Editorial

Cultural Features and Ceremonies Associated with Ancient Built Environment

Built environment takes pride of place in this number of Vidurava. The two articles on built environment in this journal tend to showcase two contrasting scenes in town and country planning as reflected in what may appear to be the characteristic landscape architecture in ancient times on the one hand, and the high technology built space architecture in modern town and country planning, on the other hand.

There is no doubt that environmental variables of ancient times have been subjected to substantial and adverse pressures over the last several centuries, necessitating progressively advanced technologies and strategies to meet the challenges affecting the natural as well as the built environment. Thus for example, the consequences of climate change, air and water pollution, garbage disposal, drainage, hygiene and sanitation, depletion of natural resources, enhanced efforts in infrastructure development including providing roads, highways, bridges and other facilities, as well as management and control of natural and man-made hazards, all of which need intense focusing in modern built environment and town planning.

Reflecting on Sri Lanka's ancient built environment, what seems to be a characteristic feature is the design and planning uniformity observed in the core physical infrastructure within each of the relevant Royal cities of ancient Sri Lanka, constructed with durable building materials. However, unfortunately, due to the use of perishable construction material in the ordinary dwelling places, there seems to be no traces of what could have been the characteristics features of the residential units of the common man in ancient times.

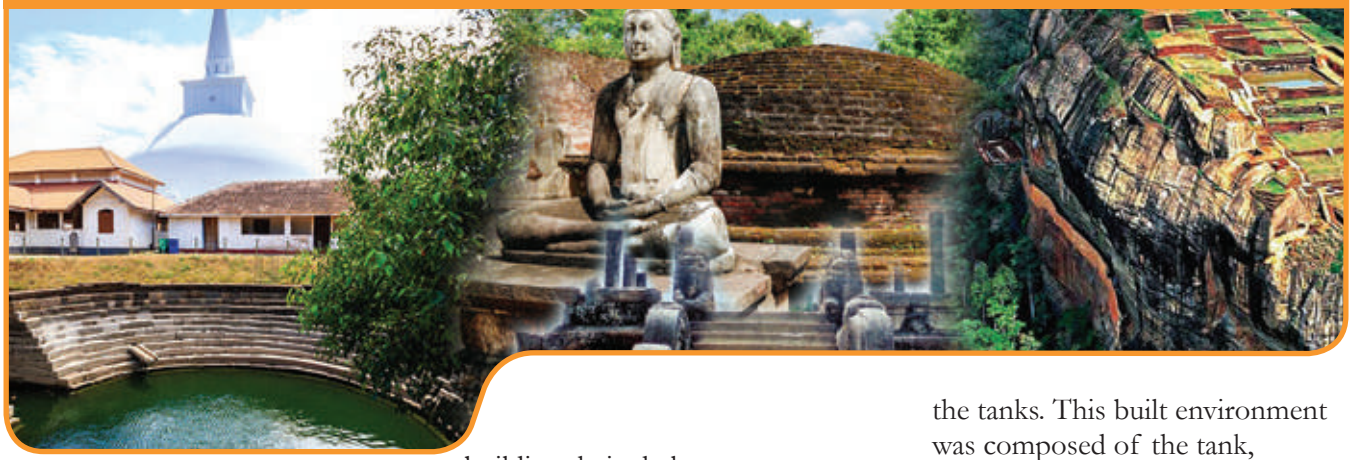
According to Prof. Lionel Benthara, formerly of the University of Visual and Performing Arts, who had done an extensive study on low country ceremonies and rituals associated with architectural contributions to the construction of dwelling houses in ancient times, a variety of rituals that were associated with every aspect of the rural built environment had been in existence. Apparently most of the ancient Sinhala and Pali chronicles are known to have given detailed accounts on how building sites were initially selected using astrological considerations and asterisms (*ñekath*), and consequently the stepwise development of the design, structural features, as well as the type of building materials that should be used.

The creation of a dwelling house that conforms to provide physical and mental satisfaction was a primary requirement. Consequently the choice of a stable and physically uniform site was the main consideration, for which local expertise was sought. Herein too astrological consultations as well as asterisms played a crucial role. In addition, wherever necessary, traditional performances of dance, drumming, and recitation of ritualistic songs (*shanthi-karma*) to expel evil spirits (*bhuthayo*), or alternately the reciting of incantations (*yathika or kannalavu yathika*) to seek the blessings of tutelary deities were all part and parcel of the architectural considerations in domestic home construction. These rituals, based on strong and positive beliefs, are known to have had an overall sense of satisfaction among common folk in ancient Sri Lanka.

