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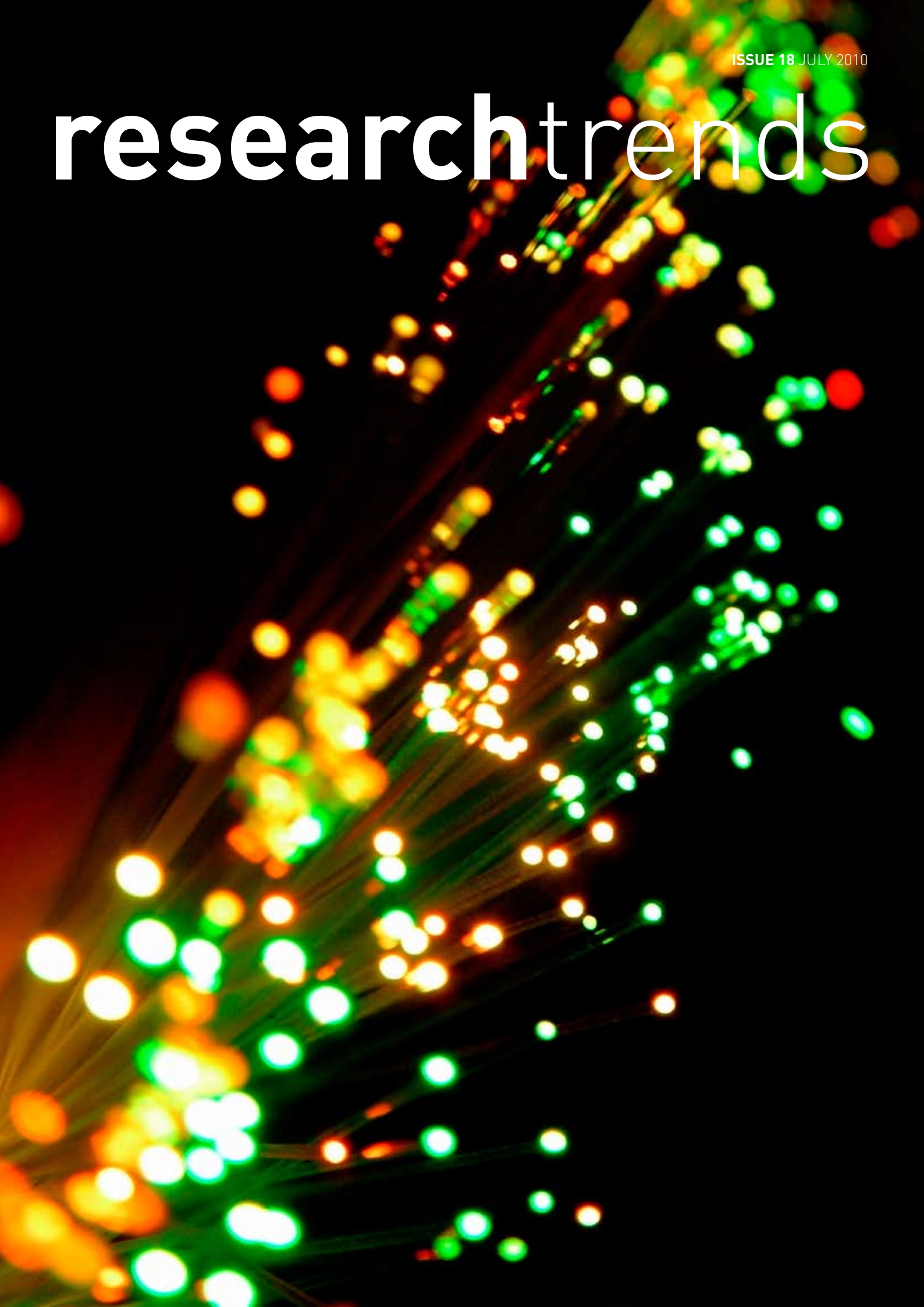
researchtrends



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researchtrends

Welcome to the 18th issue of Research Trends, which focuses on scholarly communication: past, present and future.

For many, the Enlightenment was where science really started. Looking back to the 18th century and earlier, we investigate how the so-called "Republic of Letters" was a forerunner to today's scholarly journals. We also look at how researchers migrate to new research topics, as a result of breakthroughs in work carried out in the past. In the here and now, we examine three recent cases in which scientists encountered three different communication challenges with three very different – and often surprising – outcomes.

