An Industrial Perspective on Navigating OA and FAIR Data Practices

22-February-2024

NAS: Publishing in the Age of Open Science

Session 3: Supporting the Research Community

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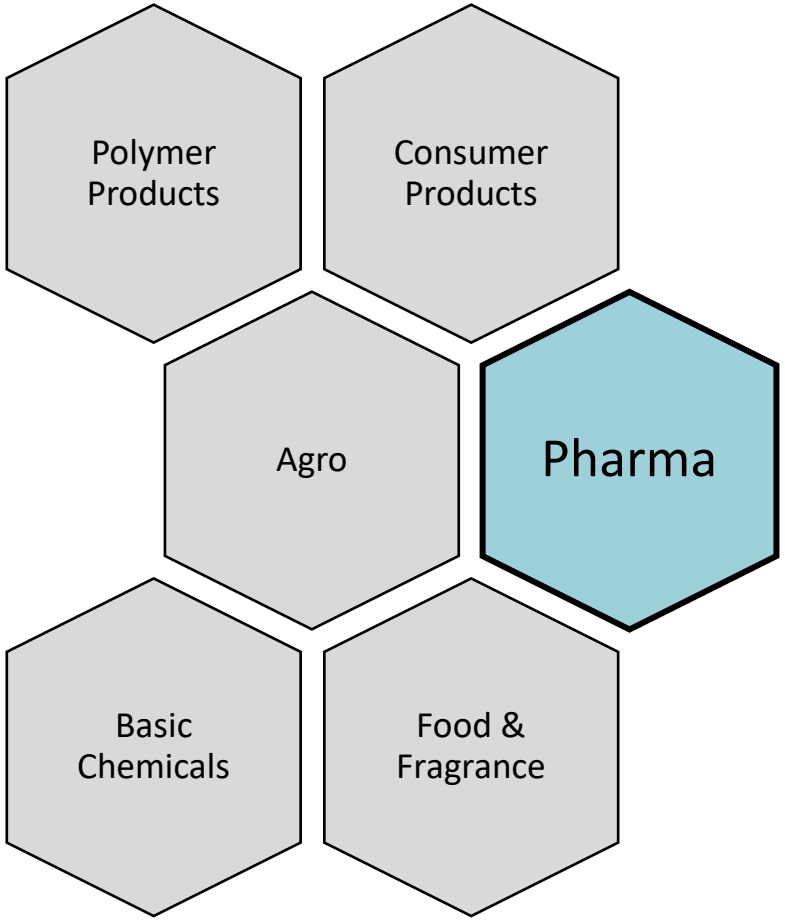
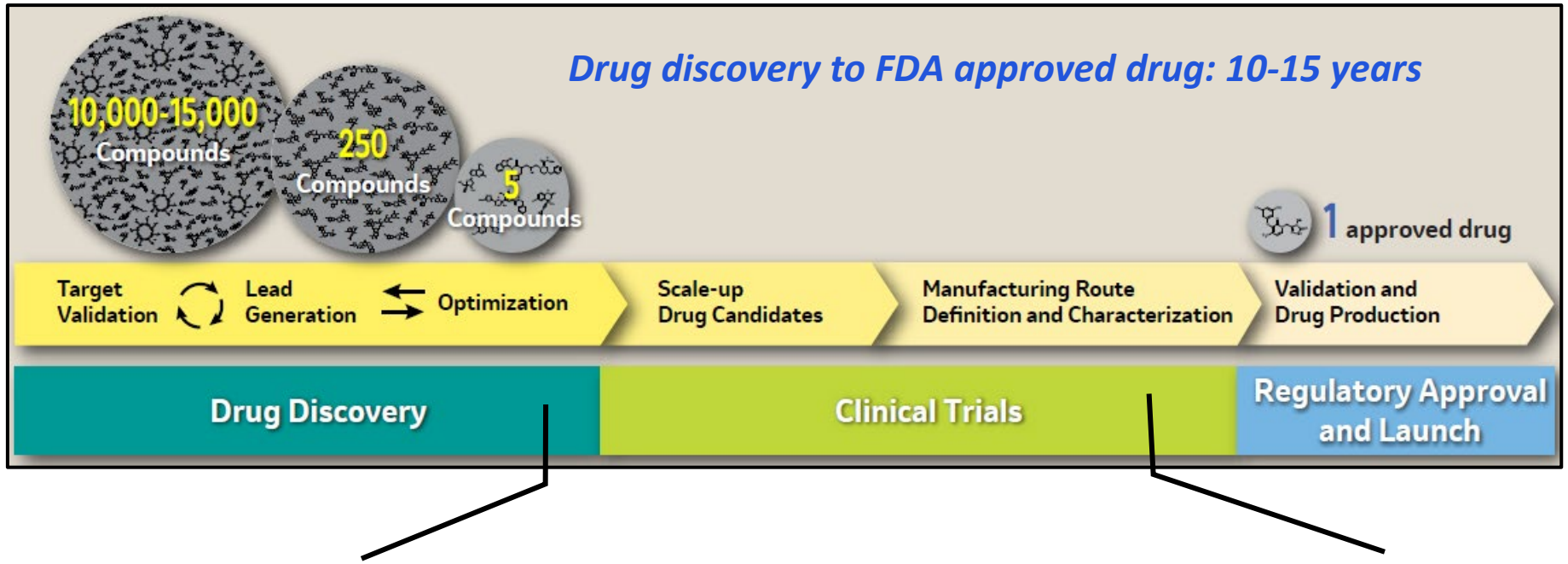
‘I thought industry doesn’t like to publish…”



