nature chemistry

ARTICLES

PUBLISHED ONLINE: 13 NOVEMBER 2017 | DOI: 10.1038/NCHEM.2879

Science beyond the paper

F. Gomollón-Bel[1]*

The biocatalytic transformations used by chemists are often restricted to simple functional-group interconversions. In contrast, nature has developed complexity-generating biocatalytic reactions within natural product pathways. These sophisticated catalysts are rarely employed by chemists, because the substrate scope, selectivity and robustness of these catalysts are unknown. Our strategy to bridge the gap between the biosynthesis and synthetic chemistry communities leverages the diversity of catalysts available within natural product pathways. Here we show that, starting from a suite of biosynthetic enzymes, catalysts with complementary substrate scope as well as selectivity can be identified. This strategy has been applied to the oxidative dearomatization of phenols, a chemical transformation that rapidly builds molecular complexity from simple starting materials and cannot be accomplished with high selectivity using existing catalytic methods. Using enzymes from biosynthetic pathways, we have successfully developed a method to produce *ortho*-quinol products with controlled site- and stereoselectivity. Furthermore, we have capitalized on the scalability and robustness of this method in gram-scale reactions as well as multi-enzyme and chemoenzymatic cascades.

Fernando Gomollón Bel – @gomobel

SCNAT Young Faculty Meeting

Bern, Switzerland, 12th February 2020

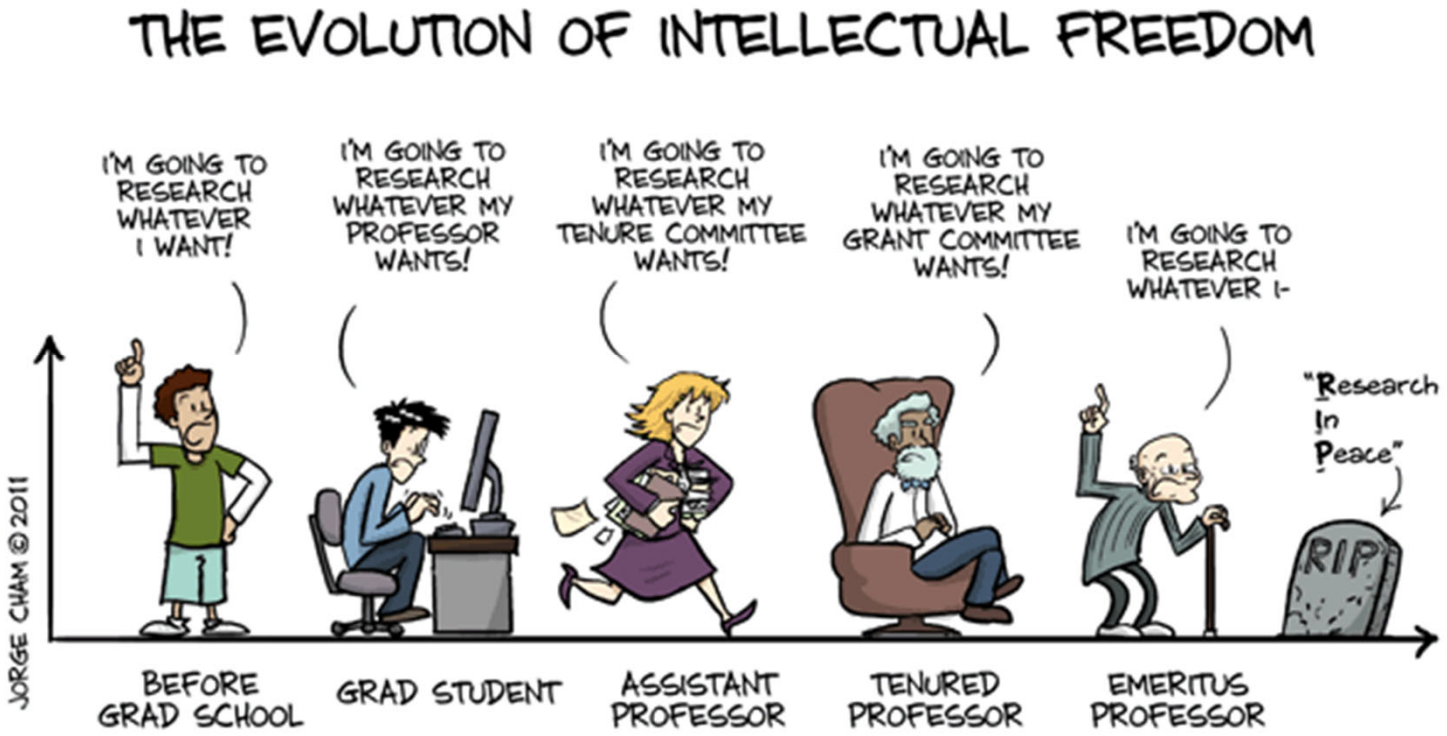

T. HANKS

Who am I?

GRAPHENE
FLAGSHIP

Beyond research

Academia



http://phdcomics.com/comics/archive.php?comicid=1436

Leaving is not a failure

Leaving is not a failure and I have references[1]

[1] P. Kruger. *Nature* **2018**, *560*, 113 (DOI: 10.1038/d41586-018-05838-y).

CAREERS

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ADAPTED FROM GETTY

COLUMN

You are not a failed scientist

PhD students who leave academia should be supported, says **Philipp Kruger**.

As a PhD student in my final year, I find it demoralizing and frustrating to be constantly reminded of the bleak job prospects in academia. This dim outlook may well increase the pressure on students and contribute to high rates of anxiety and depression among them (T. M. Evans *et al. Nature Biotechnol.* **36**, 282–284; 2018). The scientific community could help to solve this problem by encouraging us all to change the way we think about the PhD. And scientists can start by appreciating a simple truth: researchers who leave academia are not failed academics.

Students and their supervisors must begin to regard a PhD programme as a traineeship in scientific thinking and an invaluable qualification for a diverse range of careers. If everyone involved in academic science could accept a variety of roles as the default outcome, we could change our flawed definition of success. We could transition from a culture of failure to a healthier and happier scientific enterprise.

I've found it daunting to determine the best career to match my personality, skills, priorities, ambitions and interests, particularly because most people around me treat the academic path as the default. But we PhD students have an obligation to see to our own professional futures. Many of us, of course, are driven by the excitement of discovery, and we relish the freedom to pursue our curiosity in an academic laboratory.

However, some of us discover during our PhDs that in our dream job, the emphasis would be on using interpersonal and communication skills, having a more immediate impact on society or gaining financial rewards, job security or family-friendly working hours. Our direction should be the result of a conscious decision rather than a perception of a lack of opportunities. And it should have nothing to do with a sense or fear of 'failure.'

WHAT PHD STUDENTS CAN DO

To make an informed decision about their professional future, students need to use their initiative and be proactive. Here's what has worked for me and what I think my student peers could do.

Determine your preferences. A PhD provides you with diverse experiences, from conducting lab experiments to giving talks and supervising students. I've found it useful to write down whenever one of these tasks is particularly fascinating, enjoyable, stressful, boring or frustrating. Doing this over four years has ▸

« The skills you [acquire] during a PhD are highly sought by employers beyond academia.

You are incredibly resilient, hard-working and motivated.

A PhD programme is a traineeship in scientific thinking, and an invaluable qualification for a diverse range of careers. »

[1] P. Kruger. *Nature* **2018**, *560*, 113 (DOI: 10.1038/d41586-018-05838-y).

It is not an 'alternative'

ACS NEWS

COMMENT

Can we stop calling them nontraditional careers?

NATALIE A. LAFRANZO, CHAIR, ACS YOUNGER CHEMISTS COMMITTEE

In 2015, two years after I finished my graduate training, I spoke with a journalist at *U.S. News & World Report* who was writing an article highlighting how Ph.D.-trained scientists were pursuing careers outside academia. The article noted that, at that time, only 42% of people with a Ph.D. in the sciences were working in academia. Similarly, results from the 2015 American Chemical Society ChemCensus survey of the chemical workforce showed that 40.4% of respondents reported working in the academic sector.