Looking to the future, Research Trends highlights some of the new usage-based and article-level metrics that were discussed at the recent NSF workshop on scholarly evaluation in Washington D.C. Plus, we question the future of the peer reviewer, and how to recognize the importance of the work they carry out.

If you would like to comment on any of the topics covered, please use our **feedback** facility.

DID YOU KNOW?

... how much a citation is worth in real-world money?

In 1986, economist Arthur Diamond calculated that each citation could add between $50 and $1,300 to a faculty member's salary *(1)*. Differences in citation behaviour between subject areas are the main reason why this differs so much from one case to another. A more recent study some 25 years later *(2)*, looking at Political Science Faculty Salaries at the University of California, finds that an increase of one citation per year correlates to an average salary increase of $1,234: almost as much as the estimate for an additional year of seniority.

While the two studies look at completely different fields a quarter of a century apart, the figures are surprisingly similar. Inflation means that $1,300 in the 1986 had the same "purchasing power" as $2,590 in 2009 *(3)*. Even though the absolute monetary value of a citation has not changed significantly, the relative value appears to be lower now than it used to be in 1986.

References:
(1) Davis, Philip M. (2009) "Reward or persuasion? The battle to define the meaning of a citation", *Learned Publishing*, 22 (1), pp. 5-11.
(2) Grofman, Bernard (2009) *Political Science Faculty Salaries at the University of California*, UC Irvine: Center for the Study of Democracy.
(3) Officer, Lawrence H. and Williamson, Samuel H. (2009) "Purchasing Power of Money in the United States from 1774 to 2010", *MeasuringWorth*.

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Behind the data

Speech is silver, silence is golden: The challenges of scientific communication

TOM JONES

Scientists face some difficult choices. They can offer complete transparency by opening their debates to the general public via the Internet, but run the risk that normal academic criticisms could lead to libel cases. Alternatively, they could refuse to discuss anything openly, with the risk of alienating the general public. Finally, they could try working closely with journalists and other communicators, allowing them to disseminate their ideas, even though this can lead to misrepresentation of ideas and results. Three recent cases have highlighted the difficulties associated with each of these approaches.

I'll see you in court

When Simon Singh, the physicist turned science writer, published an opinion in the Guardian newspaper criticizing chiropractic therapy *(1)*, the British Chiropractic Association (BCA) attempted to sue him for libel. Eventually, the court decided in Singh's favor. *(2)*

This case highlighted risks that scientists face when the robust criticism typical of academic debate is published in the mainstream media. Within the world of academic journals, opponents have no recourse but to reasoned debate; in the public eye, however, when you run out of arguments, you can fall back on libel law. The BCA could have published their own response, providing the evidence Singh claimed was non-existent; instead, they chose to sue. For many academics, this is an unexpected response.

Storm in a teacup

In November 2009, hackers leaked internal emails belonging to members of the University of East Anglia's Climate Research Unit. According to climate-change skeptics, these emails contained evidence of data manipulation, and attempts to suppress the work of climate-change skeptics. They and the media also claimed that the content of these mails was in the public interest.

While a subsequent Parliamentary Enquiry cleared the researchers of manipulating data to show certain results *(3)*, public trust in climate-change science specifically, and the wider scientific community in general, has suffered.

The enquiry was, however, critical of the culture of withholding information *(3)*, which raises an important question for scientists: to what degree should they expect their communications and information sources, which might be private, informal and/or works in progress, to be subject to public scrutiny?

Darwin award

Few theories are as widely debated in the mainstream media as Darwinism. *(4)* In the pursuit of "balanced" reporting, many alternative theories have been given wide coverage, including intelligent design and Lamarckism. A predecessor of Darwin, Jean-Baptiste Lamarck proposed a theory of evolution by inheritance of advantageous survival traits acquired during the parent's lifetime. Darwinism superceded Lamarckism, specifically with respect to the acquisition of inherited traits.

Building on Darwinism, modern evolutionary theory suggests that evolution is a result of changes to the DNA sequence. When these changes help an organism to survive and reproduce, they pass into the next generation.

However, a recent study showing that chickens could pass on behavioral changes caused by stressful environmental conditions to their offspring, even though there were no changes to their DNA sequence, has been cited as confirmation of Lamarckism. *(5)* To anybody with a reasonable understanding of evolutionary theory, this result is completely compatible with Darwinism.

In fact, while the argument in the body of the article does not question current evolutionary theory, the headline and the introduction are rather sensationalist. Such treatment may lead many scientists to question whether they can trust journalists to treat their work responsibly, or whether they need to actively engage with the media to promote their findings in a balanced, rational and accurate manner.

