Mathematics journals: what is valued and what may change. Report of the workshop held at MSRI, Berkeley, California on February 14 – 16 2011

Mathematics relies on its journal literature as the main conduit for peer review and dissemination of research, and it does so more heavily and differently than other scientific fields. The conflict between universal access and the traditional subscription model that funds the journals has been debated for the past decade, while hard data on financial sustainability and usage under the different models has been slow to appear. However, the last ten years have seen the move from print to the electronic version of journals becoming the version of record, and the workshop took an evidence-based approach to discussing dissemination, access and usage of mathematics journals.

The workshop goal was to discuss what is important and unique to the publishing of mathematical research articles and how we can best ensure that publishing practices support peer reviewed research in the long term. Much of the current discussion is taking place between funders and publishers, including scholarly societies, but not directly with mathematicians. A second goal was to see if we can find a consensus of opinion on what is important about journal publishing to mathematicians, that is, where the balance lies between the need for profits from publishing and the desire for broader dissemination of research.

The presentations ranged widely; written reports of the talks make up the body of this document. During the first morning John Vaughn, Sam Rankin and Jim Crowley described the way the world works in Washington, leading us to think about the future of mathematics journals should new legislation be passed to mandate open access[1] of federally sponsored research in the USA. Interleaved with those talks we had a presentation on the work of the IMU from John Ball and a talk from Jean Pierre Bourguignon that placed journals in the broader context of the research they publish and the work of a mathematician.

We heard talks on how mathematics journals work in practice and saw evidence of the growth of journals and the changing behaviour of readers and authors. Information was provided on the balance between not-for-profit and commercial publishers; the governance of learned societies; who reads mathematics journals; and the value of the older material to current mathematics research from the citation records. An unscheduled talk by Kristine Fowler, a librarian from the University of Minnesota gave some very interesting results from a recent survey of mathematicians' views on open access. David Gabai's talk on the recent history of the Annals of Mathematics provided a fascinating insight to the effect of free open access on the journal's subscriptions, along with a description of the low cost of publishing the journal. Talks were presented by a variety of major mathematics publishers, ranging from the AMS and Elsevier to Project Euclid. Finally, new publishing models for changing access were presented from a variety of speakers: mathematicians, publishers and a new university office of scholarly communication.

Here is a summary of what we learned from the meeting.

Characteristics that distinguish mathematics journals from other disciplines:
- there are lots of journals in the mathematical sciences – 774 listed 'cover-to-cover' in the Mathematical Reviews database alone;
- they are fully international; one cannot distinguish how a journal operates according to which country it comes from; there are no boundaries to submission

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[1] 'Open access' refers to any research paper that is made freely available in published form at no cost to the reader; it does not distinguish between funded (gold) and unfunded (green) open access.

from overseas authors and no boundaries to the choice of country where an author may submit a paper;
- there are no speed pressures; refereeing is expected to be rigorous and detailed. The average time a paper spends between submission and acceptance is many months;
- published articles form the building blocks of future mathematical research. A proof, once proved, stands for all time and is cited for as long as the literature can be found, it is therefore important not to lose the building blocks;
- evidence was shown for the longevity of mathematics papers in terms of both continued reading and citation of the oldest material;
- the community calls them referees rather than reviewers; journals frequently rely on a single referee to provide a rigorous check of the work, plus opinions from others on the relative importance of the work;
- data sets and other supplemental materials are rare in pure mathematics and the paper stands on its own – this means there is no easy way to cheat in terms of the result presented, apart from direct plagiarism;
- applied mathematics may include data and other supplemental material, but the data sets are commonly available and it is not a part of the culture to refuse to give background data; applied mathematics is distinct from applications of mathematics – both are valid but the relevance of the work is judged on different criteria.

On the arXiv:

Mathematicians recognize the value of having free access to pre-refereed material and the presence of a preprint on the arXiv (http://arxiv.org/) already fulfils most of the requirements laid out by the green open access lobby. In view of the long referee times, posting a paper on the arXiv first establishes primacy of the result in the few cases where this is important to mathematicians. Publishers have learned that they cannot put the genies back in the bottles and that much of 'their' content is already freely available. Instead they work to promote the final published version as the 'version of record' and distinguish that from the arXiv version. Nowadays publishers encourage authors to post the early versions up to and including the final accepted version with a piece of acknowledgement 'to be published in the Journal of X'. However many authors fail to keep the record updated and there are problems with referencing an arXiv preprint. This keeps the publishers happy that they still have something of value in hosting and selling the final published version in return for the costs of editing and dissemination.

For some sampled mathematics journals, as many as half the published papers have preprint versions posted on the arXiv and the percentage is growing. This makes the arXiv by far the dominant preprint repository and it is the first place many mathematicians in certain areas of the discipline look for new research. It is supported by the many thousands who choose to post their preprints there; no university or publisher forces them to do this. As a result there is very little enthusiasm in the mathematics community for alternative institutional repositories which are viewed as self-aggrandising university projects. The prior assertion of copyright ownership made by some universities in order to deposit articles in their own repositories has the effect of removing the right of the author to decide where they wish their work to be published. In contrast, the arXiv is widely and increasingly used; it is fully international and the barriers to posting an initial preprint are very low.

A problem is that there is no long term economic model for paying for the arXiv beyond the recent plea to major universities to support it through donations. We believe that there is an urgent need for the mathematics community to come up with a truly international solution during the next few years and it is hoped that researchers from other subject areas, most notably the theoretical physicists, are also looking for a solution. The arXiv may need a fully

capitalized perpetual fund to be set up; the IMU might consider what it can do to facilitate further discussion.

On the archive:
The switch to online versions as the primary source of mathematics journals has led to an interesting dilemma. Libraries would like to be the permanent repositories of the mathematical literature but have already begun to reduce their paper archives while not taking on the direct hosting of the journals they buy. The publishers are now responsible for archiving and upgrading the online versions in line with demand for more functionality. The question is what happens if the publisher folds? In the past the literature was scattered across many libraries. Nowadays publishers sign up to archiving services like CLOCKSS but this doesn't meet the desire for upgrades, and storing out-of-date formats has little value. This is particularly important in mathematics where the rendering of mathematical symbols and formulas remains an issue. The recent development of MathJax is likely to help but may herald another change in format that will require publishers to charge for future developments. Libraries may need to review their long-term archiving policies.

Open access, green and gold:[2]
Mathematicians do not like the 'gold' open access model although Research Councils around the world are considering whether to fund mandated open access. There was general consensus that this model discriminates against unfunded authors, including retired authors and those from developing countries. The question was raised whether mathematicians should become involved in the judgement of 'who pays' for those papers where the author has no funding. It would be one more burden on mathematicians to identify the deserving needy but if they are not involved the publishers will make their own choices. If the NSF decides to fund a government-mandated open access policy, the money will go to those publishers who have set up charges for optional open access. For 'gold' open access, there is no embargo period and once the NSF has paid the fee, the article is immediately freely available online.

Evidence from the Annals experiment in 'green' open access was stark; libraries cancelled 34% of the subscriptions between 2003 and 2008 when the journal was freely available online. The Annals is one of the very best journals in mathematics and one of the cheapest journals; and so it came as a surprise to many at the workshop to hear that some of the best-funded libraries in the US had decided to save on the subscription rather than support the experiment in widening access.

On embargo periods: We did not hear anyone at the workshop support the principle of 'green' open access after a short embargo like the NIH model – a 12 month embargo period (i.e. a manuscript must be deposited by an author in a public access repository within 12 months of publication). Many mathematicians voluntarily post their preprints in the arXiv and this could answer the demand, if there is any, for public access. The window between a preprint being freely available on the arXiv, then again being freely available in published form just twelve months later is generally held to be too small given the long life of articles and the slow pace of publication in mathematics. The fear is that libraries will do as they did with the Annals, and cancel the journal subscriptions and have their readers look at the preprint version for an extra 12 months. With no subscription income and no 'gold' open

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[2] 'green' is free open access where nobody has paid but the article is made freely available; 'gold' is where someone, nominally the author but usually the research funder, pays to have the paper made freely available.

access fees, many journals will not survive. However there was appreciable support for mandating green open access after a period that is more appropriate to mathematics, say after five years. This was mirrored by proposals from French and German mathematicians for making the archives of all journals freely available after five years. Should mathematicians be forced to choose a model for publicly funded future research, we think it likely that they would see five years as the best alternative even if it were at the expense of the closure of the very few 'reverse' moving wall experiments, such as those operated by the London Mathematical Society.

Other matters: Plagiarism, impact factors

There was strong criticism of the misuse of journal impact factors to evaluate individual papers but concern was raised that it may not be possible for the IMU to provide any useful alternative index. Other concerns about the use of such metrics for quantifying journal quality have been well documented.

There was also a discussion on the apparent increase in plagiarism and in multiple submissions (where an author submits a paper to more than one journal simultaneously), along with the global rise in the number of mathematics papers being written. It was agreed that there is a need for societies/publishers to maintain standards. Tools such as CrossCheck have helped combat egregious cases, but these place an additional burden on staff and editorial boards. The arXiv is used by some Editors when checking complaints and there was a discussion on whether its use could be extended to provide a more formal registration of papers.

Conclusions

The mathematics research community values its own standards of rigorous peer review, which they call refereeing, and the longevity of its journals. They want access to the old material and the certainty that it be maintained and remain accessible regardless of the medium. Mathematicians are wary of attempts to change scholarly publishing from a non-scientific political world that does not understand the value and nature of the mathematical literature.

Many people would like to change the funding model for mathematics journals, arguing that they wish to provide public access to publicly funded knowledge. The arXiv already provides public access but it suffers from having no long-term funding mechanism; we believe the most benefit to the community would come from addressing this problem and providing a permanent solution.

There is an argument for letting mathematicians decide what they want to support voluntarily rather than forcing new business models into the market. We should certainly encourage new experimental models, some of which have been very successful. Even those that are no longer free have helped put pressure to keep the price of journals down. Through allowing mathematicians to decide which model they want to support voluntarily, one can discover sustainable long term solutions. There may need to be some fail-safe mechanism to ensure that the past volumes of failed experimental journals are not lost to the literature.

The mathematics community has long argued against the high price of certain journals and would be happy to see a change in the funding model that reduces those profits that are not fed back into the research economy. As a result, the community is not closed to the idea of freeing up access, but it recognizes that any new model should not risk the long-term future of scholarly mathematics journals by imposing dangerously short mandated embargo periods. What the US government decides to do will affect the world-wide mathematics community. It

is hoped that the US government does not force a model on its own researchers that may restrict the choice of where to submit a paper. There should also be a clear division between funding research and being involved in evaluating the output of the research once funded. Paying for publication may influence the reader's judgement of the value of the research. In general, we see such schemes as unfair and a barrier to new research from unfunded mathematicians. If mandated open access were to be funded, there would be a case for no embargo period. Many publishers have already set up optional paid open access schemes to accommodate research funders who may impose a mandate. It is to be hoped that 'green' open access would not be imposed that mandates open access twelve months after publication; five years is considered a more appropriate period for mathematics.

Disclaimer
We have written the conclusions in the knowledge that it will never be possible to find a perfect list and certainly not all the workshop participants would support these views which are our own. However, we believe it important to assert the unique value of peer-review in mathematics journals and to describe what is necessary to support a healthy structure in which the very best of mathematical research can be distinguished while maintaining the breadth of mathematics journals. The many diverse journals in the mathematical sciences provide a platform for worthy research which has real value. We hope that this report may be used in future debates as fuel for the phrase 'one size does not fit all'.

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Reports of workshop talks in order of presentation

Expanding Public Access to Research Results:
Finding a Common Path Forward

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The often too-strident, too-ideological debate over whether and how to increase public access to research results was preceded by an equally acrimonious debate over "the serials crisis," the explosive growth in the number and cost of scholarly journals and its consequences for research library acquisitions. Much of that growth reflected the increased volume of research domestically and especially internationally, surely a desirable and beneficial development. But that growth put serious strains on research library budgets, and the considerable evidence of increases in journal prices that seemed to dwarf publication costs generated a very negative reaction from university librarians and administrators.

According to data collected by the Association of Research Libraries (ARL), from 1986 through 2004, serials expenditures at ARL libraries increased 273% and serials unit cost increased 188%, although serials purchased increase only 42%. Over that same period, the U.S. consumer price index increased 73%. The impact on books was severe: while monograph expenditures increased 63% and monograph unit cost increased 77%, monographs purchased decreased 9%. These and related cost/price data led to a widely held view that universities were a captive market: research universities would need to acquire scholarly journals irrespective of price, and journal pricing policies increasingly seemed to reflect a recognition of that fact. The disparity between cost and price was particularly pronounced in the journals of certain commercial publishers, but the widespread practice of non-profit academic and professional society publishers charging prices in excess of cost to generate revenue to support their societies led many university provosts to question why research library budgets should be expected to bear a substantial portion of the cost of society operations.

With the rise of digital communications capacity, the debate shifted from the price of journals to new forms of digital publishing that would reduce the cost of publishing and enhance access and use. Though often used interchangeably, it is useful to distinguish the terms "open access" and "public access": under open access publishing, the costs of publishing are covered at the front end so that the final product has been fully paid for and can be made freely available immediately; public access refers to policies under which subscription journals are made freely available after some cost-recovery embargo period.

In the U.S., an intense debate about publishing policies has centered around whether and to what degree federal research funding agencies should mandate free public access to the results of research they fund. The warring factions have rallied behind competing legislation. Library and public interest groups and many college and university administrators support the Federal Research Public Access Act, which would mandate free public access to results of federally funded research no more than 6 months after research published in peer-reviewed journal. The Association of American Publishers (AAP) and many publishers support the Fair Copyright in Research Works Act, which would prohibit any federal agency from requiring, as a condition of research funding, the transfer to the agency of articles resulting from that funding; if enacted into law, this legislation would make NIH's PubMed Central unlawful.

