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Science or Snake Oil
Scholarship and Peer Review in the Digital Age

Aliases, call routing centers, internet and phishing scams, counterfeit metrics of quality, unregulated but lucrative trade in deception: none seem associated with scholarship and science... until recently. How do you know if a scientific publication is objectively true or accurate? How do you know if policy makers' decisions are based on the best available science? Now, perhaps more than ever, what you see is not always what you get regarding scientific journal publishers and scientific publications. For over 300 years, the editors, associate editors, and ad hoc reviewers of academic journals have generally served as the gatekeepers of quality science for use by scientists, citizens, and policy makers, reviewing and publishing articles that are expected to report reliable, scientifically sound research. Journals use editors who are experts in their respective fields of science as well as editorial boards populated by nationally—or internationally—recognized experts in their respective disciplines. These scholars carefully vet each article before publication. Using a process called "peer review," at least two scientific experts (ad hoc reviewers) read and assess the validity and relevance of articles submitted for publication. Thorough reviewers spend hours scrutinizing the manuscript, providing constructive comments that improve the quality of the manuscript or of the study being described and make a recommendation to the editor on whether or not the paper should be accepted subsequent to appropriate revision or rejected outright. Peer-reviewed journal articles are the hallmark of trusted science and quality research around the world. Moreover, the peer review process itself is a service that helps researchers in a variety of ways: to hone their efforts, to improve the presentation of their results, to make them aware of related research results, or to realize the broader significance of a seemingly idiosyncratic result. As a result, the peer review process hastens learning among young and old researchers within the discipline.

There are many more scientific journals now than in any time in the history of science. Some are open-access (unrestricted online access to peer-reviewed scholarly research); some are subscription-based. Some are fraudulent, claiming peer review and lying about it, and some are reputable (having a traditional peer review format comprising a chief editor, associate editors, ad hoc reviewers, and copy editors). Fraudulent, non-peer reviewed journals are aided by, and have undoubtedly proliferated on the back of, the open-access movement and online publication. This is simply because there is no or very little overhead or personnel cost in running a journal that electronically publishes submissions without peer review. For example, if the journal is not printed and no editor, associate editor, ad hoc reviewers, or copy editors exist, little to no funds are required to print and mail the journal or pay people to run the journal and find appropriate experts for peer review. In fact, institutes of higher learning in the US by
default pay most of the personnel costs of peer-reviewed scientific publishing because they employ many of the researchers that both produce and review the results. Moreover, at least for some journals that are run by scientific societies, the editor, for example, may work for very little additional pay (usually from the sponsoring society) or she/he may work for free. At least for now, associate editors and reviewers typically volunteer their time to the journal. Open-access journals require that the author pay a high fee (sometimes reaching thousands of dollars), such that the number of accepted articles is directly correlated with journal revenue. This comprises an obvious conflict of interest to the goals of peer review. Under this model, the scientist/author, not the reader/consumer of the information, is the paying customer. Although difficult to assess, this fee-based form of publication seems to be at odds with scrutiny of science.

As a result, scientists nowadays must be careful about the journals they cite and use to publish their work. This was highlighted by a recent “sting operation” conducted by an industrious biologist and several of his close colleagues, who also were frustrated with the rapid proliferation of fraudulent open-access journals. In 2013, John Bohannon, a trained molecular biologist who now is a journalist, used numerous pseudonyms to submit a series of “research papers” based on “hopelessly flawed” imaginary experiments to 304 allegedly peer-reviewed, open-access scientific journals. The shocking and rather disheartening result was that over half (157) of the submissions were accepted for publication (Bohannon, 2013). This practice of testing the fence of peer review and publication practices is not new, and it occurred before the open access movement. For example, in 1994, physics professor Alan Sokal submitted a sham article to a peer-reviewed journal (that was not open access) that subsequently accepted it for publication. The so-called “Sokal Hoax” (Sokal, 1996) instantly became a marquee example of a work that aimed to point out flaws in the peer review system. Again, these flaws were clearly unrelated to the practice of open-access publishing, which had not bloomed until several years after Sokal’s hoax. We mention this here to simply acknowledge that peer review is not perfect, although perhaps the best option given the alternatives.