Commenting on the article, Alice Tuff, from Sense About Science, a charity concerned with promoting good science and evidence for the public, said: "Science is a slow, continuous process based on uncertainty, while in contrast, the media demands quick, entertaining stories with clear answers and certainty. These different demands can seem difficult to reconcile, but if scientists' voices are missing from the debate, they risk being replaced by others who do not have the same regard for evidence."

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Balanced voice

Scientists need to work towards resolving this uncomfortable relationship with the media; openness is required to maintain trust, and the public appreciates lively debate. For this to be effective, however, scientists need to be able to express themselves freely and without risk of libel – a threat that could cause scientists to self-censor some of their most progressive ideas. At the same time, scientists must balance reported articles with their own communications, through interviews and opinion pieces. After all, those who actually develop and test new ideas are best placed to understand the logic and subtleties of a scientific argument and thus communicate their work accurately.

Useful link:

Sense About Science

References:
(1) Singh, S. (2008) "Beware the spinal trap", *Guardian.*
(2) Editorial (2010) "Time for libel-law reform", *Nature*, vol. 464, issue 1104.
(3) Pearce, F. (2010) "Climategate inquiry points finger at university", *New Scientist.*
(4) Darwin, C. (1859) *The Origin of Species.*
(5) Burkeman, O. (2010) "Why everything you've been told about evolution is wrong", *Guardian.*

Research trends

Buckyballs, nanotubes and graphene: On the hunt for the next big thing

ANDREW PLUME

The current focus on graphene owes its legacy to the foundations of nanoscience laid down with the discovery of buckminsterfullerene (named in homage to the geodesic domes of architect Richard Buckminster Fuller) in 1985. *(1)* This sparked the search for other fullerenes, complex carbon nanostructures typically occurring as spheres (similar in appearance to a soccer ball, and colloquially known as "buckyballs") or cylinders. The first cylindrical structures, quickly dubbed nanotubes, were isolated in 1991. *(2)* Graphene can be considered as an unzipped and flattened-out nanotube, and has been shown to have unique electronic properties under certain conditions. *(3)*

Explosive growth

The growth of the peer-reviewed journal literature on nanotubes and graphene is nothing short of remarkable. While articles on fullerenes have appeared in steadily increasing numbers annually since 1985 (see Figure 1), massive (and so far sustained) growth has been observed for both nanotubes and graphene. Early response to the "discovery" of each of these materials shows very different trends (see Figure 2). While fullerene and nanotube research expanded rapidly, graphene research has grown exponentially (at a rate of 58% per year) since the publication of Novoselov *et al. (4)*, a landmark paper describing a new method for isolating stable graphene sheets. The citation impact of this paper is visualized in Figure 3, giving a clear sense of the citation ripples emanating from this paper out into the literature, like those from a brick dropped in a pond.

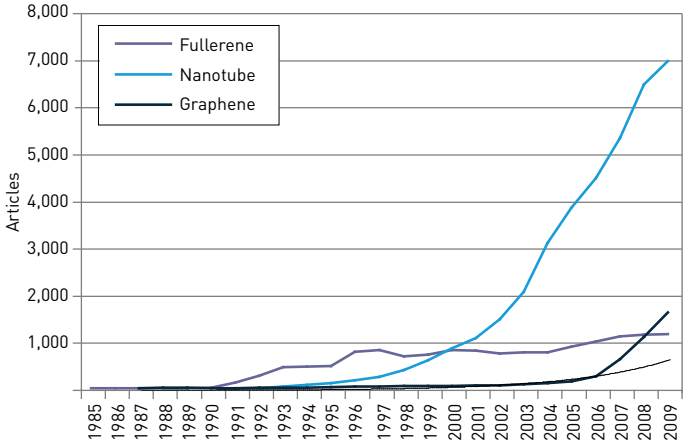

Figure 1. English-language research articles published in journals in the period 1985–2009. Keyword searches were conducted for fullerenes (*fullerene), nanotubes (nanotube*) and graphene (graphene*).
Source: Scopus.