Our purpose: *We use the power of leading-edge science to* ***save and improve lives around the world****.*

Our values: *We are dedicated to the* ***highest standard of innovation and scientific excellence****. Our research is guided by a commitment to improving health and quality of life.*

What we publish and why we care



Why we care about publishing drug discovery papers

- Novel drug design and discovery (including synthesis)
- Addressing problems commonly encountered in drug discovery
- In vivo and in vitro studies can be complex – hence worth sharing

Why we care about publishing process papers

- Green chemistry and manufacturing practices
- Novel synthetic methods
- Safety and engineering controls

The Importance of Industrial Publications *Nature Catalysis*, **2018**, *1* , 479–480
Why Should We Care About Publishing? *Org. Process Res. Dev.* **2015**, *19*, 559

Why hearing from industry matters

editorial

The importance of industrial publications

Industrial publications are a very valuable and multifaceted tool for the wider catalysis community; they can foster the productive collaboration of university and corporate research laboratories, an essential partnership for the solution of important societal problems

Organic Process Research & Development

Editorial

pubs.acs.org/OPRD

Why Should We Care About Publishing?

1. *Advancement and influence of science!*
2. *Freedom to operate*
3. *Promote our people and company = attracting top talent*
4. *Stimulus for scientific collaborations*

Journal of Medicinal Chemistry

pubs.acs.org/jmc

Perspective

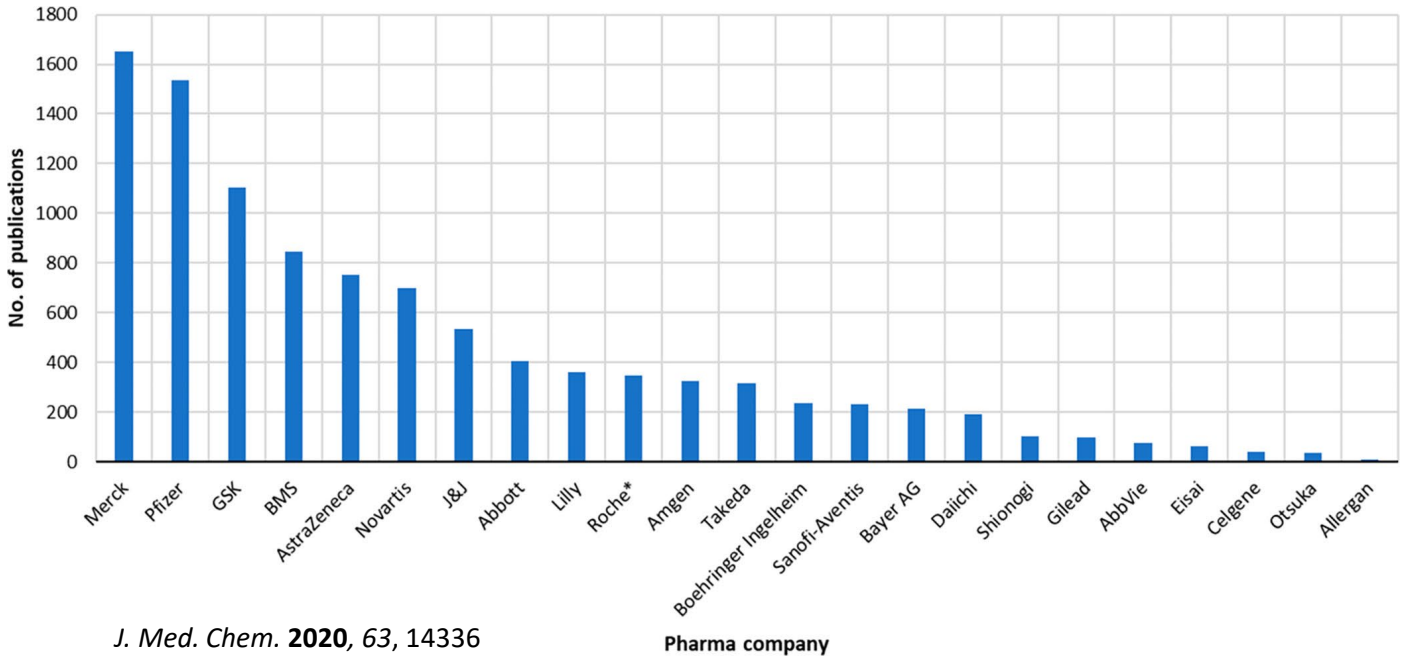
Writing Your Next Medicinal Chemistry Article: Journal Bibliometrics and Guiding Principles for Industrial Authors

Richard J. D. Hatley, Panayiotis A. Procopiou, Steven P. McLachlan, Laura E. Westendorf, Nicholas A. Meanwell, William R. Ewing, and Simon J. F. Macdonald*

1. *Publishing is not our top priority!*
2. *IP landscape can be complex*
3. *20% of science in patents ends up in journals*
4. *~5% of data is ultimately published*

