

# The Role of the Critical Review Article in Alleviating **INFORMATION OVERLOAD**

*Annual Reviews, A Nonprofit Scientific Publisher*



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# INTRODUCTION

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“Information overload is a general problem for society that extends well beyond science. Very clever people continue to invent very clever systems for organizing and interpreting information, spanning the spectrum from ‘unfiltered’ to ‘authoritative.’ At the unfiltered end of the spectrum we have the example of Google, which attempts to find everything and organizes it only by number of hits. (A search on ‘Formicidae’ in Google Web nets 2,320,000 results; Google Scholar nets 45,300 results.) Somewhere in the middle of the spectrum we have Wikipedia, which depends on self-nominated, ‘self-assembling’ groups of contributors to organize information. (Searching for ‘Formicidae’ in Wikipedia shunts you to the page for ‘Ants,’ which, despite containing a number of errors, turns out to be pretty good.) The ‘authoritative’ end of the information-organizing spectrum is the most challenging because it depends on senior-level experts with exhaustive knowledge of their fields. An authoritative review must simultaneously provide an entrée into a particular field’s primary literature, summarize current knowledge in that field, and judiciously interpret that knowledge. Frequently, as information in a particular field continues to expand, a new review must cite and build upon past reviews. It is this end of the information-organizing spectrum upon which we scientists depend in order to stay informed. And it is at this end of the spectrum that we encounter the ‘Annual Review’ model, presciently created in 1932 and eighty years later proving eminently adaptable to the brave new world of electronic information, e.g., with online access and online supplementary materials such as video and audio clips.”

- Schultz, T. 2011. Preface. *Annual Review of Entomology*. Vol. 56

# INFORMATION OVERLOAD: A GROWING PROBLEM

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*“We shall cope with the information explosion, in the long run, only if some scientists are prepared to commit themselves to the job of sifting, reviewing, and synthesizing information; i.e. to handling information with sophistication and meaning, not merely mechanically.”<sup>1</sup>*

These words are almost fifty years old.

They appeared in a 1963 report, “Science, Government and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information,” issued by the U.S. President’s Scientific Advisory Committee. Information overload, already a popular term, was a problem that merited serious consideration at the highest levels.

Since that time, the published output of academic research has undergone considerable growth; the world output of research articles tripled between 1970 and 1995<sup>2</sup> and this growth continues as developing countries begin to increase their research output. Iran, for example, increased its research output by a factor of ten in the decade to 2006<sup>3</sup>, and China is now approaching the level of output seen in the United States during the fertile 1980s<sup>4</sup>. Eighty-one percent of early-career scholars and researchers surveyed now tell us that they feel they should read more of the literature than they have time to do, and 25% suggest they would need to read for more than 24 working hours a week to keep up<sup>5</sup>.

## WHY WE NEED TO ALLEVIATE INFORMATION OVERLOAD

*“If you’re not informed, you’re going to lose touch with what is going on in your discipline, which will make you ineffective.”<sup>6</sup>*

“Every scholar is faced with the problem of hearing and understanding constantly new information from colleagues,” says Sandra Faber, Professor of Astronomy and Astrophysics at the University of California Observatories, and Vice-Chair of the Board of Directors of Annual Reviews. Researchers prioritize content that is recommended—by peers, at conferences, or by references in other articles. If it isn’t priority, it doesn’t get read. This is of concern to publishers, for whom lack of usage increasingly means no renewals, and to funders, for whom unread research is arguably wasted.

“As long as researchers have a finite capacity for reading, they will never achieve complete relief from information overload,” comments Eugene Garfield, Chairman Emeritus, Thomson Reuters Scientific (formerly ISI) and Member of the Board of Directors of Annual Reviews. “But still, each of us needs to connect with the broader scientific culture by hearing from recognized experts outside of our own particular research niches.”

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<sup>1</sup> U.S. President’s Scientific Advisory Committee. 1963. *Science, Government and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information*. Washington, DC: U.S. Gov. Print. Off.

<sup>2</sup> Abel R, Newlin L, ed. 2002. *Scholarly Publishing: Books, Journals, Publishers, and Libraries in the Twentieth Century*. Indianapolis, IN: Wiley.