M. Asoka T. De Silva

Ancient Built Environment – A Sri Lankan Legacy

Prof. Nimal De Silva



Built environment is a product of continuing cultural changes of man that interfered with the natural environment. Sri Lanka is a small island surrounded by the Indian Ocean faced with two monsoons. A large number of rivers originate from the central mountains flowing down to the surrounding ocean. People who have migrated from the Indian peninsula through prehistoric time have subsequently made their settlements along the river valleys and also on the hills as indicated by the megalithic burials widely spread throughout the country. Their living shelters other than the natural caves have vanished with time due to the impermanent materials used in building their shelters.

With the advancement of agricultural activities specially in the dry zone area, they had realised the need and importance of retaining and collecting the monsoon rain water for use during the dry season. For this they mastered building reservoirs by constructing earth bunds blocking the flow of water. Further anicuts across rivers were built to store and raise the water level, and then divert the water through earth channels to fill large and small Wewas. Sri Lankan civilization is referred to as a tank based civilization, and not a river valley civilization. More than twenty thousand tanks had been built creating village settlements next to the tanks. This built environment was composed of the tank, catchment area of the tank, paddy fields fed by the tank and the village settlement with houses built around a large central court yard with a monastery, at a higher elevation. Most of the time the tanks were built one after the other as a chain and sometimes small tanks were fed by a large tank that stored a large water acreage.



The administration of the country was carried out through principalities in addition to the capital city. Built environment of a principality was rural, but with semi urban arrangement. Royal presence of the provincial King or the Lord was placed with large reservoir or a MahaWewa that continuously provided water for the settlement or the city. The royal temple was located to the south of the city with a large stupa exhibiting a scale in relation to the power and wealth of the provincial King. The built environment created would have been semi urban harbour cities like Mantai which were fortified to perform as the trade and economic cities of the King, who was reigning from the capital Anuradhapura. Major harbour villages located round the coastal area were developed as



Fig : Ruwanwelieya

international trade ports with urban character. Kirinda was the major port that served the southern capital Magama. The built environment of all harbour cities starting from Manna along the western coast, south western coast and southern coast have grown with the trade community of Muslims settling down to carry out trade.

City of Anuradhapura continuously served as the capital of Sri Lanka for thirteen hundred years. The plan of the fortified city wall gave a configuration of '*Mrudanga*', the drum. Archaeological cultural layers within the citadel went down to a depth of ten metres, the bottom layers were dated 9th century BC. The City wall was surrounded by a protecting moat, and entry was through four gates located at four cardinal directions. The *Mrudanga* city plan was not Indo-Aryan. Indo-Aryan city plans were square, rectangular, circular or semicircular. City of Anuradhapura was located on the left bank of the Malwathuoya, and continuously grew as a religious city by establishing large Buddhist monasteries in the surrounding park land, with the MahaVihara and Jetavana to the south of the city, and Abhayagiriya monastery to the north of the city. There were four major tanks located around the city that provided water for city needs, for agriculture, and also to keep the environment green. The three major monasteries at Anuradhapura occupied a large extent of land. Built environment created a complex situation. According to evidence available, Abhayagiriya monastery had accommodated six thousand monks. Jetavana monastery had five thousand monks and MahaVihara was occupied by three thousand monks. Creation of a functional religious environment can be seen in the remains of buildings of these residential monasteries, with drinking and bathing ponds, common buildings like kitchen and refectory, hot water baths, hospitals etc. Five sacred buildings found in every monastery were of magnificent scale dominating the landscape. These are namely, the Stupa, the Image house, Congregation hall, the Bo tree shrine, and meeting halls. Jetavana Stupa is the tallest brick structure in the world, next in order comes Ruwanmali, Abhayagiriya and Mirisawetiya. These are the most prominent architectural edifices in the city scape.



Fig : Abhayagiri Stupa

Abhayagiriya monastery complex can be considered as a good example to understand the complexity in planning achievements, complexity in handling of space, creations in architecture, and sculptural aesthetics of the created built environment. In addition to the hundreds of interwoven monasteries in the complex with designed pathways, there were common facility buildings like the kitchen and refectory complex, hot water baths, drinking water ponds, bathing ponds like the twin ponds, and elephants pond etc. These monasteries exhibit the skill of



Fig : Jetavana Stupa



Fig : Baddha Seema Pasada

creating a built environment with tranquility essential for a monastery, and creating public spaces like '*salapathalamaluwa*', stone paved compound and '*velimaluwa*', the sand court, around the great stupa for many thousands of devotees and monks to gather. Axial arrangements of buildings and spaces, composition of buildings and path ways, have demonstrated their capabilities and architectural skills. Designing of all MahaVihara type monastery complexes have followed a similar pattern.