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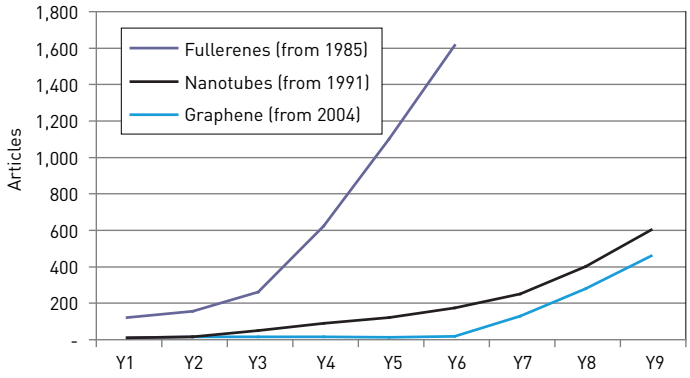

Figure 2. English-language research articles published in journals from the year indicated (i.e. for fullerenes, Y1 is 1985). Keyword searches were conducted for fullerenes (*fullerene), nanotubes (nanotube*) and graphene (graphene*).
Source: Scopus.

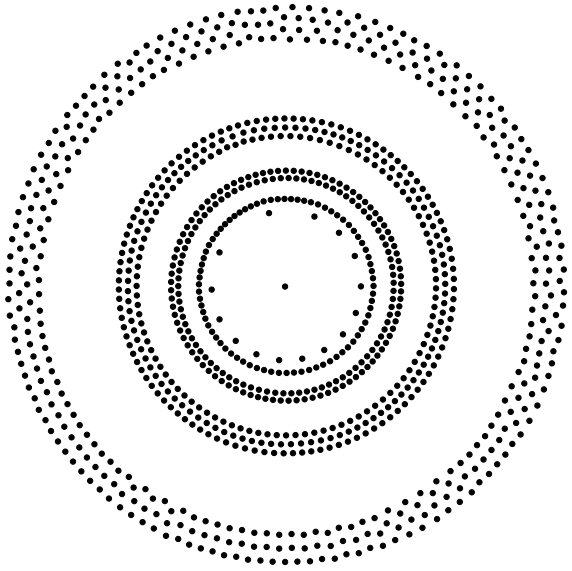

Figure 3. All documents citing Novoselov *et al.* (2004; shown at the centre of the figure). Each concentric ring of citing documents were published in 2005 through 2009 respectively and are identified by their first author – note how their number increases with each year, just like the broadening of the ripples in a pond.
Source: Scopus.

This paper effectively opened up research on the characterization and exploitation of the unique properties of graphene to a new field of scientists, many of whom had previously been working on carbon nanotubes. Indeed, the 100 most prolific authors on graphene to date have shown a recent decline in their share of publication output on nanotubes in favor of graphene, with the latter exceeding the former since 2008. These top 100 authors appear to have a low and decreasing output on fullerenes, perhaps a carryover from the origins of the nanotube and graphene research fields.

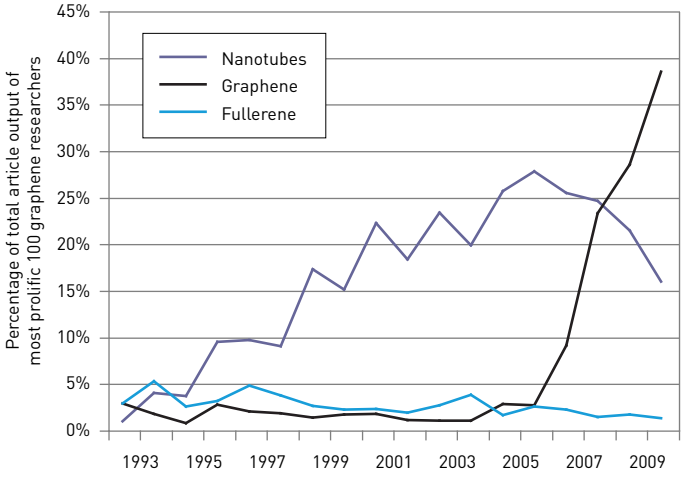

Figure 4. Percentage shares of total article output of most prolific 100 graphene researchers on fullerenes, nanotubes or graphene. Keyword searches were conducted for fullerenes (*fullerene), nanotubes (nanotube*) and graphene (graphene*).
Source: Scopus.

Graphene research boom

How does the graphene revolution feel to those working in the field? Dr Jamie Warner, Glasstone Research Fellow in Science at the Department of Materials, Brasenose College, University of Oxford comments: "The main thing I see when visiting other research groups is the massive uptake of graphene-focused research. Everyone wants to get on board the graphene revolution. Laboratories that have facilities for examining carbon nanotubes are suitable for graphene as well. So there is no real investment cost required to expand the research into graphene. [...] When combined with the ease with which graphene can be obtained from scotch (sticky) tape, it is evident why output in graphene research has boomed in such a short time.