<sup>3</sup> IPM Bulletin Board <http://www.ipm.ac.ir/ViewNewsInfo.jsp?NTID=236>

<sup>4</sup> Archimbault E. 2009. *30 Years in Science: Secular Movements in Knowledge Creation*. Montreal: Science-Metrix. Interactive trend explorer: <http://www.science-metrix.com/30years-Data.htm>

<sup>5</sup> Survey profile: Early-career scientists responded to a brief digital survey about information overload and use of academic literature in September 2010

<sup>6</sup> Faber S. 2010. Interview with the author



## TODAY'S SOLUTION

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Overcoming information overload is important to librarians to ensure collections are used; to publishers to ensure information is valued and read; and to funders to ensure research investment is not wasted.

Most of all, it is important to science and scientists to ensure that new knowledge is assimilated and applied to support and accelerate progress.

*"Our current 'global information database' is the product of the most productive period of uninterrupted progress in history, with a growth rate that is arguably exponential. ... As scientists, it is not only our desire but also our duty to keep informed of progress within our fields of concentration and in closely related fields. ... Even as the information content of each field increases, the number of fields also increases. How do we keep up with the unrelenting torrent of new information?"<sup>7</sup>*

*"It's easier to read a review than 200 papers."<sup>8</sup>*

The problem of information overload had been recognized—and addressed—long before the U.S. President's Scientific Advisory Committee's 1963 report. In the late 1920s, an assistant professor of biochemistry at Stanford University named J. Murray Luck set out to review current research in the emerging field of biochemistry. He found himself "dismayed ... by the immensity of the task. We must remember that even in 1930 Chemical Abstracts published about 6,500 abstracts<sup>9</sup> of papers on biochemistry, as it was then defined."<sup>10</sup> He arranged for the leading professors in the field to write intelligent syntheses of the key literature, and published the first *Annual Review of Biochemistry* in 1932. There are now more than 40 Annual Reviews acting as gateways to primary research in a range of scientific disciplines. They critically examine and qualify a wide array of materials including books, articles, and other sources, to summarize and evaluate each important idea or finding in an objective overview.

## A DIVERSE AUDIENCE

*"We aim for articles that people want to read, accessible at several levels, with a lively point-of-view, as well as a scholarly respect for the range of evidence."<sup>11</sup>*

The audience for Annual Reviews is unusually broad. They appeal to sub-field specialists but also to researchers, teachers and students of all levels in the broader field. "As a scientist, enmeshed in the web of knowledge and trying to find your way around, the Annual Reviews in your field are where the spokes intersect," posits Sandra Faber. "You go there and find the links to all the other places." Early-career scientists tell us they use Annual Reviews for a variety of reasons—as an introduction to a topic, to assess the current state of a related field, to save time in evaluating and selecting other

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<sup>7</sup> Schultz, T. 2011. Preface. *Annual Review of Entomology*. Vol. 56

<sup>8</sup> Merchant S. 2010. Interview with the author

<sup>9</sup> Over the next 50 years, the number of biochemical abstracts published in Chemical Abstracts grew from 6,500 in 1930 to 148,000 in 1979.

<sup>10</sup> Luck JM. Confessions of a Biochemist. *Annual Review of Biochemistry*. 50:1–23. Also available at <http://www.annualreviews.org/page/about/our-mission-and-our-founder#founder>

<sup>11</sup> Fiske S, Kazdin A, Schacter D. 2007. Preface. *Annual Review of Psychology*. Vol. 58



important literature. Senior scientists also credit Annual Reviews with helping to inculcate scientific integrity and rigor in students—building on previous experience, documenting and meticulously citing. Like other academic content, Annual Reviews journals are shared and recommended by many methods—emails, journal clubs, workshops, conferences and social networks such as Facebook and Twitter.

“Each reader values reviews for different and varied reasons. On some occasions, a review will facilitate searching the literature as an information retrieval tool,” explains Eugene Garfield. “On others, reviews serve as surrogates in citing the background literature on a particular facet of a topic one is writing about, especially in the introductory sections of new research reports.”

