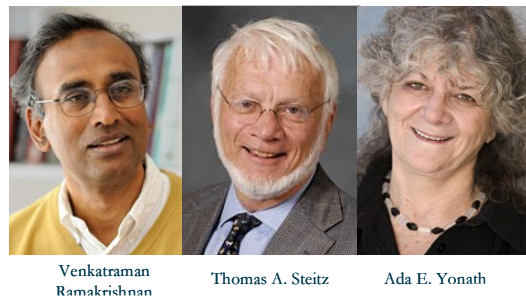


Nobel Prizes 2009

This year's Nobel Prize in **Chemistry** was awarded to *Venkatraman Ramakrishnan*, *Thomas A. Steitz* and *Ada E. Yonath* for their studies of the structure and function of the ribosome which acts as a key manufacturer of proteins that build life. The last half century of research witnessed the understanding of the 'central dogma of biology' that cascades



the transformation of DNA to RNA to protein to every life form. Nobel Prizes have recognized a number of triumphs along the way; among them Watson, Crick and Wilkins' decipherment of the helical structure of DNA and Roger Kornberg's revelation of the workings of the enzyme RNA polymerase, which turns DNA (blueprint) into RNA. The only missing link confronting scientists was the mechanism by which proteins get built in cells. It was also known that messenger RNA molecules carry a template of all the protein molecules. The exact picture of how a molecular code (mRNA) transforms into a physical molecule of protein with the aid of ribosome was only vaguely known.

In the beginning of 1980s, Ada Yonath, working with the ribosomes of thermophilic bacteria succeeded in preparing the first useful crystals of the larger of the ribosome's two subunits 50S (Figure 1). Three research groups independently set out to solve the structure of the ribosome crystal using X-ray crystallography, an imaging technique that decodes atom by atom information. In addition to the mechanistic details of protein synthesis, understanding the structure of bacterial ribosome (the target of 50% of known antibiotics) is of major therapeutic importance. With antibiotic resistance on the increase, it is hoped that an understanding of precisely how antibiotics interact with the ribosome will allow the design of new antibiotics to tackle drug-resistant bacteria. Ramakrishnan, Steitz and Yonath have all also imaged the molecular interactions between ribosomes and antibiotics, providing key data to help guide structure-based drug design of new antibiotics.

-Dr. Mahesh Hariharan

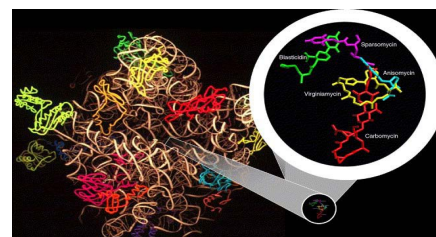


Figure 1. The peptidyl-transferase center in the 50S ribosomal subunit is attacked by a large number of existing antibiotics, now revealed at high resolution in 50S subunit crystal structures.

The Nobel Prize for **Physiology or Medicine** for 2009 adds another twist to the series of Nobel-worthy discoveries concerning chromosomes and its allied components. In less than a century, at least five Nobel Prizes in Physiology or Medicine have linkages to chromosomes.

This year the Prize was awarded to *Elizabeth Blackburn, Carol Greider* and *Jack Szostak* for cracking a long unresolved fundamental problem regarding chromosome conservation despite repeated division. Through



Jack W. Szostak, Carol W. Greider, Elizabeth H. Blackburn

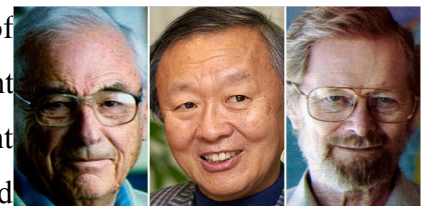
clever experiments they showed that telomeres at the chromosomal ends are responsible for maintaining chromosome integrity. Subsequently, through biochemical assays they also demonstrated that the enzyme complex telomerase was involved in the synthesis of telomeres. Telomere maintenance has vital implications for genome stability and cell viability. Shortening of telomeres is associated with cell ageing and cell death.

The discoveries have important implications for the ageing process, cancers, and other heritable diseases. Abnormal telomeres and increased telomerase activity has been seen in cancer cells. However, the connections are complex and research in this area is very intense. Anti-telomerase therapy for cancer is in clinical trials and its success is yet to be verified. It is striking that these important discoveries of the general principles of chromosome maintenance in eukaryotes, including higher mammals, were made by using relatively simple model organisms such as yeast!

- Dr. Hema Somanathan

The Nobel prize in **Physics**, 2009 chose to honor two breakthrough technologies that allow us to contemplate doing with light the same wide range of things that we already know how to do with electrons .

Charles K. Kao won the prize for relentlessly pursuing the problem of transmitting light through long thin fibers. These optic fibres are to light what wires are to electrons. The phenomenon that lets one channel light through these fibers is total internal reflection. Even before Kao entered the picture the idea of using total internal reflection in long thin fibers of



Willard S. Boyle , Charles K.Kao, George E. Smith

glass was mooted but a variety of factors led to the general conviction that doing this was not possible.

With the advent of the laser in the early 1960s it was realized that there would be lot of useful applications for a way of guiding light. Kao and his colleagues carefully investigated the effects of the impurities in the materials used and concluded that impurities in the glass were big sources of attenuation and not geometrical imperfections in the fibres (as widely held then). He was convinced that fibres made of ultra pure optical glass would be suitable for long distance transmission of light. High purity glass fibres produced much later on showed that light can be channeled over distances to the order of hundreds of kilometers.

At present optic fibers in undersea cables form the backbone of the global communications network that carry data, voice, images, video and multimedia seamlessly across borders. The Nobel foundation chose to honour Kao with one half of the 2009 Nobel prize in physics not only for providing the initial spark that led to technology with wide applications but also for relentlessly pursuing an idea until it came to fruition and not giving up in the face of several adversities.

William S. Boyle and *George E. Smith* shared the other half of the prize for developing the charge coupled device (CCD) which is the main component in almost all present day digital imaging technologies like digital cameras and camcorders. The CCD is an important component in harnessing light because it provides an interface between optical technologies and electronics.

The charge coupled device did not start off as an imaging technology at all. It was initially known as a shift register, in which an array of electronic capacitors worked together to juggle electric charges about in a controlled way. Boyle and Smith pursued the idea of coupling a shift register with a light sensitive photo-detector element. In a CCD photo-detectors and the capacitors may be arranged in a square array and once the imaging part is done, the charges are sequentially shifted out of the array for further electronic processing. Present day CCDs include several modifications to this basic idea to make it more efficient and fast.

Apart from their use in digital cameras and camcorders, CCDs are also used quite a bit by astronomers to make detailed images of far away celestial objects. Custom designed CCDs are also used in research labs for sophisticated imaging purposes.

- Dr. Anil Shaji