Recently, in preparation for a brainstorming lunch at the ACS national meeting in Boston, I was browsing the titles and positions of my fellow members of the Younger Chemists Committee (YCC). I discovered that only 17% are in an academic position (including postdocs, faculty, or support staff). In fact, nearly half of YCC members work in industry or government, and less than half of those members work in a bench or traditional laboratory position.

So if the scientific workforce, the chemical workforce, and younger members of ACS are predominantly employed outside academia, with many of them in nonlaboratory positions, why are these career paths still referred to as "nontraditional"? I'll admit, I'm guilty of using this term myself. As an accomplished bench-trained chemist who has actively pursued a career at the interface of science and business, I've chosen not to work in a laboratory setting since the completion of my graduate education. I still very much consider myself a chemist, despite having caught myself on occasion telling others that I have followed a "nontraditional path."

Some of this mind-set is perpetuated by what seems to be misinterpretation of the data. The ChemCensus data I cited above were preceded by the following statement: "The increasing rate of doctorate degree holders in the chemistry workforce appears to be fueled by the growth of employment opportunities in the academic sector."

In my opinion, that is flat-out wrong. The reality is that few academic positions are available each year, and institutions train more scientists than there are faculty positions and grant funding to support. The more likely explanation for the numbers seen in the ChemCensus is that chemists who pursue these "nontraditional paths" may (incorrectly) see less value in ACS membership. This may be fueled in part by a sense of nonbelonging—the idea that these nonlaboratory chemists are seen as less of a chemist than their academic counterparts through their continued branding as "nontraditional."

We all have to change the way we communicate with and about nonacademic chemists. We have to accept that the majority of chemistry students today will not follow an academic career path, yet we can train them as students to be exceptional professionals, which will hopefully empower them to give back and stay connec- ed to the chemistry community for their entire lives. I believe ACS membership provides a great way to do that.

I am grateful to our partner groups within the society, such as the Committe on Professional Training, which are eage working with us to understand how the s ciety can better prepare chemistry studen for careers outside academia, and even outside the laboratory. These career paths should not be considered or presented to students as failures or deviations but rather as viable options for chemists to contribute their skill sets to an institution or company and to society as a whole. The problem-solving mind-set, quantitative thought process, and attention to detail that is required to achieve a chemistry degree can be applied to many positions postgraduation. By empowering students to pursue a career path that they are passionate about, rather than what is expected or "traditional," we have a better chance of filling the workforce with smart, engaged employees.

Nearly half of YCC members work in industry or government, and less than half of those members work in a bench or traditional laboratory position.

Efforts from ACS entities such as the Division of Professional Relations, the Division of Small Chemical Businesses, the Division of Business Development & Management, and the grass of the Chemical Inno neurship Council for reaching but more we mus exper gra

Vie not n

40 C&EN | CEN.ACS.ORG | AUGUST 6, 2018

N.A. LaFranzo. *Chemical and Engineering News* **2018**, *96* (32), 40.

Beyond the paper

research

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Beyond the paper

research

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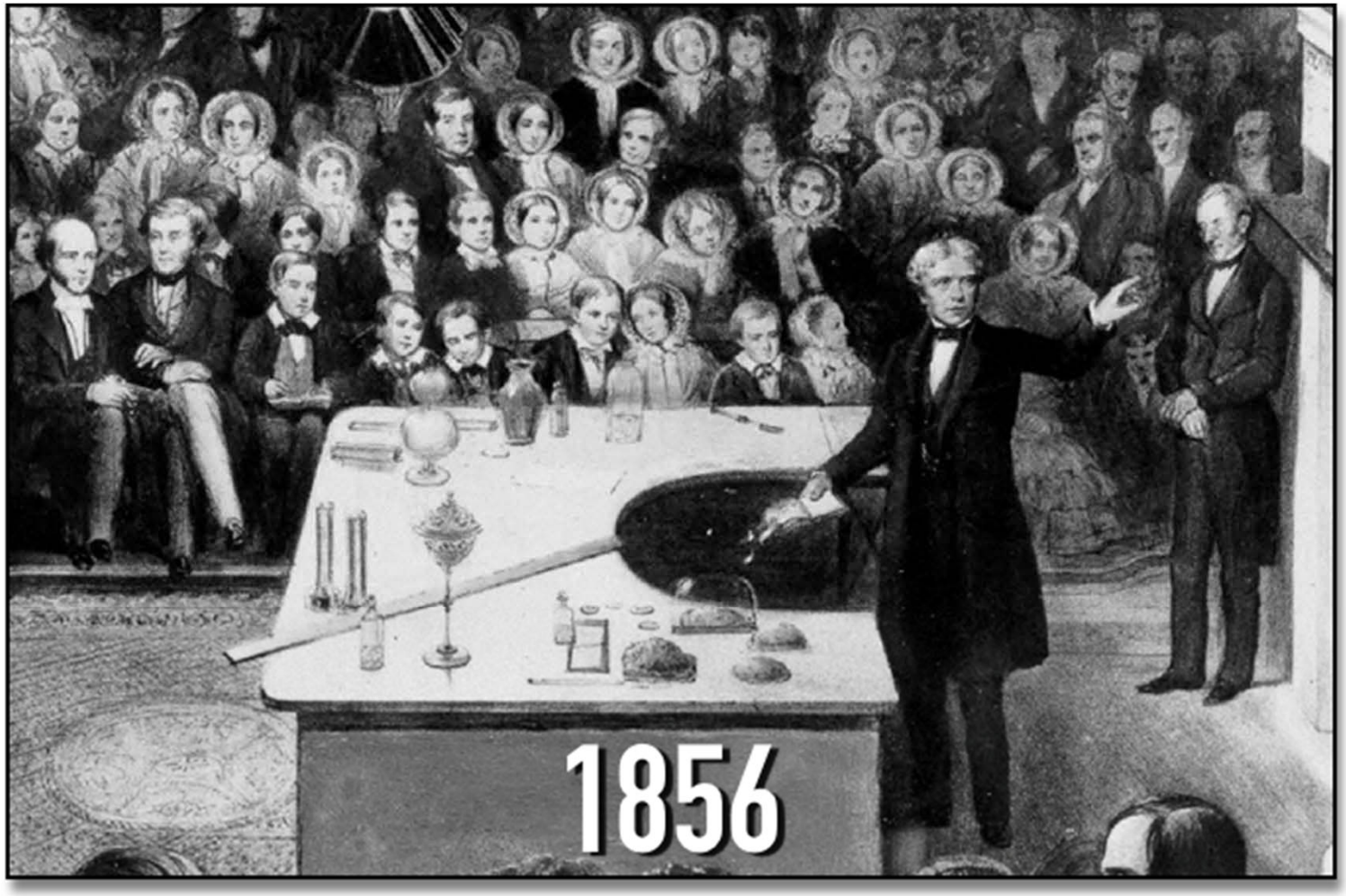
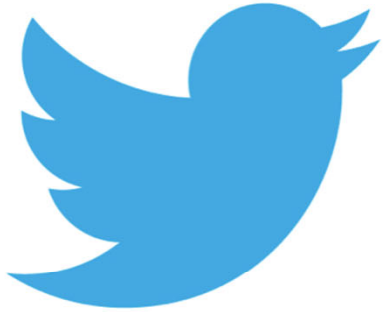
outreach



A. Blaikley: «Michael Faraday delivering a Christmas Lecture in 1856.»

Impact



+tweets = +citations

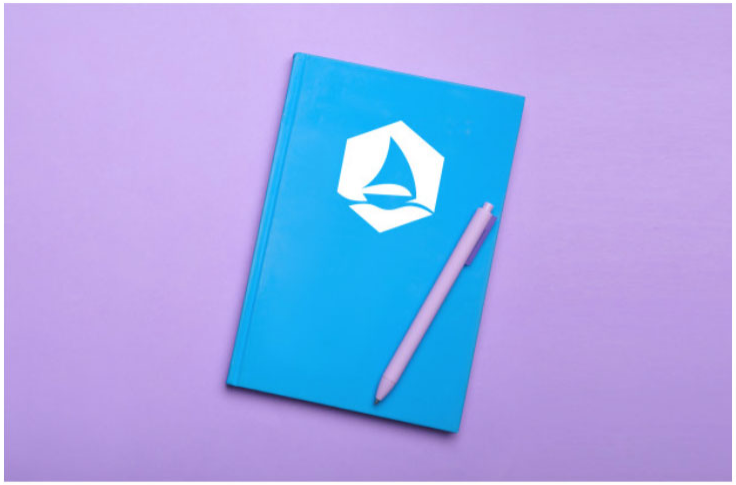
[1] G. Eysenbach. *Journal of Medical Internet Research* **2011**, *13* (14), e123 (DOI: 10.2196/jmir.2012).
[2] M. Thelwall *et al. PLOS ONE* **2013**, *8* (5), e64841 (DOI: 10.1371/journal.pone.0064841).
[3] C.T. Lamb, S.L. Gilbert, A.T. Ford, *PeerJ* **2018**, *6*, e4564 (DOI: 10.7717/peerj.4564).