## TIMELESS NEEDS

*“Particularly in this age of information explosion, we feel there is a need for succinct and reliable entry points to anthropological scholarship. The pithy short version. The intellectually guided tour.”<sup>12</sup>*

*“The review is like drinking from a fire hose. It’s concentrated; no wasted words. It’s efficient.”<sup>13</sup>*

In today’s increasingly fragmented, fast-paced research environment, scholars and researchers look to academic literature to keep up to date, find out what colleagues are working on and inform their own ongoing research. Filtering the wealth of available publications is a growing challenge, because of the extent and breadth of new material. Younger scholars, in particular, may lack the relevant experience necessary to interpret and apply literature in the context of research needs.

## FILTERING FOR QUALITY

*“The Annual Review of Psychology differs ... in its goal to provide timely perspectives by planful request, rather than by spontaneous submissions. Instead of waiting for submitted snapshots, and holding a contest, the AR commissions landscapes from different perspectives and different styles ... Choices of chapters are guided by a Master Plan of topics in psychology ... The established process allows for recognizing and responding to new areas of work and areas that have evolved or taken special advantages of conceptual or technological breakthroughs.”<sup>14</sup>*

The role of the critical review is to draw together all the primary research in a field and provide a systematic, intelligent synthesis from the perspective of an expert in that field. “It’s like being transported into the laboratory of the leading scientist in the area, to be told what’s going on in the field,” explains Sam Gubins, President and Editor-in-Chief of Annual Reviews. “You come away

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<sup>12</sup> Durham WH. 1999. Preface. *Annual Review of Anthropology*. Vol. 28

<sup>13</sup> Faber S. 2010. Interview with the author.

<sup>14</sup> Fiske S, Kazdin A, Schacter D. 2007. Preface. *Annual Review of Psychology*. Vol. 58



with a richer understanding than you could gain in any other way.” There’s another subtle benefit of commissioning experts to write the reviews: giving readers “expert permission not to read everything.” That tacit acknowledgement radically reduces the burden of readership, as readers are given a shortcut to the 200 most important citations without having to review the wider pool (which can be anywhere from 20,000 to 200,000 pieces of published material). For dissertation-level students and senior scholars moving from one field to another, that’s a significant time saver. “The expert has already done the research for you,” says Annual Reviews Director of Production Jennifer Jongsma. “They’re highlighting for you what’s important as well as future directions.”

## ESTABLISHING AND SHAPING THE FIELD

*“It is surely a coming of age for financial economics that the field is now covered by Annual Reviews.”<sup>15</sup>*

*“When I wrote my Annual Review, there was a critical issue that the community had been grappling with for 40 years. My colleague and I looked over a lot of different measurements and figured out where the truth was. The review convinced the astronomical community that dark matter actually exists, and was very influential.”<sup>16</sup>*

Substantial “macro-reviews” are not an insignificant investment for the publisher or for the author. They tend to be written by senior scholars, as a personal contribution to the field outside of their funded projects, and are widely considered to be a “coming of age” for the discipline. Critical review authors have different incentives than authors of primary research, for whom the relevance of publication to career advancement can lead to salami slicing of research into minimum publishable units. “Our authors are anxious to define a field, to contribute to what is thought and known, and to how that field can launch itself into the funded future,” explains Ike Burke, retired Director of Production at Annual Reviews. “A substantial macro-review, fully vetted and carefully polished, is going to play a significant role in getting funding to happen.” By selecting and commissioning authors not only to review the field but also to suggest the direction that its development should take, macro-reviews also shape the ongoing intellectual conversation.