The Internet and open-access publishing have undoubtedly created great opportunities for disseminating science on an unprecedented scale. But the benefit of this is also the threat: pseudoscience is now more available to the public than ever before via the Internet and open-access. If anyone can start a journal and publish articles that are not peer-reviewed, then the traditional barriers to rejecting pseudoscience or disreputable research have been cut away. Disreputable publishers exploit this trend, creating publications that use the pay-to-publish open-access model to make money and thereby generating a market for science wherein the consumer is the author (who pays the publisher, in effect purchasing a publication)
rather than the journal subscribers and readers (who pay to subscribe as readers of the content). Noteworthy is that the advertisements for these journals are not targeted toward readers but rather entice authors with the promise of quick turn around times or guaranteed acceptance of their work. Widely referred to as “predatory journals,” these outlets oftentimes lack an editorial staff or editor with any scientific credentials; in short, they are not qualified to assess the scientific rigor of the submissions or conduct any semblance of peer review. Instead, the “editor(s)” may perform a perfunctory “review” of the article, or the article may even be accepted with little or no review at all. The consumer (the author) receives the product they paid for: a “peer-reviewed publication” without the hassle of actually revising their manuscript because it was never peer-reviewed and assessed.

One annoying symptom of problems associated with scholarly publishing in the twenty-first century appears to be spam emails. Such emails solicit scientific article submissions to fraudulent journal publishers and have become commonplace on university campuses, filling the inboxes of researchers and educators. The trend has spiked in the past 3-4 years. One of us (Ash Bullard), after having received a few consecutive spam emails from a known predatory journal publisher, decided to call the phone number that allegedly belonged to the editor of the journal. The call went through a Nevada call routing center and connected to an international call center. The person who answered the phone claimed to be a researcher and the editor of the journal in question but refused to give his name, detail his field of study, name the journal, or detail how manuscripts were processed and handled. The conversation ended as the self-identified “editor” told Bullard to “shut up” (i.e., stop asking questions). As another example, Bullard emailed the person listed as an associate editor for a presumptive predatory journal. The person who responded to the email said that he had resigned as associate editor many months earlier due to the lack of standards but the journal’s staff would not remove him from the website nor respond to confirm his resignation. Also substantiated is that some of these fraudulent, predatory journals use pseudonyms and made-up online identities to fool researchers into thinking that an editorial staff exists and/or has the expected credentials. Other predatory publishers promise one to seven-day turn-around times from submission to acceptance, clearly demonstrating that peer review and copy-editing is absent, despite the claim otherwise. These fraudulent publishing operations produce a large number of works disguised as legitimate
publications; however, in reality these works never undergo peer review. Some of these publications comprise pseudoscience that can unwittingly be accepted as robust, vetted science by researchers, students, and policy makers. Again, this is a threat to science and society. It’s also a threat to a student’s term paper, as many faculty require students to reference only peer-reviewed works. Likewise, journal editors typically do not allow authors to cite non-peer-reviewed works.

**Roundtable Discussion**

On Monday, April 28, 2014, we gathered to discuss the threat level of fraudulent journal operations to research science and learning, higher education, the public’s trust in scientists, and policy making. Our collective worry is a typical one among academicians: there is a growing number of publishers who lie about flow or if submissions are peer-reviewed, claiming to conduct peer review while never soliciting reviews but accepting all submissions regardless of the reviewers’ recommendations. If no paper is rejected, the claim of peer review is dubious. It is clear that dishonest and deceptive publishers are proliferating and contaminating the body of peer-reviewed scientific literature. This contamination disrupts, misleads, and confuses the public, the media, policy makers, educators, and students.

Although clearly most faculty at Auburn University can advise students and colleagues on how to identify a fraudulent and/or non-peer reviewed journal, stand-alone consumers of “published” information (students and the public) may not be as informed or discerning. This scenario leads to confusion, erodes trust in science, and might even be a turn off for students considering a career in the sciences.

**Evaluating Scholarship**

The roundtable members comprised editors of peer-reviewed scientific journals and regular ad hoc reviewers for international peer-reviewed journals. Some members, however, were supervisors of university faculty, department chairs and heads, or school directors. These members in particular expressed concerns about the ability to evaluate faculty research if the proliferation of fraudulent journals continues. Most tenure-track and tenured faculty at Auburn University must publish their work in peer-reviewed journals to be promoted and earn tenure. But, faculty and department heads and chairs must decide what counts as an acceptable research product. For the sciences, a “publication” typically means an original article that is published in a peer-reviewed scientific journal,
including both open-access and traditional print/online journals.