Impact

Activity on social media can increase your h-index

X. Liang *et al. Journalism & Mass Communication Quarterly* **2014**, *91, 772* (DOI: 10.1177/1077699014550092).

Some GF examples



Graphene Flagship publishes handbook of graphene manufacturing

Press releases • Jan 29, 2020 18:00 CET

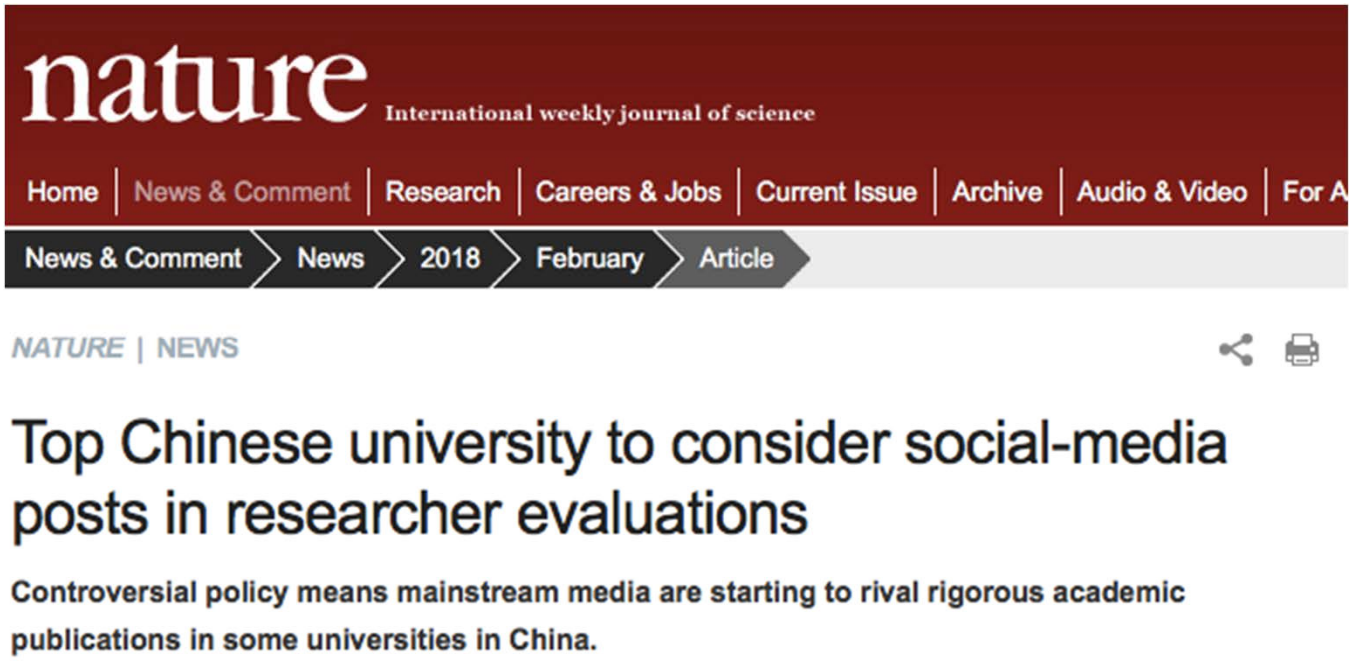
- **PR coordinated with publisher**
- **6500+ downloads in less than 1 week**
- **Altmetric x3 the average for a ‘successful’ paper**

C. Backes *et al. 2D Materials* **2020**, *7, 022001* (DOI: 10.1088/2053-1583/ab1e0a).

Some GF examples

- **Reporting about our project on a newspaper with 7M+ readers**
- **Direct impact of research outputs in the stock market**

Grants



nature International weekly journal of science

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News & Comment › News › 2018 › February › Article

NATURE | NEWS

Top Chinese university to consider social-media posts in researcher evaluations

Controversial policy means mainstream media are starting to rival rigorous academic publications in some universities in China.

D. Cyranoski. *Nature* **2017** (DOI: 10.1038/nature.2017.22822).

Grants

ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING

38.1 Communication activities by the beneficiary

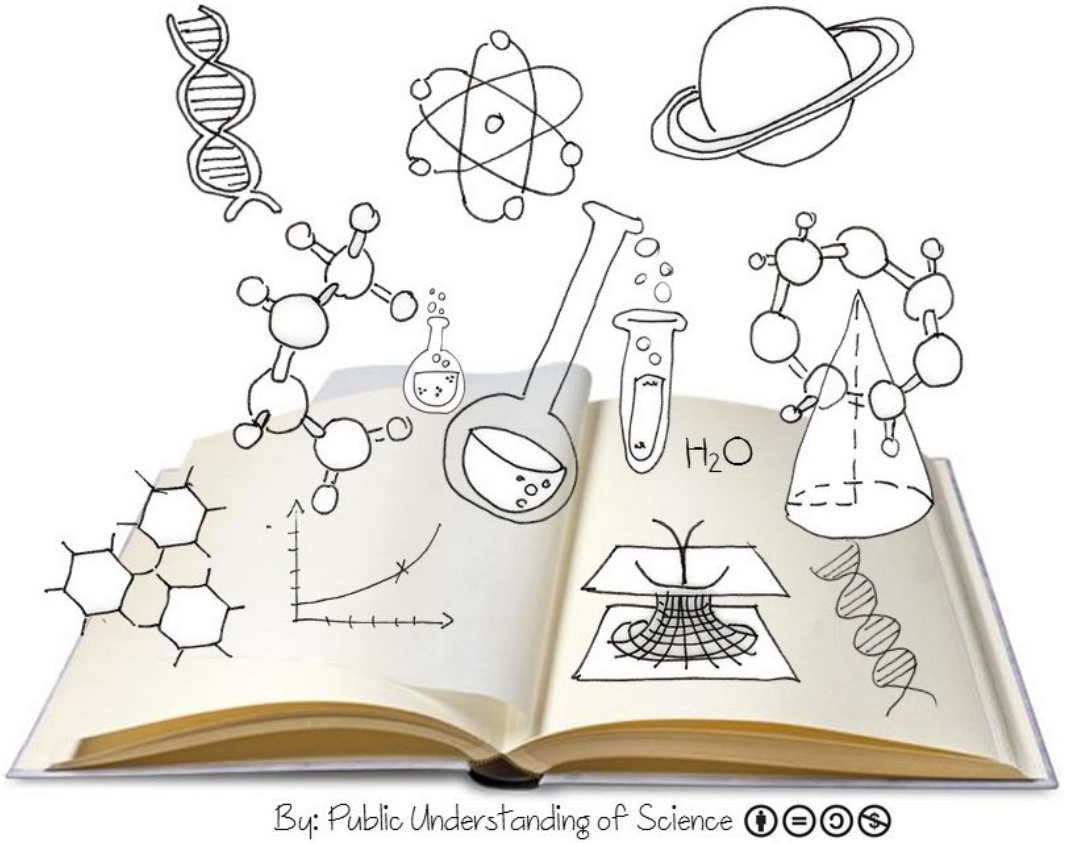
38.1.1 Obligation to promote the action and its results

The beneficiary must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner.

This does not change the dissemination obligations in Article 29, the confidentiality obligations in Article 36 or the security obligations in Article 37, all of which still apply.