As a frequent recipient of entreaties by advocates of the competing legislation, Congressman Bart Gordon (D-TN), Chairman of the Science and Technology Committee of the U.S. House

of Representatives, created the Scholarly Publishing Roundtable in June, 2009, with a charge to develop consensus policies for expanding public access to journal articles arising from federally funded research. The 14-member group included university administrators, librarians, commercial and non-profit publishers, and researchers with expertise in scholarly publishing. The group worked over the course of the year, producing a report in January of 2010. The report is available [here].

The report states a set of shared principles — properties of scholarly publishing that the group believed should inhere in all evolving forms. These include peer review, adaptable business models, increased accessibility with improved functionality, sustained archiving and preservation, and creative reuse of published research and interoperability among sites hosting that research.

The report's core recommendation is: Each federal research funding agency should expeditiously but carefully develop and implement an explicit public access policy that brings about free public access to the results of the research that it funds as soon as possible after those results have been published in a peer-reviewed journal.

The report includes a number of additional recommendations concerning federal agencies working in full and open consultation with all stakeholders in developing their public access policies, agencies establishing specific embargo periods between publication and public access, the need to foster interoperability, using to the extent possible the version of record as the version to which free access is provided, agencies working outside their statutory domains as voluntary collaborators with non-governmental stakeholders, promoting innovation in the research and educational use of scholarly publications, addressing the challenges of long-term digital preservation, and creating a public access advisory committee to facilitate communication between research funding agencies and external stakeholders.

Twelve of the 14 members of the Roundtable fully endorsed the report's recommendations. One publisher believed that the recommendations called for too much government intervention; another publisher believed that they didn't call for enough government intervention. The Association of American Publishers opposed key recommendations of the report, primarily based on concerns about unfunded public access policies threatening the viability of scholarly publishing. Among library groups, ARL took no formal position but expressed disappointment in the lack of endorsement of the Federal Research Public Access Act, while the Association of Academic Health Sciences Libraries supported the report and its recommendations.

The House Science and Technology Committee, which had convened the Scholarly Publishing Roundtable, was complimentary of the report, its favorable response made tangible in subsequent legislation introduced by that Committee to reauthorize the America COMPETES Act. The legislation, which was enacted into law last fall, creates an Interagency Public Access Committee effectively implements a number of the report's recommendations, including coordinating the development of standards for research data and reports to achieve interoperability across Federal science agencies and science and engineering disciplines; coordinating Federal agency programs that support research and education to ensure preservation and stewardship of digital research data, including scholarly publications; working with international counterparts to maximize interoperability between US and international research databases and repositories; soliciting input from, and collaborating with, non-governmental stakeholders; and establishing priorities for coordinating the development of Federal science agency public access policies to maximize uniformity of those policies as they affect the science and engineering enterprise and their stakeholders.

A number of non-governmental initiatives have been undertaken to facilitate access to and management of scholarly publishing materials. One such initiative is CrossRef, non-profit, independent organization of over 700 member publishers and 1500 library affiliate members, which increases interoperability through a journal-reference linking service providing access to article metadata through a unique article Digital Object Identifier (DOI) (www.crossref.org). CrossRef has recently begun a new service, CossMark, to certify published articles' Version of Record.

Orcid – the Open Researcher & Contributor ID is a project designed to create a central registry of unique identifiers for individual researchers and an open, transparent linking mechanism with other current author ID schemes (www.orcid.org).

In the U.S., selected members of the Scholarly Publishing Roundtable are continuing to work with government officials and non-governmental stakeholders to advance the Roundtable's long-range vision of creating a functionally interconnected global network of repositories supporting full-text interoperability – using Version of Record to the extent possible. Achieving this goal will require sustained coordination and collaboration of all governmental and non-governmental stakeholders, working within and across countries in a spirit of compromise in pursuit of common purpose for the benefit of scholarship and the broader public good.

The work of IMU and CEIC on journals and related issues

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In 2002 (with a revision in 2004, see here) the Committee for Electronic Information and Communication (CEIC) of the International Mathematical Union (IMU) issued a Best current practices document for mathematicians, librarians and publishers. This contained recommendations on documents (structure, links and versions), personal home pages and collected works (in particular advocating that mathematicians should put on their home pages copies of all their scientific papers, if necessary scanned), archiving, copyright (see also here) and (eventual free) access. In the document Digital Mathematics Library, IMU reinforced its views on access in the context of a vision of a distributed library of digitized past literature, including a moving wall (e.g. 5 years) after which material would be made freely available. On the one hand, the moving wall model proved over-idealistic in view of the value to publishers of selling access to back-runs (though at the meeting it seemed to have wide support). On the other hand there are a number of excellent projects (Project Euclid, Numdam, AMS …) which have made a significant proportion of older material freely available, listed in registries (such as those of Ulf Rehmann http://www.mathematik.uni-bielefeld.de/~rehmann/DML/dml_links.html and the AMS http://www.ams.org/dmr/). A splendid recent example is the retrodigitization of all the ICM Proceedings, thanks to the fine work of Keith Dennis and Ulf Rehmann. CEIC also produced in 2006 a Best Practice Document on retrodigitization which is useful for those (for example, mathematical societies) embarking on retrodigitization projects.

In 2010 IMU returned to the topic of mathematics journals, issuing a new Best Current Practices for Journals document that was approved by the 2010 IMU General Assembly in Hyderabad. The document was written by CEIC together with Doug Arnold, and benefitted from comments by many stakeholders to whom a draft was circulated. It is available at http://www.mathunion.org/fileadmin/CEIC/bestpractice/bpfinal.pdf and was reprinted in the

January 2011 Notices of the AMS.   The document describes the value added by good journals in terms of quality control, improving content and presentation, dissemination and archiving, and takes as guiding principles for the running of good journals:

Transparency: all the journal's stakeholders – readers, authors, referees, editors, publishers, etc. should be fully aware of the decision processes that affect them,

Integrity of the publication process: including maintaining an objective review process focused on scientific quality, proper acknowledgment of sources, and a respect for confidentiality where required, and

Professionalism: including timely handling of manuscripts at each stage of the process, and continuity of management, scope, and vision as they evolve.

The document expresses concern about the trend of referees communicating additional opinions to editors which are not meant for transmission to authors, since the principle of transparency implies that authors should be fully informed of the grounds for the decision on their work. Following the same principle, in general authors should receive complete referee reports, although there may be exceptional circumstances when an editor can reasonably decide to exclude part of a report, for example if it contains libellous or insulting remarks, or certain kinds of sensitive information. Editorial discretion should not used to suppress inconvenient comments, such as a recommendation to accept the paper when the editor's decision is to reject it.

The document also draws attention to the ethical problems involved with alternative modes of financing the publication process, such as through author fees, submission fees, page charges, or combinations of these.   First, the opportunity to publish in a peer-reviewed venue should be available to all, subject to scientific merit, not the ability to pay via research grants, institutional support or other means. Second, payment in direct return for publication creates a potential conflict of interest with the peer-review process.

In 2008 IMU published jointly with ICIAM and IMS an influential report on Citation Statistics (http://www.mathunion.org/fileadmin/IMU/Report/CitationStatistics.pdf) which drew attention to the dangers of uncritical use of impact factors, the h-index and similar measures, and to the different reasons why work is cited. (Unfortunately the uncritical use of the h-index in promotion exercises, and the imprimatur given to impact factors as a good measure of journal quality through its use by some learned societies in advertising their journals, suggests that the report has not been influential enough!)

The Citation Statistics report was followed up in the ICM 2010 Round Table on The Use of Metrics in Evaluating Research and Research. A video of the Round Table is available at http://www.icm2010.org.in/ and a written summary is available and will appear in the ICM Proceedings. The prevalence of the impact factor as a measure of journal quality, and the issues surrounding impact factor manipulation (see Nefarious Numbers, Douglas N. Arnold and Kristine K. Fowler, http://www.ams.org/notices/201103/rtx110300434p.pdf) has led Doug Arnold to suggest that IMU and ICIAM might construct their own ranking of journals. This and other issues, such as a suggestion by Stefan Müller of overlay journals attached to the ArXiv, are currently being considered by a joint IMU/ICIAM Working Group on Journal Ranking and Pricing, which will report soon.

Policy Makers and Open Access

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Acts under discussion in the US:

Federal Research and Public Access Act (H.R. 5037, S. 1373). First introduced in 2006 and then again in 2009, H.R. 5037 introduced in 2010, and

H.R. 801 Fair Copyright in Research Works Act. Introduced in 2008, 2009.
As of February 2011, these acts have not passed.

Federal Research and Public Access Act

Applies to Federal agencies with extramural research expenditures of over $100,000,000.

Requires a Federal research public access policy no later than 1 year after passage of bill.

Applies to any research supported in whole or in part by Federal government.

Submission of final published version of peer-reviewed manuscript.

Free online access not later than 6 months after publication appears in peer-reviewed Journal.

In June 2009, U.S. House of Representatives Committee on Science and Technology in coordination with OSTP convened a Scholarly Publishing Roundtable to examine the current state of scholarly publishing and develop consensus recommendations for expanding public access to the journal articles arising from research funded by agencies of the United States government.

In December 2009 Office of Science and Technology Policy solicited comments on open access. To date the Administration has not had a response to the collected comments.

America COMPETES Section 123. Interagency Public Access Committee

(a) The Director (of OSTP) shall establish a working group under the National Science and Technology Council with the responsibility to coordinate Federal science agency research and policies related to the dissemination and long-term stewardship of the results of unclassified research, including digital data and peer-reviewed scholarly publications, supported wholly, or in part, by funding from the Federal science agencies.

(b) The working group shall

(1) identify the specific objectives and public interests that need to be addressed by any policies coordinated under (a);

(2) take into account inherent variability among Federal science agencies and scientific disciplines in the nature of research, types of data, and dissemination models;

(3)coordinate the development or designation of standards forresearch data, the structure of full text and metadata, navigation tools, and other applications to maximize the interoperability across Federal science agencies, across science and engineering disciplines, and between research data and scholarly publications, taking into account existing consensus standards, including international standards;

(4) coordinate Federal science agency programs and activities that support research and education on tools and systems required to ensure preservation and stewardship of all forms of digital research data, including scholarly publications;

(5) work with international science and technology counterparts to maximize interoperability between United States based unclassified research databases and international databases and repositories;

(6) solicit input and recommendations from, and collaborate with, non-Federal stakeholders, including the public, universities, non-profit and for-profit publishers, libraries, federally funded and non-federally funded research scientists, and other

organizations and institutions with a stake in long term preservation and access to the results of federally funded research;

(7) establish priorities for coordinating the development of any Federal science agency policies related to public access to the results of federally funded research to maximize the benefits of such policies with respect to their potential economic or other impact on the science and engineering enterprise and the stakeholders thereof;

(8) take into consideration the distinction between scholarly publications and digital data;

(9) take into consideration the role that scientific publishers play in the peer review process in ensuring the integrity of the record of scientific research, including the investments and added value that they make; and

(10) examine Federal agency practices and procedures for providing research reports to the agencies charged with locating and preserving unclassified research.

(c) Report to Congress not later than 1 year after date of enactment of Act, the Director (of OSTP) shall transmit a report to Congress describing

(1) specific objectives and public interest indentified under (b)(1);

(2) any priorities established under subsection (b)(7);

(3) the impact the policies described under (a) have had on the science and engineering enterprise and the stakeholders, including the financial impact on research budgets;

(4) the status of any Federal science agency policies related to public access to the results of federally funded research; and

(5) how any policies developed or being developed in subsection (a), incorporate input from the non-Federal stakeholders described in subsection (b)(6).

National Science Board's Task Force on Data Access will also consider open access of research.
National Science Foundation developing internal committee on open access.
Publishers are beginning to think about or are participating in public access initiatives including Patient Access, Public Library Access, Journalist Access, Rental Access and Data Access

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The role of publications in mathematics research:
a systemic approach

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In my opinion, the question of the future of mathematical journals requires a systemic approach, as it is typically a question in which secondary effects can be, in the long run, of the same size as primary effects.

To take a broader view one has to come back to the true function journals occupy in the work of mathematicians, and this has to be done while taking account of the very big changes that have affected the availability of documents and the communication between people in the last 20 years.

Mathematics
Let us start with the discipline itself, as it has to remain the heart of the matter. Mathematics is a body of knowledge about elaborate concepts based on facts proved and its use at interfaces of the discipline.

As a result, the discipline advances through the creation of new concepts and methods leading to the establishment of new facts proved in articles giving explicit proofs, hence the need to get such documents to circulate.

A side issue that may turn out to have a great impact in the near future: documents bringing appropriate information to people involved in interfaces may be of a rather different nature. So far such documents have not been given a lot of attention by mathematicians, although they probably deserve it, especially at a time where domains of interaction are widening considerably and potential users come from many different horizons.

For a very long time, the standard way used by mathematicians to reach out has been by teaching students of other scientific disciplines and engineering. It is a fact that, in mathematics maybe more than in other fields, teaching, basic and advanced, has close relations with research.

This led mathematicians to develop a usage of mathematical journals that is, in many respects, specific to them. Journals are supported by the community in the sense that submitting articles to journals is free, and referees evaluate articles also for free, and this work is sometimes extremely time consuming as it requires a thorough check. Also, because of the long term value of articles, since they do contain the end product of mathematical research, mathematicians care about the long term accessibility to the mathematical literature. This leads me to talk about mathematicians themselves.

Mathematicians
Functions that mathematicians assume in connection with the problem we are dealing with are: the production of new mathematics; the teaching of mathematics; the dissemination of mathematical results through lectures and articles; the evaluation of mathematicians through their activities and their papers.

They do so as members of mathematical communities, but also as members of the academic community at large, a position that they do not always assume with enough tolerance, perhaps not always taking enough time to explain the specificities of the discipline that have built up over centuries.

In recent years all over the world, like many other members of the academic community, they have been under pressure because of the squeeze of free time, the increasing role of funding coming through projects, as well as the pressure to publish since their performance was more and more rated on the basis of bibliographic data. The overall acceleration of exchanges that accompanied the generalisation of new technological tools also contributed to increase the pressure.

