

RESEARCH

Impact of digital revolution on the practice of science communication

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DI·LOGUE

Science, Scientists, and Society

Table of Contents

Abstract

Introduction

Science Reporting in the Pre-digital Era

The Beginnings

The path forward

Moving to the present

Web of Science or Scopus?

Digital Tools for Research

Representative Results and Conclusion

Notes and Resources:

References

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Abstract

The practice of science journalism/reporting/communication has changed completely in the last three decades. Though the number of specialised areas of scientific investigations and the number of scientific journals as well as the associated technical terminologies have increased many folds, for a science journalist, the task of reporting and popularising science has become simpler. This is primarily due to easy accessibility to sources, availability of digital resources and tools to deal with the knowledge explosion on the one hand, and mushrooming of digital platforms for communication, on the other. Though these developments had a disruptive impact on scientific publishing and media industries in general, for the individual journalist/reporter/communicator, the times have changed for the better; the digital world has empowered the individual content creator by providing better, cheaper, and often free, tools of production. In this paper, I will compare and contrast how a science journalist used to work, in earlier decades and how it is now. I will review the new digital tricks and tools that a science journalist can use today to keep updated about scientific advances, to deal with the complexities of ever-narrowing disciplines, to manage knowledge outside his or her mind, to double check and validate reports, while on tight deadlines. Easing the efforts required has led to an increase in science reporting in India, but at a slower rate than the increase in scientific activity in the country. Moreover, I argue that an increase in the quantity of science reporting alone does not necessarily improve the scientific temper of citizens. That would call for

improvement in the quality of reporting involved, making the process of doing science more transparent to the public.

Introduction

Early 1980s. I was a budding freelance science communicator, writing popular articles in English dailies and magazines in Delhi. I used to admire K S Jayaraman and the team at the PTI. They used to report science. Not popularise it. Later, I saw Prof. D Balasubramanian of the CCMB doing something in *The Hindu* that I would have liked to do. While reporting recent advances in science, he had relevant comments. It was not mere reporting; it was more like current affairs in science. Later still, I saw Prof. P Balaram doing such current affairs in science, quite often without the element of reporting, in his editorials in *Current Science*.

I mention these people because the content and style of writing, as well as their intent of writing, the channels of their output, and the people who read their writings, are all quite distinct, diverse. In this paper, I will focus only on the reporting of current advances in science, not popularisation, not communication campaigns in an effort to change the world we live in, not even acting as watchdogs of scientific institutions on behalf of society.

As per the Web of Science, India produces more than 80,000 scientific articles per year. If even a small percentage of this output is newsworthy, existing mainstream media journalists cannot deal with the sheer numbers. Moreover, the complexity of simplifying terminology-ridden scientific papers is a barrier in reporting scientific advances. This paper provides digital tools that have proved helpful for citizen journalists from among the scientific fraternity who are stepping in to fill this lacuna. Strategies to generate a generation of such scientist-journalists have been described earlier ([Madhu 2019](#)).

Science Reporting in the Pre-digital Era

Consider the materials and methods available to a science communicator in the 1980s to work as a science reporter. The main primary sources of advances in science are scientific papers published in peer-reviewed journals. There were some 7000–8000 journals at that time. If you are a freelancer in Delhi, you may have access to a few hundred of them - if you take the trouble to visit some 50 odd good specialised, libraries related to science or its applications. But of course, recent issues are difficult to come by. You are lucky if you can get hold of even last month's *Science* or *Nature*, *Lancet* or *BMJ*. The academic and institutional hierarchy determines who gets to see the journal first, and who next. So you can only get journals that are three or four months old.

The fastest method to overcome the problem was to scan *Current Contents*, published weekly by the Institute of Scientific Information. Current Contents was published under different volumes:

1. Agriculture, Biology & Environmental Sciences
2. Arts & Humanities
3. Clinical Medicine
4. Engineering, Computing & Technology
5. Life Sciences
6. Physical, Chemical & Earth Sciences, and
7. Social & Behavioral Sciences

From these publications, you could get to see the contents pages of all the journals.¹ From the titles of the papers, you have to guess which paper could be interesting for the public. You would note down the references on library cards.

