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ATP as a neurotransmitter

The 1990s have been identified as the 'decade of the brain' – a device which permits greater funding for neurosciences, but at the same time emphasizes that our understanding of the chemistry and biology of neural functions is poised for another great leap forward. The transmission of information via chemical or electrical signalling is central to the process of communication between the myriad cells of the central and peripheral nervous systems. Synapses are the specialized sites where neurons communicate with one another and also with other cell types, like muscle. The two cell membranes approach closely, separated only by a small gap in the case of chemical synapses. Neurotransmitters are the small molecules secreted by one cell, which swim across this medium and are recognized by a target receptor, that in turn is coupled to an ion channel which opens to allow ions to flow across the membrane. This marvellously complex process is orchestrated perfectly, with every molecular actor playing its role faultlessly. Information flows from the brain, through the spinal cord to the peripheral nervous system. The autonomic motor neurons of the sympathetic and parasympathetic systems control the involuntary muscles around many internal organs including the heart.

The most important of the 'sympathetic' neurotransmitters is noradrenaline (norepinephrine) leading to the synonymous usage of the terms 'sympathetic' and 'noradrenergic' in neurophysiology. Are there other molecules that may indeed be involved in the responses of smooth muscle, that result from sympathetic activation? The answer, unsurprisingly, is yes. However, what is surprising is that the candidate neurotransmitter is adenosine 5′-triphosphate (ATP). To the student of classical biochemistry, ATP is the central molecule of metabolism, with most free energy changes in biochemical processes being mediated by hydrolysis of the energy-rich phosphotriester. Accumulating evidence, reviewed by Manchanda (**page 275**), argues strongly for an important role for ATP in sympathetic neurotransmission. Are there other, as yet unknown, neurotransmitters? The search should keep another generation of neurophysiologists busy.

P. Balaram

What can you do with a pair of binoculars?

The quality of our scientific work is often limited by the non-availability of sophisticated equipment. Fortunately, there are some areas of biology where exciting and important work can be accomplished with little or no equipment and it would be silly not to focus our attention to such areas and free ourselves for once, from the feeling that we cannot compete with developed countries on a level playing field. The article by V. Santharam (written from his home address!) is an excellent example of how to publish a scientific paper if you only had a pair of binoculars and plenty of patience (**page 316**). The subject matter of Santharam's article is also of special interest. Pollination of flowers by bees and other insects is rather well known but hard data on bird pollination are rather limited, especially in the context of our country – although the pioneering work by Priya Davidar, referred to in Santharam's article, is a notable exception. Santharam watched the flowers of *Helicteres isora*, a large shrub in the Mundanthurai Tiger Reserve in Tamil Nadu for all the animal visitors they received and noted not only what they were but also whether they were pollinators, thieves or robbers! He did this for five days from 7 am to 5 pm, a short time for a scientific study by any standards but considering how much he has learnt from this short study, one can only conclude that the potential for such work is enormous. Apart from providing useful data on bird pollination in general, such studies will make it possible for our students to be shown real-life data from an Indian setting – they must be quite tired of reading only about studies conducted elsewhere.

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