Bird Biomimetics

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On November 6, 2014, Prof. Ille C. Gebeshuber gave a talk on Bird Biomimetics to the MNS Selangor Bird Group. Biomimetics means learning from living nature for applications in science, engineers, art and design, for a better engineering that is good for all life. Birds are wonderful inspiring organisms. As examples she gave feather colours and feather interlocking devices, bird eyes (including the amazing capability of birds to see the ultraviolet part of the electromagnetic spectrum), beaks and bones and the navigational abilities of migratory birds. Colours can be either pigment-based or structure based. An example for pigment-based coloration is the plant-based indigo pigment that is used to colour jeans. An example for structural coloration is the colour of soap bubbles, CDs and DVDs and the rainbow. Some birds combine structural and pigment colouration. In budgies for example the green coloration comes from mixing structural blue (that is generated by scattering on minuscule particles in the feather) with pigment yellow. Selective breeding can remove the structural component from the originally green wild birds - the birds are then yellow. Removing the pigment yellow results in blue birds. Removing both the yellow and the green part results in grey birds, where the “colour” comes from melanin. Also the amazingly beautiful colouration of the peacock comes from minuscule, regularly arranged parts in the feather. We can learn from the birds how to build colours from structures alone, without the use of potentially toxic chemical pigments. Such structures can also be functionalized; they then would change with certain environmental conditions (such as swelling with humidity, or swelling due to the attachment of certain disease molecules). When the size of the structures changes, also the colour changes, and thereby the structures can be used as sensors – such as in cheap paper-based hepatitis tests, or colours that only appear in certain conditions, e.g. emergency instructions that appear on the wall when there is a fire. Feather interlocking devices are tiny mechanical hooks on the feather that ensure that the little feather parts are “zipped together”. We can “unzip” a feather, and “rezip” it, similarly to the birds when they prune their feathers. Birds can see parts of the electromagnetic spectrum that people cannot see. Some birds, such as the myna, appear just black to us, but very colourful to other birds. Since birds can see UV, there is an easy way to prevent birds crashing into windows: coatings that send signals to birds in the UV range, invisible to us people, but saving millions of bird lives. Beaks and bones are lightweight, and yet tough and strong, and have beauty on all length scales. Novel benign building materials and structures can result from learning from the birds for better materials in building constructions, for example. Winglets on the wings of large gliding birds have inspired winglets on airplanes, and lead to enormous fuel consumption reductions. And the magnetic sense that helps certain migratory birds to navigate on their thousands of miles long journeys can inspire novel navigational devices that are independent of GPS satellite systems. There are many innovations that can come from learning from our feathered friends.