If the library does not subscribe to the journal, you could use an inter-library loan system: you request your librarian; the librarian requests the library that has the journal to photocopy and send the paper...the process was tedious. It took a few months to get hold of a 'recent' paper.

The Beginnings

Flash forward to the mid-1990s. I was producing Turning Point, a magazine format television series with the intention of popularising science. And I was still itching to try and report science.

The times had changed. The Indian National Scientific Documentation Centre (INSDOC, which is now part of NISCAIR) had started a service called CAPS: Contents Abstracts Paper Services. You subscribe to journals and they give you the contents pages from the ISI database in machine-readable form, on floppy discs.

You scan through, copy-paste the references into a list. You give them the list and they give you the abstracts of the papers that you have selected. You can then identify the papers that you really want to read, and they give you photocopies of the papers.

All for a small payment, of course.² I subscribed to the contents of 400 journals of my interest.

The materials and methods for reporting science had changed. But of course, I couldn't make 'newsy' stories. The process of getting the papers still took time. And producing a weekly

[1] Similar services transformed by the digital revolution are still available from Current Contents Connect, accessible from Clarivate Analytics: <https://clarivate.libguides.com/webofscienceplatform/cc>

[2] The services are still available from NISCAIR: <http://www.niscair.res.in/Downloadables/caps.pdf>

television series does not allow time for research. The word ‘recent’ meant a month or more ago. It was still in the popularisation category – not reporting. We could not do news, but only features.

The path forward

Flash forward (again!) to the 2010s. I was working as the in-charge of the Science Media Centre in the IISER Pune. We initiated a 15-minute radio series on science for the Community Radio station, Vidya Vani, in Pune University. We oriented, facilitated and supported a team of student volunteers to put up the weekly serial called Science Radio.³

I was still itching to try out science news. So to provoke the student volunteers, to give them tips on exciting new scientific advances, I started teasing them with my comments on recent research.

The materials and methods had changed. I could access the database initiated by the ISI, by then managed by Thomson and Reuters, directly, without any intermediary. I had access to the contents of journals as and when they are published online in the Web of Science.⁴ Recent could, at last, mean recent. Yesterday, if you will, as newspapers would report.

And there was an independent parallel method that became a viable, a decent alternative even for those who do not have subscription/access to the Web of Science. All you have to do is to subscribe to the contents of the journals. I have an email account which is devoted primarily to the subscriptions that do not cost me anything. And I get to know what those journals are publishing every week. I could then choose some interesting development. If the library subscribes to the journal, I can get a PDF copy very easily. And then I would write a teaser/trailer about the paper. Given that other community radio stations can also use the same tip to cover interesting scientific advances, I used a blog, sciencenewsforcr.blogspot.com.

But, of course, even the student volunteers at the IISER Pune did not pick up the story tips I provided. The science radio show remained a magazine, popularising the research of labs in Pune, with features on labs and interviews from scientists.

I realised the roadblock: BS-MS students, even in premier institutes such as IISERs have difficulties – reading and comprehending scientific papers to report in a manner that is understandable to the public takes too much effort.

[3] The series is accessible from <http://www.edaa.in/site/science-radio>

[4] The database is now managed by Clarivate Analytics and can be accessed by subscribers only from <https://www.webofknowledge.com/>

I did not want to intervene in the production of the weekly science radio magazine since the ownership of the series had to vest in the student volunteers. The show stopped after one semester when the students got involved with their exams.

Meanwhile, in 2014, I started training PhD scholars, Post Docs, and scientists to write science. The availability of trained human resources capable of comprehending scientific papers allowed a series of successful experiments in science reporting ([Madhu 2019](#)).

In the next section, I will briefly describe the experimental results and focus more on the materials and methods that we use now.

