Tobacco lover: The tobacco hornworm (*Manduca sexta*) has adapted to cope with the plant-produced insecticide nicotine, providing an example of a complex evolutionary relationship between plants and insects. (Photo: http://www.peakpx.com.)

even though the honey bee is just a domesticated species that humans can propagate as necessary.

The observed losses in pollinators may, however, be just an indicator of wider extinction threats caused by the use of pesticides and the homogenisation of the environment. As Michael Engel has pointed out in the review cited at the beginning of this article, these rapid changes introduced by humans drive up extinctions and reduce the opportunities for speciation, undermining the long-running recipe for success of insects. Engel concluded: “Insects are better prepared to contend with an asteroid impact.”

Because insects are so widespread and crucial in virtually every terrestrial ecosystem, their demise would have dramatic knock-on effects for life on Earth in general, not least for the survival of our own species. In this situation, on the verge of a possible man-made mass extinction, it is all the more important to understand how the diversity evolved and how it survived previous crises.

“Studying insect ecology and evolution including co-evolution with plants has become even more important and urgent considering the increase in so-called ‘pest-species’ but also the dramatic decline of other insects caused by human impact,” Sabrina Simon concludes. “Only with a reliable phylogenetic reconstruction we can study how insect species influence ecosystems and sustain or endanger our natural resources.” In short, as we live on the planet of the insects, we’d better understand how it works.

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Q & A

Xinnian Dong

Xinnian Dong received her BS in Microbiology from Wuhan University in China in 1982 and her PhD in Molecular Biology from Northwestern University in Chicago, USA, in 1988. She began her study of plant immune mechanisms as a postdoc at the Massachusetts General Hospital at Harvard Medical School. Dong is currently an Arts and Sciences Professor of Biology at Duke University. She became an Investigator for the Howard Hughes Medical Institute (HHMI) and a Fellow of the American Association for the Advancement of Science (AAAS) in 2011, a member of the National Academy of Sciences (NAS) in 2012, and a Fellow of the American Academy of Microbiology (AAM) in 2013.

What turned you on to biology in the first place? I grew up during the Cultural Revolution. It was such an ironic name for the period in China when any intellectual pursuit was suppressed. People with less knowledge controlled the lives of those with more. I remember my teenage years as aimless, with little studying in school. I could manage to get 100 points in an exam without ever opening the textbook. I was extremely lucky that the Revolution ended at the time when I was about to graduate from high school. I entered Wuhan University rather than being sent to the countryside or a factory. Due to this historical circumstance, I only became seriously interested in biology during my college years, especially after reading *Molecular Genetics: An Introductory Narrative* by Gunther Stent and Richard Calendar. The ingeniously simple experiments that were performed by these pioneers of molecular biology fascinated me so much that I wanted to become a molecular biologist myself.

And what drew you to your specific field of research? I became very interested in immunology when I was in college, but I realized at the same time that I could not handle animal sacrifice. This was the reason that I decided to study plant immune mechanisms when Fred Ausubel offered me a postdoctoral position in his lab.

Who were your key early influences? My father had a significant early influence on me. He was an economist with a great vision for the future and deep scholarship. He was the one who encouraged me to study microbiology in college because he realized through his readings that molecular biology had become a major frontier in science and most of the early molecular studies were carried out in microorganisms. Both my father and my postdoctoral mentor Fred Ausubel trained many students and postdocs. I learned from them that one’s legacy can be extended through trainees.

Do you have a scientific hero? I admire many scientists for their groundbreaking work, for example, Susumu Tonegawa’s discovery of somatic generation of antibody diversity. I hesitate to call these scientists my heroes because I do not have any information about them except for the work that made them famous.

Do you have a favorite paper or science book? I already mentioned my favorite science book. Without searching too hard into my memory, my favorite paper is Witham *et al.*’s ‘The product of the tobacco mosaic virus resistance gene *N*: similarity to Toll and the interleukin-1 receptor’ (Cell (1994) *78*, 1101–1115). In this paper, Barbara Baker’s laboratory reported the discovery of the first intracellular NB-LRR immune receptor in plants, and this is required for resistance to the tobacco mosaic virus (TMV) in tobacco plants. The genetic selection performed to identify the *N* gene was brilliantly designed and executed. More importantly, it suggested a possible role for Toll, which was known at the time to be only involved in controlling *Drosophila* development, in innate immunity.