## BROADENING ACCESS TO EXPERTS

*“The single most important step toward [making each review as informative and useful as possible] is surely the selection, in the first place, of the author (or co-authors) of a given chapter. It is no secret that an author’s expertise on a topic, multiplied by his or her creativity and perspective, is the number one ingredient of a successful chapter.”<sup>17</sup>*

Annual Reviews commissions reviews from leading scientists, who are vetted and recommended by editorial committees. Editorial committees are themselves made up of the world leaders in each discipline—including Nobelists, members of the National Academies of Science, heads of major institutions—who understand what literature is missing and have sufficient prestige and influence to

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<sup>15</sup> Lo A, Merton R. 2009. Preface. *Annual Review of Financial Economics*. Vol. 1

<sup>16</sup> Faber S. 2010. Interview with the author

<sup>17</sup> Durham WH. 1997. Preface. *Annual Review of Anthropology*. Vol. 26





invite and secure contributions from the best of their colleagues. Despite the onerous responsibility of writing a 20-25 page macro-review of an entire sub-field, acceptance rates are high. “To be asked to do an Annual Review is to be acknowledged, by the luminaries in your field, as the expert in your topic,” explains Richard Zare, Marguerite Blake Wilbur Professor of Natural Science, Department of Chemistry, Stanford University and Chairman of the Board of Directors of Annual Reviews. Authors usually have about nine months to one year to submit their paper, which will then be given a technical review by an editorial committee member.

## IDENTIFYING FUTURE HOT TOPICS

*“What are the growing points that they see ahead? The promising hot spots for future research? For that matter, where are the remaining weaknesses, gaps, and unknowns?”<sup>18</sup>*

Persuading the world’s best scientists to contribute considerable time and expertise to commissioning and reviewing manuscripts should not be an easy task. “Our editors are well respected, and they don’t need to be on the board of a review journal,” says Jennifer Jongsma. However, editors commit to working with Annual Reviews for two key reasons. First, there is a public service aspect of giving back to the profession, and helping to bring clarity to particular aspects of a field that are not currently well served by the literature. Second, the editorial committees represent a community of leaders within their respective fields. Members convene annually to discuss emerging trends and consider potential authors; guests will be invited, particularly to help broaden the international perspective. The process is forward-looking; planning, writing, and production can take two years, so it’s important to consider whether the field will be sufficiently mature within that period or whether it is too early to commission a review. Meetings are “like a series of mini-lectures,” says Sam Gubins. “Each editor proposes a topic and explains why it is important enough to warrant a chapter. Everybody participates in that conversation, and learns about the ideas that are circulating in their disciplinary niche. At the end of a five-year term, departing members often tell me that it’s been one of the most valuable experiences they’ve had in their scientific career.”

## SCIENTIFIC FREEDOM, BREADTH, AND DEPTH

*“Invitations to write an Annual Review chapter typically elicit some mix of thrill, dread, pleasure, indecision, burden, intimidation, and challenge—not unlike commencing one’s PhD or undertaking a skydive.”<sup>19</sup>*

Editorial committee meetings culminate with agreement on anywhere from 35 to 60 topics on which authors will be invited to submit reviews. Beyond their desire to help shape and define their field, authors’ motivations for writing an Annual Review range from prestige, visibility, and impact, to the freedom, scope, and length they are given to cover a broad field in some depth. The editorial committee encourages authors not only to digest a topic but also to put forward a vision for its

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<sup>18</sup> Durham W. 1999. Preface. *Annual Review of Anthropology*. Vol. 28

<sup>19</sup> Fiske S, Schacter D, Zahn-Waxler C. 2001. Preface. *Annual Review of Psychology*. Vol. 52



future in their field. “The Committee prefers each review to be a critical appraisal of the current status of knowledge on a topic, based on the significant rather than the total literature available. It is important for each review to be accessible and interesting to a general anthropological readership. This means not only that jargon should be avoided but also that any necessary technical terms should be defined in the text. Within these guidelines, each author is encouraged to express his/her own views and interests.”<sup>20</sup> Sandra Faber attests to this impartiality: “I wrote a review that I knew was diametrically opposed to the editor’s view, and I wondered if he would let me publish. He wrote back saying, ‘I disagree with everything you’ve said, but it’s a very well-written review and we will publish it.’”