Moving to the present

Besides temporal immediacy, newspapers are wont to go for spatial immediacy: what happens in your town is more ‘newsy’ than what is happening far away.

The filters in the Web of Science allow one to look at the papers from scientists in specific cities/towns. I leveraged on this facility, and the manpower base that I had trained, to start a weekly column in the *Sakaal Times*, a Pune based newspaper, in 2016.

The newspaper had no science column till then. The column covered science done by scientists in Pune exclusively, for five Sundays. Then for five issues, we covered science done in Maharashtra in the same column.⁵ Having tested the processes and procedures at city and state levels, we increased the scope to cover Indian science. From March 2016 we shifted the channel also and created a new column, Science Last Fortnight⁶ in *Current Science*.

To achieve this, I had the backing of the PhDs that I had trained in two-week workshops held at the IISER Pune, 2014 and 2015. More such workshops supported by Vigyan Prasar, besides one-week workshops organised by the Current Science Association, increased the human power base to enable reporting more than 30 science news items per month.

Let me describe the materials and methods we use in a little more detail.

[5] The soft copies of this column can be accessed from <https://steamindiareports.com/archives-of-published-research-news/>

[6] The soft copies of this column can be accessed from <https://steamindiareports.com/archives-of-published-research-news/>

Web of Science or Scopus?

While Scopus,^[7] the database managed by Elsevier, covers data from about 35000 journals, Web of Science covers a little more than 20,000 journals, even after ownership changed hands from Thomson and Reuters to Clarivate Analytics.

Web of Science has a tradition of taking peer review a little more seriously than Scopus does. For science reporting, it is important that the claims of scientists are vetted or supported by independent experts as genuine before they are published. Though a faulty system, peer review does reduce the chances of picking up papers that might have inherent faults or flaws. So, as science reporters, we use Web of Science as a starting point to get to newsworthy stories. (However, researchers, who are trained to read critically, are advised to use Scopus, since it has more extensive coverage of scientific literature).

Many journals today get more papers than they can publish per issue and, therefore, they schedule the papers for publication much in advance. And they provide the information to scientific databases. Thus, Web of Science (Scopus, ScienceDirect,^[8] etc.) carries data related to papers that *will* be published. For example, on 20th November, in a search done with 'India' in address filter, I found that there were data related to 803 papers that will be published between 25th November and 10th December 2018.

Please note that this is a small subset of papers that will be actually published in a fortnight by Indian scientists. The actual number could be similar to about 4000 papers in two weeks. Web of Science (or any other scientific database) is still not complete as a crystal ball to comprehensively gaze into future publications.

When I scanned through the data of papers that would be published for the fortnight, I found 108 publications that are relevant to the non-specialist citizens of India. Newsworthy science done by Indian scientists, as per my personal judgement.

I harvest the data into Excel sheets, categorising them as

1. Earth and Planetary Sciences,
2. Evolution, Ecology, Environment
3. Agriculture, Fisheries, Forestry, Animal Husbandry
4. Medical, Pharmaceutical and Health Sciences
5. Materials Science
6. Energy
7. Water
8. Technology
9. Theory

[7] <https://www.scopus.com/home.uri>

[8] <https://www.sciencedirect.com/>

After minor editing and cleaning of the data, we share the Excel Document as Google Spreadsheets⁹ with the academics that we have trained and who have shown interest in writing about scientific advances. From different parts of the country - from universities, research labs, institutes - the members of a Google Group¹⁰ select the entry of their interest, cut it from Google Spreadsheets and paste it in a Google Doc¹¹ specifically shared for the purpose.

The volunteer science writers have to access the PDF file of the paper. They may request the scientist concerned since the email ids are given in the data, they may request Indian Researchers Group on Facebook, they may request the scientist through ResearchGate¹² or they may access the paper by searching in Digital repositories, using digital object identifier or DOI.¹³

Once they get the paper, the PDF file is dropped into a Folder in Google Drive, shared specifically for the purpose. This is useful because quite often, the stories written will have to be compared with the paper reported.

