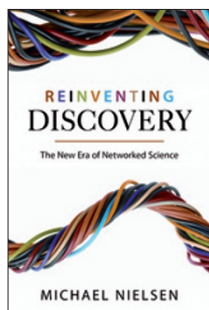


A new kind of science?



**Reinventing
Discovery: The New
Era of Networked
Science**

by Michael Nielsen

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Like so many fields of human activity, science is in the midst of a digital revolution. Yet the changes we have seen so far are no more than a prelude, with much bigger ones still to come. Researchers have generally been slow to embrace new technologies and practices, and this new era of networked science will only reach its potential when it becomes more open, necessitating new incentive structures and a culture of openness throughout research. Those, in short, are Michael Nielsen's messages. His stated aim is to encourage this transition by "lighting an almighty fire under the scientific community" to inspire "a second open science revolution". For although this book is ostensibly about science in the Internet age, it is equally a manifesto for openness in research. Is he right, and will he succeed? In my opinion, yes and maybe.

The world of twenty-first-century research is replete with examples of secrecy and resistance to change. At a recent summit on open data, I listened to a senior scientist plead with her more progressive colleagues to be reasonable. She had spent years gathering her data and it would be unfair for anyone to expect her to share it. No one proved combative enough to point out that her work had been done for money, not charity, and that she owed it to her employer — the scientific establishment — to do whatever was best for furthering its goals. The irony was not lost on me as I sat there, a businessman among academics, that anyone expressing such a self-serving and uncooperative attitude within a commercial organization would be out on their ear. Yet in science, this is somehow not merely tolerated, but accepted as normal and even inevitable. Faced with such antediluvian attitudes among otherwise sensible and well-meaning people, it is easy to despair — to feel not only that science is squandering

an opportunity to progress more rapidly, but also that it has lost its way since that earlier Golden Age in which alchemists and blood-letters began sharing their findings in the free and collaborative spirit in which modern science was born.

But Nielsen reminds us that it was ever thus. The natural state of the researcher is one of extreme possessiveness, and it was only through the cajoling of glory-seeking patrons like the Medicis and persistent editors such as Henry Oldenburg — the founding editor of the *Philosophical Transactions of the Royal Society* — that they shared anything at all. Over a period of decades, confidential notebooks were finally prised open and it became accepted that researchers would share their findings with each other through the published journals. Indeed, this became the one true route to continued funding, job security and professional respectability. But as Nielsen points out, this marvellously successful incentive structure now constitutes an enormous barrier to change. Many are the ways in which the modern Internet-enabled researcher can contribute to the broader enterprise — by generating data, writing software or otherwise applying their own particular expertise — without necessarily publishing a paper. But if papers are the only contributions that convey credit then to work towards any other end is at best a waste of time and at worst career-limiting. Modern science, with its obsession for publishing and individual credit, sometimes seems like a football team in which the only thought of each player on receiving the ball is to run directly for the goal. How to achieve the greater degree of specialization, cooperation and trust that twenty-first-century science demands?

Nielsen's principle tactic is to present a raft of success stories from inside and outside science (along with a few failures, for they hold lessons as well). To anyone who has been following this topic closely, many of them will be familiar, from open-source software to the Human Genome Project and the Sloan Digital Sky Survey. But even those who have heard the headlines before will find important and interesting details, such as the way in which the Linux kernel was modularized to support greater decentralization, or the story behind the amateurs who contributed to the Galaxy Zoo project not only by classifying astronomical images for the

professionals, but also by discovering a whole new class of galaxy themselves.

Considering his stated incendiary ambitions, Nielsen's descriptions are measured and prosaic. Until the last few pages, this book does not read like a call to arms, and nowhere is it excessively polemical. Only occasionally does he seem to lose his temper — for example, when describing the "ludicrous" discrepancy between the volume of online scientific comment and that on the subject of Pokémon products. Indeed, sometimes he ought to be more forthright, such as when debating the benefits of open research in combating science scepticism and misleading journalism.

Yet this is not a dry book. Nielsen's evident enthusiasm — he gave up a promising research career in quantum computing to become an ambassador for this cause — shines through, and he has taken great care to make his explanations both readable and accessible, aims in which he succeeds well. He also articulates some useful concepts, such as the increasing significance of data-driven intelligence (as distinct from traditional human intelligence) and the critical importance of realigning individual researchers' interests with the collective interest of research as a whole.

Inevitably, there are a few flaws. He perpetuates the all-too-common injustice of giving credit to the Public Library of Science for promoting author-pays open-access publishing while failing to mention BioMed Central, which was the original innovator of that approach. Also, some of the descriptions, though wonderfully clear, could have been tighter, and for my taste there are too many exclamation marks!

But these are quibbles. In writing this book, Nielsen has created perhaps the most compelling and comprehensive case so far for a new approach to science in the Internet age. Those of us who are devoting our careers to furthering this aim will be encouraged by his convincing analysis even while despairing at his suggestion that this may be a 50-year, rather than a 2-year, endeavour. As with scientific research itself, Nielsen admits that "[t]his will be long, slow work". But even if we are in for a hard grind then at least we have something eloquent, thought-provoking and inspiring to read. □

REVIEWED BY TIMO HANNAY

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