THIS WEEK

EDITORIALS

Count on me

Sometimes, the use of metrics to assess the value of scientists is unavoidable. So let's come up with the best measure possible.

In an ideal world, scientists applying for grants or jobs would be judged holistically — balancing quantitative measures such as their publication record against indications of their potential from recommendation letters, personal interactions and other activities. So even if a candidate had not generated many papers, it would count in their favour if the few they had published had received positive post-publication review (comments, tweets and blog posts, for instance). Also favourable would be a tendency to ask insightful questions at talks that lead to valuable discussions and new experiments, or a willingness to share reagents and expertise with their colleagues. That would be ideal. But that is not the world in which most scientists live.

Instead, hiring committees and grant reviewers sweat through hundreds of applications, often with only enough time to give each submission a cursory glance. In 2010, a *Nature* poll found that most administrators say that metrics — quantifiable measures of scientists' achievements — matter less in job decisions than scientists often think (see *Nature* **465,** 860–862; 2010), but good peer review is often simply not possible.

As a result, evaluators are increasingly turning to metrics, such as total citation count and the *h*-index, a measure of both the quality and quantity of papers (a scientist has an *h*-index of 12 if they have published 12 papers that have each received at least 12 citations). Naturally, many scientists object to such cold quantification of their contribution. Plus, all metrics have obvious flaws — a paper may gather many citations not because of its importance, but because it is in a large field that publishes frequently, so generates more opportunities for citations. Review articles, which may not add much to the research, count the same as original research papers, which contribute a great deal. And all existing metrics capture only what a scientist has done, not what he or she might be capable of. Clearly, there is a need for more and better measures.

On page 201, Daniel Acuna, Stefano Allesina and Konrad Kording suggest an alternative: the future *h*-index. Unlike other metrics, this index estimates a scientist's publication prowess five years or so into the future — a useful timescale for tenure decisions.

Using publicly available data on the history of publication, citation and funding for thousands of neuroscientists, researchers working on the fruitfly *Drosophila* and evolutionary biologists, the authors constructed an algorithm that converts information on a typical scientist's CV — the number of journals published in and articles in top journals for instance — into a number that represents their probable *h*-index in the years that follow.

Outraged? Please send complaints to the usual address. Interested? Calculate your own future *h*-index here: go.nature.com/z4rroc.

Nature receives thousands of submissions a year, some of which point out the flaws in existing metrics and propose alternatives. We accepted the piece by Acuna *et al.* after submitting it to peer review. The reviewers and our editors felt that the authors had used appropriate methods to obtain their algorithm, and its predictive values seemed realistic. Furthermore, the authors are cautious about its value, pointing out that it is probably less accurate for scientists in other disciplines, and should not be considered a replacement for peer review. At the very least, the future *h*-index should help to address some problems with the current *h*-index, which tends to favour established scientists because they have had more time to accrue citations. A forward-looking metric may give a leg up to promising, early-career scientists who don't yet have impressive CVs.

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Nevertheless, no one wants their career potential to be reduced to a number. *Nature* publishes many scientific gems that nevertheless achieve few citations; there is no substitute for examining the research itself to appreciate its value. We know that the idea of a new metric published in these pages will raise some anxieties, and a few hackles. But metrics are already being used, so it is important that they create the most accurate picture possible of someone's potential. Plus, they do hold some advantages over peer review, by helping to eliminate the unconscious biases that can creep into personal evaluations.

In that vein, scientists should continue to hunt for metrics that capture a scientist's true value, including aspects such as teaching, reviewing and public-speaking ability, as well as online responses to publications in blogs and comments — 'alt-metrics'. We may not live in an ideal world, but we can still improve the recruitment, reward and opportunities for scientists. ■

Secret weapons

US military furtiveness is hindering progress and the development of technology.

In the 1940s, with the Second World War in full swing, Japanese scientists sketched out a plan to build a microwave weapon to shoot down enemy bombers. That idea, perhaps the earliest description of an electromagnetic bomb, encapsulates much of what military officials still hope to achieve with such weapons: disabling electronics (or, in some cases, people) using a powerful energy beam, without causing any collateral physical damage. The US military's attempts to make a practical weapon based on this idea have so far resulted in only one system — at least as far as it has revealed publicly. The Air Force has built the Active Denial System, a non-lethal high-power microwave weapon supposedly able to deter an angry mob by creating the sensation of being burned.

For decades, the US military has conducted much of its research on such weapons in secret. It has often hinted that it is on the verge of a breakthrough, yet high-power microwave weapons are noticeably absent from modern battlefields and scenes of civil unrest. The military, for the most part, won't discuss its progress — or lack thereof — citing secrecy in the name of national security.

There is nothing unique about the classification of this research: nuclear weapons, stealth aircraft and satellite reconnaissance systems were all developed in secret. Although such furtiveness can legitimately protect US weapons and capabilities, it can also prevent much-needed dissemination of scientific research. And it has all too often concealed a lack of progress.