EU H2020 Model Grant Agreement

Every paper tells a story



…and the story matters

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OPINION

Storytelling matters in science

BY PHILIP BALL

Communicating ideas needs a narrative to get the point across

For those of us trying to communicate science to a wide audience, the common pitfalls are that we'll bore, confuse or patronise our audience. And, let's be honest, sometimes we'll slip up and misinform them too.

All the same, the attempt feels worth making; indeed, it's vital to maintaining well-informed public debate. It's sobering, then, to learn from a recent preprint that the old adage 'a little knowledge is a dangerous thing' might be true.[1] Federico Francisco and Joana Gonçalves-Sá report evidence that

P. Ball: «Storytelling matters in science», *Chemistry World*, 16/05/2019 (http://bit.ly/2Xvts3H).

Press

ACS Catalysis

Letter

pubs.acs.org/acscatalysis

Access to Biorenewable Polycarbonates with Unusual Glass-Transition Temperature (T_g) Modulation

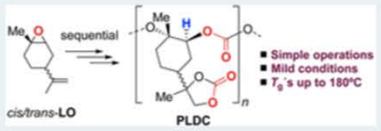
Nicole Kindermann,[†] Àlex Cristòfol,[†] and Arjan W. Kleij*[,†,‡]

[†]Institute of Chemical Research of Catalonia (ICIQ), The Barcelona Institute of Science and Technology (BIST), Av. Països Catalans 16, 43007 – Tarragona, Spain

[‡]Catalan Institute of Research and Advanced Studies (ICREA), Pg. Lluís Companys 23, 08010 – Barcelona, Spain

Supporting Information

ABSTRACT: A sequential and mild approach toward the synthesis of poly(limonene)dicarbonate (PLDC) has been developed using readily available limonene oxide (LO) and CO_2 as renewable reagents and an air-stable Al(III) complex as catalyst for the alkene-rich poly(limonene)carbonate (PLC). The developed sequence allows for the stepwise construction of different PLDC polymers, using PLC as a synthetic intermediate with molecular weights of up to 15.3 kg/mol and tunable glass-transition temperature (T_g) values of up to an unprecedented 180 °C using a commercially available mixture of *cis*/*trans* (+)-LO.



KEYWORDS: *aluminum, carbon dioxide, limonene oxide, polycarbonates, renewables*

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El ICIQ de Tarragona fabrica un polímero a partir de un aceite de la piel los cítricos

El compuesto está libre del disruptor endocrino bisfenol-A y aguanta el calor

Michele Catanzaro

Barcelona - Domingo, 13/08/2017 | Actualizado el 17/08/2017 a las 16:13 CEST

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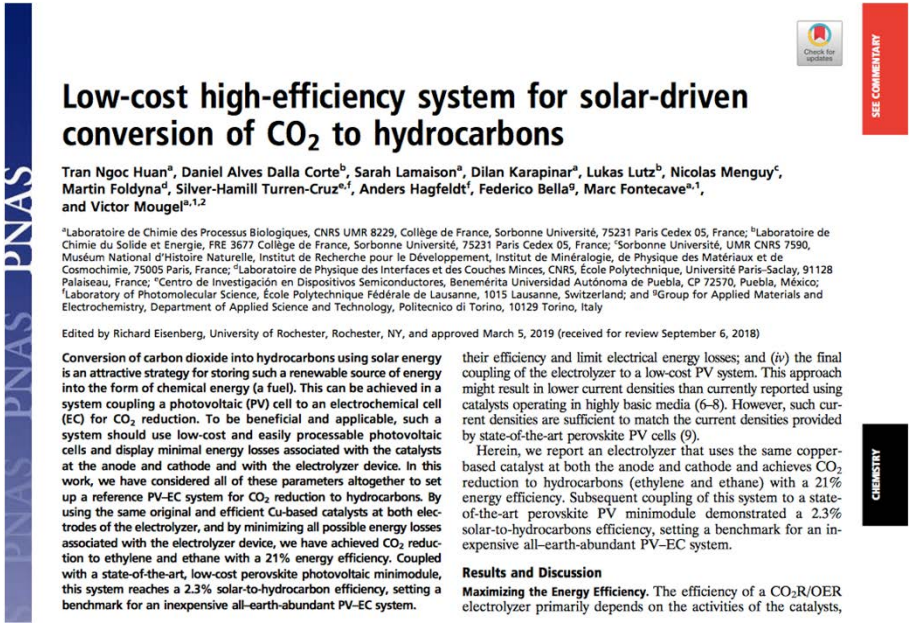
N. Kindermann, A. Cristòfol, A.W. Kleij. *ACS Catalysis* **2017**, *7*, 3860 (DOI: 10.1021/acscatal.7b00770).

Press



PNAS PNAS PNAS

Low-cost high-efficiency system for solar-driven conversion of CO_2 to hydrocarbons

Tran Ngoc Huan[a], Daniel Alves Dalla Corte[b], Sarah Lamaison[a], Dilan Karapinar[a], Lukas Lutz[b], Nicolas Menguy[c], Martin Foldyna[d], Silver-Hamill Turren-Cruz[e,f], Anders Hagfeldt[f], Federico Bella[g], Marc Fontecave[a,1], and Victor Mougel[a,1,2]

[a]Laboratoire de Chimie des Processus Biologiques, CNRS UMR 8229, Collège de France, Sorbonne Université, 75231 Paris Cedex 05, France; [b]Laboratoire de Chimie du Solide et Energie, FRE 3677 Collège de France, Sorbonne Université, 75231 Paris Cedex 05, France; [c]Sorbonne Université, UMR CNRS 7590, Muséum National d'Histoire Naturelle, Institut de Recherche pour le Développement, Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie, 75005 Paris, France; [d]Laboratoire de Physique des Interfaces et des Couches Minces, CNRS, École Polytechnique, Université Paris-Saclay, 91128 Palaiseau, France; [e]Centro de Investigación en Dispositivos Semiconductores, Benemérita Universidad Autónoma de Puebla, CP 72570, Puebla, México; [f]Laboratory of Photomolecular Science, École Polytechnique Fédérale de Lausanne, 1015 Lausanne, Switzerland; and [g]Group for Applied Materials and Electrochemistry, Department of Applied Science and Technology, Politecnico di Torino, 10129 Torino, Italy

Edited by Richard Eisenberg, University of Rochester, Rochester, NY, and approved March 5, 2019 (received for review September 6, 2018)

Conversion of carbon dioxide into hydrocarbons using solar energy is an attractive strategy for storing such a renewable source of energy into the form of chemical energy (a fuel). This can be achieved in a system coupling a photovoltaic (PV) cell to an electrochemical cell (EC) for CO_2 reduction. To be beneficial and applicable, such a system should use low-cost and easily processable photovoltaic cells and display minimal energy losses associated with the catalysts at the anode and cathode and with the electrolyzer device. In this work, we have considered all of these parameters altogether to set up a reference PV–EC system for CO_2 reduction to hydrocarbons. By using the same original and efficient Cu-based catalysts at both electrodes of the electrolyzer, and by minimizing all possible energy losses associated with the electrolyzer device, we have achieved CO_2 reduction to ethylene and ethane with a 21% energy efficiency. Coupled with a state-of-the-art, low-cost perovskite photovoltaic minimodule, this system reaches a 2.3% solar-to-hydrocarbon efficiency, setting a benchmark for an inexpensive all–earth-abundant PV–EC system.

their efficiency and limit electrical energy losses; and (*iv*) the final coupling of the electrolyzer to a low-cost PV system. This approach might result in lower current densities than currently reported using catalysts operating in highly basic media (6–8). However, such current densities are sufficient to match the current densities provided by state-of-the-art perovskite PV cells (9).

Herein, we report an electrolyzer that uses the same copper-based catalyst at both the anode and cathode and achieves CO_2 reduction to hydrocarbons (ethylene and ethane) with a 21% energy efficiency. Subsequent coupling of this system to a state-of-the-art perovskite PV minimodule demonstrated a 2.3% solar-to-hydrocarbons efficiency, setting a benchmark for an inexpensive all–earth-abundant PV–EC system.