Industrial publications are trending…

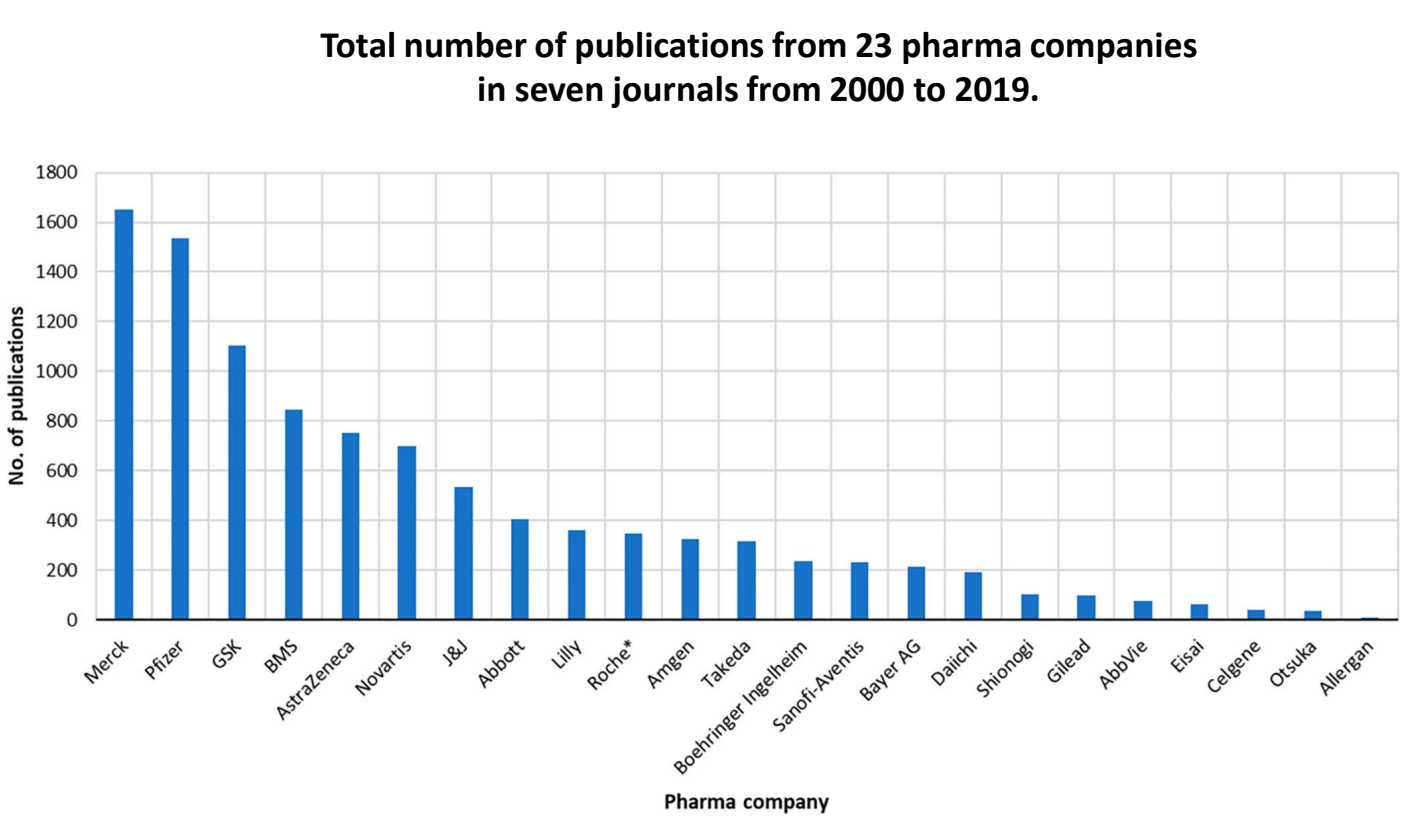
Total number of publications from 23 pharma companies in seven journals from 2000 to 2019.

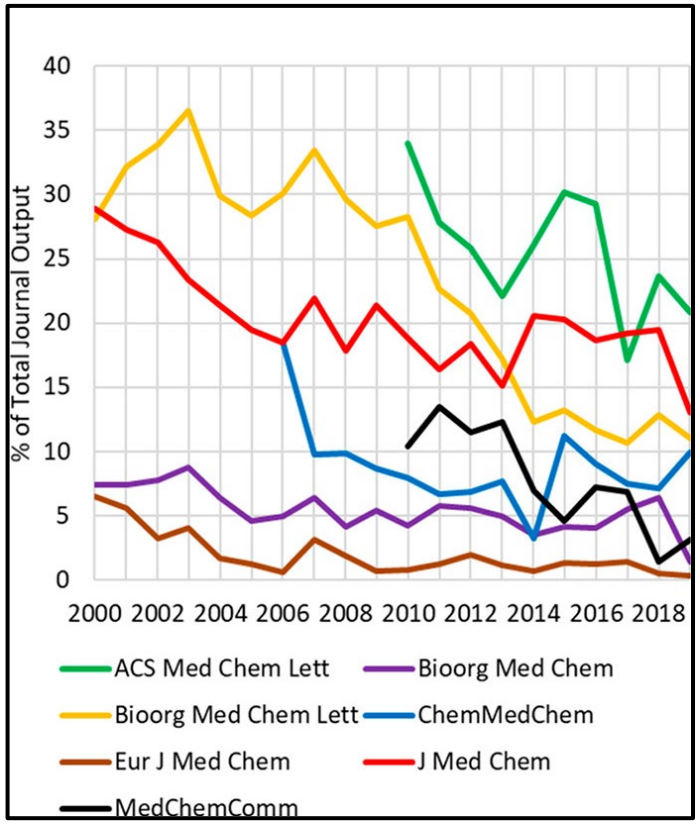


J. Med. Chem. **2020**, *63*, 14336

ACS Med. Chem. Lett.	Bioorg. & Med. Chemistry
ChemMedChem	Bioorg. & Med. Chemistry Lett.
Eur. J. of Med. Chemistry	J. of Med. Chemistry