The reporters have to read the paper. And they have also to read around the paper. Using advanced search in Google, Google Scholar¹⁴ and Open Access Databases,¹⁵ they have to get a deeper and updated understanding of the contents of the paper, to create a psychosocial, economic, political, cultural and historical context in which the scientific problem is solved - components that are not usually reported in scientific papers.

Bookmarking and organising knowledge in digital form, outside the brain, reduces the cognitive load on the reporters. Webclipper tools such as Evernote¹⁶ take a load off from the need to memorise details. The mind is, therefore, free to reflect on the content, to make connections and to weave stories. (Besides Evernote, there are other web clippers. Some of them - e.g. ReadCube,¹⁷ F1000 - double up as bibliographic tool, collaboration tool etc. for researchers).

[9] <https://www.google.co.in/sheets/about/>

[10] <https://support.google.com/groups/?hl=en#topic=9216>

[11] <https://www.google.co.in/docs/about/>

[12] <https://www.researchgate.net/>

[13] Sci-Hub, considered pirate site by some and a scientific necessity by others, has changed the way science is done; standing on giant shoulders to peep behind pay-wall is now a matter of clicks.

[14] <https://scholar.google.co.in/>

[15] You can access quite a few open access databases from [http://www.loadb.org/Control.do? brse](http://www.loadb.org/Control.do?brse)

[16] The software is downloadable from <https://evernote.com/>

[17] <https://www.readcube.com/>

Our reporters must have an in-depth understanding of at least one field and a keen interest in other fields. For improvement in this direction, we usually suggest Researcher,¹⁸ an App that delivers data related to publications in journals of your choice, every day. Scanning through literature related to areas of interest can now be done on a smartphone while travelling, waiting for meetings, while having coffee in the morning. For many researchers, to keep up with what is new in their field has never been easier – in spite of the information explosion, because of the digital revolution.

In fact, scientific publishing is going through a phase of rapid evolution. Scientific journals will have to reinvent themselves to survive and grow. Even open source journals. Preprint publications such as ArXiv¹⁹ and bioRxiv²⁰ are gaining traction among scientists. While we encourage our participants to use these for their personal research, for reporting, we still fall back upon traditional peer-reviewed journals. But as open, incisive, voluntary peer reviews start taking place on such preprint platforms, both science and science reporting will change further.

Digital Tools for Research

PDF is the main digital form of scientific papers. As researchers download PDF files, managing them becomes more and more difficult. Mendeley, another digital tool, helps create a library out of your collection. It also doubles up as bibliographic tool.²¹

Zotero,²² another bibliographic tool, is useful for writing papers. It helps to organise the references. Gone are the days when we used to spend more time putting together references than writing the paper. As you finish writing your paper, your references are also ready. You just have to decide which referencing standard you want – or the target journal wants.

SciNote²³ keeps the workflow in your lab streamlined, eases the burden of managing projects, keeping track of inventory, laboratory protocols, materials and methods...It also doubles up as an individual lab journal or even a collaborative one. The App claims that, ultimately, it reduces the burden of writing a paper: just have to collate the materials, methods and results... Many similar apps are being developed to help researchers. We will have to keep our minds and eyes open for digital tools that make our work easier.

We encourage the use of such digital tools among our group of science writers. Besides being useful for their research, these tools build their capacity as science reporters. By reducing time

