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Editorial

Insect Inspired Innovations for Future Science and Technology

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Almost everywhere you look and find diverse group creatures belonging to insecta that constitutes about 80 percent of animal kingdom. In fact, these six-legged animals evolved before the human life started on the planet earth. Since, they take part in many natural processes entomologists now believes that if all insects would suddenly disappear, humans would not be able to survive in new conditions longer than 10 years. Unfortunately, many of us perceive them as problematic such as mosquitoes, lice and bed bug that transmit diseases, some damage our possessions, buildings, such as termites and others hurting agriculture (weevils and locusts). Yet, without insects, ecosystem services like pollination, nutrient cycling and waste management will stop completely leading to lack of food for human. Besides, they can be a very good source of food for man and animals especially to fight hunger and malnutrition as they are very good source of protein and vitamins and relished as delicacies world over.

Human civilization has learnt so many lessons from these creatures' especially social and organized living and maintaining harmony in the group. We can be inspired in many ways by social insects to solve up surging problems faced by human society these days like public health and development of efficient information and transport systems. Since they are the master of survival, their unique ability to perform in extreme nature has led to incredible inspirations for engineering marvels. For example, bio mimetics based on insect structures such as antennae, legs, wings and eyes is an emerging science for future world. Bombardier beetles spitting ability inspired human to design fire extinguishers that are more effective and use less water besides the development of more efficient inhalers, and fuel injectors that burn fuel more efficiently and reduce pollution. Tiny scales and ridges on the wings of certain butterflies reflect light in a way that creates optical interference that can perfect for smart hand-held devices. Using this knowledge, efforts are on to develop video display that uses near-zero power whenever the displayed image is static (a real battery-saver) and refreshes fast enough to handle video images. By mimicking the structure of scales of Cyphochilus beetle engineers are trying to develop material that could make our teeth whiter and even to make brighter paper or surface. Termites open and close vents as needed to keep the temp so close to 87 degrees in their mounds that is inspiring to develop ingenious system of vents for a building that can automate natural ventilation by synchronous control of motorized windows at the upper and lower levels. This led to the development of sensors that determines when to open or close the windows as in Eastgate Shopping Centre in Zimbabwe. Serrated hypodermic needle that resembles a mosquito's proboscis touching the skin at fewer places pain free is being developed (Coxworth, B. 2011). Flying insects are inspiring human to develop intelligent micro machines with excellent manoeuvres in unpredictable environments. Understanding these systems advances our knowledge of flight control, sensor suites, and unsteady aerodynamics (Andre, N. 2008). Many robots or micro air vehicles (MAVs) for example robo bees, hector etc have now been successfully developed. Further there are so many successful examples on future warfare's based on insect biomimetic like F-35, stealth plane, robo bees and biosensors to detect bombs. To sum it up it is concluded that if insects had not evolved, humans probably wouldn't exist either and we need to change our perception towards these creatures as they are far less dependent on us than we are on them.

The process of natural selection has led to the evolution of numerous materials, structures, models, systems, and processes that

have been optimized for a broad range of functions. Bioinspiration involves learning nature's design principles in building highly complex and sophisticated engineering models at various length scales and utilizing the wealth of knowledge to solve the critical challenges faced by humanity. Considering that natural materials and systems have evolved to perform a broad variety of functions including structural support, signal transduction, actuation, sensing, catalysis, trafficking, gating, and light-harvesting, charge transfer, molecular recognition, self-assembly, self-organization, self-replication, or combinations of two or more of these functions, nature's "solution manual" is quite exhaustive. Learning from this exhaustive solution manual and gaining inspiration or even directly applying the design principles can be a highly effective approach to solving various critical global challenges such as food, water, homeland security, public health, and clean energy. Of all the advances in science, technology and engineering in the past few decades, the deeper understanding of biological systems has led to an ever more intimate contact between individuals and technology [1].

This personal impact of biology-based technologies has been demonstrated to be a very powerful force in shaping the scientific community. The creation of biology-centered enablers is the result of the pursuit of three general research paradigms: biomimicry, bioinspiration, and bioderivation. Bio-inspired technologies have the potential to enhance human welfare and lifestyle by providing innovative solutions to a wide range of problems. By drawing inspiration from the natural world, these technologies can contribute to sustainability, efficiency, and improved quality of life in various domains. However, it's important to consider ethical and environmental implications while developing and implementing these technologies to ensure they truly benefit society and the planet. These technologies have the potential to significantly impact human welfare and lifestyle in various ways:

- Sustainable Energy: Biomimicry can help in the development of more efficient and sustainable energy solutions. For example, studying the way plants convert sunlight into energy through photosynthesis has inspired the design of more efficient solar panels and energy storage systems.
- Healthcare: Nature often provides solutions to complex healthcare challenges. Researchers have looked to animals like the gecko to develop adhesives for surgical applications, and the structure of the human eye has inspired advancements in camera technology, leading to better medical imaging.
- Materials Science: Natural materials often possess remarkable properties. For instance, spider silk is incredibly strong and lightweight, inspiring the development of new materials for various applications, from textiles to medical devices.
- Agriculture: Learning from ecosystems and natural processes can lead to more sustainable and productive agricultural practices. Mimicking the structure of ant colonies, for example, has led to improved algorithms for optimizing supply chain logistics.
- Transportation: Studying the efficiency of animal locomotion, such as birds or fish, has inspired the design of more aerodynamic and fuel-efficient vehicles and aircraft.
- Environmental Conservation: Bio-inspired technologies can help address environmental challenges. For example, studying the way termite mounds regulate temperature and airflow has led to more energy-efficient building designs.
- Robotics: Biomimetic robots can be used in various fields, from search and rescue operations to space exploration. The design of robots based on the movement and abilities of animals like insects and birds can lead to more agile and adaptable machines.
- Medicine: The development of drug delivery systems and medical implants often draws inspiration from natural biological processes to enhance their effectiveness and reduce side effects.
- Water Purification: Biomimetic membranes based on the filtering mechanisms found in nature can help improve water purification processes, providing clean and safe drinking water.
- Aesthetics and Design: Nature's beauty and efficiency often inspire creative design in architecture, fashion, and product development, leading to more aesthetically pleasing and functional products and spaces.

- Learning and Education: Teaching biomimicry principles can foster creativity and critical thinking in education. It encourages people to observe and appreciate the natural world, leading to a greater understanding of ecosystems and biodiversity.
- Resilience and Adaptation: Studying how organisms adapt to changing environments can inform strategies for resilience and adaptation in the face of climate change and other global challenges.

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