Mathematical Journals
First of all, one must keep in mind that there is a huge diversity among journals, and this diversity is fundamentally healthy, even if some of the journals can disappear without affecting the overall functioning of the community. Nevertheless, it is certainly an illusion to believe that the community can still function soundly from a scientific point of view while keeping only 10 to 20 % of the presently existing mathematical journals.

The function of mathematical journals is indeed manifold:
      of course their main function is to disseminate knowledge;
      yet, as access to mathematical results over a long period of time is critical for the development of research (because of the permanence of the information contained), they must keep knowledge easily available on a long term basis;

an other obvious function is to check the accuracy of results and the quality of their presentation, but a secondary one, directly connected to it, is the pressure that the submission to a journal exerts on authors because they know one or several anonymous readers will formulate comments and in the end judge the article submitted to them as referee;

not to be forgotten also, some journals help communities develop, either at a regional, national or thematic level.

The production of mathematical journals involves several stakeholders, and each one of them is legitimate:

publishing houses, both academic and commercial, are enterprises that need to find an economic model making the product viable;

mathematicians are involved in many functions, as authors, as referees and as editors; the last two functions have been for some time under stress as it is more and more difficult to convince the right colleagues to contribute in this way;

professional evaluators have focused their attention on journals to try and establish a new discipline, bibliometrics; the principle on which it is based is that statistical data collected over a certain period of time can give important information on the performance of a researcher; my view is that many elements in this principle can be challenged.

It is obvious that new technological developments have led to major changes in the business models of journals, the rapid generalisation of electronic access and also of hyperlinking between articles bringing the possibility of new services and also of new ways to use the resource. The question of "open access", now a major issue up for discussion, challenges the economical models that emerged in this transitional period.

My Main Concern: the Threat on Content
The need to consider the question of the future from a systemic point of view comes for me mainly from the fact that we are presently facing a threat on the content of mathematical research. Why is that so?

First, mathematicians can devote less and less time to content:

the pressure to publish quickly is building up;

a lot of time is traditionally dedicated to evaluating the content of articles is taken away by the demand for evaluating projects, structures, career development, etc; in the last twenty years, these demands have grown considerably at the expense of reading genuine articles.

Second, the worldwide generalisation of research management schemes has had a uniformising effect, specificities of disciplines being almost fully erased. This is especially adverse to mathematical research, whose final product is indeed contained in published articles, i.e. in mathematical journals, with very little obsolescence and a potential broad impact. It is a fact that mathematics has kept its unity, while undergoing a constant reorganisation of its internal subdisciplinary structure with the result of creating new opportunities of relevance and contact between subareas.

Another aspect of the threat on content comes from the mathematical community itself: in the constrained environment described above, more and more published articles tend to be "almost" correct in the sense that the happy few, i.e. the true experts in the field, can determine how some proofs (or some statements) have to be modified (most often slightly) to make complete sense, and to achieve what they promise.

The existence of "grey areas" in publications poses a real threat to the development of the mathematical enterprise, since it may prevent newcomers, and I think typically of young mathematicians coming from communities that are being formed in emerging countries, from participating at the right level to the advancement of mathematics. This is both unfair and

unhealthy for the discipline. As responsible members of a scientific community, we should not tolerate that such a situation develops, and fight against this tendency with determination.

Conclusion
As you have read, I personally feel that the main functions of mathematical journals are still fully valid. The aspect "keeping the quality" may even be more critical than ever.

I want to warn against neglecting secondary effects of the recent evolution of management of research, and changes in the general economic model underlying mathematical journals on the production of new mathematics. The critical value of the content is being underestimated against other more fashionable and much less substantial concepts, such as speed, fashion and submission to outside imperatives.

With the recent invasive technological changes, the risk is to put too little attention on implicit dimensions of the functioning of the mathematical enterprise such as the true value of a new result, the universality of the potential impact, free thinking, ...

The Manifold Atlas Project: a model for future publishing?

Matthias Kreck
University of Bonn

I have addressed two topics. The first concerns the fact that mathematics is growing so fast that - even in a single subarea - nobody can follow what is going on. Thus in a way the problem is not too little information but too much. This problem is of course not completely new and has led to writing encyclopedias. I started a project which is a sort of encyclopedia but based on the internet and adjusted to its options. It is a sort of Wikipedia and called "Manifold Atlas" but there are some essential differences between the Manifold Atlas and Wikipedia. The first is that people cannot write anonymously, the second is that although as in Wikipedia articles can develop, if they reach a mature form, they are refereed. If the refereeing is positive this is a source which can be quoted in scientific papers. Accepted papers will be published in a journal of the Manifold Atlas called Bulletin of the Manifold Atlas (BoMA). At the same time the same article will go back to the Atlas and can develop further. An impressive editorial board of more than 40 topologists and geometrists agreed to work for the Atlas. Their duty is to look at pages from time to time and observe when they are mature.

Then they will ask the managing editor to contact the authors of a page and ask them whether they agree that the page is ready for refereeing. The Manifold Atlas is sponsored by the Hausdorff Center at the University of Bonn. The Center finances a Postdoc and gives some money for supporting a programmer. In the last one and a half years the platform of the Atlas was built up and is now essentially ready.

In August the funding of the Hausdorff Center ends but the Max Planck Institute for Mathematics in Bonn could be convinced to pay the Postdoc (Diarmuid Crowley) for another two years. The hope is that until then the Atlas is so successful that a long term financing can be achieved.

The second topic addresses the question how stable the journal system is. At the moment most mathematicians are happy with our journals, as far as peer reviewing is concerned. Accessibility is (at least for mathematicians working at a rich university) no problem. But it would be better if also the other mathematicians had this access and there are worries that the price of many journals is so high that even richer universities cannot afford them. How

dangerous is such a development for the mathematical publishing? To answer these questions I considered the following scenario: Suppose that the politicians worldwide cancel the budget for mathematical libraries as far as journals are concerned but give the mathematicians a considerable amount of money to built up a new system, suppose in addition that the politicians guarantee the existence of a server like Arxiv. Would this be a drama? My opinion is: not at all. We could keep our system essentially unchanged, meaning that all journals remain with their excellent editorial boards and high quality peer reviewing which also now is completely in the hands of mathematicians (as now some support for managing editors could be given from the central pot). The only difference would be that at the end of this process where now the managing editor sends a mail to the publisher containing the accepted paper, the managing editor would put the paper on the server where the different journals would have their separate home. So we would have: Annals of Mathematics, 3rd series (Arxiv), Inventiones, 2nd series (Arxiv), and so on.

Avenues for Mathematics Journals—on the road to 2025

Hans Koelsch,
Springer

Abstract: The talk bridges from the foundations of mathematics publishing at Springer to community-driven partnership, and new opportunities in 21st century publishing.

Contents: Mathematics and Springer, Community-Driven Partnership, New Opportunities

Summary: Mathematics has a long-standing tradition at Springer. Journal partnerships with and for the mathematics community stretch from journals such as Mathematische Annalen (founded in 1868) to newest developments like the Bulletin of Mathematical Sciences (2011) launched under the SpringerOpen umbrella as an Open Access journal.

The transition from classical print subscriptions to database licensing is nearly completed, allowing many more users to access many more journals than ever before in the history of journal dissemination.

Visibility of journals, findability of content, usage of articles, and their citations can be seen as a scientific-community driven spiral up to even better visibility, content exposure, more usage, and ever more citations, for the benefits of research.

Open Access has become a new way of content dissemination. While it plays rather a minor role in mathematics still and the funding remains unclear for many mathematicians, growth is seen both in the number of new journal titles published under this model and article submissions.

SpringerOpen journals publish under the Attribution license (cc by) which is the most accommodating license even allowing for commercial use and re-use of articles. In cooperation with BioMed Central's membership program more than 120 U.S. institutions including affiliated top-notch mathematics departments can benefit already from this new form of Open Access Publishing.

Most recent examples for SpringerOpen are The Journal of Mathematics in Industry published in partnership with the European Consortium for Mathematics in Industry, and the Bulletin of Mathematical Sciences in cooperation with the King Abdulaziz University, Jeddah, Saudi Arabia.

In addition, new ways of accessing knowledge are offered to the research community via SpringerImages or via RealTime allowing instant monitoring of journal usage. Apps for mobile devices will help researchers on the move to always be able to access content anywhere with a variety of devices.

"Do what you are doing now [and more!] but find a different economic model."

Jim Crowley
Executive Director, SIAM

This is the challenge that is posed to us: to find a different financial basis that will continue to ensure the long-long stability and vitality of scholarly publishing in mathematics without sacrificing quality and standards while broadening access. While this is taking place, the concept of a journal itself is evolving and such changes complicate any decision process to adopt a new model.

Like many scholarly societies, journal publications have been a central mission of SIAM from its origins in 1952. SIAM was established to advance the application of mathematics to engineering, industry, science, and society; o promote research that will lead to effective new mathematical and computational methods and techniques for science, engineering, industry, and society; to provide media for the exchange of information and ideas among mathematicians, engineers, and scientists. Scholarly journals are not just something we do; they are part of our raison d'etre.

Because a society exists to serve a discipline and those who work in that discipline, societies have a special charge for ensuring the high quality and integrity of research in their field. SIAM now has fifteen peer-reviewed journals, accounting for over 3,700 articles submitted per year; about 1,100 articles accepted in a typical year; and over 1,200 papers published (not including SIREV and TVP) in 2009 (with a total 27,559 pages).

This has become a global enterprise. In 2009 North America accounted for 38% of submissions to SIAM journals, while Western Europe accounted for 42%. East Asia (11%) and South America (2%) were relatively smaller, but are growing significantly.
And so scholarly societies like SIAM cannot take a US-centric view of journals and must look at any recommended changes in terms of the global situation.

What We Do Now
SIAM's approach to journals publishing has evolved carefully over the decades since its formation. Whereas volunteer editors handled much of the administrative work in the early days, SIAM has over time developed a professional staff whose goal it is to relieve editors of much of the administrative burden and to leave it to the editors to deal with the scientific issues.

SIAM staff work with the editors to assist with managing the peer review process. This includes providing the software for submission and review as well as tracking papers and assisting with reminders. SIAM does perform copyediting on all the papers that are published to ensure readability and standard formats. Bibliographies must be carefully checked to ensure that appropriate links to cited references can be made. These effort are performed by SIAM staff.

In addition, DOIs for electronic version of the articles are posted in CrossRef and files are prepared and sent to AIP for posting on the Scitation platform. A rather new step is that

articles are also run through CrossCheck to catch any obvious duplication; when any duplication is noted.

Journals Continue to Evolve
SIAM was early to have its journal online, starting in 1996. The nature, format and presentation of scholarly journals generally has been slow to evolve, but is certainly in the process of adapting to new capabilities. These changes will have an impact on mathematics journals, and even more so on journals in computational mathematics.

As journals evolve it is important to maintain high standards of scholarship, ensure a reliable record of research, and keep up the integrity of the scientific record.

As an example of new tools to help with checking against plagiarism is the CrossCheck software. It is an interesting example because it shows how a tool created to make it easy to check whether portions of a paper duplicate something previously published actually creates more work. Because running CrossCheck can be a time-consuming process, editors ask staff to do a preliminary screening and to alert them only when there appears to be problem. SIAM now performs CrossCheck on all submitted papers and again on final versions of accepted papers before publication.

More interesting than new tools are new modes of communication that go beyond the printed page (or its electronic correlate). We will see new kinds of content and new formats emerge. These will be driven by the desire for reproducible results and/or more exposition for the non-specialist and students who are only learning the field.

New types of content may include data, software/code, and multimedia (video output from simulations, for example). Other material, such as that from oral presentations, may be included to enhance the exposition. Discussions forums that allow commentary on accepted papers may be used in the future as well.

SIAM has been an early adapter of multimedia files to supplement journal articles (SIAM Journal on Dynamical Systems, an all-electronic journal, adopted this policy when it launched).

Experiments will test various ideas, and some will survive and become part of future journals. Standards will need to be developed, discipline by discipline, to decide what becomes part of the official record and what supplemental material is subject to peer review.

At the same time, the process the mathematical sciences have used for decades to produce journal articles – TeX to PDF – may change as well, motivated in part by the need to provide access to a wide variety of mobile platforms.

The point is that whatever financial model that is adopted must be sufficiently flexible to respond to such changes and the costs to implement them.

New Financial Models
So how do we change to a new financial model? And what model should we adopt?

I would argue that there is no simple, clear-cut choice, assuming that we wish to continue the functions of maintaining high quality and standards without placing greater administrative burden on the scientific community.

Consider first the subscription model – the one we are most accustomed to. In this model, libraries, in consultation with the users at their institution, are the one who make the purchasing decisions. Electronic access is free to users at the subscribing institution.

Subscription prices can vary widely and access is generally limited to those at subscribing institutions.
>>staff support, copyediting, etc.; society vs. commercial; factors affecting price.

Access under this model is not universal but there are mechanisms to extend access. Societies offer low-cost access to members. Various organizations are emerging to help provide access to developing countries. And some societies are experimenting with providing public access through public libraries.

It should also be noted that the arXiv, used by many as a pre-print server, also ensures that much of the literature is available in some form.

However, it is argued that subscription model limits access. Some feel that open access is needed to help advance science and to make results available to those who might not otherwise have access.

Open Access
Open access has several variants, including publication delays and author-pays models. The publication delay model poses some problems for the mathematical sciences. In this model, subscriptions are maintained but the literature is placed in open access after a period of delay. In the biomedical literature, a delay of six to twelve months might suffice to make the information available to the public in a short period of time but allow enough time that researchers will still seek access through subscriptions.

Because literature in the mathematical sciences remains vital for a long period of time (a long half-life), a short delay might be meaningless and render subscriptions worthless. This would mean that publishers would be unable to recover their costs.

Many feel that a delay of anything less than five years might pose problems for the subscription model.

Another variant of open access is the model where the author, rather the library, pays to have his/her published. This particular model might have had a better chance of success when pages charges were standard, but funding agencies eliminated paying publication costs under grants in the 1980s.

