The first AsiaEvo conference, connecting Asian evolutionary biologists to the world

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‘Nothing in biology makes sense except in the light of evolution.’ Theodosius Dobzhansky wrote this sentence 45 years ago to point out the pivotal role of evolutionary biology in understanding any question about living organisms. Since then, the evolutionary perspective based on Darwinian natural selection and particulate inheritance has become a major integrative force across the biological and medical sciences, and the field continues to achieve further theoretical and empirical advances.

During the first decades of the twenty-first century, the flood of new molecular techniques, genome-wide big data and bioinformatics has revolutionized biology, but these developments also underlined that an overall appreciation of evolutionary processes is crucial to ensure that biology remains a well-integrated hard-core science. Although Darwinian evolutionary theory was introduced to Eastern Asia nearly 150 years ago, evolutionary biology research in Asia has long been underappreciated. Asian research groups that primarily focus on evolutionary biology have therefore remained scattered even in China and Japan—the two Asian countries with the largest number of professional biologists.

To make Asian evolutionary biology more visible to the world and to encourage more biological researchers to participate in the recent increase in research devoted to or interfacing with evolutionary biology, over 800 delegates from 34 countries met in Shenzhen, China, from 18 to 20 April for the first AsiaEvo Conference (http://asianevo.org/). The conference hosted 44 symposia and attracted contributions from many fields: genomics, paleontology, developmental biology, neurobiology, evolutionary ecology, phylogenetics, speciation, organismal adaptation, mathematical modeling, and technical approaches. The conference explicitly highlighted the importance of natural biodiversity in study system, and the complexities of regulation in producing organismal form and function, and the increasing need for cross-disciplinary studies.

\textbf{CONNECTING EVOLUTIONARY BIOLOGY, MEDICAL SCIENCES AND PUBLIC HEALTH}

Evolutionary studies normally emphasize the principles and processes of selection and adaptation and focus less on organismal malfunctioning. Medical researchers have made enormous progress in understanding the mechanistic causes of human diseases, but the idea that many modern diseases emerged from evolutionary mismatches between our bodies and their current environments has not been appreciated until recently \cite{1}. The field of ‘evolutionary medicine’ operates at the interface of evolutionary biology and medicine. Its aims are to achieve a more encompassing understanding of the ultimate causes for human health problems that may well stem from evolutionary tradeoffs (developmental compromises shaped by natural selection in our ancestors), ongoing co-evolution between human populations and their pathogens, and complex gene-by-environment interactions during development \cite{2}.

Evolutionary medicine approaches interface with genetics, psychology, psychiatry, nutrition, endocrinology, physiology, gynecology, and microbiology, and may improve our ability to diagnose and treat diseases in more efficient ways than a purely clinical approaches. It was therefore timely that several symposia addressed these questions, also because Asia has always been the world’s most populous continent, with a long history of human evolution shaped by natural selection and a huge diversity of cultures. Recent initiatives focusing on population genomics, cancer genomics and the emergence of novel diseases have put Asian countries in a pivotal position to further develop evolutionary medicine when technology-driven biology can be adequately combined with conceptual evolutionary biology.

\textbf{TOWARDS A BETTER UNDERSTANDING OF THE GENETICS OF DOMESTIC ORGANISMS}

As first outlined in the \textit{Origin of Species} and later expanded in his two volumes on \textit{The Variation of Animals and Plants under Domestication}, Darwin described a number of striking examples of what artificial selection by humans has achieved \cite{3,4}. Although the changes through domestication were highly complex, especially for animals, Darwin’s writing on the successes of domestication contributed...
greatly to the acceptance of his theory of evolution. When humans control breeding in plant crops and husbandry, wild-type traits are lost and new desirable traits for higher productivity and better taste can quickly arise. While natural selection can often achieve rather little in 10,000 years, evolutionary changes imposed by humans since the end of the Pleistocene have been enormous.

