Industry scientists are often asked by their colleagues from academia why they do not publish more. The caricature, it seems, is of an active and productive industry generating lots of data that could be of benefit to the scientific community and yet keeping them all under wraps for various purposes related to profits. The patents we write, and which patent offices publish, appear not to count as shared information. When it comes to actually sharing materials, well, everyone knows just how much red tape is involved whenever they have to deal with industry people.

In reality, industry scientists do publish in refereed journals, although almost certainly with less frequency than our counterparts in universities and research institutions. The reasons for this, however, are less related to companies being over-secretive about research results and have more to do with the prosaic demands of life for an average scientist working in industry. Industry scientists do wish to share the materials described in their publications but have to live by a set of rules that, although applying to industry and academia alike, tend to be enforced more diligently in industry. This article will attempt to describe, from the point of view of scientists working for a company, how the complex formula balancing individual career, institutional interests, and the natural desire to share knowledge create different constraints for an industry scientist from that of an academic. The outcome of the equation, however, the desire to share in the scientific community and advance scientific knowledge, is ultimately the same within ivory towers and behind company walls.

**DOES THE NEED TO PATENT INHIBIT PUBLICATION?**

A common perception is that scientists in industry cannot publish work because they must patent their work. This statement is misleading for several reasons. First, of course, academic scientists are increasingly filing patent applications on their own work, so if patenting inhibits publication, it is no longer a problem unique to the industrial sector. Second, a patent is by definition in fact a publication. This requires a short discussion of what a patent is. To encourage innovation, society (in the United States in the constitution) has granted innovators the right to prohibit others from using their invention, in most countries now 20 years from the date of filing. See the article by Shear and Kelley (2003) earlier in this series for a more complete description of what a patent is and is not. But that is a two-sided bargain. In return for that temporary right, the inventor must describe the invention and its methods of use in sufficient detail so that others may use and improve on it at the end of the 20 years. This seems a long time, but inventors need to balance the desire to have protection for a product for as long as possible with the need to file patent applications early to gain protection for their inventions and so enhance the chance of obtaining a return on company research investment. The result is that patent applications are generally filed some time before a product is ready for the market. This is particularly so for plant molecular biology, where several seasons of breeding are usually required before a molecular invention can be sold. Finally, although there is no “research exemption” with regard to use of patented material, the pregnant publication of patent applications (generally 18 months after filing), although still in the prosecution phase, means that other researchers in the field can see at an early stage what the invention is and consider alternative strategies, resulting in further innovation in a field. Note that a patent is such only when the patent office to which it was submitted has formally granted particular claims; until then it is a patent application. In some contexts, the term “patent” may be used more loosely as a generic term to refer to both. A patent application will usually be filed in multiple countries, and the term “patent office” as used in this paper is meant generically.

In short, patents do not inhibit publication; they are publications, albeit not of the tradition academic nature. They are not peer reviewed, although they have to meet a different set of stringent criteria established by the patent office through the individual examiners, who can be as frustrating to inventors/authors as manuscript reviewers. They are in general equally dedicated and in principle are more practiced in the task because it is their full-time job.
The length and detail of a patent disclosure may be quite narrow, if all that is desired is a patentable claim of commensurate breadth. Combined with the incentive to file as early as possible, this means that patent applications are often filed before work would be ready for a traditional publication. This has two implications. It explains why some patents do not contain sufficient information to replace a traditional publication, but it also explains why patents need not inhibit the publication of a more traditional manuscript. At the time of patent filing, the data may not be sufficient for a journal publication, but once the patent application is filed, a traditional publication can proceed, buttressed with additional data to satisfy the criteria of journal editors and reviewers. Thus the timing of publication need not be significantly different from what it would be without a patent filing. In practice, then, the only time the need to patent may inhibit scientists from “publishing” is in the decision whether or not to include preliminary results in a seminar or symposium presentation, where inclusion of incomplete data is often more acceptable than in a journal publication.

**SO WHY DO SOME INDUSTRIAL SCIENTISTS PUBLISH LESS?**

If patents do not make publication difficult, what explains the smaller number of publications from that sector? Does company senior management discourage publication? This may be so in some fields where material is often not patented but kept as a trade secret. The practice of keeping trade secrets is found more often in industrial processes or methods. This is often because improvements in a process that result in competitive advantage are often not detectable or traceable in the final product. In other words, there it would be difficult to determine whether a patent on a practice is being infringed solely on the basis of examining the materials that are produced. In the plant sciences, grain or food processing techniques are examples: A more efficient industrial-scale protein isolation technique may save large amounts of money, but the soy (*Glycine max*) protein isolates produced using old and new protocols may be undistinguishable.

However, these examples are more commonly found in highly specialized, highly applied fields, and not so much in more basic science. In fact, most companies are pleased to see their scientists work represented in prestigious journals and understand that their employees are more likely to stay at the forefront of a field if they participate in the scientific community. For young startup companies, publications are often crucial in establishing credibility not only with the scientific, but the financial community. Publications in journals understood even outside of scientific circles to be highly prestigious (*Nature, Science, Proceedings of the National Academy of Sciences*, and certain medical journals for the pharmaceutical industry) can encourage investors to support a young startup.