The author-pays model also has several variants. It has its challenges and problems as well. There is the issue of fairness. Will requiring fees from authors place certain authors or authors from certain countries at a disadvantage? This raises numerous global issues where some nations may play publication fees, and others may not.

There is another hidden, and perhaps more insidious risk. Less scrupulous publishers might encourage more papers to be accepted, even if of lower quality, in order to enhance revenue. It has been noted that on average (across all mathematicians in a sampled large research mathematics department) the number of papers per mathematician is not large. But highly published mathematicians can publish a substantial number of papers in a year. Even if they co-publish these with graduate students and/or postdocs they supervise, the researcher must find the funding to cover these publication costs under this model. Given that fees might be several thousand dollars per article, according to some estimates, the costs to the author could be substantial. This raises the question of the potential source of these funds.

Libraries now cover much, if not all of the publication costs, through subscription models (at least in the tradition subscription model). Several decades ago, these were complemented in part by (often voluntary) page pagers that authors paid from grants or from employers (especially in the case of companies). However, funding agencies in mathematics tended to

discontinue paying publication charges on grants over two decades ago. This is yet another area where mathematics may find differences with some other disciplines.

Third-Party (Government) Funding.
This is not quite a separate model, but is a significant factor in how other models might work. Assuming that the government accept the role of funding publications costs, there would be several questions that would arise. Who would set the costs and would these be uniform? If so, would granting agencies then determine what functions are performed on articles (such as copyediting and formatting)?

Another question would be how the funds for publications costs would flow. Would these go to author (through individual grants as did page charges), to the library, or directly to the publisher?

If the federal government did accept responsibility for paying publication costs, how would this affect funds currently allocated to research? And is there a risk that placing funding for publication costs under federal budgets might create another risk to scholarly publishing if future leaders decide to drastically reduce whatever budgets were originally established? Furthermore, how would actions by one federal government affect those of other nations?

Challenge.
There are a range of services provided by publishers and within that a range of costs. The community and the marketplace will decide which of these services are necessary or even desired. For example, we will continue to provide professional copyediting until such time as it is deemed that this is no longer needed or desired by our authors and editors.
Many publishers, large and small, will experiment with new technology, new tools, new formats, and new modes of delivery. These will continue to add costs in the short term.
In the meantime, publishers will experiment with new financial models as well. Those ideas that prove successful will be adopted by others.

Summary survey results as presented at the workshop

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In December 2010, I administered a survey of mathematicians' attitudes and behavior on selected publishing issues. Within a random sample of mathematicians worldwide, over 600 responded. The questions addressed journal publishing decision factors, Open Access, research dissemination via the internet, intellectual property, and collaboration technologies. The first three of these being most relevant to workshop discussion, the following highlights were reported:

When submitting research papers for publication in a journal, three factors were "very important" to over half the respondents: the journal's quality and reputation, its inclusion in literature indexes, and lack of author fees.

Other important factors included speed of publication, a large number of readers, and assurance of long-term availability.

Factors less frequently cited as important included access costs to readers or libraries, author rights policies, and existence of a print version.

A third (34%) report that they have published a paper in an Open Access journal (although some of these are mistaken, as a quarter of the titles specified are not in fact OA). The top 5 reasons for publishing in an OA journal are the same as for any journal publishing decision,

with lack of author fees rising somewhat in importance. Correspondingly, over two-thirds of the verifiable OA journals in which respondents have published have no author fees.

Many mathematicians remain unaware of the OA journal model and/or of OA journals in their field. Among objections to OA journals, there was significantly greater "unwillingness" than "inability" to pay author fees, and several comments indicated that author fees call into question the integrity of the editorial process. This concern could perhaps be addressed by the CEIC recommendation to "insulate peer review and editorial decision-making from monetary considerations."

Posting papers to a personal website remains prevalent: 81% do so at least occasionally. A smaller majority, 56%, have at least one paper in the arXiv (possibly deposited by a co-author), and 30% "regularly" post their own papers there. The top reasons for contributing to the arXiv include early dissemination, better availability of published or unpublished papers, and free reader access; nearly half of arXiv posters say it is "standard practice in the field." Among those who haven't contributed papers to the arXiv, there are few objections to it—they simply haven't found a sufficient reason to do so.

Two-thirds (65%) of respondents judge that mathematicians are more likely to make their research openly accessible, compared with other science researchers. They cite the lack of patentability or other immediate economic gain of mathematics results, as well as recognition that sharing furthers collaborative research. There appears to be a critical mass for open sharing within mathematics, both due to a general altruistic culture, and because effective sharing mechanisms are in place.

The full study is to be published in the summer of 2011, including a guest column in the Notices of the American Mathematical Society.

The View from a Learned Society:
Open Access and Complications for our Ideals of Advancing Mathematics

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The London Mathematical Society (LMS) was founded in 1865, and since then it is the leading learned society for mathematics in UK. We have a membership of about 2400, of whom 589 are based outside the UK, 209 are based in USA.

What do we stand for? (From our charter)
The advancement, dissemination and promotion of mathematics in the UK and worldwide. Our legal status is that of a charity. We are answerable to the UK Charity Commission, and on statutory matters to the Privy Council. Our principal source of income is the publication of mathematics.

Governance
The LMS is governed by a President and 20 Council members, including 2 Vice-Presidents, a General Secretary , a Treasurer and three other "Secretaries" responsible respectively for the Programmes, Education and Publication Committees). The Secretaries are elected every year by the membership and the other Council members for 2 years at a time. The President's term is restricted to 2 years.

Members of Council are Trustees of the LMS, with very serious legal responsibilities.

There is an LMS Publisher (currently Susan Hezlet) with a staff of 3. Professor John Jones is the Publications Secretary. All recommendations of the Publications Committee must be approved by Council. Both Susan and John regularly report to Council.

Financial matters are carefully monitored by Council. There is a publicly stated policy on the price of publications, with the intention of keeping the rate of price rises no higher than the rate of inflation, except when there is added content or value.

The LMS Publications Committee has a great deal of delegated responsibility, and its long meetings give time to take a long term view. Attention is paid to the balance of expertise, and Council is deeply involved throughout (a VP, and a Council representative, are members, and the Treasurer visits regularly). Many Editors and Editorial Advisers are involved and there are two external advisers from the publishing world. The Committee occasionally holds a Strategy Away Days which works well giving the chance for concentration on long term publishing policy.

The entire operation is about highly respected research mathematicians considering current proposals, and bringing to Council worked out ideas for future enterprises.

Publishing activity and profits
The scale of our publishing activity is second only to AMS and SIAM in not-for-profit mathematics publication. We have had journal submissions from at least 83 countries. Less than 20% of our published articles come from UK institutions, with about 20% coming from US institutions. There is some evidence (of uncertain reliability) that the US provides 24% of our readership, and UK about 8%.

We are not allowed simply to salt the profits away, and to the greatest extent possible we plough them back into supporting a wide range of mathematical activities. For example:
     1. Many rapid-response small grants (of considerable diversity).These are not, and cannot be according to our Charter, restricted to LMS members or particular sectors of mathematics. There is a particular need for this in UK, where not only is government funding being cut, but traditional, and provenly effective, responsive mode funding is being cut in favour of grandiose schemes ladling out large dollops of funding to the likes of "Mathematical Underpinnings of X";
     2. Provide grants for international collaborations, in many cases involving US mathematicians;
     3. Adhere to large organizations such as IMU and EMS;
     4. Support liaison with industrial mathematics, statistics and operations research, in the daunting task of improving both the quality and the quantity of UK government support for mathematical research;
     5. Support Women in Mathematics;
     6. Support young Russian mathematicians;
     7. Support groups of early career researchers, by funding their own conferences, and allowing them to develop a community spirit;
     8. Support mathematics in the developing world, by mentoring schemes, and collaboration with IMU , AMS and other organizations;
     9. Involvement in broader educational matters;
     10. Outreach activities, including Popular Lectures.

What can be the Impact of Open Access on the activities above?
The loss of very many subscriptions from US libraries would surely put an end to most of the charitable activities mentioned above. We fear the situation when US mandates Open Access after one year for all US-funded research (GreenOpenAccess), and library funds are diverted

to cover Open Access payments. Replacing "one" by "five" here could still jeopardize subscriptions. The thorough-going Gold Open Access, where every author is responsible for finding payment to cover Open Access for her/his article, seems to us unfair, for reasons explained shortly.

We are confident that if we could continue our current so-called reverse wall arrangement, in which access is entirely open for the first six months, and then followed by the regular subscription arrangements (and inexpensive pay-to-view arrangements), we would have a harmonious system, whereby we disseminate free to those researchers who need rapidly our latest publications, and are able to continue our traditional charitable activities, which, in our opinion, are good for mathematics in the world at large. We also subscribe to developing countries initiatives to enable people in those countries to access all of the journal volumes free of charge after the initial six month period.

We reluctantly introduced the current hybrid arrangements whereby an author may pay for a permanent open-access arrangement but this has hardly been used. In a period, likely to be of long duration, where funding dwindles in the UK, it is going to be hard, especially for senior retired mathematicians, to find funding to pay Open Access fees. We doubt that this problem is unique to UK among developed countries, and the threat to our colleagues in the developing world is even greater.

Dynamics of Mathematics Journals, 2000 to 2009

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The characteristics of mathematics journal articles have changed dramatically over the last decade. The data described herein encompass articles published by virtually all publishers worldwide as reflected in the data bases of Mathematical Reviews. A snapshot is also presented of the articles with publication year 2009 that were published in one of the four primary research journals of the American Mathematical Society.

Figure 1 below shows growth of at least 36% in the number of mathematics journal articles being published over the nine year interval from 2000 to 2009. The counts that are graphed show the number of "regular items" added to the Mathematical Reviews data base (MRDB)[3] by Publication Year of the journals. These are items that are judged by an Associate Editor at Mathematical Reviews to have mathematics content, they are classified according to their Mathematics Subject Classification code, they are processed for author and institution identification and they have complete bibliographic information reported. The counts include only journal articles and exclude papers in proceedings of conferences and edited book volumes.

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[3] The data were extracted from the MRDB on January 25, 2011. At that time, items were still being added for the most recent publication years, including 2009.
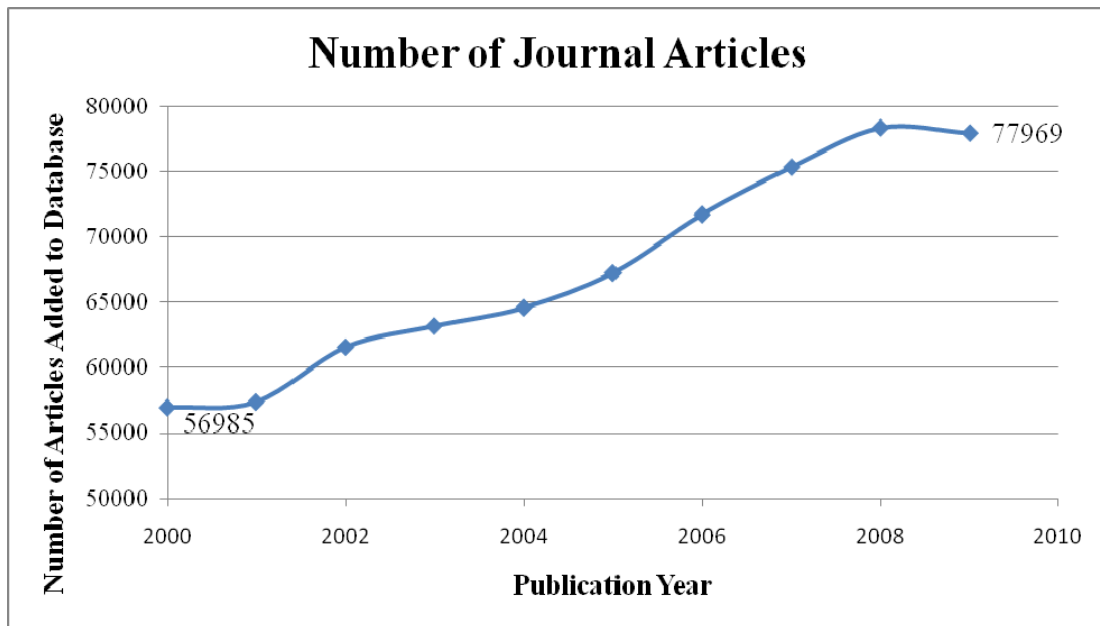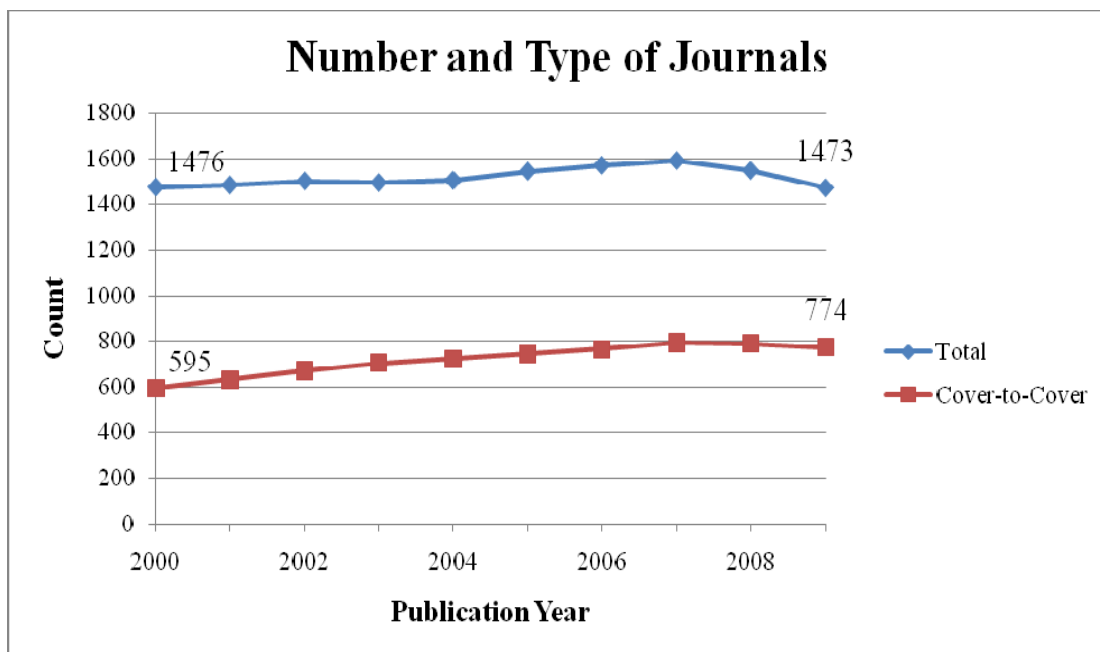
Figure 1

Figure 2

Figure 2 shows the number and type of journal in which these articles appeared. In particular, in 2009 the MRDB data, as of January 25, 2011, included items from 1473 journals of which 774 are so-called "cover-to-cover" journals. All of the articles in a cover-to-cover journal are mathematics articles. For example Annals of Mathematics is a cover-to-cover journal. If a journal is not a cover-to-cover journal, then it typically contains articles that do not have original mathematics content and such articles are not entered into the MRDB. 774 of the journals in 2009 were cover-to-cover and 699 were not.