Industrial publications are trending…down

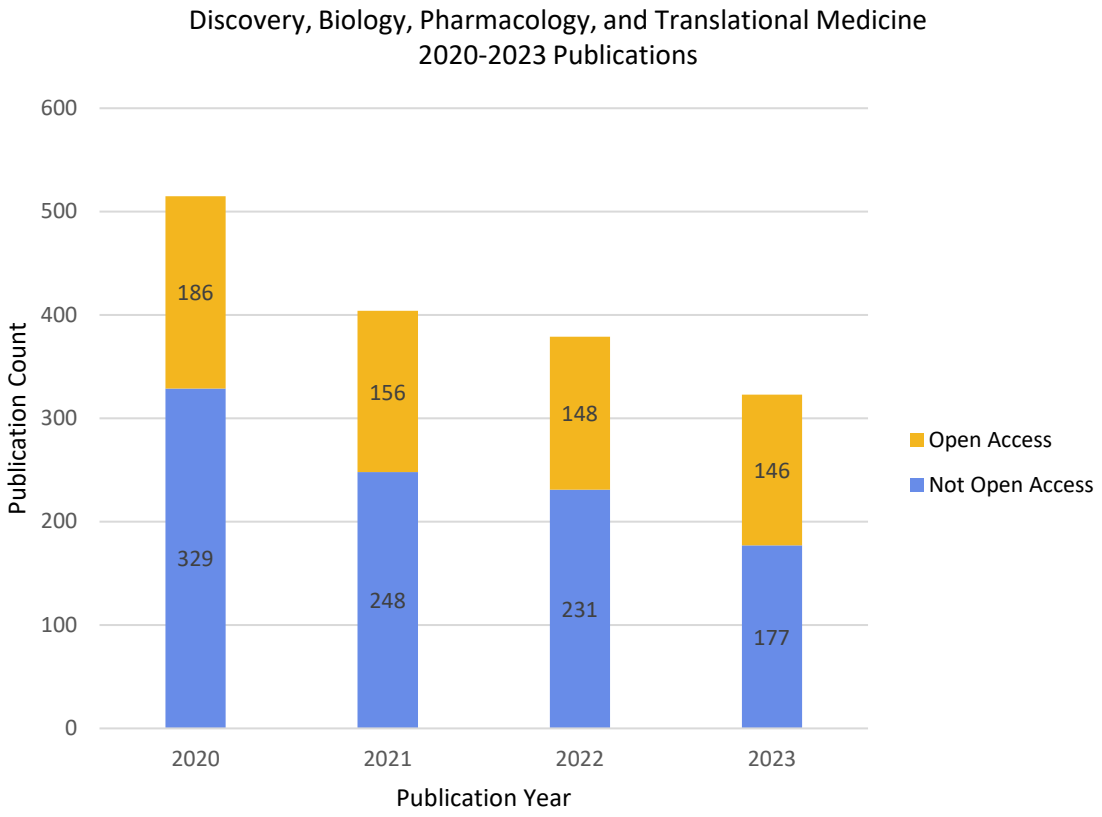


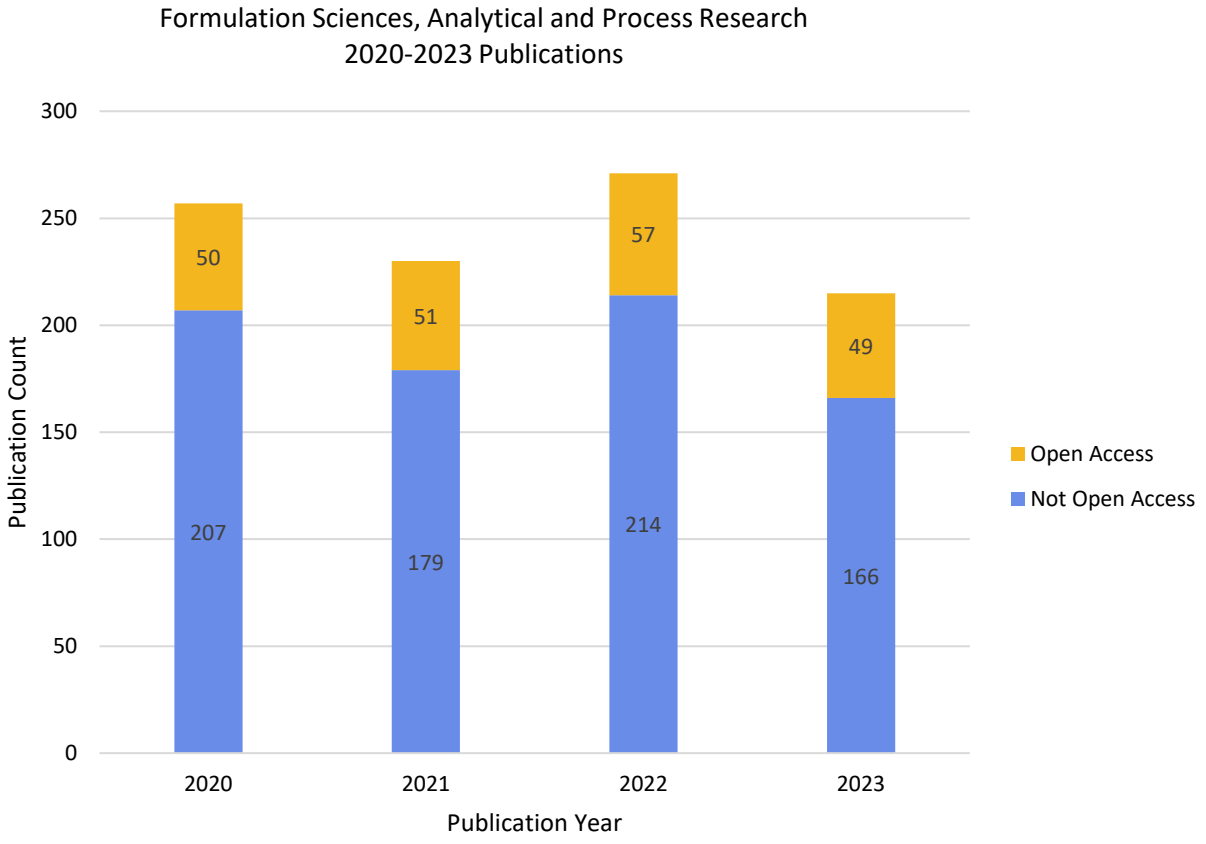


"…the total number of medicinal chemistry articles published in the 7 [leading medicinal chemistry] journals from 23 big pharma companies ***has decreased by about 25% from 2000 to 2019****."*

J. Med. Chem. **2020**, *63*, 14336

Merck Publications at Glance: 2020-2023 by Publication Type