Results and Discussion

Maximizing the Energy Efficiency. The efficiency of a CO_2R/OER electrolyzer primarily depends on the activities of the catalysts,

SEE COMMENTARY

CHEMISTRY

THE TIMES SUBSCRIBE

Artificial plant mimics leaf to make fuel from sunlight

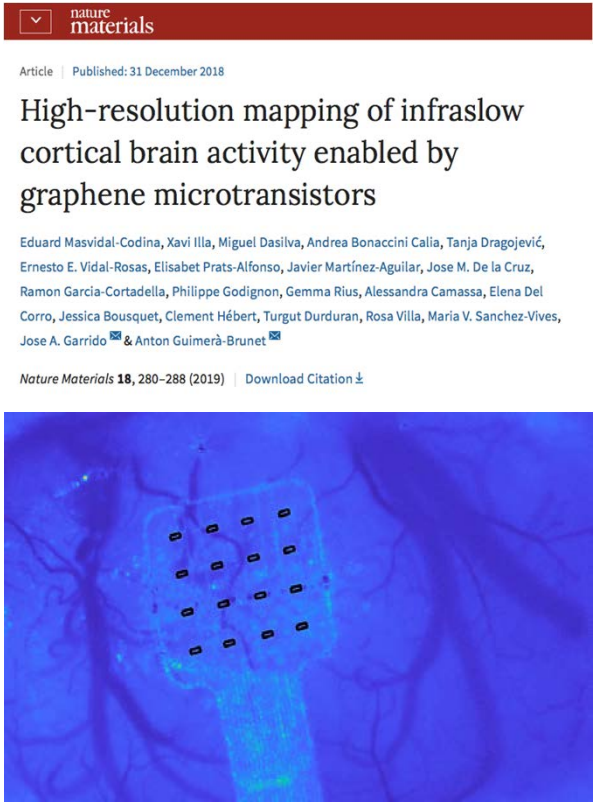
Rhys Blakely,
Science Correspondent

March 26 2019, 12:01am,
The Times

Scientists have developed a process that mimics photosynthesis to create oxygen
ALAMY

T. N. Huan *et al. PNAS* **2019,** *116* (20), *9735* (DOI: 10.1073/pnas.1815412116).

Science writing



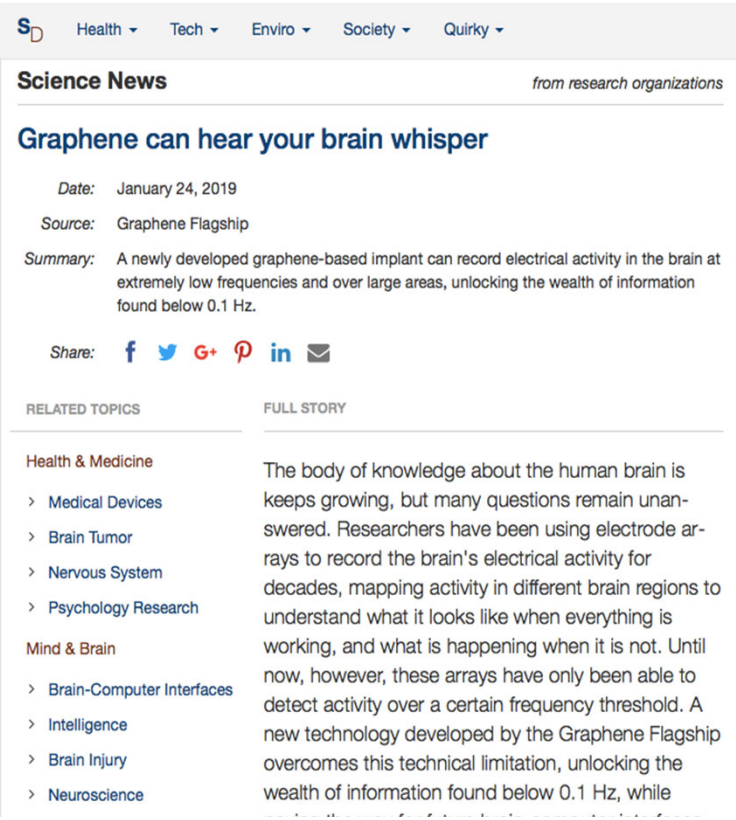
nature materials

Article | Published: 31 December 2018

High-resolution mapping of infraslow cortical brain activity enabled by graphene microtransistors

Eduard Masvidal-Codina, Xavi Illa, Miguel Dasilva, Andrea Bonaccini Calia, Tanja Dragojević, Ernesto E. Vidal-Rosas, Elisabet Prats-Alfonso, Javier Martínez-Aguilar, Jose M. De la Cruz, Ramon Garcia-Cortadella, Philippe Godignon, Gemma Rius, Alessandra Camassa, Elena Del Corro, Jessica Bousquet, Clement Hébert, Turgut Durduran, Rosa Villa, Maria V. Sanchez-Vives, Jose A. Garrido & Anton Guimerà-Brunet

Nature Materials **18**, 280–288 (2019) | Download Citation



Health Tech Enviro Society Quirky

Science News *from research organizations*

Graphene can hear your brain whisper

Date: January 24, 2019

Source: Graphene Flagship

Summary: A newly developed graphene-based implant can record electrical activity in the brain at extremely low frequencies and over large areas, unlocking the wealth of information found below 0.1 Hz.

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FULL STORY

The body of knowledge about the human brain is keeps growing, but many questions remain unanswered. Researchers have been using electrode arrays to record the brain's electrical activity for decades, mapping activity in different brain regions to understand what it looks like when everything is working, and what is happening when it is not. Until now, however, these arrays have only been able to detect activity over a certain frequency threshold. A new technology developed by the Graphene Flagship overcomes this technical limitation, unlocking the wealth of information found below 0.1 Hz, while

E. Masvidal-Codina *et al. Nature Materials* **2019**, *18*, 280 (DOI: 10.1038/s41563-018-0249-4).

Science writing

ORGANIC CHEMISTRY

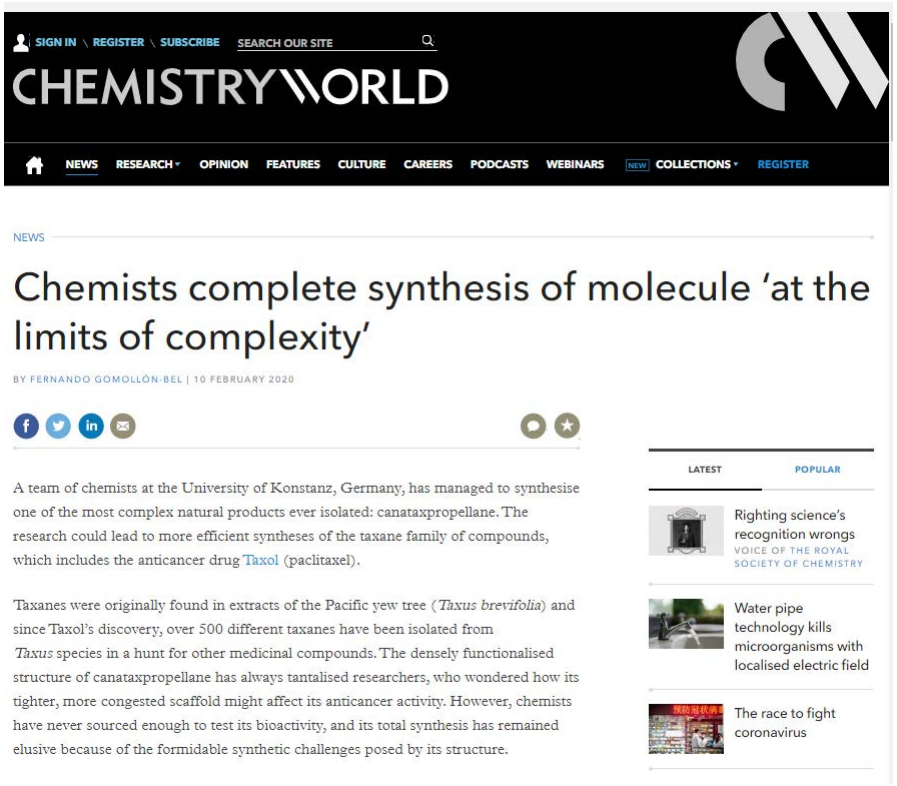
Total synthesis of the complex taxane diterpene canataxpropellane

Fabian Schneider, Konstantin Samarin, Simone Zanella, Tanja Gaich*

Canataxpropellane belongs to the medicinally important taxane diterpene family. The most prominent congener, Taxol, is one of the most commonly used anticancer agent in clinics today. Canataxpropellane exhibits a taxane skeleton with three additional transannular C–C bonds, resulting in a total of six contiguous quaternary carbons, of which four are located on a cyclobutane ring. Unfortunately, isolation of canataxpropellane from natural sources is inefficient. Here, we report a total synthesis of (–)-canataxpropellane in 26 steps and 0.5% overall yield from a known intermediate corresponding to 29 steps from commercial material. The core structure of the (–)-canataxpropellane (2) was assembled in two steps using a Diels–Alder/*ortho*-alkene-arene photocycloaddition sequence. Enantioselectivity was introduced by designing chiral siloxanes to serve as auxiliaries in the Diels–Alder reaction.