A lot of the research mathematics literature appears in journals that cross disciplinary boundaries, Figure 3 below shows the proportions of articles for each publication year that appear in the two types of journals. The proportion in cover-to-cover journals is increasing

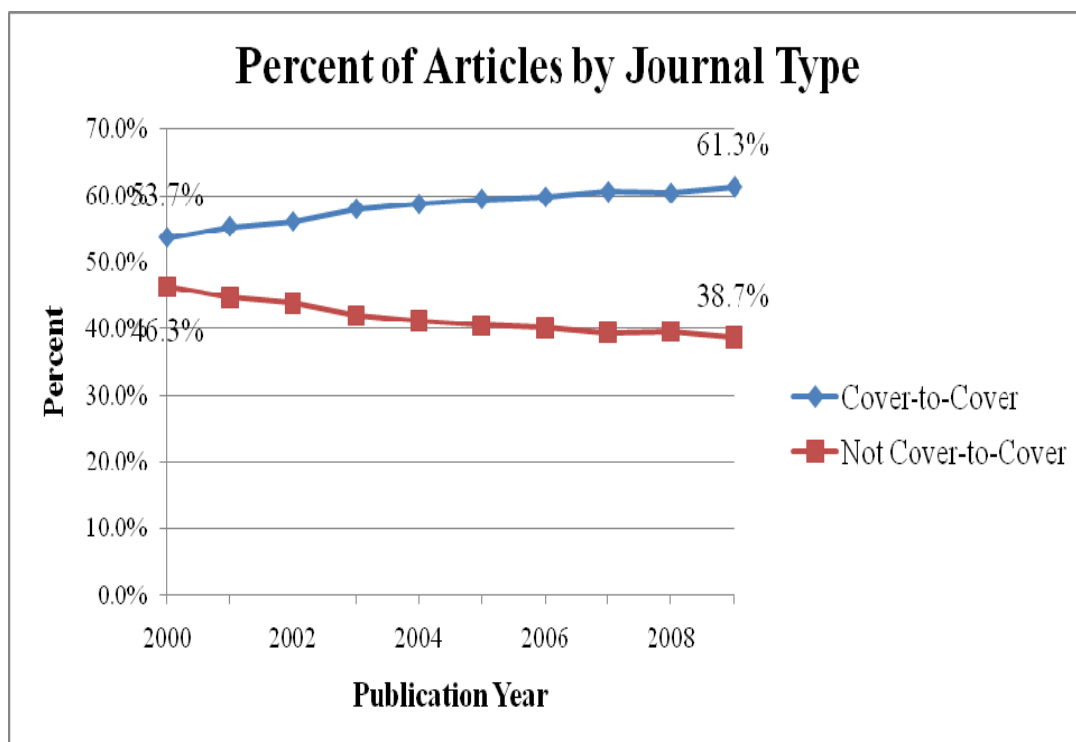slowly but steadily. Still, over 38% of the journal articles in 2009 were in cross disciplinary journals.

Figure 3

Table 1: Number of Journals by Country for Publication Year 2009

COUNTRY	NUMBER OF JOURNALS
United States	291
England	150
The Netherlands	141
Peoples Republic of China	110
Germany	90
Japan	71
India	68

Table 1 includes all countries that publish more than 50 of the journals reported herein in publication year 2009. The total number of journals published by these 7 countries is 921, or 62.5% of the 1473 journals in that publication year.

Figure 4 below reports information from the MRDB about market share of different categories of publishers. It is clear that the large commercial[4] publishers will have strong influence over the business models adopted in the future of scholarly publishing.

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[4] What is a "commercial" publisher? In the data extracted from the MRDB, a publisher was categorized as a commercial publisher if they have a ".com" domain name. The results of using this criterion were reviewed by the Mathematical Reviews acquisition librarian, who was impressed by the reliability of the results.
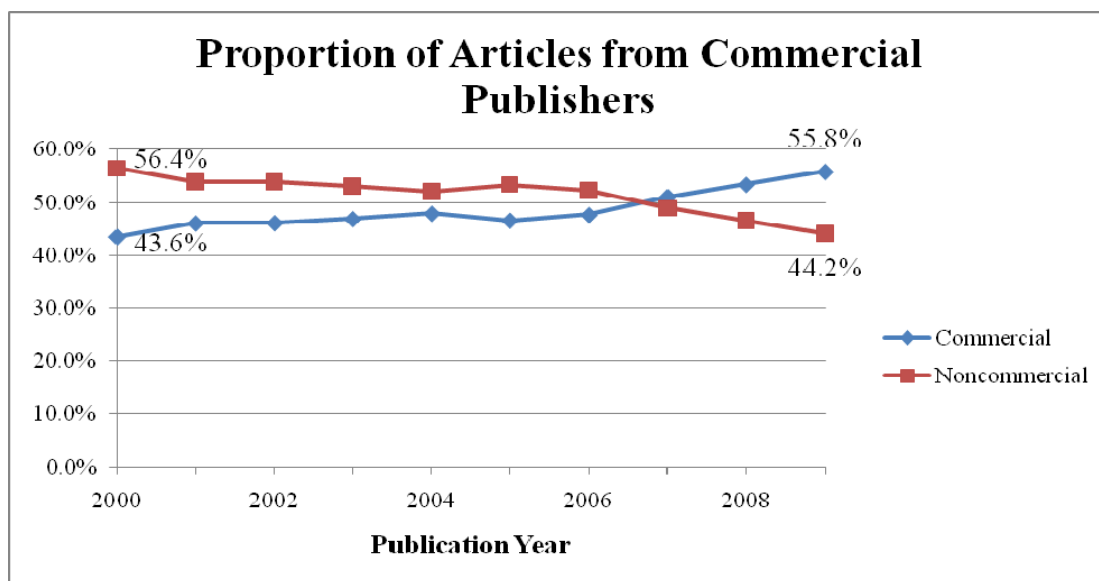
Figure 4

Table 2: Percentages of Articles With or Without Support by a U.S. Agency in Publication Year 2009

	JAMS[5]	TAMS	PAMS	MathComp
NSF Support	47.1%	18.3%	14.2%	12.4%
Other US Support	5.9%	1.5%	1.8%	4.1%
No US Federal Support	50.0%	81.0%	84.8%	84.3%

The AMS and other journal publishers are naturally interested in the impact on their journals of new public access requirements for federally funded research. Table 2 provides information about the patterns of research support for the four primary research journals published by the AMS. The data source and the journal acronyms are explained in the footnote to the table.

TAMS, PAMS and MathComp published a total of 882 articles in 2009, and JAMS published 34 articles. At first it is surprising to see the small percentage of articles in TAMS, PAMS and MathComp that have any U.S. Federal Agency research support. But the explanation lies in the small percentage of papers that have an author from the U.S. The data on Author Domicile are presented in Table 3 below.

Table 3: Author Domicile for Articles Published in 2006 – 2009. Data are from the AMSPDB.

	JAMS	TAMS	PAMS	MathComp
U.S.A.	55.9%	36.1%	31.0%	25.5%
Canada	3.9%	4.0%	4.2%	5.3%
Europe	28.3%	39.7%	35.7%	45.1%
Asia & Asia/Pacific	10.0%	16.4%	23.7%	21.0%
Other	1.9%	3.8%	5.4%	3.1%

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[5] The source of information for this table is the AMS Publication Data Base (AMSPDB). The data were extracted on February 2, 2011. JAMS = *Journal of the American Mathematical Society*. TAMS = *Transactions of the American Mathematical Society*. PAMS = *Proceedings of the American Mathematical Society*. MathComp = *Mathematics of Computation*.

For publication year 2009, only about 21% of the journal articles in the MRDB have at least one co-author from the U.S. Only a fraction of these have research support from a U.S. Federal Agency.
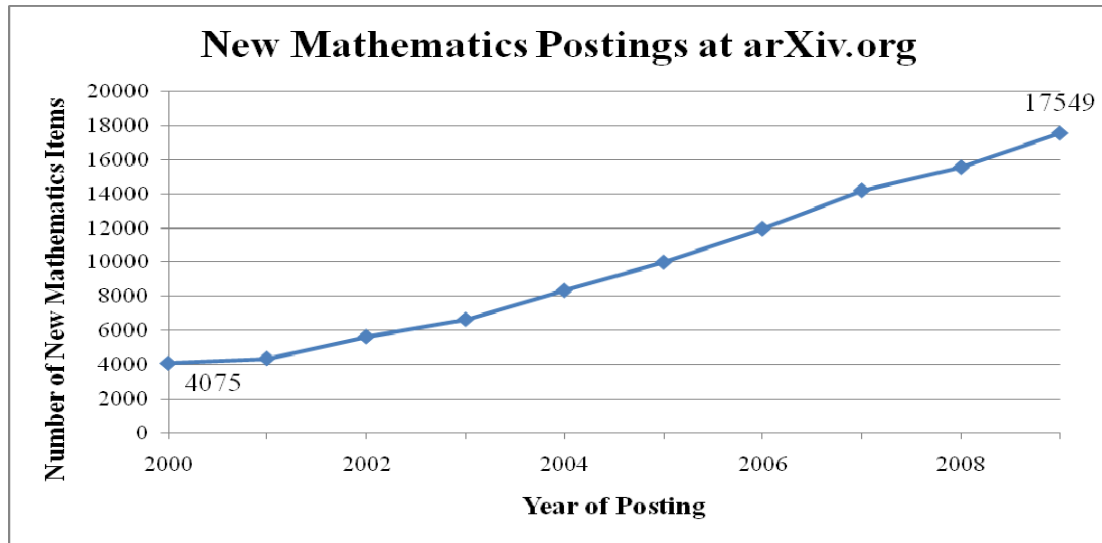

Figure 5

How much of the refereed, published mathematics literature is already freely available on the web? arXiv.org is a popular and highly valued resource among mathematicians for posting research manuscripts. Figure 5 shows how many mathematics manuscripts have been posted at arXiv.org over the years 2000 to 2009. The counts include so-called cross-listings, articles whose primary listing is in another part of the arXiv, but for which the submitter chooses to also list it in the mathematics section.

We can compare these counts to the number of mathematics articles published each year. But we should keep in mind that there is a time lag between posting a preprint to the arXiv and the time, if ever, that the article is published. Many articles posted to the arXiv are never published.

Table 4: Proportion of Published Articles with a Pre-publication Version Posted at arXiv.org
Publication Year 2009

	JAMS	TAMS	PAMS	MathComp
Number of articles	34	268	493	121
Percent with preprint at arXiv.org	70.6%	56.6%*[6]	27.0%*	23.5%*

Table 4 reports the percentages of articles published in JAMS, TAMS, PAMS and MathComp in 2009 have a preprint version posted at arXiv.org. The percentages vary with the character of the journal.

Figure 6 and Table 5 that follow show the longevity of the mathematics literature. Among the citations occurring in articles published in 2009, 20% were to articles published in 1984 or earlier and 50% were to articles published in 1998 or earlier. The source of these data is the MRDB.

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[6] The Percents reported for TAMS, PAMS and MathComp are statistical estimates for which the Standard Error is less than 5%. The source of the data is the AMSPDB.
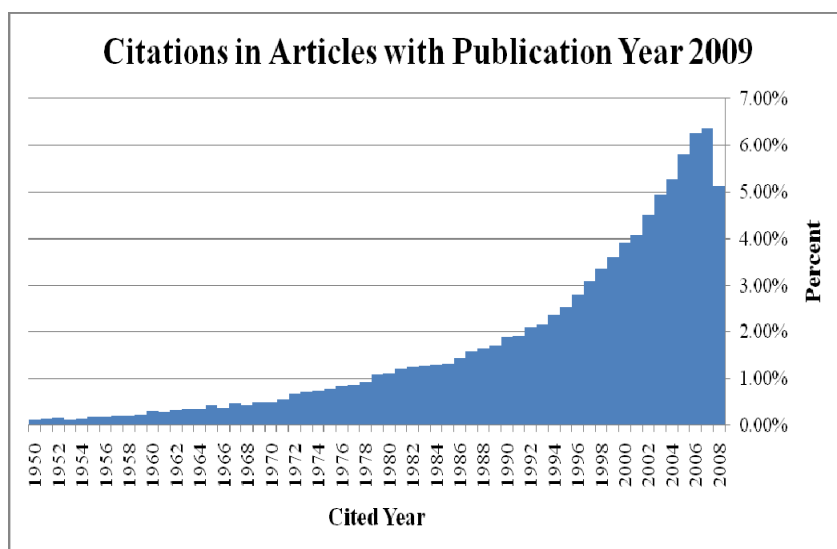
Citations in Articles with Publication Year 2009

Figure 6

Table 5

Quantile	Value for Citation Database
10%	1975
20%	1984
30%	1990
40%	1995
50%	1998
60%	2001
70%	2003
80%	2005
90%	2006

Access and Dissemination of Mathematics Journals:
A Commercial Publisher's Perspective (with some Asides on Peer Review)

David Clark,
Elsevier

What matters in scholarly publishing?
David's presentation focused on what we at Elsevier see as key to any discussion of journal publishing. In short:

Quality, which includes peer review but also extends to the efficient and transparent, the registration of research findings and the maintenance of ethic standards;

Preservation, to ensure usability in perpetuity, regardless of future technological changes;

Efficiency for authors, readers and funders;

Value and cost-effectiveness, ensuring both affordability and the avoidance, for instance, of currency shocks; and

Access, with the goal of achieving the maximum access achievable, including cutting across technological, linguistic and ability/disability barriers.