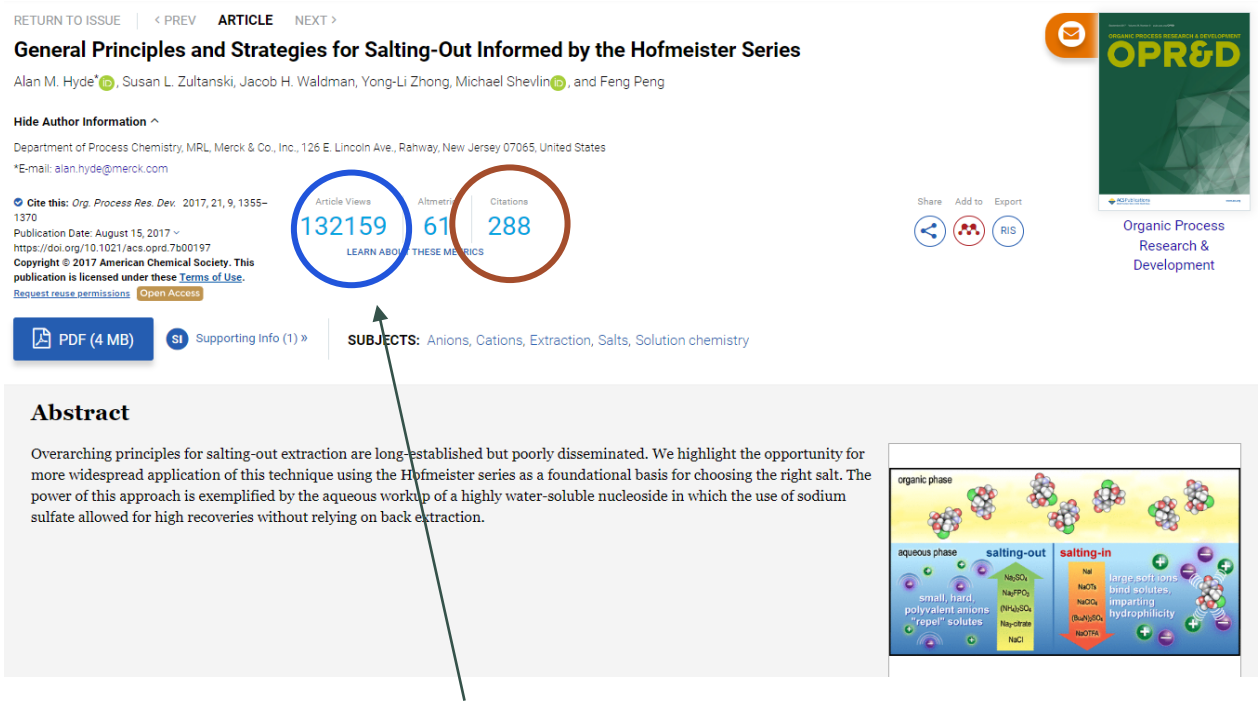




❑ ~40% OA publications

❑ ~21% OA publications

The potential impact and reach of OA publishing



Top 1% of papers published that year

❑ Cited in >25 countries

Thoughts on how an OA future could impact industrial publications

*Drug discovery and development is a **huge innovative achievement**, that with OA could globally impact human health*

Why should industry want an OA future?