The second ring of monasteries around the fringe of Anuradhapura city, have exhibited three other types of monastery complexes, namely, the Cavere type, *Pabbatha* Vihara type and double platform or western monasteries.

Vessagiriya is centered within adopted natural caves as monks' residence in a plan with an axial arrangement for constructed buildings. Vessagiriya is an excellent example to show the Sri Lankan theory of landscape driven architecture that integrated the tranquility and beauty of nature with built environment.

The second type *Pabbatha* Viharas were planned residential monasteries with an axialy arranged development on a square or rectangular plan form. It has a moat filled with water right round the monastery outside the boundary wall. It can be entered across the water only through one gateway. The center square with sacred buildings is raised to a height of about a meter, and entered through a flight of steps placed on all four cardinal directions. Five buildings comprising the stupa, image house, Bo tree shrine, congregation hall and saba or meeting hall are placed on a raised platform. Two storey residential buildings are placed in the area between the outer wall and the raised platform situated in the middle. Bathing and drinking ponds are also located in the same area. This form of built environment is seen in *Pabbatha* Viharas of *PachinaTissaPabbatha*, Puliyankulama, Pubbarama, Pankuliya etc. Tholuvila monastery was built on a well-developed central axial form covering a large area of land.

The third type known as *Padanagara* and Western monasteries are located to the west of the city. They were strictly meditation monasteries. The built environment was prepared to create a space isolated from the surrounding activities, and providing the meditating monks, isolation and tranquility suited and supportive for concentrating the mind in meditation. Each unit has two platforms connected by a large rectangular monolithic stone bridge across the moat around one of the platforms. There is only one

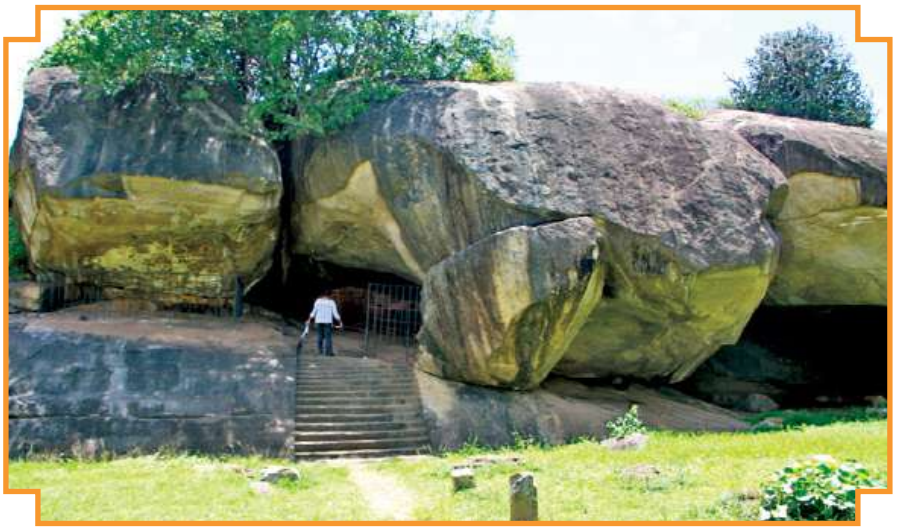


Fig : Wessagiriya

entrance to the rectangular walled area, while all ancillary buildings like toilets,refectory, kitchen etc. were placed outside the walled area. The architectural space and environment created were very special, and this building type was developed not only in Anuradhapura but throughout the island as forest monasteries with a large number of double platform buildings.

Their designed forest monasteries were excellent architectural achievements of the Sinhala civilization, incorperating natural caves, or without any cave. Sri Lankan cave dwelling was unique with a cut drip ledge along the top edge of the cave to prevent rain water running along the interior rock surface. These caves are linked with the common service building by constructing stone steps and pathways on axially organic form. Mihintale, the first monastery built in the 3rd century BC on a rockey hill in close proximity to Anuradhapura, was the first to be built.

The forest monasteries at Kaludiya, Arankele, Ritigala etc. are excellent architectural achievements of Sinhalese architects who created these by integrating all natural elements, the topography,waterstreams, rocks and boulders as well as the thick forest in achieving a built environment carefully and artistically integrating nature in creating an environment suitable for meditation. Stone paved serpentine pathways creeping through the full grown forest can be aesthetically valued and appreciated as architectural achievements. Scale was limited to man and the forest. Artistically utilised and integrated rocks, boulders and streams in the built environment, was a unique architectural concept. Use of water as a component in the architectural design had created the required physical and mental isolation needed for meditating monks. The City of Anuradhapura evolved with Sri Maha Bodhi