[18] <https://www.researcher-app.com/>

[19] <https://arxiv.org/>

[20] <https://www.biorxiv.org/>

[21] <https://www.mendeley.com/>

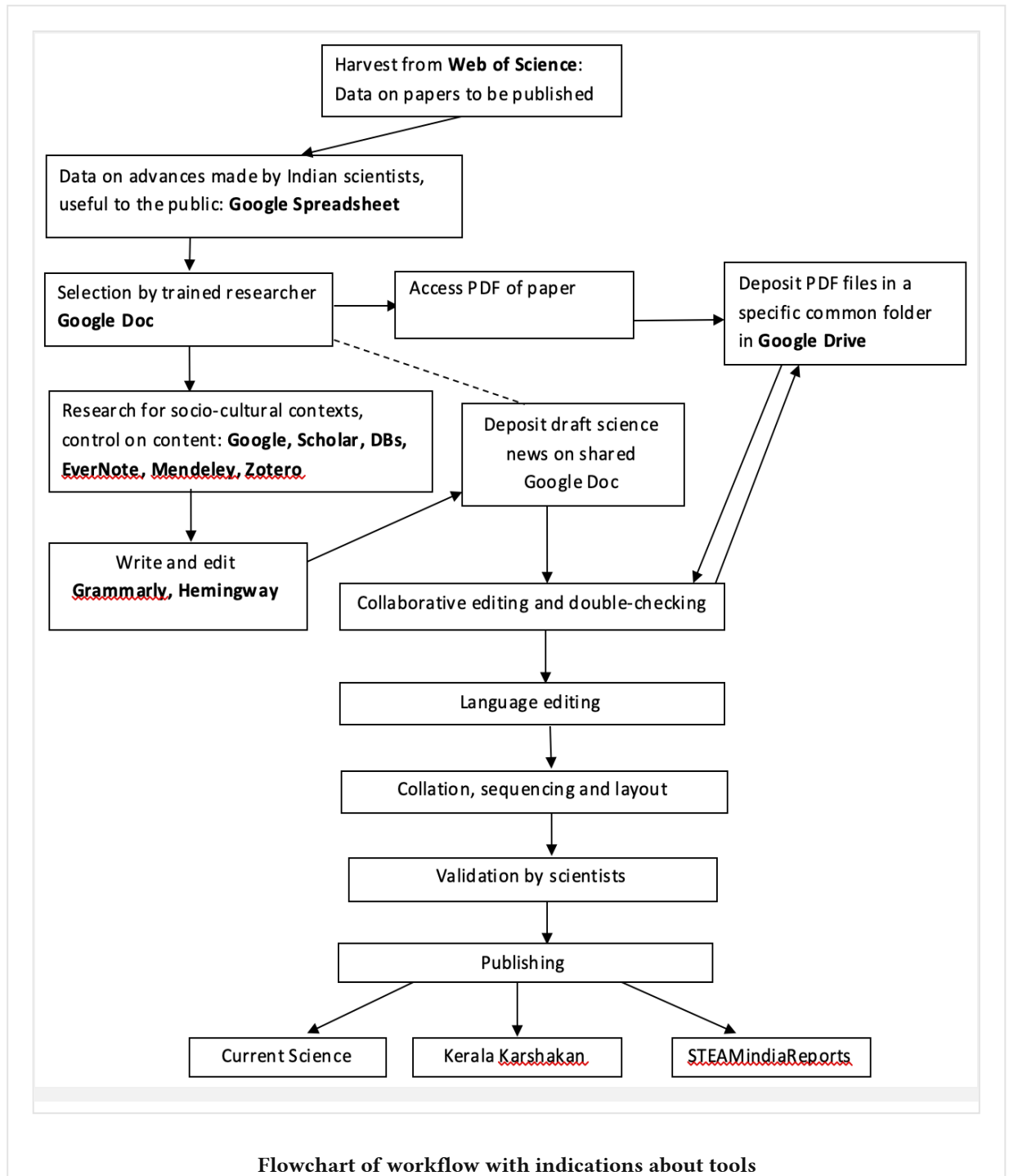
[22] <https://www.zotero.org/>

[23] <https://scinote.net/>

and effort for the researchers and by making their work more systematic, we wrest time from them for science writing. After all, this is unpaid work.