- Broad access to healthcare providers, researchers, and the public
- Acceleration of research through dissemination of cutting-edge science
- Avoids duplication of research (ie re-inventing the wheel)

OA unknowns and potential impacts

- High APC fees could deter from industrial publications (patent over publish)
  - Only publishing a fraction of research
  - Journals with lower APCs might be preferred
- Data requirements

JOURNAL	PUBLISHER	HYBRID OR FULLY OPEN ACCESS	ARTICLE PROCESSING CHARGE
ACS Central Science	American Chemical Society	Full	$1,000
Angewandte Chemie International Edition	Wiley for the German Chemical Society	Hybrid	$5,000
Cell Reports Physical Science	Cell Press, part of Elsevier	Full	$5,200
Chem	Cell Press, part of Elsevier	Hybrid	$5,200
ChemComm	Royal Society of Chemistry	Hybrid	$2,150[a]
Chemical Science	Royal Society of Chemistry	Full	$0
Chinese Chemical Letters	Elsevier for the Chinese Chemical Society	Full	$300[b]
JACS Au	American Chemical Society	Full	$5,000
Journal of the American Chemical Society	American Chemical Society	Hybrid	$5,000
Nature	Springer Nature	Hybrid	$11,390
Nature Chemistry	Springer Nature	Hybrid	$11,390
Nature Communications	Springer Nature	Full	$5,560
PLOS Biology	PLOS	Full	$3,000
Proceedings of the National Academy of Sciences of the United States of America	National Academy of Sciences	Hybrid	$4,700
Science Advances	American Association for the Advancement of Science	Full	$4,500
Science China Chemistry	Science China Press and Springer Nature	Hybrid	$3,860

Widener, A. C&EN (2021), volume 99, issue 2

Would industry be interested in OA agreements and what would they look like?

Academic-industrial collaborations @ Merck

- ❑ **Building New Capabilities at Merck and Universities**
- ❑ **Professional Development**
  - ➢ Training for Merck Chemists
  - ➢ Training for Grad Students/Post-docs
  - ➢ Recruiting
- ❑ **Scientific Curiosity**

50+ active academic and industrial collaborations

Leverage the ingenuity of all chemists to impact human health

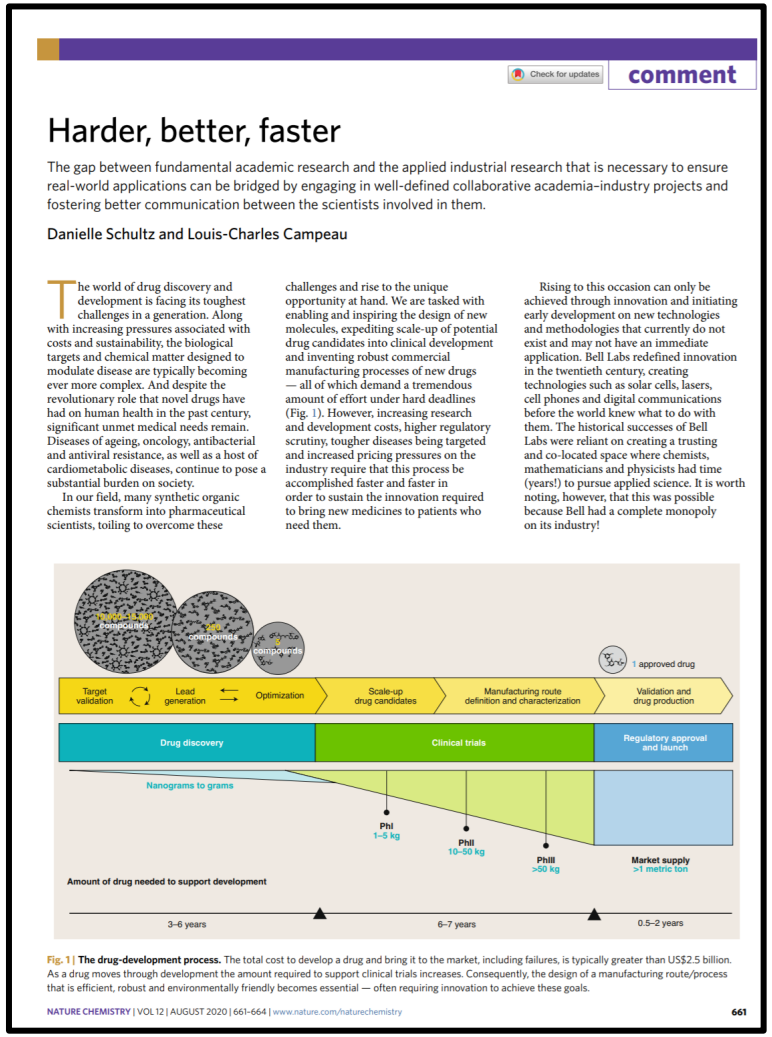
Looking External

"Organic synthesis provides opportunities to transform drug discovery." *Rees and coworkers, Nature Chemistry* **2018**, *10*, 383

Pfizer gsk AstraZeneca Roche astex pharmaceuticals

Organic synthesis in academia
Discover new technologies and disconnections

Drug discovery in industry
Synthesis design for drug discovery projects



Check for updates

comment

Harder, better, faster

The gap between fundamental academic research and the applied industrial research that is necessary to ensure real-world applications can be bridged by engaging in well-defined collaborative academia–industry projects and fostering better communication between the scientists involved in them.

Danielle Schultz and Louis-Charles Campeau

The world of drug discovery and development is facing its toughest challenges in a generation. Along with increasing pressures associated with costs and sustainability, the biological targets and chemical matter designed to modulate disease are typically becoming ever more complex. And despite the revolutionary role that novel drugs have had on human health in the past century, significant unmet medical needs remain. Diseases of ageing, oncology, antibacterial and antiviral resistance, as well as a host of cardiometabolic diseases, continue to pose a substantial burden on society.