Fig : Mihinthale

Shrine, Ruwanmali. Thuparama, Jetavana, Abhayagiristupas and the monasteries, served as the Religio-cultural capital of Sri Lanka for thirteen hundred years until the capital was shifted to Polonnnaruva, where they have followed the same religious and cultural planning principles in addition to defense elements. Alahana Pirivena and other monasteries were given high priority to the total built environment. Stupas, image houses and residential monasteries have independantly followed the inheritance of the MahaVihara, Abhayagiriya and Jetavana sects. In city planning, street bazaars, road ways and Hindu shrines were also given a prominent place. The scale of the seven storey palace of Parakramabahu I, Royal gardens and public parks also gives an indication of the type of environment planning they developed in an urban context. In traditional city planning with safety considerations different types were identified, such as *Giridurga* – based on an impenetrable hill, *Jaladurga* – providing protection from water, *Vanadurga* – protecting forest, and *Pankadurga* – protected with mash. Sigiriya, Kurunegala, Dambadeniya, Yapahuwa were cities designed incorporating a rockey mountain with city walls and moats, where royal presence is afforded with protection on top of the rock. Out of these, Sigiriya is a unique World Heritage, a landscaped city built in the 5th century. Sigiriya is a city designed on a north-South axis incorporating inorganic principles and forms of nature. Sigiriya is totally a landscape-driven architectural product. The Architect has harnessed the beauty of the natural setting, and incorporating it with designed elements, buildings , pathways, ponds, flight of steps and forceful special and varying level compositions. They have combined the selected rocks and boulders with the built environment, resulting in an excellent architectural setting. Irrigation technology has been simplified and incorporated in the built environment as an important component in architecture in creating ponds with geometric forms, harnessing the beauty and tranquility in flowing water, their reflection, coolness, fountains, cisterns, bathing ponds, reservoirs and two sets of moats around the city.

All the royal cities of Kurunegala, Yapahuwa and Dambadeniya focused on defense, considering the Giridurga concept. Kurunegala was comparatively a larger city well

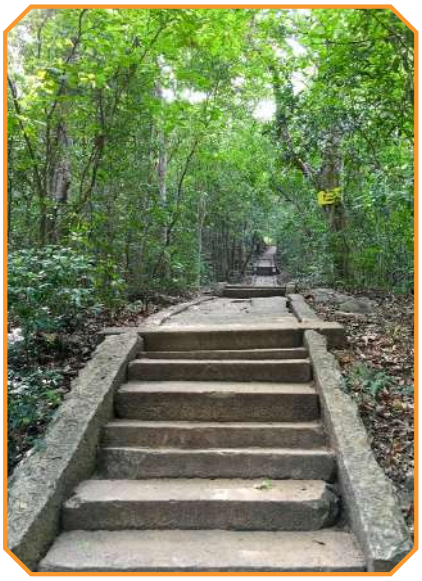


Fig : Ritigala

designed embracing the Ethugala rock. City walls were both earth and stone built. Yapahuva city was circular in plan with two city walls and surrounding moats. Beautifully designed, decorative and with a steepstaircase, were the most dominating features. The center part of this staircase which would have been in timber and removable during an enemy attack, has now been restored with brick steps. Dambadeniya city plan was

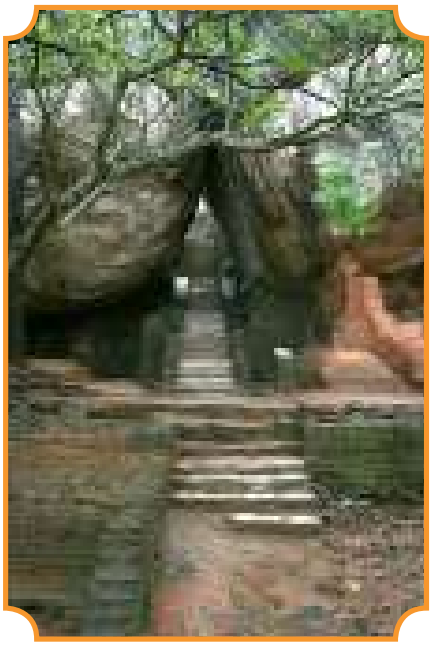


Fig : Sigiri Garden

a larger version of Yapahuwa. Kotte was a *Pankadurga* surrounded with marshland water. Only about one kilometer of cabok built city wall remains today as it was totally destroyed by Portuguese, who took away the cabok blocks of the city wall to build the Colombo Fort.

During the Gampola period of Sri Lankan history, there was a new concept where temple villages have been introduced.