Taxane diterpenes (*1*–*3*) are a medicinally vital family of natural products exhibiting potent anticancer activity (*4*–*6*) that were originally isolated from slow-growing evergreen shrubs in the genus *Taxus*, commonly known as yews. In 1994, major synthetic efforts (*7*–*15*) culminated in the first total syntheses of the most prominent anticancer drug, Taxol (**1**) (*4*–*6*) (Fig. 1A), by Holton (*7*, *8*) and Nicolaou (*9*), which turned out to be one of the top-selling anticancer drugs (peak sales in 1999 of 1.5 billion USD) over the past three decades (*16*). Ever since, different *Taxus* species have been screened for their constituents and >500 taxanes have been isolated.

(–)-Canataxpropellane (**2**) comprises a heptacyclic [5,5,5,4,6,6,6] carbon framework (Fig. 1C). It is densely functionalized and highly oxidized (five hydroxyl groups; one ketone), containing only two CH_2 groups. Among the features distinguishing the compound's structural complexity are the following: (i) it is the only natural product harboring two propellanes (*18*) simultaneously {see the colored portions of the structures in Fig. 1C **I** (a [3.3.2]-propellane) and **II** (a [4.4.2]-propellane)}; (ii) it contains 12 contiguous stereocenters (Fig. 1C **III**) including five quaternary centers, four of which reside in a cyclobutane ring (Fig. 1C **IV**); and (iii) except for two carbon atoms (6 and 14), its



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NEWS

Chemists complete synthesis of molecule 'at the limits of complexity'

BY FERNANDO GOMOLLÓN-BEL | 10 FEBRUARY 2020

A team of chemists at the University of Konstanz, Germany, has managed to synthesise one of the most complex natural products ever isolated: canataxpropellane. The research could lead to more efficient syntheses of the taxane family of compounds, which includes the anticancer drug Taxol (paclitaxel).

Taxanes were originally found in extracts of the Pacific yew tree (*Taxus brevifolia*) and since Taxol's discovery, over 500 different taxanes have been isolated from *Taxus* species in a hunt for other medicinal compounds. The densely functionalised structure of canataxpropellane has always tantalised researchers, who wondered how its tighter, more congested scaffold might affect its anticancer activity. However, chemists have never sourced enough to test its bioactivity, and its total synthesis has remained elusive because of the formidable synthetic challenges posed by its structure.

LATEST POPULAR

Righting science's recognition wrongs
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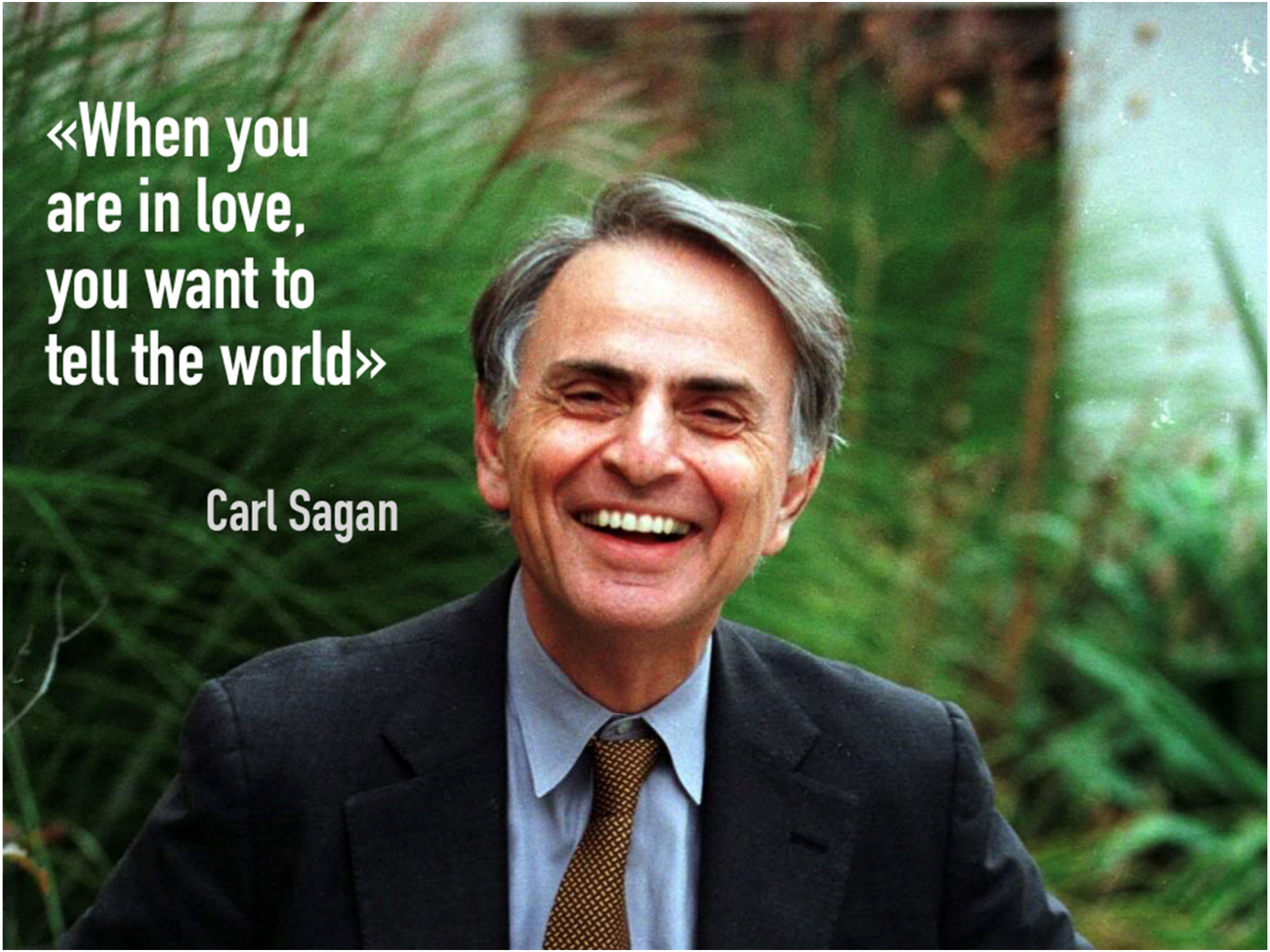
Water pipe technology kills microorganisms with localised electric field

The race to fight coronavirus

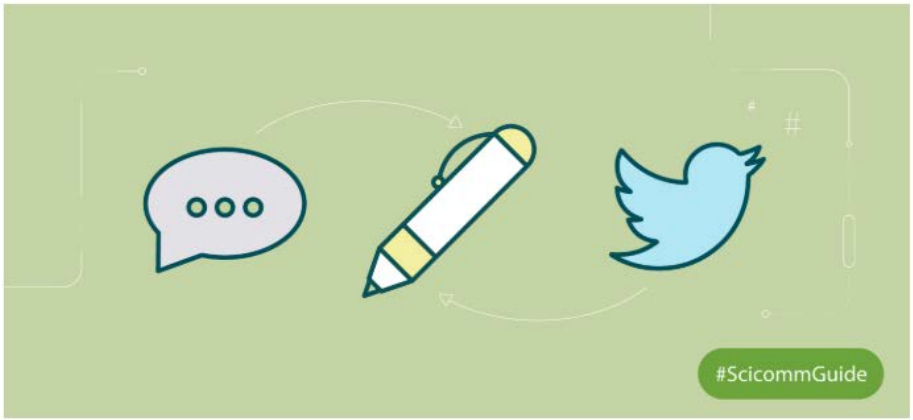
F. Schneider *et al. Science* **2020**, *367*, 676 (DOI: 10.1126/science.aay9173).