In our field, many synthetic organic chemists transform into pharmaceutical scientists, toiling to overcome these challenges and rise to the unique opportunity at hand. We are tasked with enabling and inspiring the design of new molecules, expediting scale-up of potential drug candidates into clinical development and inventing robust commercial manufacturing processes of new drugs — all of which demand a tremendous amount of effort under hard deadlines (Fig. 1). However, increasing research and development costs, higher regulatory scrutiny, tougher diseases being targeted and increased pricing pressures on the industry require that this process be accomplished faster and faster in order to sustain the innovation required to bring new medicines to patients who need them.

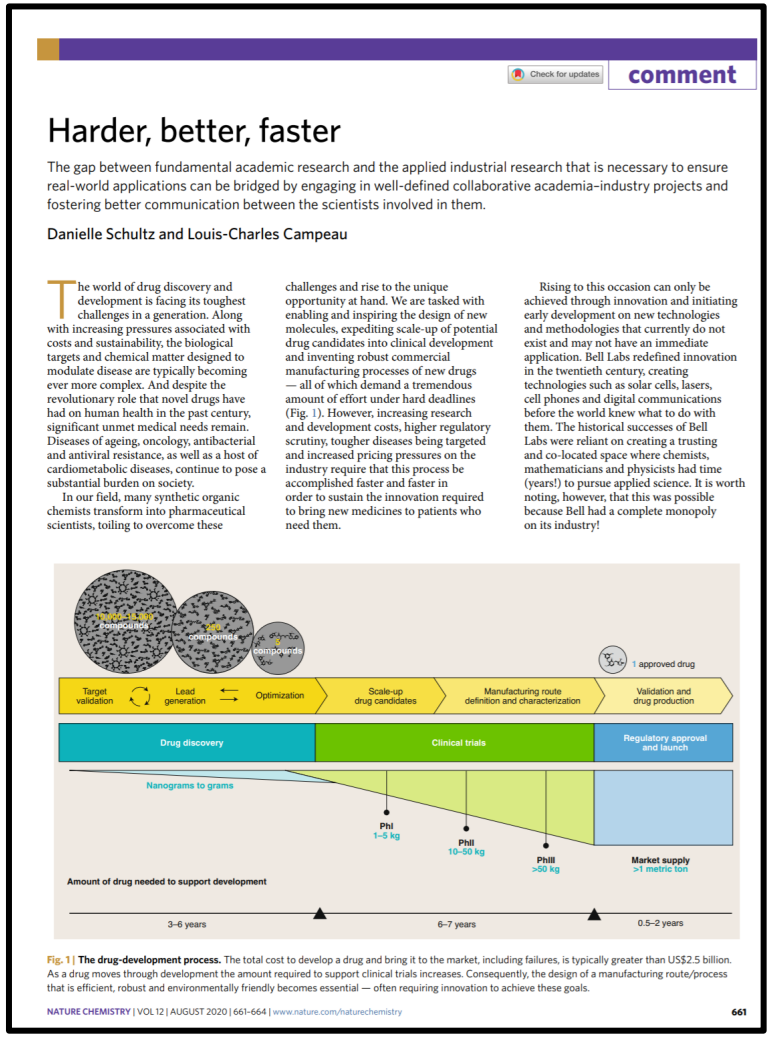
Rising to this occasion can only be achieved through innovation and initiating early development on new technologies and methodologies that currently do not exist and may not have an immediate application. Bell Labs redefined innovation in the twentieth century, creating technologies such as solar cells, lasers, cell phones and digital communications before the world knew what to do with them. The historical successes of Bell Labs were reliant on creating a trusting and co-located space where chemists, mathematicians and physicists had time (years!) to pursue applied science. It is worth noting, however, that this was possible because Bell had a complete monopoly on its industry!

Fig. 1 | **The drug-development process.** The total cost to develop a drug and bring it to the market, including failures, is typically greater than US$2.5 billion. As a drug moves through development the amount required to support clinical trials increases. Consequently, the design of a manufacturing route/process that is efficient, robust and environmentally friendly becomes essential — often requiring innovation to achieve these goals.

NATURE CHEMISTRY | VOL 12 | AUGUST 2020 | 661–664 | www.nature.com/naturechemistry

Nature Chemistry **2020**, *12*, 661

Leverage the ingenuity of all chemists to impact human health



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Nature Chemistry **2020**, *12*, 661

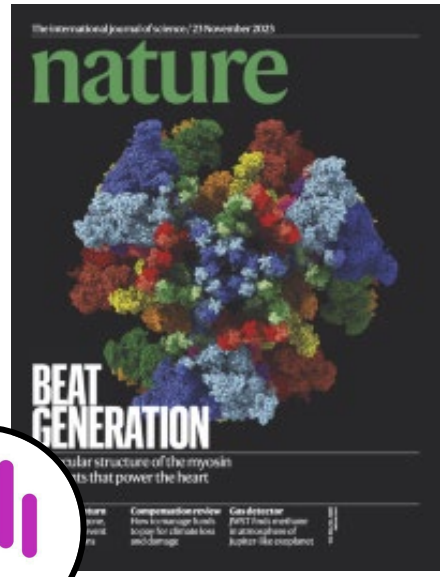
Some recent (and notable) academic-industrial collaborations

ORGANIC CHEMISTRY

Photomediated ring contraction of saturated heterocycles

Justin Jurczyk[1] | Michaelyn C. Lux[2] | Donovon Adpressa[2] Sojung F. Kim[2] Yu-hong Lam[4]* Charles S. Yeung[2]* Richmond Sarpong[2]*

Saturated heterocycles are found in numerous therapeutics and bioactive natural products and are abundant in many medicinal and agrochemical compound libraries. To access new chemical space and function, many methods for functionalization on the periphery of these structures have been developed. Comparatively fewer methods are known for restructuring their core framework. Herein, we describe a visible light–mediated ring contraction of α-acylated saturated heterocycles. This unconventional transformation is orthogonal to traditional ring contractions, challenging the paradigm for diversification of heterocycles including piperidine, morpholine, thiane, tetrahydropyran, and tetrahydroisoquinoline derivatives. The success of this Norrish type II variant rests on reactivity differences between photoreactive ketone groups in specific chemical environments. This strategy was applied to late-stage remodeling of pharmaceutical derivatives, peptides, and sugars.