Fig : Temple of Tooth Relic

Embekka, Gadaladeniya, Lankathilake, and Vegiriya were the Buddhist-Hindu temple villages in Sinduruwanarata, Gampola. Saman Devala, Soraguna, Ukgala pothnuwara, and Bolthumbe were found in Rathnapura valley. The plan form in these is such that the temple is approached by the main street, or the processional path ending with a *Sinhasana* position. Ware houses of temple servants were placed on either side of the processional Path. These temples were based on a new approach, where combining both Buddhist and Hindu temples was the result of Hindu Pandarams dominations, the social status that occurred during Gampola Period. .

The last capital Kandy or Senkadagala Nuwara was originally the temple village of Natha Devala.

The location of the city was well protected, as three sides were bounded by the Mahaveli River, while one side was protected by the Bahirawa Kanda Mountains and the forest to the east extending from the city up to the Mahaveli River giving protection as *vanadurga*. With Royal presence, the temple of the Sacred Tooth Relic was built on the hill slope on terraces; all buildings are single storey other than the two storey temple. The other four temples dedicated for Vishnu, Natha, Pattini and Kataragama were found outside the moat of the royal presence. The residential part of the city with grid pattern streets were placed next to the temple area. The present Lake Kirimuhuda was originally a paddy field belonging to MalwatteVihara until 1803.

During the Kandyan period the buildings were comparatively small, but well decorated with paintings and carvings done out of timber, ivory, stone, metal, terracotta etc. Buddhist temples built during this period were cave shrines; solid buildings in clay and timber; and temples on pillars. The traditional architecture and the sustainable built environment had changed with the colonial influence brought in from the 16th century in the maritime region, and after 1815 in the hill country.

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Modern Built Environments

Dr Upendra Rajapaksha



Ever since human evolution, man has made numerous changes to his surroundings.Among the basic needs of a man, shelter is one of the main requirements that is vital for his existence.Built environment satisfies needs in both qualitative and quantitative terms (or psychological and physical) of people, similar to medicine.Man has been transforming natural spaces into built and shaped spaces to match their needs firstly, then for shelter and food mostly, and finally for the luxury of living. This has ever since been the endless and overwhelming creation and recreating built environments that kept changing from time to time, enriched with different cultures, beliefs and perceptions.

This process of shaping and transforming space creates the built environment, separating it from the natural environment.

Built environments are created by people for the people, which continue to be influenced by socio cultural, economic and various human perceptions and beliefs from time to time. The built environment must be shaped to cater to the needs of its inhabitants in all aspects of their existence including where they live, work and play, and thus to benefit people. Once Winston Churchill stated that 'We shape our buildings, and afterwards they shape us'. Built environments can be defined as the vast spectrum of tangible and intangible forces which are either characterized by form or formless, that is, related to existence of human beings and the built spaces. In creating and shaping the built spaces, attention needs to be given for every single detail of each slight alteration that a designer attempts. Each line, each curve sketched on a paper has a great impact on built environment. Often this is not understood.Our built environments must be created to enhance human life by shaping and reforming the built spaces, while adapting to the natural flow to keep the balance, catering to the qualitative and quantitative patterns of interplay amongst people, nature and built spaces, to promote desirable and sustainable qualities and perceptions that can be applied across various living environments. This requires ample creativity and ability to nurture the love of a place



Fig : The Centre Pompidou in Metz by Sheuru Ban depicts the innovative use of Bamboo for structure



Fig : The stainless-steel exterior of Frank Gehry's Walt Disney Concert Hall in Los Angeles



Fig : Moshe Safdie's Kauffman Center for the Performing Arts in Kansas City, Missouri

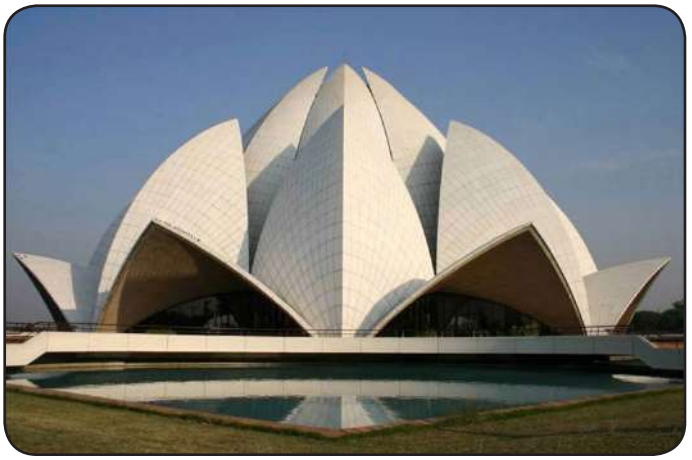

Fig : Lotua Temple in India by Architect FariborzSahba



Fig : The Heydar Aliyev Center in Baku, Azerbaijan by Zaha Hadid; a building of concrete that dances like folded paper



Fig : City of Shanghai with its modern sky scrapers





Fig : Anticipated new additions to Colombo's skyline

in harmonizing built with unbuilt, to create a pleasing interplay to enhance the quality of life.