## ADDING VALUE

*“Your editorial changes are really excellent. Both of us thank you for your expert assistance in improving our manuscript.”<sup>21</sup>*

*“I can say that I have never, ever, had a manuscript look so good. Usually I put my published manuscripts in a file cabinet somewhere. This one I’d like to frame. Thanks again for all your hard work on it.”<sup>22</sup>*

*“In all of my 25+ years of publishing here [in the Department of Molecular Genetics], I have never had an editor ever make an improving change in a figure, but you made several! Thank you!”<sup>23</sup>*

Authors usually write their review within nine months to a year of being invited. (If for any reason an author is unable to complete a review, the topic is returned to the committee for consideration, to ensure it is not bypassed altogether.) The paper is submitted first to the production editor, who will pass it to selected members of the editorial committee for technical review. The committee members will identify serious errors, as well as technical corrections and improvements (such as whether the figures are clear and illustrative) and will also ensure the paper takes a broad enough view. For example, the review must not be too focused on the author’s own work. For the most part manuscripts are quickly approved. “We have a very low rejection rate,” says Jennifer Jongsma, “because the articles are commissioned from highly experienced authors.”

Once accepted, the copyedited and reviewed manuscripts are then revised and approved by the author before entering the “Review in Advance” pre-print service. Papers may appear on this online service up to 6 months before the final publication date because each journal publishes one volume on the established publication date each year. Additional improvements are made to the pre-print version, with continued input from the author. “We serve the scholar as deeply and substantially as we can, to make review creation easy and rewarding, helping with linking, illustrations, reference look ups, and error correction,” says Ike Burke. The Annual Reviews illustration department is able to add particular value by revising and redrawing images, which authors then go on to use in

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<sup>20</sup> Durham W. 1999. Preface. *Annual Review of Anthropology*. Vol. 28

<sup>21</sup> Dr Rodger McEver, Member and Program Chair, Cardiovascular Biology Research Program at the Oklahoma Medical Research Foundation, Co-Author within Volume 26 of the *Annual Review of Cell and Developmental Biology*

<sup>22</sup> Larry Blume, Professor at Cornell University, Co-Author within Volume 2 of the *Annual Review of Economics*

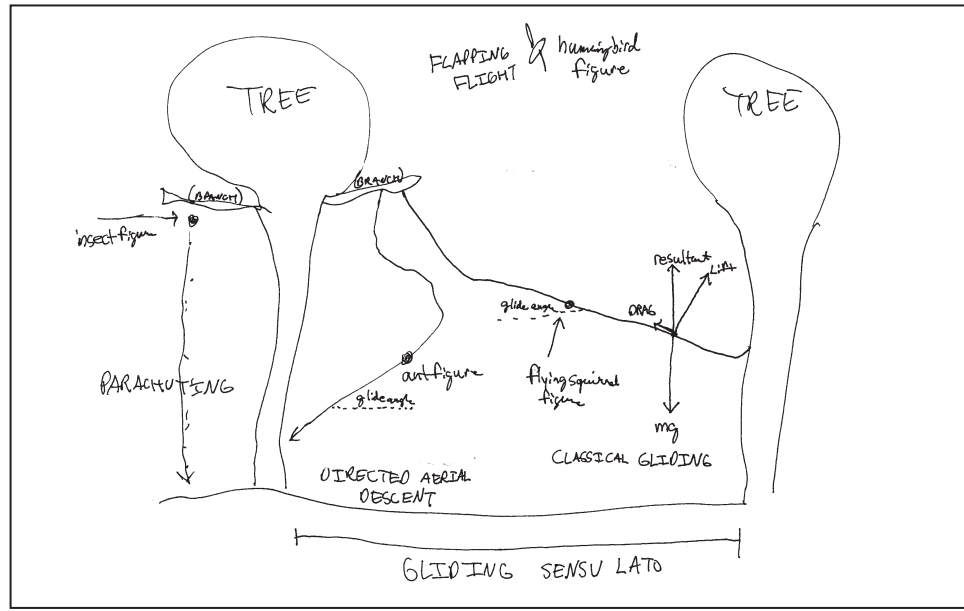
<sup>23</sup> David Russell, Professor at the University of Texas Southwestern Medical Center, Co-Author within Volume 78 of the *Annual Review of Biochemistry*