If you had not made it as a scientist, what would you have become? I admire the life of an artist and a writer because of the creative freedom associated with these two professions, but I have no special talent for either one. I am very happy being a scientist, especially a scientist supported by HHMI. I am pretty much free to explore things that are of interest to me.

What's your favorite experiment? I like genetic experiments in general, starting with Luria–Delbrück's fluctuation and Lederberg's replica plating experiments used to demonstrate the spontaneous nature of mutations. When a genetic experiment works as expected, it is really definitive and satisfying.

Have you made any costly mistakes? If we learn from our mistakes, they become 'good' mistakes. I have been extremely lucky so far to have avoided devastating mistakes.

Do you feel a push toward more applied science and, if so, how does that affect your own work? I read somewhere that "science always loses its way when guided by ideology or wishful thinking". The current emphasis on translational research has good intentions and makes sense to the public. But, as a scientist, I have witnessed too many game-changing discoveries generated through basic research that initially had no application value to let the push toward more applied science affect my own work. Once the work is ready for application, most scientists — myself included — have the desire to put their new knowledge to good use. Whether we have the skill to make this transition is a different matter.

Do you think that there is an increased need for scientists to market themselves and their science as a brand? In this information age, it is harder to stand out in the crowd, hence an increased need for scientists to market themselves. However, public opinion is transient and can be manipulated, while scientific discoveries are long lasting. To me, scholarship is a life-long private endeavor that has nothing to do with marketing. I have done a few publicity gigs. They were fun, but I do not want to get too used to them.

Any strong views on social media and science? Social media provides great opportunities for scientists to publicize their findings and educate the public. However, I do not think that it is a substitute for the more conventional forms of scientific discussion and debates because the purpose of using social media is to engage more people in the process. For many scientific topics and debates, only a few scientists who are in the immediate field have sufficient information to carry out such tasks. In order to be effective in using social media, one often has to simplify the matter to get more people interested. For scientific matters, context and nuance are important.

Which aspect of science, your field or in general, do you wish the general public knew more about? Plant biology is a major part of biology with critical importance in making basic discoveries. I have encountered more than a few colleagues who would readily — if not proudly — admit their ignorance in plant biology while acknowledging that they follow research performed in *Escherichia coli*, yeast, and the fruit fly. Excluding plant biology as mainstream and associating it only with agriculture or possible threats of a famine is incomprehensible to me. I would wish for the general public to just imagine a world without plants to understand the fundamental importance of plant biology. Many plant biologists are doing cutting-edge research, contributing to major discoveries in biology, such as small interfering RNA in posttranscriptional gene silencing, light perception, innate immune receptors, and cross-kingdom small RNA communications. So, please open your mind to plant research.

Do you think that there is too much emphasis on 'big data'-gathering collaborations as opposed to hypothesis-driven research by small groups? Both are important. If we consider big data-gathering collaborations as a step toward generating raw material, then hypothesis-driven research by small groups is a step toward using the material to make products. The key is to find the right balance. It would be wasteful if the big data that are gathered are not actively used by individual groups. Hypothesis-driven research can also guide the design of big data-gathering efforts. Who says that big data-gathering efforts cannot be hypothesis driven?

What steps need to be taken to improve our understanding of the natural world? Biological processes,

such as immune mechanisms, are very complex processes that have been perfected throughout evolution. In order to understand them and make application in real life, we need to use holistic approaches as much as the current technology allows. In other words, we need to design our experiments as close to natural conditions as possible. I am not saying that we should abandon reductionists' approaches but rather suggest that we include more parameters in such experiments and study a phenomenon from molecular and cellular to organismal levels. For example, we not only need to study how to turn on an immune response in our effort to generate disease-resistant crops or to develop immune therapy to treat cancer, it is also important to know how to turn it off (immune resolution) to limit the damage to self.

If you could ask an omniscient higher being one scientific question, what would it be? How much longer can mankind enjoy such an accelerated expansion in population and rapid consumption of natural resources? We do not want to reach a point of no return.

What is the best advice you've been given? Patience is a virtue.

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