Thus with exceptions, the mere fact of being with a company usually need not inhibit publication. So why the differences? The main explanation is more mundane—incentives. With the exception of the startup companies struggling for investor recognition, although publication is generally not frowned upon, there also are few direct incentives. In an academic environment, the publication is the final product—no papers, no new research grants, promotions, or tenure. In industry, the product is, hopefully, just that, a marketable product. A patent is a necessary milestone on the way to protect the product, but a journal publication is a nice byproduct but has only intangible value. Yes, scientists realize that publications are good for their curricula vitae, and particularly younger people will try harder to find the time to publish. Company career progression plans will usually have words of praise for external publications, but everyone knows that presenting even newer results or progress toward a new product at the next project review is more likely to result in promotions or other rewards. In the end, then, the main reason that many scientists working in industry publish less is one that everyone who has tried to work on a manuscript at the end of a day spent at the lab bench will understand—it gets done at the end of long days or on the weekend and even then, only for indirect rewards.

There are some other less important but still significant factors. Industrial work will tend to have a more applied flavor to it, and this is sometimes more difficult to publish in highly desirable journals. The work may appear to be a mere reduction to practice of earlier academic findings. Industrial work is often done in more difficult experimental systems. If a reviewer asks for more controls on experiments using transgenic Arabidopsis, this is easier to deal with than if the work was done in transgenic corn (*Zea mays*), soy, or wheat (*Triticum aestivum*). This is not to say that work in those systems should be held to a different standard, but having perhaps already spent hours negotiating with a patent examiner, the energy required to deal with a different set of objections may be lacking. There is often a feeling that “the observation is what it is. We are willing to share that in a publication for those to whom the observation may be useful while understanding its limitations, but the cost of meeting the objections of a reviewer who does not understand the limitations of the experimental system are too high.”

Most company scientists do make some attempts to publish, as can be seen in almost any issue of this journal. They will tend to publish larger stories—all of the factors discussed above mitigate against “thin slice” publishing. Most companies have postdoc programs and sometimes even sponsor internship pro-
grams for graduate students. For reasons of career development, these individuals will provide both the extra incentive and also extra energy needed to get journal publications done. But for very human reasons rather than the more complicated reasons sometimes assumed to be the case by academic colleagues, these will be rarer and later than would be the case in academia.

WHAT ABOUT THE PATENT LITERATURE?

Despite its limitations, there is much useful information in the patent literature, and it is often a source of frustration to industrial scientists that their academic colleagues to not recognize this. Academic scientists in turn express frustrations that patents are so difficult to read and often also difficult to find. In this section, the structure of a patent is briefly summarized, and methods to access this body of literature are explained.

Patent documents include issued patents as approved by the granting authority (for example, the Patent and Trademark Office in the United States) and patent applications. Although these differ with respect to the rights that an applicant (or assignee) may hold, both are often useful sources of technical information. But patents, although containing much useful information, cannot completely replace traditional journal articles. The criteria set by the patent office are different from those set by journal editors, and so the type of information in the documents is different. The purpose of the written disclosure of a patent is to provide support and definition for the claimed subject matter. It is often up to the skeptical reader to determine the degree to which the findings reported in a patent or application have technical or “academic” value.

Patents may be thought of as solutions to practical problems rather than the advancement of knowledge and understanding—they are formally required to have “utility.” An applicant is expected to identify why the material presented for patenting addresses a problem. In this presentation, there is typically a brief discussion of the problem, a summary as to why currently available technologies have left the problem unsolved, and how the solution presented for patenting addresses the need. A primary purpose of the written disclosure of a patent is to provide to the public whatever information is sufficient to reproduce and operate the claimed invention, and so a detailed description of the invention discloses how the invention works. This may be quite detailed with respect to the intricacies of the materials used and the methodologies applied, but it can also be quite brief. Most academic readers will identify with the “Examples” of a patent as approximating a hybrid of the standard academic publication sections “Materials and Methods” and “Results.” One frustration academics will likely identify is the lack of an equivalent to a “Discussion” section in a patent that places the material in a broader scientific context. With the exception of addressing directly related “prior art,” there is no expectation or requirement for inventors to reconcile their results with possibly conflicting results of others. This contrasts with the standing expectation of work submitted for peer-review that the author be able to identify and ground his or her work on mechanistic principles, to integrate the findings with the broader body of work and to discuss the implications of results that are at odds with current thought. In fact, patent applicants are frequently discouraged from venturing into such a narrative practice. One reason for the absence of discussion is that speculation as to the unproven benefits of an invention may undermine a future ability to secure patent rights to those benefits. Patents conclude with a set of claims, which are the actual property of a patent, with respect to the enforceable rights of the patent holder of licensee.