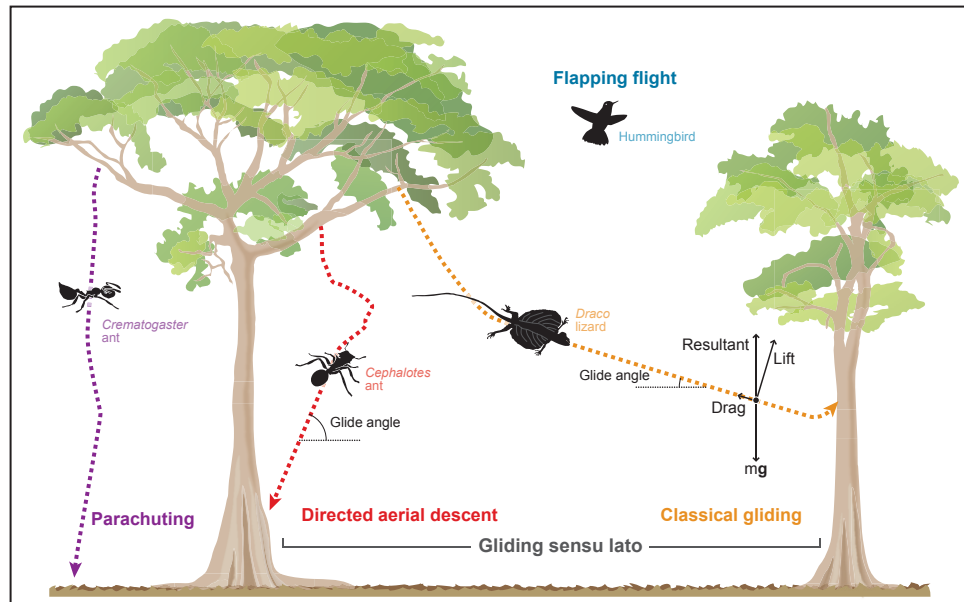
presentations and other publications; the example below shows how authors' original illustrations are made easier to read and the concept or processes they represent made easier to assimilate. "The question we're always asking is, what can we do to enhance the value of this communication for the students and the researcher?" explains Sam Gubins.

## ILLUSTRATION ENHANCEMENT EXAMPLE

**BEFORE:**



**AFTER:**



## NOT-FOR-PROFIT PHILOSOPHY

Annual Reviews was established by scientists as a not-for-profit organization to serve scientists, and that ethos still pervades its activities. “We really are not for profit,” says Richard Zare. “I don’t know another publishing house that operates in the same way.” Sam Gubins agrees: “Our mission is dissemination.” A comparison of Annual Reviews journals’ pricing to other review journals shows that they are a good value for the money. Even in a climate where libraries have seen budget cuts of 30%, Annual Reviews subscriptions are steady. “We offer reasonable prices, and our articles are read and used by students and faculty,” explains Jennifer Jongsma. “In everything we do, we try to adhere to our mission statement. Community needs drive commissioning and the editorial committee reviews every article. At every step in the production process, we work to make the manuscript better.”

## DEFINING IMPACT

*“A substantial use of Annual Review articles is for teaching. That impact is hard to assess, because articles that get downloaded for teaching are not necessarily highly cited. It’s a way to be more current with a broad area.”<sup>24</sup>*

Review journals typically achieve higher impact factors than journals predominantly publishing fast-moving original research, as reviews provide a snapshot of the field over a period of time, which is then commonly used—and cited—as an introductory source and a conduit to other key material. Consequently, Annual Reviews journals are consistently ranked in the top 3 for their respective categories in Thomson Reuters’ Journal Citation Reports. Annual Reviews journals also function as a record of the longer-term development of science. “As the frontier expands, as the edifice of science is built, it has to be documented,” continues Sandra Faber. “There are so many lessons to be learned in understanding where you are, what is known, and how you got there; the knowledge of how you got from point A to point B is going to help you get to point C.” Recording this history in one place increases the duration value. “Annual Reviews statistics show a longer half-life of citations because their papers are really important pieces of work—in depth and breadth—that are still important and still cited 15–20 years after they are published,” explains Sabeeha Merchant, Professor of Biochemistry, University of California, Los Angeles. “We’re lucky, as a not-for-profit organization, to be able to look beyond how much money an article makes, or how many downloads it has, and consider instead whether it contributed something to the field,” concludes Jennifer Jongsma.