"It's clear that many researchers are riding the graphene wave in the hope of high-impact papers. The quest for all scientists is to be among those leading the field. But there are few who are setting the trend for others to follow. In such a fast-moving field, it may be hard to stay ahead."

Contribution to the carbon community

How has this fundamental shift in research direction affected the communities of physicists (interested in graphene's electronic properties), materials scientists (seeking potential applications in new carbon materials) and chemists and surface scientists working on its large-scale synthesis?

Dr Warner continues: "The coalescence of nano-carbon communities hasn't really changed that much. Groups have always collaborated worldwide; that is the nature of science. More interesting is how established groups have shifted focus or expanded. Research groups that were previously working on nanotubes are now entering the graphene field.

"Groups with established expertise in examining carbon nanotubes with high-resolution transmission electron

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microscopy – such as Kazu Suenaga and Sumio Iijima at the National Institute of Advanced Industrial Science and Technology (AIST) in Japan, and Alex Zettl at UC Berkeley – were able to translate their expertise directly to graphene. The large-scale growth of graphene using chemical vapor deposition (CVD) was a similar case: groups with experience and apparatus set up for CVD of nanotubes – such as Rodney Ruoff at the University of Texas at Austin – were able to modify the catalyst structure to grow graphene. Surprisingly, it was two scientists with no background in carbon nanotubes or fullerenes, Kostya Novoselov and Andre Geim, who made the biggest contribution to the field of graphene. This highlights how people from outside the immediate field can make a massive impact.

References:
(1) Kroto, H.W., Heath, J.R., O'Brien, S.C., Curl, R.F., Smalley, R.E. (1985) "C60: Buckminsterfullerene", *Nature*, vol. 318, issue 6042, pp. 162-163.
(2) Iijima, S. (1991) "Helical microtubules of graphitic carbon", *Nature*, vol. 354, issue 6348, pp. 56-58.
(3) Soldano, C., Mahmood, A., Dujardin, E. (2010) "Production, properties and potential of graphene", *Carbon*, vol. 48, issue 8, pp. 2127-2150.
(4) Novoselov, K.S., Geim, A.K., Morozov, S.V., Jiang, D., Zhang, Y., Dubonos, S.V., Grigorieva, I.V., Firsov, A.A. (2004) "Electric field in atomically thin carbon films", *Science*, vol. 306, issue 5696, pp. 666-669.

Reporting back

Metric mad: the future of scholarly evaluation indicators

ASHLEA HIGGS

In mid-December 2009, around 50 science colleagues assembled for what was tipped to be a veritable bibliometric wonderland. Attended by George Hirsch and Henry Small among others, the event offered a practical workshop rather than one-way theoretical presentations.

Jumping on the interdisciplinary bandwagon, the speakers and attendees represented many differing points of view: government vs. academic vs. corporate; evaluator vs. proposer; funding vs. policy vs. scientist; metric theorists vs. practitioners. But while debates were spirited, discussions were collegial and focused on advancing work on new metrics.

Two particular questions occupied participants, to which all discussions of new metrics circled back. Herbert van de Sompel of Los Alamos National Laboratory, the first speaker and one of the event organizers, asked attendees: "What are the qualities which make a metric acceptable to all stakeholders? And how do we move from conception to acceptance?" The workshop centered on projects investigating or proposing new metrics, including the MESUR project, Eigenfactor, h-bar index, and PLoS ONE's article-level metrics. Many of these new metrics center on usage data.

Usage-based versus article-level metrics

Metrics based on usage data are central to the **MESUR (MEtrics from Scholarly Usage of Resources) project**. Johan Bollen from Indiana University, and principal investigator for the MESUR project, presented his findings to date. When comparing traditional citation-based metrics with usage-based metrics, he observed that usage data are very good indicators of prestige, but that evaluating scholars solely on rate metrics and total citations is "like saying Britney Spears is the most important artist who ever existed because she's sold 50 million records."

In contrast, Peter Binfield of **PLoS ONE** presented the journal's work on article-level metrics. In PLoS ONE, article views, downloads, star ratings, bookmarks and comments join

New usage metrics: recurring themes, fresh challenges

Small beginnings: it took centuries for citation structure to develop; technologies are only now available to make new metrics possible.

Incentives work both ways: people need incentives to adopt new metrics, while metrics incentivize both positive and negative behavior.

Availability of raw data: usage data can be proprietary, fragmented, and not overtly displayed.

Metrics are only part of the answer: peer review continues to play a role.