There are a number of services that a scientist, whether in academia or in industry, may use in identifying patents or applications of interest. Many of these services are provided on a cost/subscription basis, and academic researchers may wish to consult their technical libraries or information specialists at their home institutions for assistance. Some of the most popular databases are the Derwent World Patents Index and the USPATFULL, databases that are available through literature database providers such as Dialog or STN. Fully rendered image files are available on a fee-per-document basis from MicroPatent and Delphion, each of which operate user-friendly Web sites. Irrespective of the service or provider, these utilities offer tools for searching the vast worldwide patent literature, and a little practice within these information environments can return very useful results. The European and U.S. patent offices have Web sites with no fees, although they are less user-friendly than the commercial Web sites. Free searches can also be found at the CAMBIA IP Resource (http://www.cambiaIP.org) or PIPRA (http://www.pipra.org; see also the Editor’s Choice by Delmer et al. [2003]).

The “granting authority” noted above is usually a national government, although mechanisms exist to file in multiple groups of countries at once. Because most companies will wish to cover the largest markets, by looking for patents in Europe (which has a combined filing system through the European patent office), United States, and Japan one is likely to find most of the patents in a given field. However, to varying degrees and in combination, the databases mentioned cover all jurisdictions.

ARE INDUSTRY SECTOR SCIENTISTS LESS ABLE TO SHARE PUBLISHED MATERIALS?

It is generally perceived that it is more difficult to obtain published research materials from industrial
Sharing Data and Materials

Companies may be under more stringent constraints. Modify the above example so that the promoter is a widely used constitutive promoter and the laboratory that created the chimeric gene that was the subject of a publication is a commercial entity. Assume the promoter is actually the subject of a patent from a leading agricultural company. If that company should choose not to enforce that patent against academic institutions, the latter might applaud them. But the agricultural company is certainly not in the business of helping their competitors, so commercial entities that wish to use the promoter will have obtained licenses to do so. The terms of such licenses between companies are generally very strict in terms of not passing the material on to other parties, without any distinction in the license between passing materials to academic or commercial entities. Furthermore, it might well be that the license would be invalidated if its terms were breached. That would make it very difficult for the commercial entity to share the chimeric gene containing the promoter. In short, commercial entities are willing to share published materials but cannot promise to share things they do not have a legal right to share. That reasoning of course applies to academic institutions as well, but so far in practice has been less of a problem. It is for this reason that many publications now have a statement saying that novel materials will be shared, but getting any necessary permissions from other parties will be the responsibility of the requestor.

There are two classes of materials unique to the plant sciences that cause special problems. Transgenic plants, in particular crop species (as opposed to laboratory models), raise highly sensitive issues. No amount of legal language in an MTA or other agreement would protect a company or university from public if not regulatory and legal approbation if transgenic material originating with that institution were to be used in a manner not consistent with regulations, either accidentally or intentionally. As the transformation of previously “difficult” species becomes more routine, a broader range of institutions from both the private and public sectors will face this issue. The situation is similar to sharing of plant pathogens—an institution would only agree to make such a disease agent available for research if satisfied that the recipient was in a position to conform to legal requirements and prevent its release. If a public sector laboratory requests transgenic lines from a company, it stands to reason that the scientists, legal experts, and management will always be highly conservative and insist that appropriate levels of control be maintained before materials are transferred, and then only to other institutions deemed capable of dealing with regulatory and other complexities. This is thus an area where companies, journals, and the academic community need to work toward constructive understandings if results of such experiments are to be published.

Finally, seed companies are understandably very sensitive on the subject of germplasm. Elite corn, soy, or wheat lines represent the results of literally decades of work by such a company. Molecular biologists or geneticists with such companies have on occasion not been cognizant of this and have been told when requesting to share a transgenic line or a line in which they have isolated an interesting mu-
tation that the transgene or the mutation are not the problem, but that to share the genetic background in which the work was done is to give away the “crown jewels” of the company. The solution here has been internal, either to make sure that work to be published is done in public domain or otherwise nonsensitive lines or to publish in journals commonly used by the breeding community where such limitations on exchange are accepted.

CONCLUSIONS

Despite the caricatures noted earlier, most scientists working with profit-making companies desire to and often do publish and participate in other activities of the broader scientific community. However, the career pressures and financial incentives are different, and so publication assumes a lower priority than for their colleagues in academic settings. Generalizations are always false, but when they publish, they will tend to publish in different ways and “thicker slices,” often using different experimental systems than the most popular models. Patents can provide a useful way of following work in industry; understanding the structure of a patent, its purpose, and where to look for this literature can make that body of work easier to access for nonindustrial scientists. Company scientists want to “play by the rules” on sharing of published materials, but need to carefully observe other rules governing material exchange, rules which apply to academia as well. Understanding the differences in perspectives of scientists in the two groups will contribute to reduced frustrations and hopefully enhanced interactions to the benefit of both.

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LITERATURE CITED


