. Can you tell us about it? How does it work? Why is it preferable to the current peer review processes being employed by publishers?

JVR: The peer review process has several challenges — a lack of recognition for reviewers, the difficulty of finding reviewers by editors, and overall a lack of transparency leading to a decline of trust in the process, to name a few. We believe that these problems can be solved if we better share data on review activities within the research ecosystem.

In response, we co-founded a new initiative that involves collaboration between our team, several publishers (**Springer Nature**, **Cambridge University Press** and **Taylor & Francis**), **ORCID** and **Katalysis**, an Amsterdam-based blockchain startup. By sharing data, we can recognize reviewers better, create

better reviewer finding tools using complete review profiles, allow reviewers themselves to indicate their interest and availability, and verify and validate the review process independently.

One of the key challenges when we're talking about storing and sharing information about the review process is of course trust — how to make sure we share information while still complying with the demand on confidentiality and privacy, for example, in the case of single blind and double blind review. It is here, we believe, where the blockchain can help. Using the blockchain, we can build a decentralized datastore of review information, and there is no single owner or gatekeeper that we have to trust enough to have access to the data. Moreover, we can make use of encryption techniques ensuring that confidential information (e.g., reviewer names) remains obfuscated. We are currently building on a proof of concept and are hoping we can share the results at the end of this year.

ATG: You've mentioned that your blockchain peer review initiative relies on a sophisticated permissions system. Can you clarify? You've also mentioned that good governance is essential. How do you envision that governance? What would its structure look like?

JVR: An important priority is how to make sure people do not gain access to information they're not entitled to. We do that by not storing the information itself on the blockchain, but instead provide links to the information stored on existing platforms such as **ORCID** and submission systems. This allows us to harness the tested and trusted permissions systems of these platforms.

Governance is absolutely essential, to make sure there is an agreement on fundamentals such as what data is being stored, who is participating and who has access to what part of the information of the review process. One of the options available to us is to eventually create a (not-for-profit) membership organization that will ensure a representative governance. Here, we're looking at successful initiatives like **Crossref** for inspiration.

ATG: How much current adoption of blockchain has there been in the industry? Who are the main players? Can you point to specific examples and initiatives that demon-

strate how blockchain technology is currently being used?

JVR: Blockchain technology is still in its infancy, but in the last eight months we've seen the launch of numerous initiatives demonstrating the many ways in which blockchain could have a positive impact on research and scholarly communication. To name but a few: *Artifacts.ai*, *scienceroot.com*, and *Project Aiur* are all projects still in early phases, but with really interesting propositions. So it is a case of "watch this space!"

ATG: We understand that Digital Science wants to expand the adoption of blockchain with grants. What level of funding are we talking about? Who is eligible for these grants? What type projects do you envision funding?

JVR: Basically anyone is eligible for **Digital Science** blockchain grants, as long as a project is still at an early stage! As for the type of projects that we would consider, **Digital Science** has already provided grants to blockchain projects in data management and peer review. However, we also have an interest in exploring the wider potential application of blockchain in research and scholarly communication. Anyone with ideas they are looking to get funded should get in touch with us via our *Catalyst Grant* programme!

ATG: Is there something about blockchain technology that we should have asked you but didn't?

JVR: Between blockchain theory and practice stand factors like legacy, habits, and vested interests. In theory, blockchain could be an ideal technology for research and scholarly communication, but for this potential to be realized many participants within this ecosystem will need to collaborate, including funders and institutions, as well as researchers themselves. **Digital Science** seeks to play an active role in that process! 🌲

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*Editor's Note: For those of you attending the **Charleston Conference**, **Mr. Van Rossum** will be presenting a Neapolitan session entitled **Blockchain: The Big Picture for Publishing!** It will be held in the **Grand Ballroom 3, Gaillard Center** on Thursday, November 8, 9:30am-10:15am. — **TG & KS***

ATG: George, as busy as you are, it must be important to find time to kick back and relax. What do you do in your down time? How do you unwind?

GM: My leisure time really revolves around the family. I enjoy travel, adventures, reading, stamp collecting, astronomy, walking/hiking, and technology. I am a news junkie and find it very relaxing, even with all of the drama. 🌲

Media and publishing intelligence firm **Simba Information** has released the latest edition of ***Open Access Book Publishing 2018-2022***. The report found that despite multiple years of growth at more than 30 percent CAGR (compound annual growth rate), total revenue generated from book processing charges (BPC) remains small, well under 0.5 percent of total book revenue, comparable in size to a single university press

book publisher or a single open access journal publisher. On the "glass half-full" side of the equation, growth by any metric remains strong. Every company, every program and the overall market continue to grow. An important difference between OA books and journals is that the overall market for journals, particularly life sciences, remained stable through OA's development. The current book market is troubled, which will impact OA books' ability to progress as OA journals did. OA books may become "a" response, not "the" solution, to a crisis in social science and