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the traditional citation counts. There are, however, downsides to article-level metrics like the star-rating system: Peter cautions that it is not yet widely used, and there is a propensity to give articles a five-star rating. The full scale is rarely used, meaning that it can be hard to infer much from these ratings.

Missing from the current metrics available, claims Peter, include those that predict an article's impact from day one; ratings by reviewers, editors and other experts in an article's particular field; mainstream media coverage; publicly available usage metrics that track article downloads, views of abstracts, re-posts of articles online and so on; tracking of "conversations" (comments, forum discussions and so on) outside the original place of publication; and the reputation of metrics among commentators.

Moving with the times

Recognizing that citation analysis has a history hundreds of years in the making, the discussion of new usage indicators has only been possible in the last decade or two. It will take a long time before scholarship catches up with these new (technological) metrics; and we are only just beginning to understand what the impact of these technologies will be.

Will Jorge Hirsch's h-bar index take hold with the speed of the *h*-index? Will collaboration between the MESUR and Eigenfactor projects deliver MESUR-able results? Which approaches to network analysis will become mainstream in identifying influence, prestige and trust? When will measuring re-use of data sets become commonplace? Will metrics ever replace peer review? Whatever the answers, we look forward to the next workshop to carry the debate forward.

Useful links:

Scholarly Evaluation Metrics: Opportunities and Challenges
Scholars Seek Better Metrics for Assessing Research Productivity
MESUR
PLoS ONE
Visualizations on PLoS

The burning questions

Cart before the horse: new usage-based metrics require the collection of new data for future analysis. But what data with what standards and for which metrics?

Variances in usage-tracking systems: without a central repository, how to measure usage across databases for the same article?

Power of simplicity: simple calculations, such as the *h*-index and impact factor, have high adoption rates; will relatively complex, computer-dependent network analyses ever achieve the same rate?

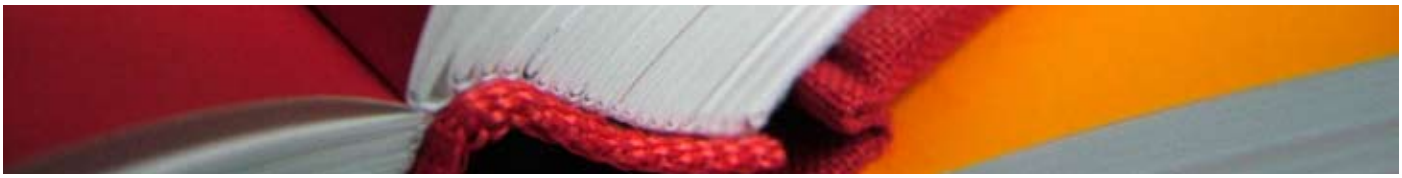
Scholarly vs. public attention: when analyzing usage data of publicly available articles, can scholarly attention be distinguished from general curiosity? Does it need to be?

What's "new": do existing systems for scholarly attention and funding decisions drive attention to the norm, to the detriment of breakthrough research that pushes the boundaries of science?

No single metric: while one metric will never suffice, which set of metrics will serve as a standard group?

Metrics for non-article research output: how can re-purposing mathematical formulas or re-using data sets be tracked?

Expert opinion



Letters from the past

MICHELLE PIROTTA

Today, we take scholarly communication so much for granted that we rarely consider how we would share ideas and meet like-minded researchers if there were no journals or research institutes. Yet these are relatively recent developments. The first journals did not appear until the 17th century and universities did not become widespread until the 16th century. Before (and during) these developments, scholars exchanged opinions, hypotheses and conclusions within a forum they called the Republic of Letters.

The Republic of Letters was a forerunner of our modern scholarly communications, incorporating the activities of today's journals, societies and research institutes. Starting in the mid-15th century and reaching its peak during the Enlightenment period of the late 17th and 18th centuries, this was both a real and an imagined community. Ideas were exchanged via handwritten letters and cultural-intellectual gatherings in salons.

According to Paula Findlen, Ubaldo Pierotti Professor of Italian History and Chair of the History Department at Stanford University: "It was a scholars' Utopia; a kind of transnational, global community of minds."

Mapping the Republic

Findlen, along with her colleagues at Stanford University, Dan Edelstein, Assistant Professor of French, and Academic Technology Specialist Nicole Coleman, is working on a major collaborative project to map the exchanges within the Republic of Letters.

Producing the maps, however, is only a starting point for the team. They are using them to test theories and gain an overview of the landscape. The maps make it possible to view each writer in context, and to search and compare different thinkers. It is also much easier to see how a correspondent's career developed along with his network.

