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EDITORIAL

Chemistry Is Central to Repairing Genes and Global Health: Reflections on the 2015 Nobel Prizes in Chemistry and Physiology or Medicine

Autumn—a time associated with the changing of leaves, a crisp note to the air, and the smell, at least for scientists, of anticipation. Scientists and laypeople alike wait with bated breath in early October for the consecutive Nobel laureate announcements—first Physiology or Medicine, then Physics, and finally, Chemistry.

The weeks preceding the announcement elicit a spirited atmosphere of Nobel prize-winner predictions among colleagues, including this year's *C&EN*'s webinar featuring a fellow Editor-in-Chief, Jillian Buriak from *Chemistry of Materials*. The crowd was mostly in agreement, favoring John Goodenough for the lithium ion battery that now is glued semipermanently to the linings of most of our pockets. This year, as in most years, the vast majority of the hype did not come to fruition, but I do not think that is really the point of the banter. I believe it is simply gratifying to ponder all the wonderful accomplishments that enrich our lives, and know that for a few days, at least, the rest of the world cares almost as much as we do.

After discussion of batteries, bioinorganic chemistry, the role of applied science and many other potential winners, the day went to the discovery that our genes must constantly be fixed and the study of the machinery involved in such processes. Tomas Lindahl, Paul Modrich and Aziz Sancar each made seminal contributions to the field of DNA repair, each discovering distinct mechanisms by which the macromolecule that constitutes our genetic blueprint recovers from light or chemically induced damage or by mistakes that inevitably occur during DNA replication.

In the run-up to the day, another frequently mentioned candidate discovery was CRISPR, the genome editing tool that has taken the biomedical sciences by storm. One has to wonder if the committee was subtly trying to underscore the importance of understanding how natural DNA repair systems work as a foundation for recent technologies in chromosome engineering. In any case, the notion that DNA repair and editing are worthy of recognition as breakthroughs in chemistry highlights the fact that our world is molecular and that transformational developments in biomedicine often have their roots in chemistry.

Indeed, people who do not necessarily define themselves as "chemists" win chemistry's top honor fairly regularly. But the reverse relationship occurs as well and not infrequently. One of the other gratifying aspects of Nobel week, for me, is how so often the other scientific prizes rely on chemistry. Last year, this was seen in the physics prize for blue LEDs, and a few years earlier for graphene. On the physiology side, one can argue that several recent prizes have also had certain chemical components—from the cargo being moved in the vesicles that won in 2013, to the genes that must be manipulated to afford Pluripotent stem cells. These are all molecules after all.

The tie-in was especially obvious in this year's citation in Physiology or Medicine. Here, the prize was split for work discovering lifesaving natural product drugs against parasitic scourges of the developing world—awarded to William C. Campbell and Satoshi Ōmura for the discovery of avermectin (and various analogues) for treatment of river blindness and lymphatic filariasis, and to Youyou Tu for elucidating the structure of artemisinin, a key component in the global fight against against malaria. In both cases, brilliant combinations of analytical, synthetic and medicinal chemistry, inspired by clues from ancient medicinal practices, led to medicines that have saved millions of lives.

When you look at these structures, one cannot help but wonder if not for the power of nature and the persistence of these three people, would we have such therapeutics? Natural products, to this day, remain the most prevalent source of clinically approved medicines despite trends in the pharmaceutical community toward screening strictly synthetic compound collections.[1] These libraries give lead compounds that are synthetically tractable and more easily modified, to be sure, but they lack the rich structural complexity and capabilities honed by millions of years of natural selection. By contrast, every complex natural product

Published: October 28, 2015

DOI: 10.1021/acscentsci.5b00336
ACS Cent. Sci. 2015, 1, 343−344

has a story to tell, written during the battles of interspecies competition and the triumphs of coevolution, but decoding and exploiting this information remains a significant research investment. This year's Nobel reminds us that such investments in natural products discovery and synthesis can pay huge dividends in the realm of global health, and also sets in stark relief the relative neglect of infectious diseases of developing nations in today's collective pharmaceutical effort. This last idea brings me back to the concept of the week as a whole. While we start by celebrating science, we end with literature and peace: a clear reminder of Alfred Nobel's priorities. Should we not all aspire to beauty and the greater good?

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Notes

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DOI: 10.1021/acscentsci.5b00336
ACS Cent. Sci. 2015, 1, 343−344