Graeme Lockaby, Interim Dean for the School of Forestry and Wildlife Sciences, evaluates faculty regularly as part of his administrative duties and argued that this is a question of fairness: "Predatory journals, in my opinion, shouldn't be comparable to peer review in promotion and tenure decisions and in the annual review of faculty. To me, at least in the context of the world I deal with, this is an enormous problem: trying to have a level playing field where everybody is evaluated equally." All faculty should be held to the same or comparable standards, but logistically, this level of fairness is difficult to achieve when administrators and other faculty must evaluate other faculty's publications without sufficient knowledge about the journals in which they are published. Other members of the roundtable discussion added that commonly used ratings services, such as Web of Science, do not measure all peer-reviewed academic journals, especially regional journals critical to local research and policy; for example, many fisheries journals are regional, but they are critical for informing fisheries management decisions on behalf of regional natural resource agency personnel. Another hurdle to consider is the time required to "validate" each journal publisher. An applicant for tenure and promotion may have dozens of articles collectively published in tens of journals, requiring the assessor to confirm the legitimacy of the numerous journals in a very short time window.

In the context of evaluative processes and quality metrics in academia, the roundtable discussion also underscored the delicate (and highly contentious) interplay among many elements of academic journal publishing: traditional vs. open-access journals, journal impact factor, acceptance rate, and peer review. It is a daunting task to succinctly treat these matters herein, given the diversity of views and the space limitations of this article. But we try.

Regarding impact factor: depending on the specialization, researchers publish in journals with a range of impact factors. Medical researchers, for example, typically have access to journals with high values, whereas researchers in the natural sciences typically publish in journals with lower values. It is undeniable that impact factor currently is one of the most widely accepted metrics for assessing the scientific prestige of a given journal (inferred from how often its content is cited) and, by extension, that of the science published therein, the author, and the author's institution. However, impact factor can be difficult to apply evenly in the context of evaluation across disciplines and to the researchers operating within them. Also, because some fraudulent journals have adopted various dubious imitation metrics of impact, it is perilous to use the term, "impact factor" (sensu lato) alone as an indicator of journal legitimacy and quality. A barrier to assessing legitimacy of publication metrics, including ISI impact factor (broadly considered the strongest impact factor metric), is that information may be proprietary. For example, by Jeffrey Beall, Scholarly Communications Librarian at the University of Colorado-Denver and founder/curator of Beall's List and Scholarly Open Access, writes "because true impact factor information — the data supplied by Thomson Reuters' Journal Citation Reports — is proprietary, it can be hard to verify
publisher impact factor claims" (2014) Amazingly now, some fraudulent companies offer an impact factor for a fee, the equivalent of purchasing a fake certificate of journal authenticity. On his website, Beall (2014) states, “I wish there were an easy and quick way for scholars to determine whether the impact factors assigned to a particular journal were bogus or authentic. At this time, my list of misleading metrics is the only source I know.” Moreover, we know of two fraudulent predatory open access journals that were assigned ISI impact factor values (these impact factors were later revoked). In addition, citation metrics for researchers such as the h-index (an ordinal ranking of how many times a person’s publications have been cited by others) could theoretically be manipulated by exploiting predatory open-access journals. For example, an author could publish under a pseudonym and then pay to publish articles that cite their legitimate, peer-reviewed works. As a result, a search engine such as Google Scholar Citations, which indexes predatory journals, would count citations sourced from the predatory journal publications toward the h-index value of the author’s real name. Moreover, different h-index sources (such as Scopus, Web of Science, and Google Scholar Citations) yield different h-index values, and the variation can be large.

Regarding rejection rate, it is a common perception, quantitatively accurate or not, that manuscript rejection rate and journal impact factor are directly proportional. In other words, low-impact factor journals reject fewer submissions. Although fraudulent, non-peer-reviewed open-access journals and regional journals with low-impact factors may both have low-rejection rates, the reasons for this numerical coincidence should not be blended or confused. Predatory open-access journals accept all submissions because their profits are proportional to the number of accepted submissions. In stark contrast, there are many legitimate peer-reviewed journals that have a narrow scientific focus or regional significance. These journals may also trend towards having low rejection rates simply because they have proportionally fewer submissions coupled with a service mission for the supporting society that runs the journal.