They have long-term plans to allow researchers to annotate the data and test hypotheses. "Humanities projects can face the challenge of presenting disputed and/or incomplete data in a way that offers most clarity to researchers, so we want to create space for interpretations when we create visualizations," says Coleman. However, simply gathering the data was the team's first obstacle. "We're working with incomplete data. And many gaps will never be filled in because the documents are lost," she explains. "It's a bit like trying to do modern bibliometrics, but you only have *Nature* left," says Edelstein.

Left to right: Dan Edelstein, Nicole Coleman, Paula Findlen
Photo: Linda Cicero

Paula Findlen is Ubaldo Pierotti Professor of Italian History and Chair of the History Department at Stanford University. Her research focuses on the scientific culture of early modern Italy, the role of the Jesuits in early modern science, the history of collecting, and the Republic of Letters as seen from an Italian perspective.

Nicole Coleman is Academic Technology Specialist for the Stanford Humanities Center. She works on large-scale international collaborative research projects, currently focusing on information visualization for humanities research.

Dan Edelstein is Assistant Professor of French at Stanford University. He works primarily on 18th-century France, which also serves as a launching pad for forays into the 19th and 20th centuries, as well as the early modern period.

While it is feasible to explore the content of the letters, the team chose only to look at metadata. "The discovery of new knowledge in the humanities relies on rich context, which can be obscured when the objective of visualizing this data is primarily about managing complexity or quantity. When gathering these remnants of the past, our big challenge is to

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present it in a way that gives context. Context helps us make sense of it rather than numerical analysis," she adds.

Exploring the periphery

Findlen is particularly interested in the outliers: people in far-flung locations or those forgotten by history. "We can see how they fit in with and contributed to the flow of ideas. Everyone knows that London and Paris were important, and the maps confirm this. But we can now see how the Republic appeared to its members living outside the capitals, such as Benjamin Franklin in Philadelphia," she says.

At the same time, some people were highly prolific, but did not have a big impact, while others wrote few letters, but had a massive impact. In fact, if history has shown us anything, it is that sheer quantity of output is only a small part of the story. Important figures, like Isaac Newton, actually refused to accept correspondence, while others, like Thomas Hobbes and René Descartes, have a relatively small output when compared with their impact.

Establishing past impact

While the output – maps of the Republic of Letters – echo modern bibliometric attempts to map science, the team's starting point is very different. One significant distinction is that where modern bibliometrics aims to establish the impact of living authors, Findlen, Edelstein and Coleman already know who was important.

"What we're really doing," says Edelstein, "is comparing reality with imagination. For instance, many French Enlightenment thinkers believed that England was a haven of liberal, progressive thinking and hoped to emulate this free society. However, the reality is that key French Enlightenment figures, like Voltaire, weren't really corresponding with England. In fact, less than 1% of his output went to, or came from, England."

Gossip will always be with us

When drawing parallels between the Republic of Letters and current scholarly communications, it is important to remember that letter writing was a quite different activity from today. While some were personal, many were written with a wider audience in mind. Correspondents in the Republic assumed that their letters would be shared.

According to Edelstein, "these letters were essentially gossip: gossip about ideas, books, publications and other members of the Republic." And this background chatter whereby scholars bounce ideas, vent steam and make private comments has never really stopped, continuing today in emails, blogs and university corridors the world over.

Edelstein adds: "Everyone is part of a community. While we celebrate individual genius, most ideas emerge from debate, and this has never changed. We have always constructed virtual communities, whether by writing letters or joining today's global online networks." Debate is a cornerstone of all academic pursuits, and while our media may change, we will always need to discuss our ideas within a community.

Useful links:

Mapping the Republic of Letters (project website)
Mapping the Republic of Letters (visualizations and explanations)

People Focus

In recognition of peer reviewers

SARAH HUGGETT

Peer review, the assessment procedure of a scholarly manuscript carried out by external experts prior to publication, is an essential part of scholarly communications. It has recently been described as the cornerstone without which "the whole edifice of scientific research and publication would have no foundation". *(1)* However crucial, peer review goes nonetheless mostly unrewarded.

Researchers are always struggling for time between conducting and documenting their research, obtaining funding through grant applications, and keeping apace with the literature in their field. A large proportion of researchers also have to deal with the tasks of teaching and mentoring students, managing labs, and travelling to present their findings. It seems paradoxical, therefore, that a fundamental yet time-consuming task such as peer review is not formally incentivized, especially in our times of budgetary restrictions for science, growing competition for grants, and increasing emphasis on productivity.