What are the current clear trends?
We identify the following as clear trends in the STM journals ecosystem:

the switch to digital is nearly complete;

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there's greater openness and sharing across the system, with more use of pre-print servers (the arXiv) and significant amounts of new use of existing material;

for Elsevier, that means most mathematics journals are accessible at more than 5,000 locations;

submissions continue to rise, but the quality of those submissions is more mixed than ever, putting pressure on the system;

agreements with Universities, for Elsevier at least, are increasingly driven by large licenses rather individual journal subscriptions with much weight given to usage; and

elements of the article are being aggregated to create new tools.

For publishers, this means that there are some things which have changed, such as the reduction in the physical printing and despatch of issues, while other things have expanded including :

the preservation of journals both in existing electronic platforms and in dark archives (it was interesting to note that some in the audience did not see this as part of a publishers role while my view is that it should really be everyone's role and that one sole provider cannot fully meet the need of preservation);

the increasing role of publishers in managing the technical running of peer review and involvement in checking and pre-screening with the introduction of tools such as cross check;

the inclusion of new forms of material including video, tabular data, smart and deep linking;

the maintenance of electronic services 24/7/365; and

on-line promotion, dissemination, deep linking and search engine optimisation.

Last, but not least, Elsevier and other publishers are confronting the challenge of ever increasing numbers of submissions from new authors in countries without the same traditions of journal publishing as in the traditionally active scientific countries, placing burdens on the existing pool of editors and referees, and challenging us all to recruit and prepare referees and editors from these emerging scientific nations. This is typified by China's World article share almost doubling between 2004 and 2008.

Access and dissemination
The electronic revolution has given the publishers the opportunity to reverse some of the trends of the 90s and to broaden access significantly. Consortia agreements have given libraries more ability to maximize holdings while electronic access involves more transparency about the level of use of journals.

The consequence is that access has improved greatly from the low point of the 1990s. Despite this, there are still gaps in access which all publishers are seeking to fill through programmes such as Hinari (biomedical and related social science), Agora (Access to Global Online Research in Agriculture) and Oare (Online Access to Research in the Environment) – Elsevier now provides access to more than 1,500 of its journals to public institutions in over 100 developing countries. Participating countries have increased research output by almost 200% over the last 5 years.

Open Access
Elsevier, like many publishers, have a range of Open Access options for authors and, over time, have adjusted our policies to reflect the needs and expectations of authors, keeping in mind the needs for sustaining the core values of scholarly publishing.

These have included enabling authors to chose to post their final manuscripts, incorporating changes made during the peer review process, to pre-print servers and the option of individually sponsored open access articles. The latter has not proven so relevant for mathematics.

Some journals, particularly in the life sciences, such as the Cell Press journal have delayed access open access which is possible in fields where most of the usage and citation happens in the early period after publication. Areas such as mathematics, with very long citation half-lives, could only be offered delayed access with longer delay periods.

The technological future
Technologically, there are many exciting options on the horizon including:
the increased role out of cross check and other technologies to identify duplicate submission and related issues early;
technologies to improve presentation of mathematics, such as Mathjax;
the improved ability to cite within the article, down to the proof or theorem;
interchange of article content with external applications and data sets;
search engines that can work with mathematical fonts;
the aggregates of journal articles becoming useful, and
embedded applications and contextual linking.

But there is also a need to address more fundamental issues that are not technological: simply the need to protect and assist the pool of referees, to encourage new referees and to use their time as effectively as possible.

On the Exchange of Apples and Ideas

Paolo Mangiafico
Duke University

The title of the talk is based on a quote attributed to George Bernard Shaw that goes "If you have an apple and I have an apple and we exchange apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas." Knowledge and ideas are non-rivalrous – they can be shared freely and consumed without diminishing the original. The ecosystem of scholarly publishing evolved by necessity to be more like the exchange of apples than of ideas because the most common container of those ideas – print publications – are rivalrous, and market-based exchanges are an efficient way to manage transfer of rivalrous goods.

As digital publication becomes more common, the physical publication is no longer the key unit of exchange, and this has led to the growth of a movement advocating for open access to scholarly publications, and treating the sharing of scholarly works more like the exchange of ideas than apples. This trend continues to grow, with universities, governments, and funding agencies increasingly requiring that scholarship they have supported be made freely available, raising questions about how the costs of publishing can be supported if subscriptions by readers or their proxies can no longer be relied on as a significant source of revenue.

There are a number of studies of funding models for supporting open access, a few of which can be found here:
http://www.arl.org/sparc/publisher/incomemodels/ , http://www.ithaka.org/publications/
http://library.duke.edu/blogs/scholcomm/2010/09/24/the-economics-of-open-access/

Many of these analyses rely on unbundling different aspects of scholarly publishing (for example, into registration, certification, awareness, and archiving) and examining how some aspects can be done more efficiently in a digital networked environment. For those that continue to have significant costs (notably, certification, or peer review and quality control), can the costs of these particular aspects be covered as services, funded through the mission-based funding model of the research process, rather than building them in to the overall costs

of a product that must be treated as a limited resource in order to make it worth paying for in a market-based exchange?

The SCOAP3 project is one example of an experiment that is attempting to make this change across an entire discipline at once, to reduce the risks to any individual players and avoid the key funding sources having to pay for two different models (subscription and service-based) simultaneously. SCOAP3 starts from the premise that most high energy physicists now deposit their articles in the open access arXiv preprint repository, and do most of their reading from articles found there, at no cost to them. Yet despite this, libraries continue to pay for subscriptions to journals in the field because the process of peer review performed by the journals is still valued. SCOAP3 is attempting to convert the key journals in the field to an open access model, and to redirect subscription funding to pay for peer review as a service rather than journals as a product. Such a model requires a stable and trusted coordinating body (in this case, CERN) and that agencies (libraries and research funding bodies) are willing to contribute fair share costs for peer review services that are roughly commensurate with what is being spent now on subscriptions, even though the resulting publications would now be available freely. It's not clear whether this model will succeed, even in the narrow circumstances of this experiment, but so far SCOAP3 has received pledges for approximately 70% of the required funding, and has agreements with the publishers of the journals to be included in the project.

Other examples of mission-based scholarly publishing are emerging from some universities, who are developing publishing services based in (or funded like) their libraries, including some cases of university presses merging with libraries. Libraries are a key node in the scholarly communications ecosystem, and are funded on a mission-based model. Can other aspects of scholarly communication also be funded as a public good under this model, and be considered part of the mission of a university?

Duke University is engaging in a number of projects aimed at exploring new models for scholarly communication, including an open access policy for peer-reviewed articles by its faculty, a small fund to assist Duke authors with article charges if they publish in an open access journal that requires them, a platform for publishing open access journals via the library (using the Open Journal System software), pledging support for SCOAP3, and providing consulting services to Duke researchers who wish to work more with open access. Information on these initiatives can be found here: library.duke.edu/openaccess/. Duke sees these initiatives as an investment in promoting changes in the scholarly communications ecosystem, and supporting the university's strategic goal of putting knowledge in the service of society.

Individual scholars are encouraged to work with their librarians and provosts to participate in experiments like these and to encourage them to engage with their peers nationally and internationally to support systemic change. Are there ways publishers and societies can work with their partner scholars and institutions to adopt new models in tandem, to reduce risk while achieving rapid change?

Are there ways to successfully move toward scholarly publishing models that are based on paying for services rather than products, and are aligned more with the mission-based models of scholarship?

A charter for sustainable journal publishing

Bernard Teissier

(CNRS, Institut Mathématique de Jussieu, Paris)

The French national network of mathematics libraries (RNBM) has the originality that it is composed of librarians and mathematicians; it contains practically all the libraries of French Mathematics labs and departments. Its present director is Odile Luguern, head of the Mathematics library at ENS Paris and I am its scientific director. It was the first entity in France to initiate negotiations, with Springer, for a national consortium agreement (in 1997, for all French Mathematics libraries}. It is currently engaged in promoting national acquisition of electronic Math Archives and national subscriptions to Math academic journals. It works very closely with the Cellule MathDoc which is certainly known to you through its project NUMDAM. Let me point out that it has other very useful projects such as CEDRAM which gives access to journals and seminars and MiniDML which gives access to a large number of digitalized mathematical works.

The diffusion in space of mathematical results and ideas is now largely and successfully electronic. The success is so great that it tends to overshadow the validation of results and their diffusion in time (a.k.a. long-term archiving) as validated results, for which the only method is some version of journal publishing. It is not because validation by peers is not perfect that it should be disregarded, and I hope we all agree that judging the quality of a paper or book by the number of times that it is quoted is not appropriate for Mathematics.

 I shall postulate that we should preserve and improve our journal publishing system, albeit with adapted goals (validation and time diffusion) and also preserve its diversity, which is not a luxury but a part of is adaptation to the diversity of mathematical inventiveness.

 It is now quite clear that the big deals of some of the commercial publishers threaten to eliminate academic publishing of journals in Mathematics simply by gradually absorbing all the resources of libraries. It is also clear that their aim to sell e-only subscriptions and gradually make the printed version a luxury without providing a reliable long-term accessible archiving threatens the long-term preservation of our access to our own documentation. The big deal is not sustainable for us, scientifically or economically. We are (with our close neighbors of theoretical Physics and theoretical Computer Science) rather isolated within the scientific community, since other sciences have different methods and preoccupations concerning their documentation. We can therefore hardly hope for a spontaneous trend reversal. Nor can we continue to hope (for those who did) that tomorrow some new form of online publishing will play the same role as our current system for a nominal price. It appears that in Mathematics Open Access publishing is not really flourishing, perhaps because of the lack of guarantee of perennity and the reactions to author fees, which give to those who control the money the possibility to control publication. Anyway good publishing does have a non-negligible price, and so does long-term preservation, and subscription rates should not stray too far from that. On the other hand there is the need to make freely available to the public what it paid for in taxes is more and more recognized, and this trend can take forms which disregard the price of editing, refereeing, etc.

I propose that we should promote with great determination a system close to our present system of academic publishing, which is a very important asset for us, and delineate and publicize such an economic and scientific model, which is clearly different from the unsustainable ones of a part of the commercial system.

We should have the goal that an increasing proportion of mathematical papers are published within the framework of such a model, so that it becomes a stronger and stronger competitor for the big deal in our field. I think that is the only way to make ourselves heard (if at all) in the boardrooms.

In order to achieve that goal, we should make the postulates of academic publishing explicit: the aim is not to maximize profit, but to have an economically and scientifically sustainable system.

Here are some of the aspects taken into account by the academic publishing system: Our measure of quality for mathematical work is not by impact factor but by the educated subjective judgment of peers in the evaluation committees and indices adapted to the particularities of our field[7]. Subscriptions to journals whose value/price ratio drops can be freely cancelled since clearly the absence of this possibility is scientifically noxious. Long-term preservation is guaranteed by a (probably more and more limited) number of archiving-quality printed copies in addition to the electronic archiving systems, etc.

The academic system does have its perils, such as the formation of cliques, and it is healthy that it should have some external competition. It is true also that the commercial system, which can more readily invest in scientifically meaningful but risky endeavours, has a positive role. But at this time the situation is much too unbalanced and we need to set up competition for the big deal and its business model as it stands.

The reason given to justify the very high price of some journals was the visibility which they give to their content, what I call the browsing factor and deem more significant than the impact factor for Mathematics. The validity of this argument diminishes rapidly as we get more and more of our information about recent work from the ArXiv.

The RNBM has been trying for years to encourage mathematicians (the established ones at least) to avoid dealing with journals with a low quality/price ratio. It is a long struggle, and I think part of the problem is that we cannot offer clearly defined options.

Right now we are trying to set up in France a system of permanent national subscriptions for some academic mathematics journals (not just the French ones!) and national acquisition of their archives. One of our goals is precisely to encourage academic publishers to develop by offering them some long-term stability. But we also worry that some large academic publishers, who now distribute more and more of the previously isolated academic journals, could come to be tempted by the business models of commercial publishing.

I propose that publishers of Mathematics journals should be given the possibility to adopt a precise "sustainable publishing charter" with commitments concerning in particular:

the absence of author fees and the possibility of subscribing with appropriate rebates to selections of individual titles instead of publishers' bundlings/packagings,

the determination of prices and of their increases (in particular in comparison with the increase of the quantity of published material).

The quality of journals is maintained; no increase of volume and price by lowering the quality. Subscriptions can be freely cancelled if the value/price ratio drops.
sending papers (copy of record) to an open access archive after a short time (say 3 to 5 years).
providing paper copies of archiving quality or the files needed to print them, cooperation with archiving libraries and all systems of dissemination and organization of data concerning mathematical literature.

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[7] Ranking journals as a means of evaluating mathematicians according to their publication record is a very questionable option, encouraging the fragmentation of work for publication. Moreover the value of a mathematical journal has a local component, it usefulness to a given community, and a global one. How can a ranking take this into account?

Obviously it would not be easy to formulate such a charter, but there are competent people to do it. Indeed a part of it could be a "charter" version of the best current practices recommendations of the IMU for journals (2010) and recommendations 11 to 15 of its 2004 document on this subject (see http://www.mathunion.org/publications/reports-recommendations). A roundtable of mathematicians, publishers, librarians and IMU experts could produce the desired charter. By and large, many academic publishers are already within its scope as I envision it, while the business models of some commercial publishers are clearly outside of this scope. The IMU could perhaps serve as a referee to check, with the help of librarians, whether those who sign the charter really respect it.