“As the waterfall of information crashes over us, we get more concerned with limiting the quantity that we have to deal with,” says Ike Burke. “Network-based scholarly interaction has transformed science—our role is to keep translating our core reviewing function to new media, to keep watching, attending, learning, and determining what scholars really need, so that when they need us, we’re where they expect us to be.”

Annual Reviews’ vision for the critical review of tomorrow is shaped by its ongoing research among early-career scientists, and can be structured into three key areas: skills and responsibilities, technologies, and contextual content.

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<sup>24</sup> Merchant S. 2010. Interview with the author.



## VISION FOR: SKILLS AND RESPONSIBILITIES

Today's digital natives will be the researchers of the future. As **readers**, their experiences in reviewing, selecting, and digesting multiple sources of data from an early age will help them to develop different information skills that will complement their scientific expertise and enable them to keep up with the wealth of relevant information. The online survey respondents suggested that information overload would be partially overcome in the future with improved skills in reading ("learn to skim better") and overall time management ("streamlining other aspects of the research process").

The next generation of **authors** will also be more technologically savvy, and will be capable of adopting responsibility for aspects of the production process that will support easier navigation, interpretation, and application of their work once it is published. Respondents' suggestions ranged from "better abstracts, summary points, and conclusions" for quick analysis, to "embedding of ontological terms" to facilitate semantic data mining and cross-referencing.

Respondents suggested that **editors** take on a strong role in alleviating information overload by pre-selecting and recommending important content, and facilitating access to it, for example with selective editorials. The journal as a branded entity will continue to play an important role as the gate-keeper, providing a first level of evaluation and selection, and saving readers' time in finding good quality, relevant content.

The role of the **librarian** as information curator is evolving, as is the role of the **publisher** as information provider. David Nicholas, Professor and Director of the Department of Information Studies at University College London, asserts that disintermediation has transformed the information landscape and information seeking behavior during the past 10 years.

*"...the removal of the intermediary (typically the librarian, but sometimes the publisher) from the information seeking chain...means we are all librarians now, and have to behave like them—constantly reviewing and validating data."<sup>25</sup>*

To be effective and relevant, both librarians and publishers must understand "information seeking behavior in the digital space." Annual Reviews continues to introduce review journals in additional scientific disciplines and is also investing in new delivery methods for journal articles. To aid in the discovery of relevant information, each Annual Reviews article is linked to other articles through "relatedness" features which connect authors, citations, and keywords. Users can learn from other users via the extensive "chain of reviews," which can perhaps stimulate future research ideas and directions.

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<sup>25</sup> Nicholas, D. 2010. The Virtual Scholar: The Hard and Evidential Truth. *Digital Library Futures, User Perspectives and Institutional Strategies*. IFLA Publications Vol. 146



## VISION FOR: TECHNOLOGIES

Research workflows are becoming increasingly oriented around technology, and users' technological literacy is increasing. Although this has created new tools for finding, storing, and sharing academic materials, there is no evidence that algorithmic alternatives are detracting from traditional mechanisms and trust networks. The survey showed that technology-oriented solutions such as social bookmarking and search engines were less influential in selecting reading material than recommendations from colleagues and peers, reference lists in other material, and the journal brand. Nonetheless, respondents anticipated that usage of RSS readers, algorithmic article recommendations and social bookmarking would all increase. One proposal, for more granular RSS feeds and email alerts (allowing the user to filter by keyword, author, and research group), supports the expectation that our ability to overcome information overload in the future will depend on the quality of the metadata that is added—by authors, editors, and readers.

Better metadata will also support greater interoperability and integration across multiple information sources, which will improve readers' ability to follow research paths and help to increase the visibility of critical research by emerging authors. Several respondents suggested that improvements to search functionality, including better results clustering and ranking of multiple keywords, would help them to filter more effectively and isolate particularly relevant research.