From the simplest structures, today the built spaces have evolved to be much complex and eye catching. With the technological advancements, impossible has become possible, where structures of any shape can be built with the use of numerous advanced materials and advanced construction technologies. Potential to experiment, and materializing imaginations, has given birth to masterpieces and landmarks highlighting the creativity of the architects and designers.

However, on the other hand, modern built environment has more challenges than in past decades. Today built environments



Fig : Intervening greenery to modern built environments

must be formed to address the challenges faced with urbanization trends, climate change phenomena as well as numerous health issues, while at the same time satisfying the basic needs. It is evident that we humans, and our actions in forming the built spaces have collectively been the cause behind every consequence we face today. Our actions and decisions in creating chaotic urban-scapes, depletion of green cover, extensive energy use etc., have given birth to many critical issues. These issues are interlinked, and are growing each day. In present skyscrapers glazed with mirrors and energy craving buildings are popping up like mushrooms, causing more and more heat islands. Pollution has overtaken some cities, making lives vulnerable to various ailments. It is commonly seen that the majority lacks the true understanding of how the built spaces enhance and influence the daily life. Thus, the building and the built spaces are often looked at as just a composition of materials, and as a form that would please individuals' aesthetic appeal rather than the true impact of planning, functioning and socio cultural context. Lack of concern of human beings on the natural surrounding when shaping the spaces in accordance with their personal requirements and luxuries has led to make man a threat to nature and to himself. It must be understood that buildings and built spaces, should be created to address the needs of people, considering all the contributing forces that refine and shape them. It must also be kept in mind that this should be achieved with selfless motives and due responsibility, attention and care, that will sustain and nurture love for nature and all living beings including mankind.

With well-planned sustainable approaches modern built environment including buildings, can satisfy these trends, and help people to live healthy and peacefully.Modern built environments have the potential to avoid existing problematic situations and find solutions to such issues. Regenerating greenery and promoting energy efficient and sustainable buildings to form friendly and healthy built environments that promote socio-cultural well-being as well, is identified as the main requirement in modern built environments.

Many novel concepts and trends have been identified, researched and practiced globally. This practice is also slowly being introduced to Sri Lanka as well. Such decisions will enable cities to become places where we can live happily, healthily and have sustainable lives. Sustainable and green architecture, low energy architecture, zero emission buildings, smart cities,



green cities are concepts that have arisen and are being experimented as solutions to address the crisis situation arising from congestion. Instances can be found where buildings are created in harmony with nature, peacefully linking the built environments with natural environment.

Architects and building designers have the best potential to make the difference. Each building no matter how big or small, residential or commercial contribute in forming the overall built environment and its characteristics. Thus, when designing every single building, not only the specific building aspects but also the surrounding built and natural environments and overall built environment must be considered. In Sri Lanka too, many architects are taking efforts



Fig : Community Library at Ambepussa by Dr. MilindaPathiraja; mastering the material use to inspire innovation



Fig : Artist's Retreat by Archt. PalindaKannangara ;an escape merged with nature



Fig : Santani Retreat –Theldeniya; a building subtly blended with nature by Archt. Thisarahanapathy



Fig : Nikini Automation,Colombo: by Dr. Upendra Rajapaksha; linking effects of microclimates to building design, section and internal planning to reduce the building's energy foot print

to make a change and ensure sustainability to modern built environment with the intension of creating eco-friendly, sustainable built environments. Buildings that blend with nature; buildings that are live and have utilized novel technology and sustainable materials; and buildings that use natural energy sources are being added to the modern Sri Lankan built environment.

Cities around the world have started making their way towards a sustainable and greener future with goals for zero emissions, 100% renewable energy etc. Human society is embedded in environment. We should keep in mind that the human being is first and foremost an animal, sharing living space with other animal species in an environment in which they are mutually dependent. It is quite evident that because of our unchecked actions, we have disturbed the ecological balance of our environment, and hence are facing various critical issues. It is high time that we take some strict actions to preserve our environment and conserve the environment for our generations. It is our responsibility to shape our built environments to be in harmony with the natural environment, and ensure the possibility of healthy and happy life here. The creation of a pleasant and healthy living environment.