As we discuss on page 198, this has been the problem with the programme to develop high-power microwave weapons: the little information that has been released points to obvious scientific and technological problems. Crucially, power sources for such devices are often too unwieldy to use. More than ten years after the Active Denial System was first revealed to the public, its size and complexity mean that it is still nearly impossible to deploy. The military rejected the system for use at checkpoints in Iraq because it would have taken 16 hours to cool down the weapon's pulse generator to superconducting temperatures to fire it.

Many records related to the Active Denial System remain classified and inaccessible to the public and the scientific community. The US Air Force's unwillingness to reveal the full scope of its research into the biological effects of high-power microwaves in the 1990s, which included work on their auditory and lethal effects, flies in the face of the defence department's claims that it is interested in classifying only weapons technology, and not science. If, as the Air Force says, the biological research never led to weapons, then there is no reason not to release it.

Work on high-power microwaves designed to take out electronics has not fared much better. Advocates can always claim that classified programmes are yielding great progress, but information in the public sphere does not paint a rosy picture. Military officials and academics acknowledge that developing compact power sources remains the biggest hurdle. The Air Force and a contractor have touted efforts to develop a high-power microwave cruise missile, but neither will release details that might allow independent experts to judge the programme's potential. The Pentagon is staying quiet on a system developed to take out improvised explosive devices, but what little information is available indicates that — like the Active Denial System — it has proved too cumbersome to use effectively.

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This is not to say that all government spending on high-power microwaves is a waste. Academic funding under Multidisciplinary University Research Initiatives is contributing to a host of peer-reviewed publications and collaborative research. But for the government to take full advantage of that research, it must be willing to share data and findings between military labs and academia. The defence department's own science board has found that reluctance to share is a barrier to progress.

Getting to the truth about high-power microwaves requires transparency. Independent experts must be able to scrutinize technology to enable scientific–military cooperation and to provide a reality check for those who make fantastic claims about a weapon's potential.

By the time it cancelled the Airborne Laser programme earlier this year, the US defence department had poured billions of dollars into the weapon: a chemical laser in the nose of an aircraft, designed to shoot down ballistic missiles. In the end, the question was not whether the laser would work, but whether it would be usable, given the scientific and technological practicalities of integrating such a complex system. "There's nobody in uniform that I know who believes that this is a workable concept," concluded former US defence secretary Robert Gates, when he finally moved to kill the project. The same concerns would probably be expressed about high-power microwaves — if more information about them were available. ■

The name game

After several years of wrangling, zoologists can now name new species online only.

With access to the Internet, the (official) world of animals and plants will soon be at your fingertips. In a landmark ruling, zoologists last week agreed that newly identified species can be named in online-only publications. Previously, the first official description of anything that crawled, flew, wriggled, walked or swam across Earth needed to be formally written up and recorded in print, where it would remain in perpetuity for future scientists to reference.

That made sense when Henry Fairfield Osborn described *Tyrannosaurus rex* in 1905; less so when Rob Gay named a new theropod, *Kayentavenator elysiae*, in 2010, which helps to explain why Gay broke with convention and claimed the first description of the species in a self-published print-on-demand book.

As technology blurred the distinction between what is published and what is not, some predicted online anarchy, with 'taxonomic vandals' taking to the Internet to self-publish reports of new species. An obvious solution to the problem would have been to extend the rules from print to cover online scientific journals, and to draw the line there. But there were concerns about whether online journals would endure. In a messy compromise, online journals that published descriptions of new species printed and bound several dozen copies of the paper — in case a twenty-second-century palaeontologist should call. In an even messier compromise, some scientists printed papers from journal websites and posted them to libraries themselves.

No more. The International Commission on Zoological Nomenclature (ICZN), which sets the rules for the naming of new species, announced on 4 September that it was relaxing its code to encompass publication in online-only publications. The change, which followed a vote of 23 in favour to 3 against, with one abstention, comes into force at the start of next year. The amendment allows for descriptions of new species in "widely accessible electronic copies with fixed content and layout". New animal species will also need to be registered with ZooBank.org, the official registry of the ICZN.

It is a sensible move, and one that most in the field should welcome. It comes a year after the International Botanical Congress endorsed online-only publication for new types of plant. In an Editorial at the time (*Nature* **475,** 424; 2011), which called on zoologists to follow suit, *Nature* said: "At this point, it seems that there is little reason to continue to demand paper on a shelf to make a species name official."

On hearing the news from the ICZN, one member of *Nature*'s staff quipped: "Now to name a dinosaur you don't have to behave like one." But that is a little unfair. Proper taxonomy and a robust archive are crucial to science, and the zoologists were right to consider with care the possible negative aspects of such a change, as well as listening to the clamour to embrace the new. True, the change has been a long time coming. It is overdue, even. Still, when you have been dead and waiting for a name since the Mesozoic era, what are a few extra years? ■

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