In this issue

Once an orphan, now a master

De Duve and co-workers, during their Nobel Prize-worthy studies on lysosomes (the bag of digestive enzymes in cells) came across an odd lysosome fraction. Those cellular components lacked acid hydrolases, the marker enzyme for lysosome. They were, however, rich in catalases and oxidases. The organelles were appropriately christened as peroxisomes. Microscopists had fifteen years earlier observed these 'microbodies', membrane-bound spherical particles, in kidney tubules and regenerating liver cells.

Peroxisomes were primarily associated with cellular functions such as removal of molecular oxygen and breakdown of H_2O_2. Several other activities linked to peroxisomes are now recognized. Cells involved in cholesterol metabolism and steroid synthesis have peroxisomes in abundance. The organelle is involved in glycerolipid synthesis, biosynthesis and breakdown of cholesterol and oxidation of fatty acids.

Proliferation of peroxisomes has been noted in many conditions. The significance and mechanisms were unclear until a decade ago. The discovery of a peroxisome proliferator-activator receptor (PPAR) by I. Issemann and S. Green was the clue to the explication of peroxisome proliferation. Since the discovery, three major types of PPAR (α, β and γ) have been identified.

PPARs were considered an orphan receptor initially because direct binding of compounds to the receptors could not be demonstrated, although a wide variety of chemicals were found to activate them. Several physiological and pharmacological ligands are currently known. They include natural substances like leucotrienes and prostaglandins as well as drugs such as clofibrate, antidiabetic 'glitazones', indomethacin and ibuprofen. There is hope that pharmacological agents, which would interfere with the different regulatory transcriptional controls of the PPAR gene would be useful for cardiac protection and cancer treatment.

Significantly, PPARγ is of interest to Indians specially, for other reasons. The high risk for insulin resistance, Type 2 diabetes and atherosclerotic coronary artery disease in South Asians is attributed to a 'thrifty gene'. Human genetic studies and findings in 'knock-out' animals indicate that PPARγ coordinates fat cell differentiation, the ultimate thrifty response. PPARγ interacts with insulin, a pivotal participant in the thrifty response. PPARγ expression is actually a part of a set of genes that are modified by caloric restriction. A rare mutation in the PPAR gene can result in obesity.

PPAR, having gained the reputation as a master controller of several genes, has fired the imagination of physicians the world over. In their review on PPAR and diabetes mellitus, M. Balasubramanyan and V. Mohan (**page 1440**) dare to quiz whether a loss-of-function mutation of PPARγ would account for the syndrome of higher insulin resistance and early onset of Type 2 diabetes in Indians in whom a strong association with obesity is not seen.

C. C. Kartha

NMR and the art of quantum computing

An interdisciplinary area of research in quantum computing is here to stay. It involves concepts developed in physics, mathematics, computer science and chemistry. The second half of this century might see the phasing out of today's conventional supercomputers, heralding in 'quantum computers', slated to be manifold faster. The first stage of application would be in the form of 'quantum-co-processors' similar to present day co-processors employed in PCs for computation. However, subsequent applications of these next-generation processors would be in locating hits in vast databases such as the world-wide-web in quick time, modern cryptography, in addition to a host of other high-speed computational applications.

The tiniest of transistors in 'classical computers' are soon to be replaced by a cup full of organic molecules pumping in a quantum mechanical way – the heart of the quantum computer. Computers as they exist now, have 'bits' (digits 1 and 0) that operate as an 'on' and 'off' switch. On the other hand, a quantum computer would have a 'qubit', able to operate the 'on–off' mechanism simultaneously, thus increasing speed. This is permitted in quantum theory, which says that if two states are possible to describe any system, then at any point of time the system is represented by a linear combination or superposition of the two states. Qubit thus represents an atom in one of two different states 0 or 1 which can exist simultaneously and whose probability or strength is related to numerical coefficients c_1 and c_2 accompanying them, respectively. Thus two qubits require four ($=2^2$) numbers (c_1, c_2, c_3, c_4) as coefficients and n qubits require 2^n. Thus a quantum computer becomes immensely powerful as they can be in multiple states at once due to this principle of superposition, performing parallel processing while using only a single processing unit.