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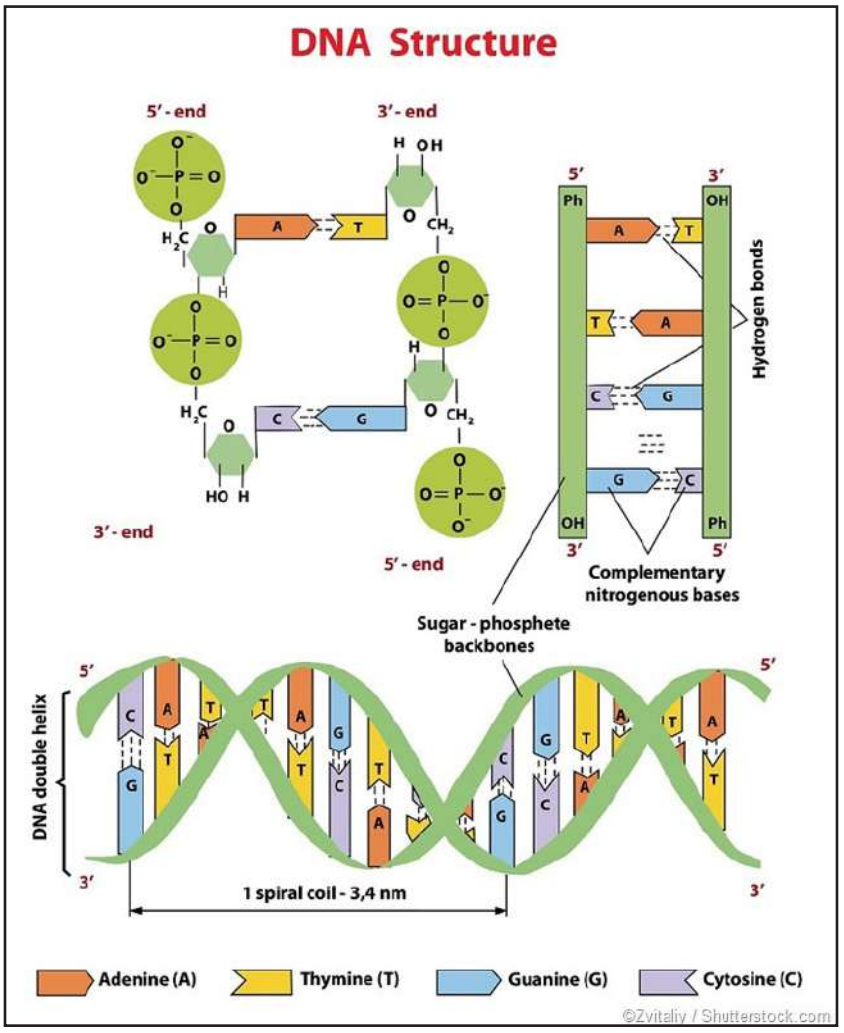
New inventions in the field of gene technology

Ms Vajirapani De Silva



When Rosalind Franklin took her x-refractory images of the DNA molecule over 60 years ago, she probably had no idea that her work was a mile stone in paving the way to "The unthinkable power to control evolution". As Jennifer Anne Doudna one of the leading ladies in modern-day gene technology, a major contributor in the discovery of CRISPR/Cas9 and programmable gene editing in living organisms, refers to the ability to delete , add or change the blue print of life in her book "A crack in creation", Doudna explains the possibilities of creating the unthinkable, considered to be impossible creations out of living cells. A brain child of Jennifer Doudna and Emmanuelle Charpentier gene editing is becoming a fast developing technology showing promise in applications in fundamental protein research for treatment of diseases including inherited genetic disorders and cancer. Like many other advanced technologies that were introduced in the past, this also is facing criticism due to cultural and ethical reasons. What is important is how we use such advanced techniques invented by man for the greater benefit of the planet, its inhabitants, and the preservation of earth for the future generations.

When the human genome project was completed in 2001, it was considered as an event equivalent to placing man on moon. There have been many leaps in life sciences since then with the advancement of gene mapping, research on genetic