The digital resources and tools available for science journalists today allow the preparation of the news report before the paper is published. And that allows time for journalists to double check the veracity of the news reports with the scientists concerned, and reduces the

possibility of faulty reporting – a phenomenon that estranged scientists and media professionals in the earlier decades.



Representative Results and Conclusion

Scientific activity in India has been doubling every decade in the recent past. Presently, the output from India is more than a lakh of papers, as per Scopus. Even by strict standards of selection, more than 10% of this output is directly useful for various target groups among Indian citizens and therefore report worthy in news channels - which means that we are missing out on more than 10,000 papers per year that are not reported in any Indian media.

Newspapers that allocate two or three pages for the coverage of sports do not have even a weekly science column. This is primarily because reporting scientific advances is not an easy task for a person trained as a journalist. However, training scientists to become citizen journalists – a task easier than converting a journalist into a citizen scientist – can overcome the problem.

To aid such researchers and scientists interested in writing science news, there are quite a few digital tools that have evolved in the recent past. Many more are, of course, expected. The digital resources and tools currently available are adequate to report science as it happens - or even before it happens. These resources and tools have led to an increase in science reporting in India during the last few years.

However, the regular output from the India Science News Wire of Vigyan Prasar, Research Matters and the periodic output from our group, along with occasional reporting of science in newspapers, cover only a minuscule part of Indian science. It is subcritical and inadequate to make an impact on the citizens' way of thinking. To create scientific temper among media consumers, the present activities will have to be scaled up to ten thousand fold, given the fragmentation of media audiences.

Increase in the number of reports alone, of course, will also not lead to the desired outcomes. Indian news reporting quite often disregards the strategies and methods used by scientists and focuses primarily on the results. To improve scientific temper among the readers, however, it is important to spell out the way scientists solve their problems. Once the logic of scientific discovery – except the cases of accidental or serendipitous ones – is understood by the public, they too would start using it. So we must focus more on the materials and methods section of the scientific papers and use the results that are useful to the public only as a hook to fish for attention in the high pitched clamour of news.

Science News is distinct from other types of news where the journalists often do not provide the source. Science news, on the other hand, has to be transparent about its source. Providing the reference to the source papers is important in today's context where the number of citizen scientists is growing and scientific research is happening outside research institutes.

Representative results from such efforts intended to improve science writing in India can be seen in the column Science Last Fortnight in *Current Science*, in the column Lab to Land in

*Kerala Karshakan*²⁴ and in the website steamindiareports.com. As can be noticed in the column in *Current Science* and on the website, the reports are based on research done by Indian scientists. We may use some results from outside the country in Lab to Land since here the attempt is to take any useful science to farmers, fishers and foresters. But even in this column, the ultimate success would be measured by the provocation provided to the citizen scientists among readers.

The times have changed from the days of Jayaraman, Balu and Balaram whom I mentioned in the beginning. One doesn't write with a pen and then revise it on typewriters. The digital revolution has changed the ways that science writers work – it has become more complex technologically, yet easier, in practice. The same is true for research. The time spent in 'climbing on the shoulders of giants' has become less tedious. Literature review that would take a year during PhD in the 1980s, can now be done within a few weeks.

The time taken for researching and writing has come down in the last few decades. And the number of PhDs, too, has multiplied many fold. The only other resource needed is money. But science reporting does not call for huge financial inputs too. It does, however, require committed and passionate people. Creating a core community of such people can, as Kerala Sasthra Sahithya Parishad and Ekalavya demonstrated in the 1980s, generate a more rational mindset among people by concerted efforts at science popularisation and communication. However, as history has demonstrated, the enthusiasm of such communities are transient and often, they do not survive – perhaps due to the lack of mentoring needed to evolve next-generation leadership within such organisations. Only time will tell whether our efforts will sustain the present rate of growth into the next decade.

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*This is a revised version of an article with the same title submitted to the Indian Social Science Congress organised in Bhubaneswar in December 2018.

Notes and Resources:

[24] The column is accessible from <https://steamindiareports.com/archives-of-published-research-news/>

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