Most of the evolutionary details of genetic changes imposed by domestication have only recently been revealed thanks to the accelerating development of genomic technology. We are now able to genetically modify and clone domestic species. At the same time, ancient DNA analysis and paleoecology increasingly allow us to reconstruct the genetic changes that our ancestors achieved. In recent years, it has also become clear that the sustainability of farming and husbandry needs to be greatly improved to protect our living environments. Several symposia during the first AsiaEvo Conference addressed these questions in a timely and cutting-edge manner, covering the genomic basis of domestication and experimental evolution.

TOWARDS A MORE ENCOMPASSING APPROACH TO THE STUDY OF BEHAVIOR

In his seminal article, ‘On aims and methods of ethology’ [5], Nobel Laureate Niko Tinbergen summarized that there are four complementary approaches for answering questions in biology. This paper became a solid foundation for the study of animal behavior, but applies much more widely because all biological questions in biology can be (and need to be) addressed with respect to: (i) genetic and cellular mechanism, (ii) ontogenetic development, (iii) phylogenetic history and (iv) adaptive value in terms of reproductive fitness. In outlining these four complementary questions, Tinbergen expanded an insight by Ernst Mayr [6], who argued that proximate explanations (i and ii) are as equally important as ultimate explanations (iii and iv) for general understanding in biology.

In spite of substantial progress in the study of behavior since the mid-20th century, researches often remain focused on just one of the complementary approaches advocated by Tinbergen and Mayr, rather than seeking more interdisciplinary collaborations. The first AsiaEvo Conference hosted several symposia related to animal and human behavior that tried to adopt at least some of this broader approach, covering the genetic and neural basis of behavior, the origin and evolutionary modifications of nervous systems, the evolution of behavioral responses that facilitate biological invasions and the evolution of human culture and consciousness.

THE EMERGENCE OF ECO-EVO-DEVO APPROACHES

Individual development from fertilized egg to reproductive adult involves highly complex interactions between networks of co-expressed and co-regulated genes and the environmental conditions that change as an organism grows to express phenotypes that are subjected to natural selection. Waddington pointed out the crucial importance of integrating developmental biology and evolutionary biology almost 60 years ago [7], but a distinct science of Evo-Devo did not emerge until the early 1980s. Today, this field—which actually represents one of the four Tinbergen approaches summarized above—has become very mature, exploring the crosslinks between genetic regulation mechanisms underpinning development, their adaptive significance and the historical difficulties that may complicate the extrapolation of micro-evolutionary changes and macro-evolutionary processes.

The most recent developments have suggested that it is timely to further integrate research efforts in Evo-Devo with studies in paleontology, epigenetics, co-evolutionary interactions and global change ecology, to create a new field of
Eco-Evo-Devo. The first AsiaEvo Conference had a number of symposia illustrating these new developments, including topics such as the evolution of early organ systems during the Cambrian explosion, the macroevolution of vertebrate morphology, the origin and later development of insect wings, and the possible significance of epigenomic evolution.

UNDERSTANDING THE FUNDAMENTALLY SYMBIOTIC NATURE OF LIFE

Darwin’s view of life focused on individual organisms as the units of competition for resources and natural selection for differential survival and reproduction. However, many organisms have social or symbiotic interactions that matter greatly for reproductive success. It is becoming increasingly clear that homeostatic microbial communities are crucial for the fitness of all multicellular organisms and many now agree to conceptualize organisms as ‘holobionts’ [8]. The idea that selection will affect the degree in evolutionary specialization in host–microbe interactions was only established a decade ago [9,10], but the number of studies documenting how plants and animals may critically rely on obligate symbiotic mutualisms to cope with demanding environments is rapidly increasing. Also, these topics were adequately covered in the program of the first AsiaEvo Conference, with symposia on evolution of symbiosis, evolutionary genomics of pollinating insects and their symbionts, and new models of cooperation and mutualism.

THE FUTURE OF ASIAEVO CONFERENCES

Although it was a pioneering initiative, the first AsiaEvo Conference in Shenzhen appears to have been very well received by its more than 800 participants. The second AsiaEvo Conference will be held at Tokyo Metropolitan University in the spring of 2020 and multiple suggestions have been received to further institutionalize the regular interactions between Asian evolutionary biologists. This will hopefully lead to the establishment of a permanent sequence of biennial AsiaEvo conferences, if possible supported by a Society for Evolutionary Biology in Asia.

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