But the principle of superposition, based on which the quantum computer would work spells its demise as well. This is because when a measurement is applied to determine the coefficients, the unique or coherent character of the individual states is lost and a single, very definite state, results. This is called decoherence. It is thus required to find methods for maintaining coherence as this is of prime importance for success in quantum computing.

A revolution in defining a qubit has come around by a way of redefining the problem and employing a technique called Nuclear Magnetic Resonance (NMR), used by chemists over decades for determination

of molecular structure. The qubit is now defined by a vast collection of molecules, where one can select some atoms and change a specific property which becomes the identifier state 0 or 1. This property is called spin whose orientation can be altered at will, as energy pulses (in presence of a big magnet whose poles N and S fixes the reference frame) when supplied to a small magnet (i.e. the nuclei of atoms) orients the spins of the small magnets. One can be selective as well, as the frequency of the energy pulse determines the atom whose orientation would change.

There is another property in NMR which allows computer logic to be built in. The spin orientation of a particular atom is conditionally connected with that of its neighbour. Thus a logic operation such as the exclusive-OR gate (called XOR) where an output Y=1 is only possible to achieve when inputs A and B are 1, but not simultaneously. These are then units of computation in the quantum computer.

The paper by Dorai *et al.* (**page 1447**) reviews work done by them in the area of quantum computation using NMR. They studied the interaction within a molecule by the help of a quantum logic 'gate' constructed with nuclear spins forming the basis of a unit in a computation. They have coined the name 'Portmanteau' gates inspired by Lewis Carroll's, 'Through the looking glass and what Alice found there'. Quantum computation requires addressing inherent features such as entanglement and superposition arising out of quantum theory itself. They have demonstrated the utility of transition- and spin-selective pulses in their experiments as well as described the creation of pseudo-pure states.

Neem seeds: Making the right choice

Neem (*Azadirachta indica* A. Juss.) based pesticides have gained in importance in recent years for combating pests. This has been necessitated by factors such as dwindling export market for produce treated with chemical pesticides and enhanced awareness for use of safe environment-friendly pesticides. The slogan for the future should read, 'Use of safe pesticides. Not safe use of pesticides'. In spite of widespread use of synthetic chemical pesticides in every stage of crop management, India looses several crores of rupees each year due to damages inflicted by pests. Pests are systematically becoming resistant to them. Also, chemical pesticides poison life and are a major 'health hazard' for the environment.

The development and production of new 'environment-friendly' pesticides in India has become synonymous with integrated pest management for continued agricultural production. Herein lies the role of neem pesticides. Neem, used traditionally in India as an insecticide and fungicide has attracted modern scientific research worldwide. It has a variety of biologically active ingredients, each with a different mode of action.

However, in order to extract the active ingredients of neem for use in insecticidal formulations, the right choice of the neem tree and its seed becomes significant to optimize the efficacy of the product. At present, large variations exist in the insecticidal content of the neem seed kernel extract (NSKE) that depends on the geographical location of the trees. Thus, having a simple method by which a neem tree, growing in a particular region, can be quantified for its inherent insecticidal property would help in zeroing in on a particular tree and its seeds.

The question is 'How does one make the right choice? This has been addressed by Kumar *et al.*, in their paper (**page 1474**). Using an index called 'Relative Insecticidal Value (RIV)', the authors have made available at hand a simple procedure to characterize the insecticidal yielding ability of neem trees by striking a 'balance' between parameters such as seed weight and LC_{50} (lethal concentration fifty) values. They achieved this by laboratory bioassays of NSKE against the cabbage diamondback moth, *Plutella xylostella* (L.). The extent to which azadirachtin (the active ingredient generally acknowledged for the insecticidal property of neem) alone might contribute to differences in LC_{50} values observed in this study, 'is not known' according to the authors. Based on this study they recommend farmers to 'mix the seeds from several neem trees' for preparation of NSKE thereby reducing the risk of collection of seeds from one tree with low insecticidal property. The sampling was conducted in six locations in Karnataka in 38 neem trees.

Achieving neem afforestation for social forestry, using micropropagation techniques, while taking care to select the trees bearing the right seeds, as reported in this paper merits consideration by policy makers.

Nirupa Sen