Although no member of the roundtable argued that publications in fraudulent non peer-reviewed open-access journals should be counted towards tenure and promotion, some did argue that works published in low-impact factor journals should not count towards tenure and promotion (this includes both fraudulent non peer-reviewed journals and legitimate peer-reviewed journals with low-impact factors). Others argued that all legitimate peer-reviewed and published work should count equally, regardless of how the work is disseminated or the level of impact factor. Perhaps these beliefs vary according to academic lineage as well as institutional research diversity and culture. Nevertheless, these aspects are indeed relevant to how faculty are assessed, and all of these issues are being magnified by open-access. For example, low standards for tenure and promotion, or lack thereof, could be viewed as creating demand for fraudulent open-access scientific journals.

Educating Students

Along with publishing their own research, faculty members collaborate with undergraduate and graduate students on research projects. Much
of this process involves teaching students how to locate, evaluate, and use other scientists’ published research. All roundtable participants expressed concerns that students, who often struggle to evaluate quality of a research publication, will encounter similar problems when evaluating journal quality. Henry Kinnucan, Professor of Agricultural Economics, stressed the necessity of teaching graduate students how to evaluate journals before using them or submitting article manuscripts to them: “PhD students in my field have to have at least one article in a reputable journal to be competitive in today’s job market. Given the difficulty of getting work accepted by reputable journals (acceptance rates are less than 50 percent) PhD students are particularly vulnerable to predatory journals.” Students do not always recognize that just because something is published on the web and is available through search engines like Google, it’s not always valid, peer-reviewed research. Accordingly, the doctoral program in Agricultural Economics formally teaches students how to evaluate journals: “The program includes a required course wherein students learn the mechanics of writing for journals. Students are taught how to identify important contributions to the literature and how to steer clear of dubious contributions.”

As more and more academic writing is published online, students at all levels—including undergraduates doing research—need to have better awareness of how to spot fraudulent, non-peer-reviewed work. Dennis DeVries, Professor of Fisheries, Aquaculture, and Aquatic Sciences, argued, “It’s not that we’re saying, ‘Don’t use Wikipedia.’ It’s about educating students on what it is you’re looking for. There are some very nicely written, peer-reviewed publication-supported topics. There’s also some exceptionally poor work that is published. It’s trying to educate students on how to tell those different published works apart from each other.”

**Preserving the Public Trust**

Ultimately, the missions of scientific research are to help educate and inform society as well as to solve important problems. In return, American taxpayers fund billions of dollars of scientific research each year. Obviously, such a relationship must be built on a foundation of trust. If the public believes that scientists are publishing fraudulent research, they will be less inclined to fund that research and more likely to distrust scientists. Bullard argued that educators should do more to educate citizens about the process of scientific publication and help them understand the meaning of peer review. The public may see no difference between an outlandish pseudoscience article published in a non-peer-reviewed (fraudulent) journal and an article in a legitimate, peer-reviewed scientific journal. “Without an understanding of scientific peer review and publication, the public may think that reputable journals and predatory journals are all the same. So, the public views them equally, which destroys the credibility of the good science—it just rips the credibility away.” This problem is compounded by the fact that non-academics generally do not understand information published in journals or, more likely, are too busy in their work and personal lives to assess it, so they rely on news outlets to boil down
and generalize the science. News outlets, however, do not typically distinguish between information derived from non peer-reviewed journals and that obtained from peer-reviewed journals.

**What Can You Do?**

The informed and discriminating student, staff, and faculty researcher can be part of the solution by simply refusing to publish their work in fraudulent or predatory open-access journals. Yet, fraudulent journals are not always easy to spot, even by seasoned researchers. Being duped into publishing good science in a fraudulent journal may be professionally damaging to an author and diminishes the impact of the science being reported. The assumption is that the research itself is poor if published in a predatory/disreputable/fraudulent journal. Below we provide a few simple actions, among many other potential ones, that can help ensure fraudulent journals are avoided.

Refer to “Beall’s List: Potential, possible, or probable predatory scholarly open-access publishers” on Beall’s website (2014).

Curated by Beall himself, “Beall’s List” is a clearinghouse of journal publishers that are “questionable, scholarly open-access publishers” as per a list of criteria related to the journal editor and staff, business management, integrity, and other miscellaneous criteria. It is the only list of its kind that is as widely accepted and trusted. As of November 13, 2014, the list included 654 publishers. The site is transparent, and any listed publisher may appeal. If a journal is listed there, take pause and dig deeper before considering a submission. Beall’s “Scholarly Open Access” website is an invaluable source of current information and trends in open access publishing.