The Web 2.0 generation will also be more expectant of interactivity and more willing to engage in ways that their predecessors have not, for example, post-publication open review, comments and discussion, suggestions for new and updated topics. Open comments and ratings, in particular, will help save readers time in evaluating content.

As ongoing projects demonstrate, scientists feel strongly that factors and rankings relating to impact and quality should be established at the level of the article, or attached to the author, rather than the journal. Rachel Ruhlen, a Research Assistant Professor at A.T. Still University, explains, "Good journals publish bad papers sometimes, and good papers can be hidden in insignificant journals. Impact factor is useless in determining the quality of a study or review." Allowing the community to rate the significance of selected articles, as well as supporting the development of metrics such as the *h*-index and Eigenfactor, will begin to change the way in which content is evaluated and selected.

Technology will also enable other mechanisms for helping readers to evaluate and find information, including audio and video article summaries, autolists and behavioral targeting of relevant articles, and mobile applications to enable searching and capturing of relevant content. Mobile technologies will make time away from the lab more productive, enabling scientists to evaluate, log, and prioritize articles in their reading list. Annual Reviews is working with multiple partners to exploit mobile technologies in different ways. Apps and website innovations have been developed to facilitate productivity, including enabling users to access institutional resources off campus.

## VISION FOR: CONTEXTUAL CONTENT

Although many publishers are already creating additional materials to support journals, they are not always in line with readers' needs. Survey respondents suggested a number of contextual content options that they anticipate will help them to overcome information overload:

**Author-related content**, such as interviews, commentaries, debates, and profiles, will provide readers with a bite-size entry point to content, helping them assess its relevance and key points. Giving authors more prominence will further increase the accessibility of experts that Annual Reviews seeks to offer. The development of "micro-views" would offer readers an alternative to the macro-review, providing metasummaries (similar to summary points), and the division of the full text into tabbed or anchored sections. Each section would be headed with a summary, to help readers skim through the text more effectively and focus on key points. The advantage of combining micro and macro in this way is that the full macro-review text is readily available when the reader does reach the point of wishing to drill down into greater detail.

Critical reviews are by nature educational tools, and often draw students and professionals into working in a specific subject area; as such, **teaching needs** will increasingly drive the development and licensing of extractable article elements, such as figures, slides, and interactive text excerpts. "I'm not an expert in all areas, and I don't just like to teach out of the textbook," says Sabeeha Merchant. "Using Annual Review content is a way for me to be more current with a broad area." Building on the audio and video content currently integrated to aid teaching will also enable greater currency of contextual content, with news updates, citations, and opinion pieces all integrated for teaching as well as RSS and email alerting. Annual Reviews is already experimenting in this area, with licensing and technology support for online syllabus creation to help faculty use Annual Reviews content in teaching. The organization also offers flexible terms that enable authors to use Annual Reviews content in institutional repositories through unique and trackable URL codes. Authors are encouraged to disseminate their articles in this fashion, thereby supporting their research community and the mission of Annual Reviews.

## CONCLUSIONS

Information overload is not a new problem, but technological and cultural change have created new challenges even while resolving others. In the midst of that change, scientists' requirements and behavior in relation to selecting and reading literature remain relatively constant, with slow adoption of digital alternatives. While this might suggest that existing mechanisms are meeting their needs sufficiently, many believe that an important shift is on the horizon. For a publisher such as Annual Reviews, it means nurturing the timeless valuable concepts and services at the core of current products, while anticipating future changes in research workflows, reading behavior, and technological expectations. By experimenting with new ways of structuring and delivering valuable content, Annual Reviews will continue to serve the future needs of scientists.

### ABOUT THE AUTHOR

Charlie Rapple is head of marketing development at TBI Communications, which offers strategic consultancy and marketing implementation to publishers and societies around the world. Charlie speaks regularly at conferences and frequently authors papers for industry publications including *Learned Publishing*, *Serials*, *Against the Grain* and *Research Information*. She holds a BA Hons from the University of Bristol and a Postgraduate MDip from the Chartered Institute of Marketing, of which she is a chartered member.

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