Of course, commercial publishers would be welcome to adopt it for some (or all) of their mathematical publications and I do believe that some could, especially as the competition from sustainable publishing grows. Hopefully more mathematicians would prefer to submit to (or referee for, or be editors for) the journals which respect that charter, and one may expect that in a few years many of these would react by significantly increasing their volume of publication. This respect of the charter could also come to be important in the policies of academic libraries and a tool in the negociations of subscriptions. It could even be, in an ideal world, of some significance to hiring and promotion committees in the case of established mathematicians.

At least a clear choice would be offered to editors, authors, referees, librarians, and publishers.

Of course the same principle could be extended to the merchandising of e-archives and e-books, for which some publishers and distributors are right now trying to create again rent-based business models which are not in the interest of users. In particular in those models libraries get less easily accessible information (catalogues) on each e-book, to encourage them to buy packages. This is not acceptable.

In time the sustainable charter publishing of Mathematics journals may converge with an evolution of some of the current open access publishing models, but right now it seems to be both the fastest and the safest way to move towards sustainability.

Experimentation of new models is extremely useful but if we do not define as clearly as we can what we deem necessary for sustainability in our field, we cannot complain if those who make universal models for publication and access, whether they are commercial publishers or government agencies, do not take our needs sufficiently into account.

An Editor's view of recent challenges faced by the Annals

David Gabai,
Princeton

All statements that I make are my personal opinions and do not necessarily represent the opinions of the other members of the editorial board.

The Annals has a long and distinguished history. (See slides) The Annals has an editorial board of six editors and six associate editors. Editorial decisions are made by the editors but heavily rely on the opinions of the associate editors. The Annals does not have a managing editor, a situation that has several advantages and disadvantages. The main advantage is that no one editor is subjected to an inordinate amount of non mathematical work. Most of the work done by a managing editor is done by Maureen Shupsky, who is known as the journal manager, a job which entails a very wide range of duties.

By essentially any measure, the Annals is one of the premiere research journals in mathematics. It strives to set the standard for not only publishing top level research but making it available at a minimal possible cost. An examination of the cost slide shows that its cost is far less than any of the top journals. (A list which is not meant to be all inclusive.) Indeed, the cost of most other top journals is higher by multiplicative factors, indeed over an order of magnitude higher for CPAM. In the aggregate, the journal is minimally financially subsidized by Princeton University.

In recent years, as detailed in the slides, the Annals has faced many challenges. In 2003 (before my time as editor) the editors decided to make the journal freely available through Euclid. The idea was that the journal was of such high quality and so minimally priced that any rational subscribing institution would continue to support it. In 2008, the editors were jarred by the realization that many institutions simply cancelled the Annals, including some of America's most distinguished universities. Effective March 2009, Annals dropped free electronic access and its subscription numbers have recovered somewhat.

Mathematics Journals: who reads them?

Susan Hezlet,
Publisher, London Mathematical Society
hezlet@lms.ac.uk

For journals, we can identify two sources of demand: from the readers, and from the authors who want to see their research disseminated; but what happens when demand from readers and authors takes place long after *payment* for the newly published volume? At the moment all journals are paid for upfront, whether subscriber based or open access, thereafter someone is responsible for looking after the print or electronic media.

Thirty years ago, the libraries were responsible for looking after print and many publishers did not keep archive copies. Libraries still look after access to the electronic journals, and theoretically they could archive everything they buy but this doesn't seem to be happening. Readers, these days, expect to find and read the literature in the latest formats and for it to be readable on the latest machines. (think e-book readers and ipad) and this is where the responsibility has shifted; we expect the publisher to provide upgrades to the electronic versions of journals and new formats for new machines.

I illustrated the talk with data on five journals, beginning with the core LMS journals, the Proceedings, Journal and Bulletin of the LMS who share a common Editorial Advisory Board who look after the peer review, finding referees and making recommendations. The staff facilitate this process through answering author queries, moving the papers around and monitoring delays; they send out reminders to referees and alert the LMS to any serious problems before they become catastrophic. This is where the bulk of our work lies; we actually manage seven journals in house and we manage the copy-editing and typeset quality, rights and permissions and pay for the outsourced publishing services: sales, distribution, online hosting etc.

Table 1: Number of submissions (new and revised) handled versus number of papers accepted

	BLMS	JLMS	PLMS
# submissions	672	370	256
# accepted	100 (1152 pp)	99 (1622 pp)	50 (1830 pp)

We will also see some data on *Nonlinearity*, a more applied journal launched this journal in partnership with the Institute of Physics, and *Compositio Mathematica* which is owned by a

Dutch Foundation and we manage the business of publishing for them and look after the post acceptance stages. Thee journals have different access policies to the core LMS journals.

In general, all five journals have been increasing in size over the last ten years but not as fast as the number of submissions and the impact factors have also been on the increase. All the journals participate in developing countries initiatives which account in part for the very large number of countries who download the papers:
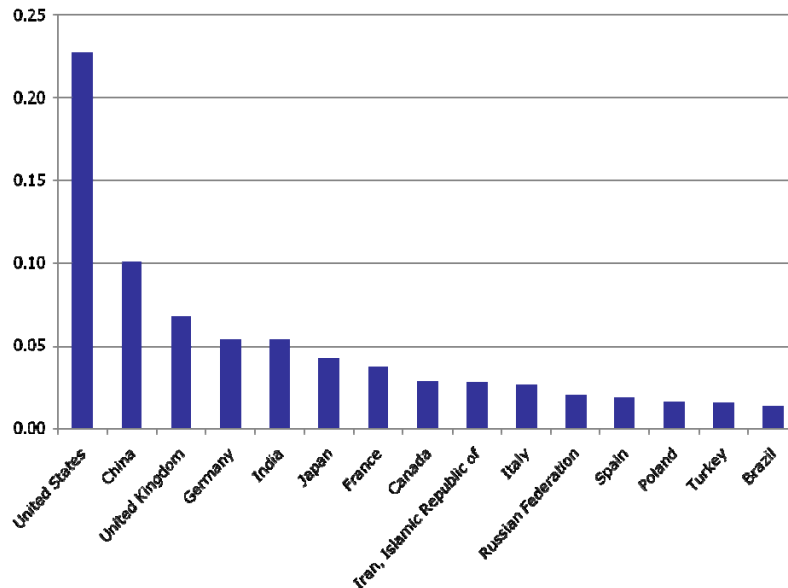

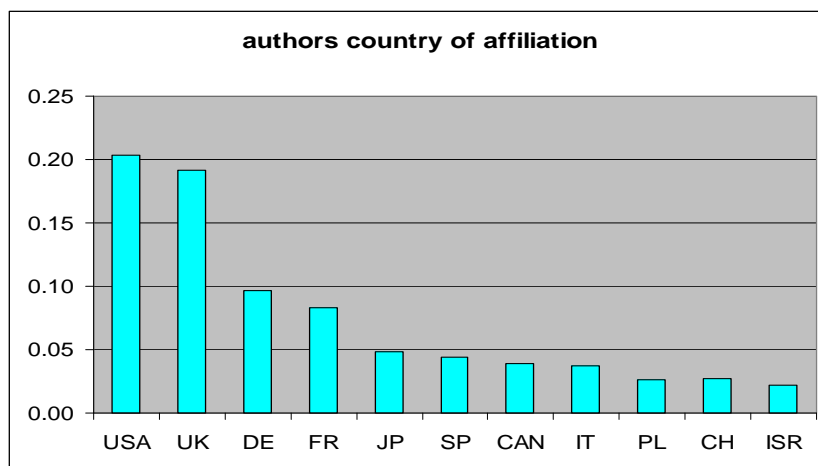*Figure 1* Journal usage for LMS journals (full graph extends to 209 countries in total)

Figure 2 Author affiliation for LMS journals (full graph extends to 42 countries in total)

Readers vs authors
Compare Figure 1 with Figure 2, the author's country of affiliation, and you will see that there is a relationship between where the journals are read and where the papers are written.[8] Interestingly, the extra countries in Figure 1 that do not appear in Figure 2 until further down the graph are China, India, Iran, Russia and Brazil. Four of these are known as 'BRICs', the

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[8] For British journals, as for any other national journals, there is a disproportionate level of locally based authors. For journals published in America, the US based authorship would be about 30% and the British would make up only about 8% of the authorship.

newly emergent nations. This may be an indication that where the journals are read today will be a source of authors in the future.

Access policy
The core LMS journals are free to view for the first six months and thereafter go behind a 'reverse' moving wall. The full archive, dating back to 1865 for PLMS, is available to current subscribers as part of the annual subscription to each journal. In contrast, Compositio Mathematica has no initial free access, but a moving wall of free access to the articles after five years. Much of the archive sits on a different site to the current journal articles, at NUMDAM. Nonlinearity articles are free to view just for the first month of publication; the archive is also sold separately.

It is clear from Figure 3 below that free access increases the number of downloads and this seems to be most effective when it is free during the first six months. However it also shows that readers *do* read the old material and the long tail of readership on these journals is very significant; the average number of downloads per article dating all the way back from 2000 to 1865 for the Proceedings has the same profile at the 'older' end as Nonlinearity, launched as recently as 1988.

Further evidence of the value of old papers in mathematics comes from Figure 4 below which shows the average number of citations; a substantial number of very old papers are still being cited. This also illustrates the problem with impact factors. Only the yellow and green columns contribute to a journal's conventional impact factor, whereas the bulk of citations for our journals occur during the years 2001 – 2008. A ten year impact factor would seem perfect, but it has the disadvantage to being slow to change; a badly-handled journal can collapse in a shorter period of time.
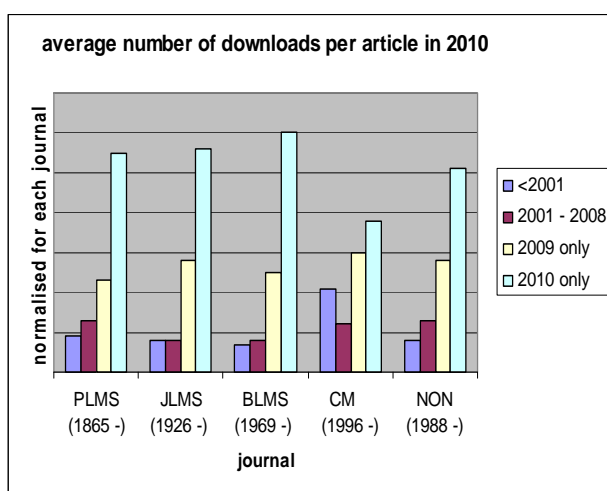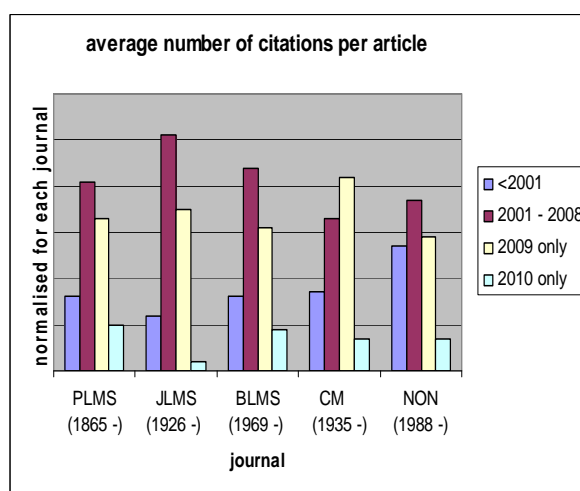

Figure 3

Figure 4

Conclusions
Readers look at what is freely available more than what is behind a payment wall.
Readers keep reading the old stuff. It has real value, backed up by authors citing the old material.
Readers are more diverse than authors but same general profile, BRICS will be important.
US has dominant position (not just for LMS), as readers and authors.
US government policy on research dissemination is relevant to the Rest of the World.
Almost all journals are already freely available to developing countries.

What might we do with this information? We want to keep two new services:
1. upgrading the systems as and when there's a major shift and according to where the demand lies;
2. retain enough money to support developing country initiatives.

Could we find a more direct solution for payment? The perfect answer would be to charge a submission fee to authors and charge pay-per-view to readers but this just illustrates the problem with 'perfect' models – most are unworkable in our less-than ideal world.

The Mill(in)er's Tale

Prof. Thomas Ward
Pro-Vice-Chancellor (Academic)
VCO, UEA

The Miller's tale features people sometimes holding crude caricatures of each other, and a protagonist who predicts a terrible event – a flood twice as deep as Noah's flood – but of course it turns out quite differently. Both aspects have some relevance to the issues discussed at the meeting. Many people involved with journal publishing do so wearing many different hats – hence the milliner.

I attend mathematics conferences, where we all speak a common language and broadly agree on where we are trying to go and how to value what we achieve. I attend conferences as a PVC (the UK equivalent of something like a Provost) and there the different groupings – types of university – are sometimes in entrenched conflict. The journals conference seemed to be a hybrid, with some genuine value-driven conflicts and the potential for a great deal of learning from each other.

I start with two snapshots from recent emails illustrating some of the naivety and dangers around us. The first calmly suggests that the full text of all research outputs in a certain time period should be uploaded to our institutional e-print server, with no mention of where any potential copyright liabilities might reside. The second suggests – in an email sent to every higher education institution in the UK – that we each seek legal advice on some technical questions to do with publishing data sets. If each recipient were to do so, that might divert several million dollars from education or research.

Overview: I will try to illustrate the many hats, all but one of which I have worn personally, on a simple picture (shown below) with axes indicating some of the parameters we juggle with. Conventional subscription versus "author" pays; unfiltered versus clearly edited & reviewed; costly versus "free"/open access.