**Refer to Journal Citation Reports and consider journal impact factor.**

The topic of impact factor was not our focus for the roundup but it plays a role, however contentious, in assessing the quality of a peer-reviewed scientific journal. Again, however, realize that some fraudulent journals have been assigned real impact factors related to Thompson Reuters’ Journal Citation Reports. Impact factor can be measured at different scales from one year to five years, with three-year and five-year impact factors being typically reported. If considering a new journal (one that is less than three years old), perhaps more caution should be used in checking the credentials, costs, and publication processes associated with that journal. We emphasize again that some fraudulent journals have created imitation, impact factor-like, metrics that obviously are meant to be mistaken for ISI impact factor. We recommend that authors refer to Beall’s (2014) discussion of “Misleading Metrics” on his website.

**Scrutinize the journal's scope alongside the research credentials of its editor and editorial board members.**

A journal with a well-defined scope and relevant editors helps ensure robust peer review. Legitimate peer-reviewed scientific journals are well circumscribed regarding scope of the research they publish. Moreover, the editors and associate editors of the journal will have the scientific credentials such as publications in the field of study that help them locate qualified reviewers to assess submissions. If you see a marked mismatch between the stated scope of the journal and the expertise of the editor or associate editors, take pause.

**If doubt remains, call or email the editor.**

Editors of legitimate peer-reviewed scientific journals are willing to correspond and answer legitimate questions regarding journal scope and their peer review process. Fraudulent, predatory publishers may lack scientists’ functioning as editors. As such, the point of contact for the dubious journal may be obviously unfamiliar with the field of specialization within the journal’s stated scope.
In addition, many, if not most, fraudulent publishers attempt to hide their actual geographic location. Knowing, with certainty, the identity of the journal staff and where they are located is a simple but critical bit of information that can help reveal a fraud (keeping in mind that call routing centers are often used to cloak the location). A conversation using human voice or email correspondence may quickly expose fraud.

**A Brave New World for Scholarly Publishing and Scholars**

Clearly, it is a brave new world for scholarly publishing and young scholars. Frankly, undergraduate students and graduate students in the sciences are and will continue to be, confronted with new professional hazards like open access predatory journals. Noteworthy is that this hazard did not exist when the vast majority of present-day professors (including the authors of this work) were matriculating through their graduate programs. As such, the roundtable agreed that mentorship and communication are key elements of graduate education. For example, scholarly awareness can be hastened by mentorship of students and young researchers regarding reputable journals, the peer-review process, and editorial structures of reputable journals. Communicating about what a reputable journal “looks like” helps identify those that are fraudulent. Certainly, increasing scholarship in high impact factor journals (calibrated for the field of study and career stage of researcher) and avoiding predatory journals go hand-in-hand towards boosting the university’s academic reputation and simultaneously enhancing the students’ post-grad job prospects.

We hope that this roundtable discussion and the present article are relevant to research and publication standards in academia, fairness and integrity of faculty evaluation processes, ensuring high caliber student research training, enhancing public understanding of science and scholarly communication, and spreading awareness of fraudulent journals among academicians. In short, we hope it contributes to the call to arms regarding pseudoscience and fraudulent scholarly publishers. Another productive outcome of the roundtable discussion and the writing of this work was that we clearly identified notable differences among disciplines as to the importance of quantitative metrics of quality such as the different uses of journal impact factor and varying metrics among the diversity of citation indexes. Concurrently, some discussion glanced the notion of university and departmental guidance on journal targets for publishing Auburn University-sponsored research. In other aspects, these discussions touched upon the need for a given university to compete for national rankings while simultaneously serving the specific career goals of its students, teachers, and researchers as well as the needs of its stakeholders in the context of the land-grant mission. University scholars seldom agree unanimously (especially regarding standards and metrics of quality across disciplines) but an important outcome of these discussions was unambiguous, broad consensus for increased awareness (particularly among students and young professionals) about the existence of, and characteristics of, predatory journals. Clearly, publishing in such fraudulent journals represents a potential threat to the reputation of Auburn University and, more broadly, to the public trust in the scientific enterprise.

We hope that this narrative helps promote continued discussion and debate on these important issues. They are timely and increasingly relevant to all of us, but especially to our students, in twenty-first-century academia.