«When you
are in love,
you want to
tell the world»
Carl Sagan

Choose your favourite

Speak, write, tweet: ways to communicate science

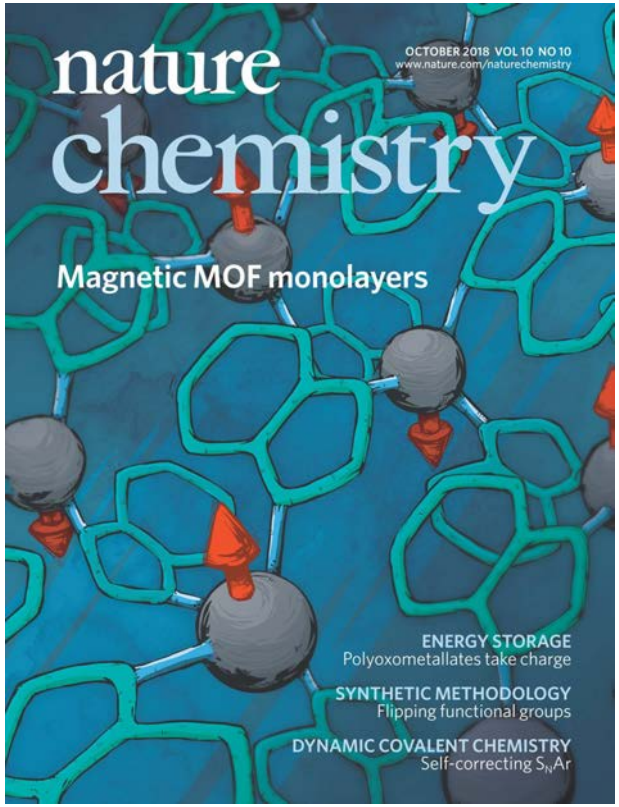
Opinion



Sharing your science: what type of communication is best for you?

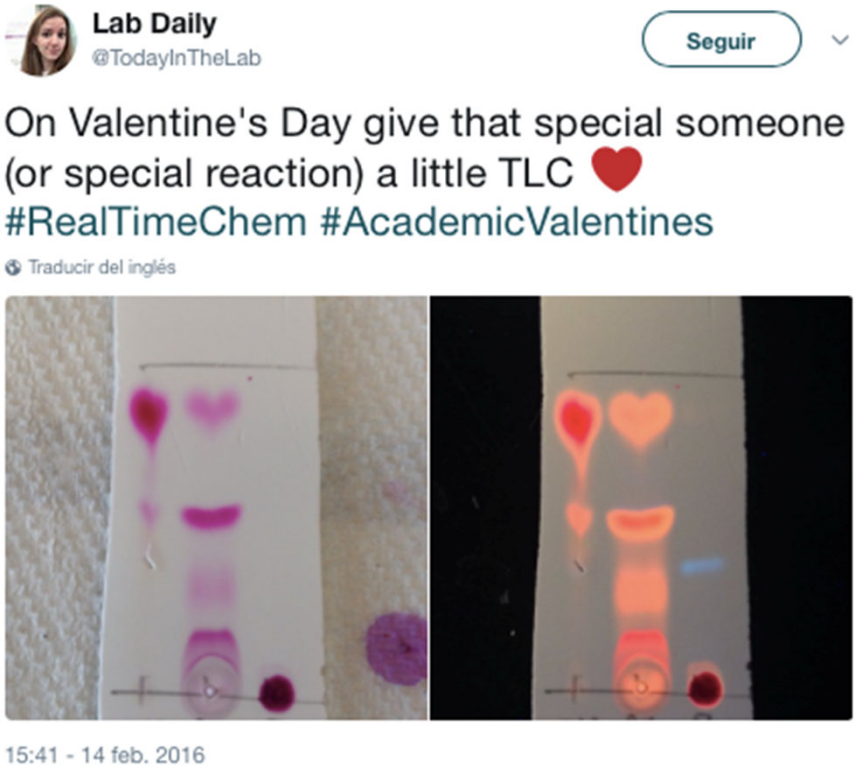
J. Bowers: «Speak, write, tweet: ways to communicate science», *Hindawi Blog,* 04/02/2020 (http://bit.ly/3but4tv).

Covers and art



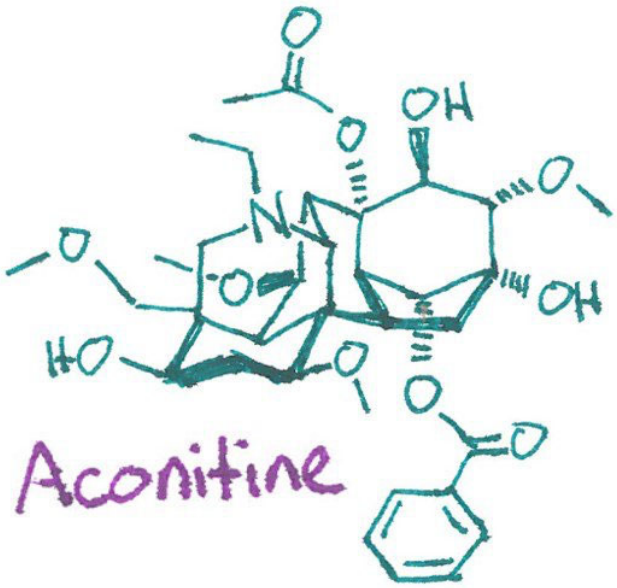
J. López-Cabrelles *et al. Nature Chemistry* **2018**, *10*, 1001 (DOI: 10.1038/s41557-018-0113-9).

Pictures



Original tweet by Lab Daily (@TodayInTheLab)