Author (Groucho Marx): Has a paradoxical interest in publishing in journals that is better than their work. Prefers the cost to be hidden from them, and is not strongly engaged with price questions unless involved directly in a campaign on the question. Has strong irrational fears, for example may connect electronic or open access with low quality (because of the low entry barriers). Weights the stature of a journal far more highly than questions of how much it costs, how many libraries carry it and so on. If pushed, likes the idea of cheap journals of high status. "Professors don't pay subscriptions, libraries do."

Editor (white cap): Clear interest in editorial/refereeing quality control. Likely to be up for reasonably high charges in two ways: as a proxy for quality and as income to a learned society. May be strongly resistant to "author pays" model.

Researcher (David Hilbert): This is a pure researcher, thinking about scientific problems not career advancement. Primary desire is to simply be able to search, follow threads, and access

any and all journal articles. Loves the arXiv, has a naive faith in open access. Does not understand why this has all become so complicated, and is strongly irritated by the experience of following a chain of references and suddenly not being able to access a journal. Views access to content, including the historic archive, as ideally a utility – it should just happen, and is not very engaged with how it comes about. Would love, for example, to have more and more of the historic literature in Math Reviews (with retrospective reviews and citation data, for example) without any concern about how much that might cost.

Adviser (baby in a hat): Wants their student protected from author charges until they have research grants. Wants the imprimatur of peer review, and wants to make sure their student publishes in very conventional safe ways that will help launch their career. Cost not a primary concern. Interested in the cultural question of how new entrants can break into a field.

Head of Department (hard hat): Not very concerned about journal prices until a crunch comes and they have to dragoon colleagues into decisions about cutting journals. Has a strong need for clarity about refereeing and editorial standards of a journal. Suspicious about impact factors in their own area, but sometimes has to rely on something in assessing other areas. Finds the detailed citation data from Math Reviews useful, but not when negotiating across disciplines.
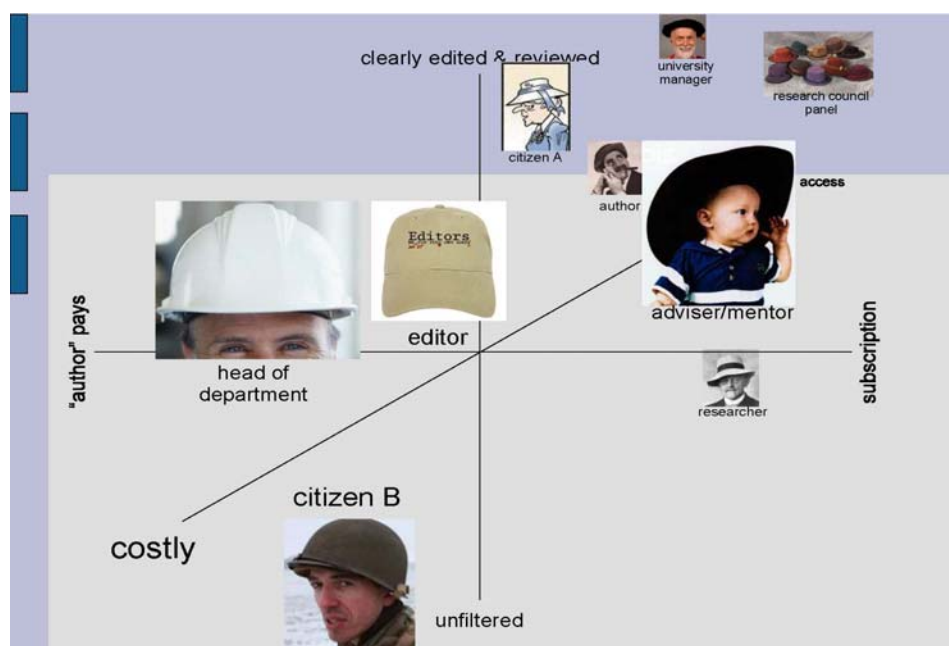
University Manager: Fearful of escalating costs; faces strong political pressure for open access from funders and government bodies; wants clear editorial and peer review control. Particularly fears the implication of being squeezed between government/funders and publishers. Anxious about the realpolitik of lacking the institutional muscle to impose something like a Harvard amendment. Sleeps little.

Citizen A (Lacey Davenport): Respects peer review and understands the importance of research integrity for society. Does not understand why journals are sometimes so expensive, and would be troubled by significant funds flowing from students or taxpayer-funded research bodies to journal publishers.

Citizen B: Quite happy for market forces to operate, and if a journal offers a good product or a high quality is quite happy for it to be expensive. Suspicious of peer review and views consensus as innately suspect. Interested in the web's capability for supporting sceptical debate and publications.

Research Council Panel: Insistent on open access, willing to pay for project outputs to be made open source. Unconcerned about the impact of this on other players – willing to let universities and publishers slug it out.

The economics of math journals supported by page charges

Rob Kirby
University of California, Berkeley

We begin with some data. The average mathematician at a top 50 university publishes about 30 pages per year. This figure was obtained by randomly picking 7 universities and sampling every other professor (not postdocs nor emeriti) to see how many pages the professor published in a journal (not proceedings or book) in 2005. The number is higher at the very best departments, lower at lower ranked departments.

It is reasonable to assume that $30,000 of that professor's salary went to research whose result was those 30 pages, so around $1000 per page.

Mathematical Sciences Publishers, MSP, the non-profit I am associated with, would be happy to publish those papers in an electronic only, fully open access journal, for $20 per page, or only 2% of the cost to the university of creating the page in the first place. Universities both create knowledge but are also involved in teaching and disseminating it. Two percent for dissemination seem to me a no-brainer.

One can ask whether $20 per page is reasonable. Hans Koelsch from Springer said that Springer was offering an open access journal supported by 800 Euros per paper. That's over $1000 for a paper which might average around 20 pages, so let's say $60 per page. Part of the difference between Springer's price and MSP's price is accounted for by overhead and by profit. Perhaps $40 per page is a more reasonable price for a more typical journal.

Who pays for this? If we choose a large American state university such as Minnesota or Berkeley or Ohio State, then there might be as many as 100 faculty and postdocs for whom the university needs to pay $40 per page for papers. Those 100 professors produce 3000 pages which will cost $120,000. But those math libraries spend well over $300,000 on subscriptions to journals, so there still would be a saving of $180,000 to the university if we mathematicians switched completely to open access, electronic journals supported in this manner.

This utopia could be reached if a number of leading universities said they would support these journals by simply transferring money from the library journals budget to the open access journals. Presumably open access journals would start, grow, and gradually take over.

Such open access journals would self archive their papers, as well as make them available to whatever organizations would wish to copy the papers, and index and add value in whatever way mathematicians would pay for. In particular, at least one organization should print the papers, so as to make them available for scanning in the future. The act of archiving should be separated from the act of publishing, although some journals would do both.

Random thoughts on mathematical publishing

Robert Guralnick, USC,
Transactions, AMS Managing Editor

Some issues to consider

Mathematics is only a small part of university libraries and their decisions are going to be based more on what is going on with medical sciences, life sciences and engineering.

We should try to convince NSF and other funding agencies that there needs to be consultations regarding mandates about making funded research available.

Clearly, there are ways to publish more cheaply than the for-profit publishers and we should explore these options, but we are not going to lose the private publishers anytime soon (especially in view of the first point).

It is important to have the societies and academic publishers to help provide competition to Springer, Elsevier, etc.   For example, Transactions increased the number of pages per year from 5500 to 6600 with essentially no increase in prices.

There has been increased use of the Arxiv making access to papers before being published easier than ever (as well as private web pages and google).   It is not clear what the precise percentage of published material is actually on the Arxiv (statistics were mentioned earlier, roughly 17K papers posted on the Arxiv and 80K papers in MathSciNet, but many of the 17K papers on the Arxiv will never be published).

Preprint servers are not free and the community should figure out a way to regularize the funding of the Arxiv (or other such mechanisms).

One of the essential values of journals (as opposed to preprint servers) is that papers have been refereed and so are more likely to be correct than preprint. Also, the quality of the journal is used (perhaps inappropriately) in tenure and promotion cases.

As was pointed out in an earlier talk, the number of published papers is increasing rapidly. The number of potential referees is hardly increasing at all. This is a big problem that we will need to confront in the next decade (or sooner). It is getting harder and harder to get qualified referees to agree to referee, to actually referee and to do a very good job of refereeing.

There are lots of complaints about refereeing but not so much appreciation for their efforts (which are unpaid, anonymous and done out of a sense of giving back to the community). This is true as well for people serving as editors.

Nonprofit Publishing:
Juggling Resources and Balancing Conflicting Needs

Mira Waller
Project Euclid: Joint venture between Cornell
University Library and Duke University Press

My talk focused on the challenges faced by independent and small society publishers in balancing publishing costs with the needs of customers and the desire to provide for freely available content. Since my perspective is based upon my experiences with Project Euclid, I concentrated on the primary issues and concerns raised by librarians, mathematicians, and publishers who have used and partnered with Project Euclid.

In 2000 Cornell University, with support from The Andrew W. Mellon Foundation and encouragement from Cornell faculty who wanted to see mathematics on the Web, launched a not-for-profit initiative to provide an online repository and publishing mechanism for small and independent mathematics and statistics journals. By late 2005 the project's budget was in the black with fixed costs of approximately $300,000. Today Project Euclid, jointly managed by Cornell University Library and Duke University Press via a formal Joint Venture Agreement, includes over sixty journal titles, and the platform holds over 107,000 articles and 161 monographs. Project Euclid supports non-profit publishing and the dissemination of scholarly literature with over 70% of the content freely accessible. An eleven-member advisory board—composed of mathematicians, statisticians, publishers, and librarians—provides strategic, programmatic, and fiscal guidance for Project Euclid. Thirty-five publishers from eleven countries disseminate content through Project Euclid, including the Association for Symbolic Logic, the Belgium Mathematical Society, the Institute of Mathematical Statistics and the Mathematical Society of Japan.

In mathematics there are three current models of publishing: print only, print plus electronic, and electronic only. While Project Euclid only works with electronic materials, many of the publishers on Project Euclid still work primarily with print. In both print and electronic production, general publication costs include peer review and editorial services, production services, marketing, and customer support. Although the amount spent on each of these areas differs according to publisher and according to the publishing model (i.e. print, print plus electronic, or electronic only) these are very real costs, at least currently, to all the publishers.

In Project Euclid there are two main access models: restricted and unrestricted. Restricted access includes subscriptions, membership, and exchanges. Unrestricted access includes partial open access (a chronologically moving wall); open access with article processing fees; open access subsidized by institution, department, or government; and open access subsidized by print subscriptions. While the online environment can reduce some costs, especially if print is jettisoned, online delivery adds substantial costs such as digital content management, online platform maintenance and development, hardware and networking services, digital preservation, Crossref DOI registration, and COUNTER compliancy.

Independent and small society publishers can find it difficult to compete with larger commercial publishers unless economies of scale can be found to help offset some of the issues that are arising in the digital environment. Some of the issues for Project Euclid partners and small publishers interested in Euclid are: transitioning from the print environment to the electronic environment; securing funding for open content; increasing subscriptions in an environment increasingly made up of large bundles and consortia sales; and providing electronic exchanges. Some of these issues have been created by budgetary pressures on librarians, who often determine—in consultation with faculty--which content to purchase. These pressures include justification of purchases or cuts based on usage statistics, decreasing library budgets leading to the attractiveness of consortia sales and bundling, and the need to ensure that what is being purchased will be preserved for ongoing access. In turn these issues have translated into difficulties for the independent and small publisher who find it difficult—due to a lack of critical mass—to provide COUNTER statistics, online subscription management tools, preservation guarantees, and attractive sales options to library consortia.

On the other hand the researchers and scholars who access content on Project Euclid often request that we unblock their access or help them find a version of an article in a certain format (both print and electronic have been requested simultaneously). Sometimes the resources asked about are not even on the Project Euclid platform. Researchers and scholars in mathematics and statistics do not seem to be interested in making the distinction between restricted or unrestricted access nor do they seem to solely require the material in digital form.

If the independent and small society publishers in mathematics and statistics are to survive and even thrive in the evolving landscape of scholarly communications, we (as a society) will need to find balance and the middle ground between disseminating knowledge and generating revenue to cover the costs of the distribution. The independent and small society publishers will need to balance the need for identity and independence with strategic partnerships, learn how to navigate the evolving requirements of libraries and researchers, keep abreast of technology, operate in a global economy, and be willing to step out of what is comfortable and explore new models of scholarly communication.

Finally, we had some impromptu presentations:

Liber Mathematicae:
a web-based documentation and collaboration project for mathematics

Markus J. Pflaum and John Tuley,
University of Colorado

The Liber Mathematicae project, http://www.libermath.org, looks to bring the open source model of software development to mathematics publishing by employing cutting edge XML technology, high-quality mathematics fonts for the Web from the STIX Fonts project, and relational database technology to allow for a sophisticated version control and review process for the submitted mathematical content. We have developed a web site, where members of the mathematical community can not only view articles but can additionally participate in the creative process by contributing corrections, suggest improvements, or by expanding on the original content. In contrast to traditional mathematics journals, the main goals of Liber Mathematicae are to have articles which are expandable, correctable and dynamic, with tools for collaborative writing and open access to the entire mathematics community. Moreover due to their online nature, articles on Liber Mathematicae may contain more than static text and images and may in fact hold animations, live computational demonstrations, and so forth, and may use hyperlinking to strongly cross-reference other articles. An additional goal is to create a logical dependance tree for all mathematical theorems on Liber Mathematicae. We hope that with this new environment for communicating mathematical knowledge, the openness and cooperation will help to increase both the pace and quality of new mathematical research.

An economist's view

Daniel Goroff,
Sloan

Daniel Goroff discussed how economists might look at academic publishing. First, the information in an article when viewed as a commodity has the properties of a "public good" like a lighthouse or a park. Second, a journal can be viewed as operating in a "two-sided market" like those for credit cards or game consoles. He also mentioned a recent study suggesting that publishing an economics article in an open access journal does not necessarily cause it to be cited more than if it had appeared in a traditional journal.