Article

Complex molecule synthesis by electrocatalytic decarboxylative cross-coupling

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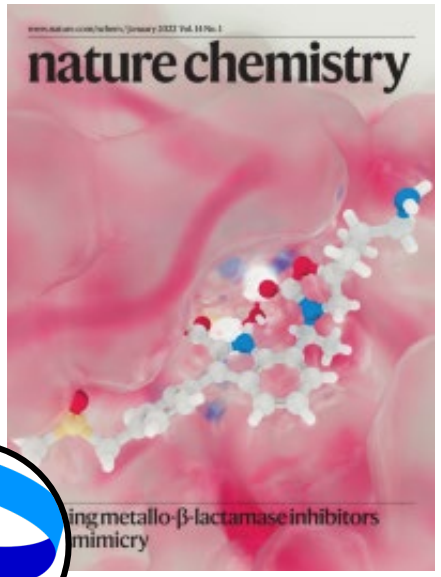
Received: 31 March 2023
Accepted: 26 September 2023
Published online: 3 October 2023
Check for updates

Benxiang Zhang[1,10], Jiayan He[1,10], Yang Gao[1], Laura Levy[1], Martins S. Oderinde[2], Maximilian D. Palkowitz[2], T. G. Murali Dhar[4], Michael D. Mandler[4], Michael R. Collins[5], Daniel C. Schmitt[6,7], Philippe N. Bolduc[8], TeYu Chen[8], Sebastian Clementson[8], Nadia Nasser Petersen[8], Gabriele Laudadio[1], Cheng Bi[1], Yu Kawamata[1] & Phil S. Baran[1]

Modern retrosynthetic analysis in organic chemistry is based on the principle of polar relationships between functional groups to guide the design of synthetic routes[1]. This method, termed polar retrosynthetic analysis, assigns partial positive (electrophilic) or negative (nucleophilic) charges to constituent functional groups in complex molecules followed by disconnecting bonds between opposing charges[2–4]. Although this approach forms the basis of undergraduate curriculum in organic chemistry[5] and strategic applications of most synthetic methods[6], the implementation often requires a long list of ancillary considerations to mitigate chemoselectivity and oxidation state issues involving protecting groups and precise reaction choreography[3,4,7]. Here we report a radical-based Ni/Ag-electrocatalytic cross-coupling of substituted carboxylic



ARTICLES
https://doi.org/10.1038/s41557-021-00834-8
nature chemistry
Check for updates

Decarboxylative cross-nucleophile coupling via ligand-to-metal charge transfer photoexcitation of Cu(II) carboxylates

Qi Yukki Li[1,3], Samuel N. Gockel[1,3], Grace A. Lutovsky[1], Kimberly S. DeGlopper[1], Neil J. Baldwin[2], Mark W. Bundesmann[2], Joseph W. Tucker[2], Scott W. Bagley[2] and Tehshik P. Yoon[1]

Reactions that enable carbon–nitrogen, carbon–oxygen and carbon–carbon bond formation lie at the heart of synthetic chemistry. However, substrate prefunctionalization is often needed to effect such transformations without forcing reaction conditions. The development of direct coupling methods for abundant feedstock chemicals is therefore highly desirable for the rapid construction of complex molecular scaffolds. Here we report a copper-mediated, net-oxidative decarboxylative coupling of carboxylic acids with diverse nucleophiles under visible-light irradiation. Preliminary mechanistic studies suggest that the relevant chromophore in this reaction is a Cu(II) carboxylate species assembled in situ. We propose that visible-light excitation to a ligand-to-metal charge transfer (LMCT) state results in a radical decarboxylation process that initiates the oxidative cross-coupling. The reaction is applicable to a wide variety of coupling partners, including complex drug molecules, suggesting that this strategy for cross-nucleophile coupling would facilitate rapid compound library synthesis for the discovery of new pharmaceutical agents.

GOALI Grants

GOALI (Grant Opportunities for Academic Liaison with Industry): *GOALI is a type of proposal that seeks to stimulate collaboration between academia and industry. Under this proposal type, academic scientists and engineers request funding with a regular proposal submitted to a standing National Science Foundation (NSF). The proposed research should be transformative, beneficial to industry, and further collaboration between the academic and industrial partners.*

As of January 2024 – there are >300 active GOALI grants that span all STEM fields

Award Abstract # 2247478
GOALI: An Industrial-Academic Collaboration for Sustainable Catalysis with Earth Abundant Metals

Award Abstract # 2154928
GOALI: CAS: Iron-Catalyzed Suzuki-Miyaura Cross Coupling Using Pseudohalide Alkyl Electrophiles

Award Abstract # 1955284
GOALI: Fluoroalkylation Enabled by Lewis Acids

FAIR data practices

Thanks!