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The reviewing crisis


Prof. Philippe Baveye

For Prof. Philippe Baveye of the SIMBIOS Centre, Abertay University, this very real problem is nonetheless only the tip of the iceberg: "Now more than ever, many more manuscripts are submitted to journals than really deserve to be. A huge amount of them are junk, submitted for reasons other than the sharing of new knowledge, which understandably nobody wants to review. It is in this context that the peer-review crisis has to be interpreted."


Prof. Bernard Grabot

Although there have been ideas for penalising late reviewers *(2)* as an incentive for prompt reviews, the majority of suggestions focus on positive reinforcement. *(3)* Prof. Bernard Grabot, of the Ecole Nationale d'Ingénieurs de Tarbes, France, agrees that this is the right approach: "In my opinion, the idea is to encourage people to review; we should therefore avoid any penalty, even for 'poor' reviewers, as people would prefer not to respond than risk a bad evaluation."

Peer-review metrics


Dr Elena Paoletti

While some journals do provide access to e-content or Abstracting & Indexing services such as **Scopus**, publish lists of reviewers and/or frequent reviewers, or even pay reviewers a token sum for each completed review, most peer reviewing goes unrewarded. The most recent proposals to change this have advocated the application of scientometrics to peer review. *(4)*

In November 2009, Dr Elena Paoletti of the National Council of Research, Italy, proposed the Reviewer Factor: a simple indicator based on the number of reviews multiplied by the citation influence of the journal, which would be "a concrete way to provide public recognition of [reviewers'] attitude to evaluation and importance in the field, and a succinct measure of [their] experience in peer review." *(5)* Late reviews may or may not be taken into account.


Dr Pedro Cintas

Meanwhile, Dr Pedro Cintas of the University of Extremadura, Spain, suggested a Peer Review Index: a metric or "peer review capability [which] would be the quotient between the number of papers evaluated (q) and the number of papers published (p) within a given period." *(6)* This could be made to incorporate the quality of the reviews in terms of relevance and usefulness, as evaluated by the editors.

Prof. Bernard Grabot comments: "Concerning what would make a 'good' index, the discussion is open [...] The important thing would be – if possible – to get a single index for a reviewer, summarising his/her activities for most of the journals [...] but I suppose it is quite difficult. It would be useful to get similar indices for all the journals, which could then be computed at reviewer level."

While Prof. Philippe Baveye does not deny the usefulness of these types of indicators, he believes that they are only part of the solution: "Certainly, peer-reviewing effectiveness indices like those that are being proposed would help, [...] but that would not be enough. The solution to the problem has to be sought by attacking the 'publish or perish' mentality directly, wherever it manifests, and by reducing drastically the number of articles published in most disciplines." *(7)*

Although there is a clear need for the academic community to incentivize peer review in order to preserve a fast and efficient quality check of scientific manuscripts submitted for publication, there is as yet no uniformly established method to do so. With the recent incorporation of the nascent reviewer metrics, the issue has the potential to turn into a hotly debated topic.

Useful links:

Rewarding reviewers – could a Reviewer Factor be a solution?
Increasing visibility and recognition of reviewers – is a Peer Review Index a possible solution?
Sticker shock and looming tsunami: the high cost of academic serials in perspective

References:
(1) (2008) "The pitfalls and rewards of peer review", *The Lancet*, vol. 371, issue 9611, p. 447.
(2) Hauser, M & Fehr, E (2007) "An incentive solution to the peer review problem", *PLoS Biology*, vol. 5, issue 4, p. e107.
(3) Baveye, PC, Charlet, L, Georgakakos, K P, & Syme, G (2009) "Ensuring that reviewers' time and effort are used efficiently", *Journal of Hydrology*, vol. 365, issue 1–2, pp. 1–3.
(4) Baveye, PC & Trevors, JT (2010) "How Can We Encourage Peer-Reviewing", *Water, Air, & Soil Pollution*, pp. 1-3, article in press DOI 10.1007/s11270-010-0355-7.
(5) Paoletti, E (2010) "Rewarding reviewers – could a Reviewer Factor be a solution?", *Elsevier Reviewers' Update*, issue 4, March 2010.
(6) Cintas, P (2010) "Increasing visibility and recognition of reviewers – is a Peer Review Index a possible solution?", *Elsevier Reviewers' Update*, issue 4, March 2010.
(7) Baveye, PC (2010) "Sticker shock and looming tsunami", *Journal of Scholarly Publishing*, vol. 41, issue 2, pp. 191-215.

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