Poetry



Justin Brower
@NaturesPoisons

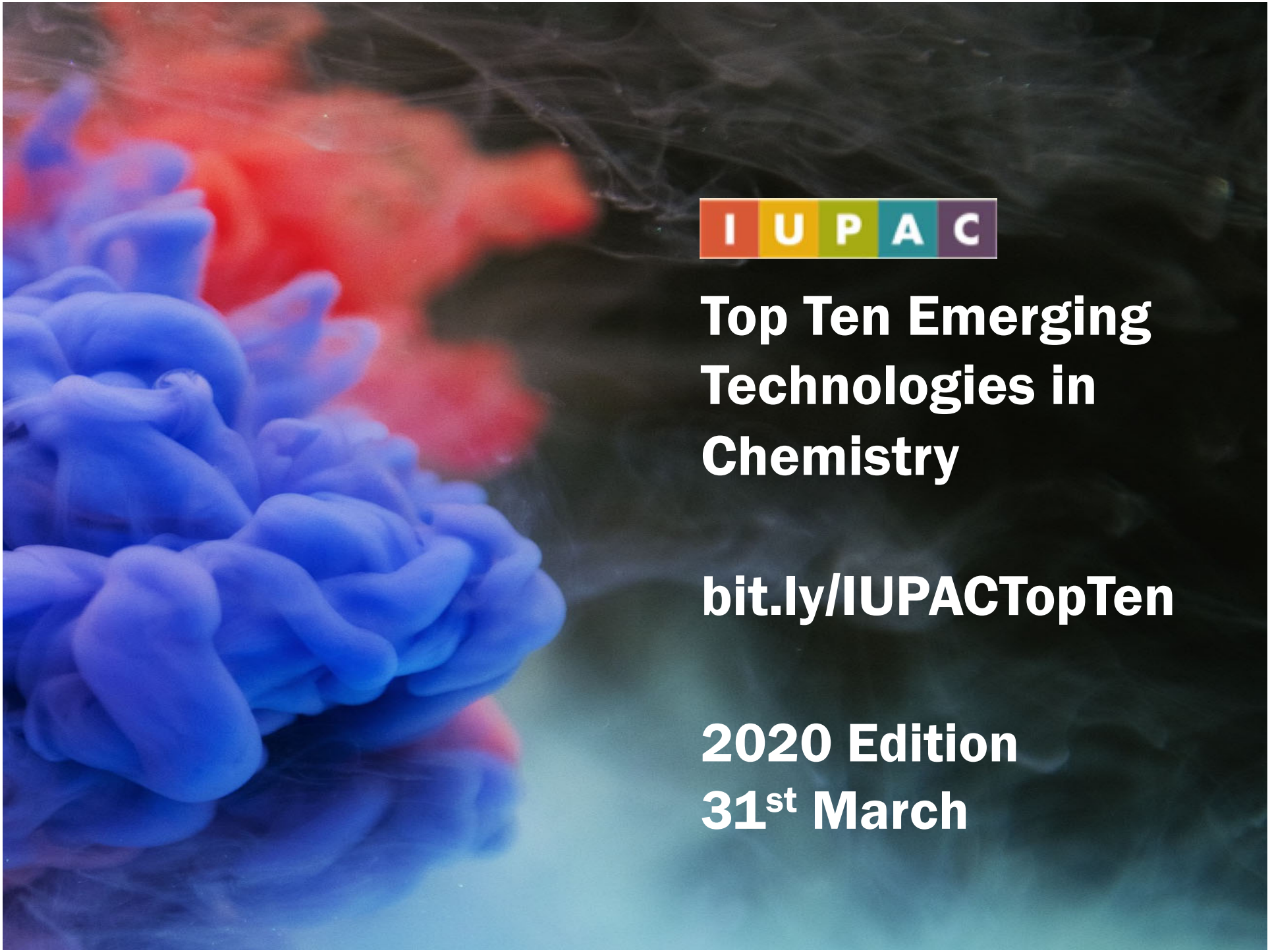
A is for aconitine,
the Queen of Poisons she's called.
Acting on ion-channels
flutters the heart, leaves it mauled.

There is plenty in Monkshood,
roots and leaves look delicious.
But snuck into a curry
is awfully suspicious.

Original tweet by Justin Brower (@NaturesPoisons)

emojis

Original tweet by Nicola Gaston (@nicgaston)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It works

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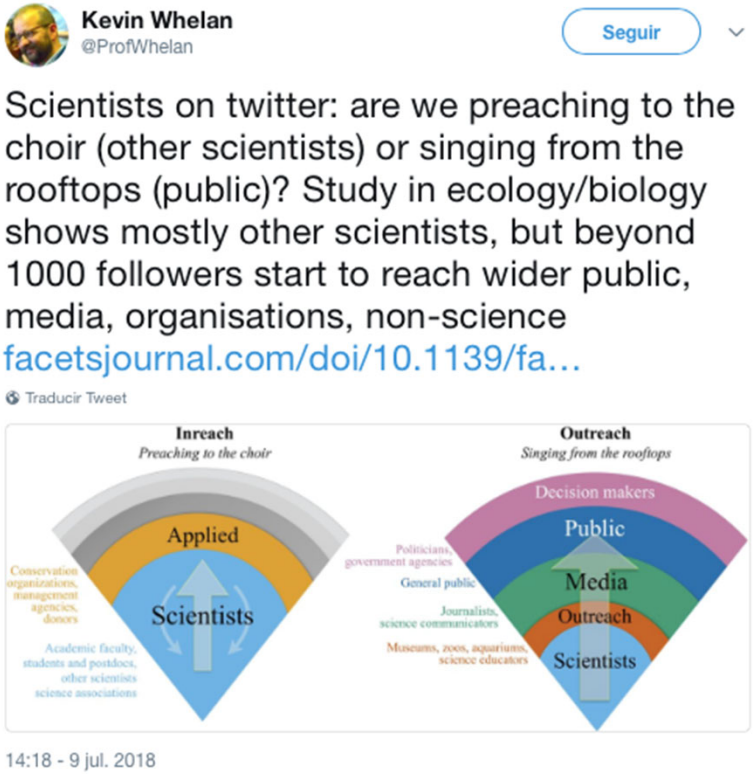
21% of the researchers were contacted by interested companies.

Public communication improves prestige and the likelihood of getting more funding. »

J. Alonso-Flores, *et al. Inmediaciones de la Comunicación* **2018**, *13* (2), 115 (DOI: 10.18861/ic.2018.13.2.2870).

Global impact



Original tweet by Kevin Whelan (@ProfWhelan)

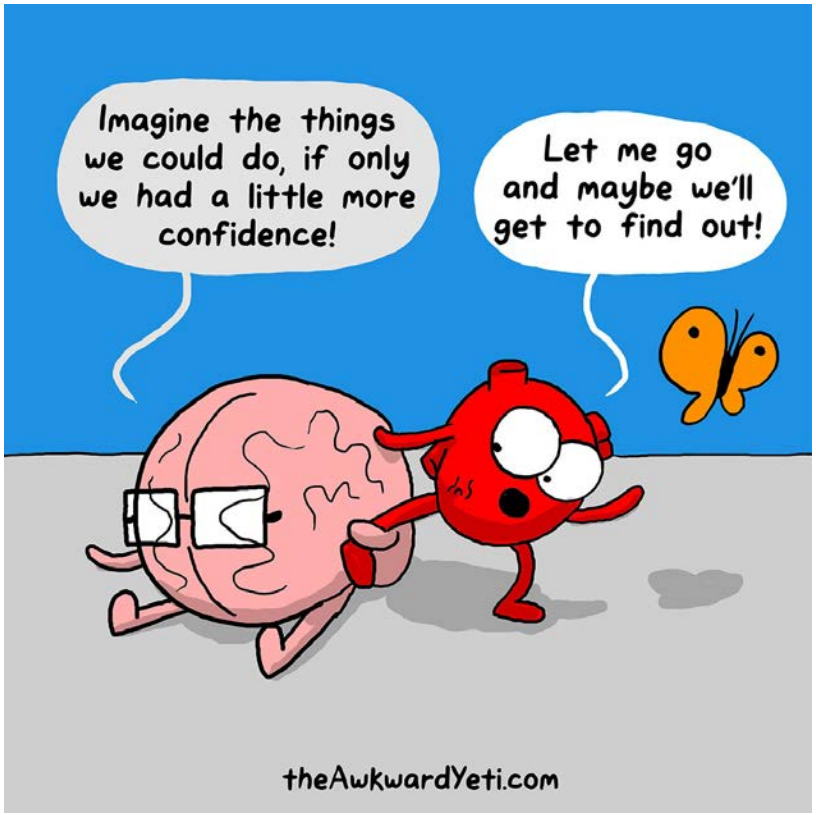
Global impact

@Amonterodel

A Twitter account with less followers than people attending a conference gets:

- **more visibility**
- **better engagement**
- **more interactions**

Explore and learn



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dark side

nature chemistry

ARTICLES

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Science beyond the paper

F. Gomollón-Bel[1]*

The biocatalytic transformations used by chemists are often restricted to simple functional-group interconversions. In contrast, nature has developed complexity-generating biocatalytic reactions within natural product pathways. These sophisticated catalysts are rarely employed by chemists, because the substrate scope, selectivity and robustness of these catalysts are unknown. Our strategy to bridge the gap between the biosynthesis and synthetic chemistry communities leverages the diversity of catalysts available within natural product pathways. Here we show that, starting from a suite of biosynthetic enzymes, catalysts with complementary substrate scope as well as selectivity can be identified. This strategy has been applied to the oxidative dearomatization of phenols, a chemical transformation that rapidly builds molecular complexity from simple starting materials and cannot be accomplished with high selectivity using existing catalytic methods. Using enzymes from biosynthetic pathways, we have successfully developed a method to produce *ortho*-quinol products with site- and stereoselectivity. Furthermore, we have capitalized on the scalability and robustness of this method in preparative reactions as well as multi-enzyme and chemoenzymatic cascades.

Fernando Gomollón Bel – @gomobel

SCNAT Young Faculty Meeting

Bern, Switzerland, 12 February 2020