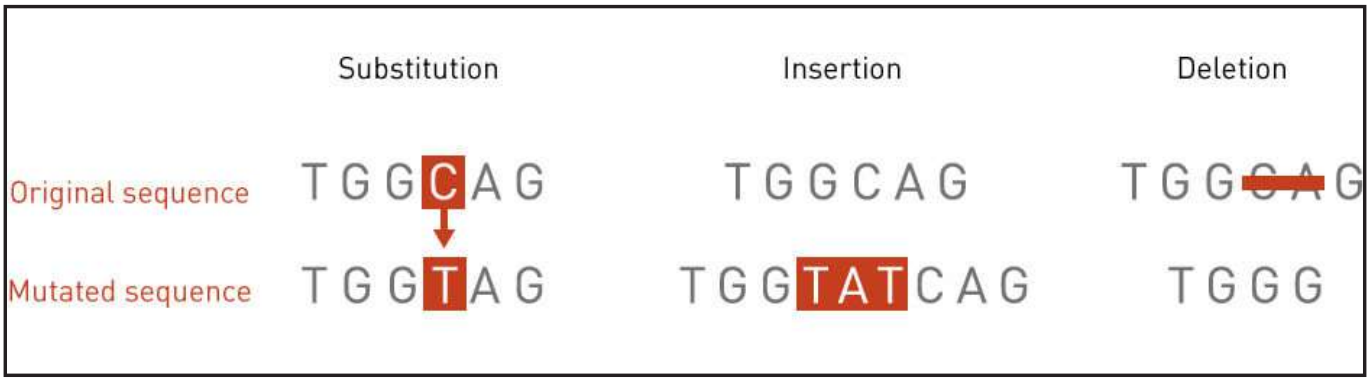


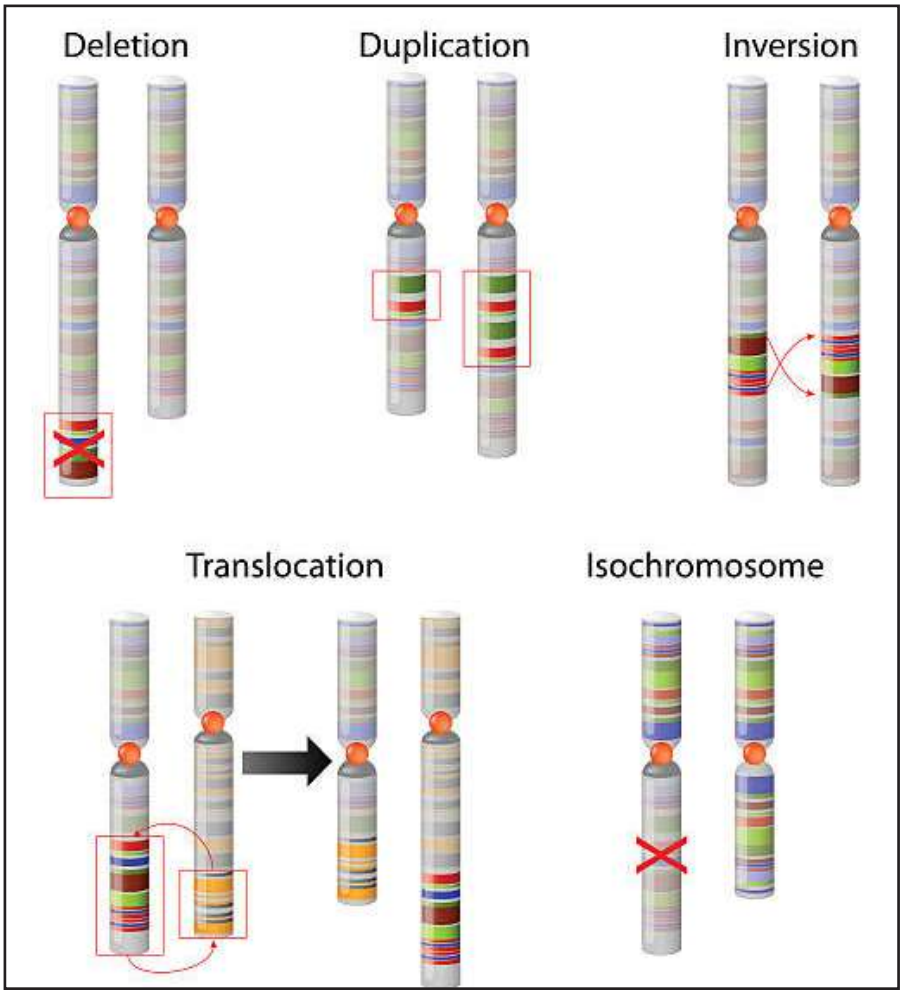
Fig : Mutations within chromosomes

disorders, gene therapy and gene editing. Though all these terms sound high-tech, they have been developed using simple principles of chemistry, and discovered by people who have dedicated themselves to research. Whatever the technique, DNA remains the blueprint of life with A, T, G and C making all the differences and similarities among the living organisms on earth.

Genetic disorders

Genetic disorders can be either inherited or non- inherited, and occurs due to random mutations in the genome. These mutations can be deletions, transfers , replacements , mixing of DNA between two different chromosomes , etc. Most of these disorders are considered to be incurable with the existing medical treatments. Genome mapping and sequencing have revealed valuable information on how these disorders occur, and consequently the control of gene expression studies can help in treating them. Epigenetics has become the major contributor to the study of control of gene expression.

Chromosomal Translocation

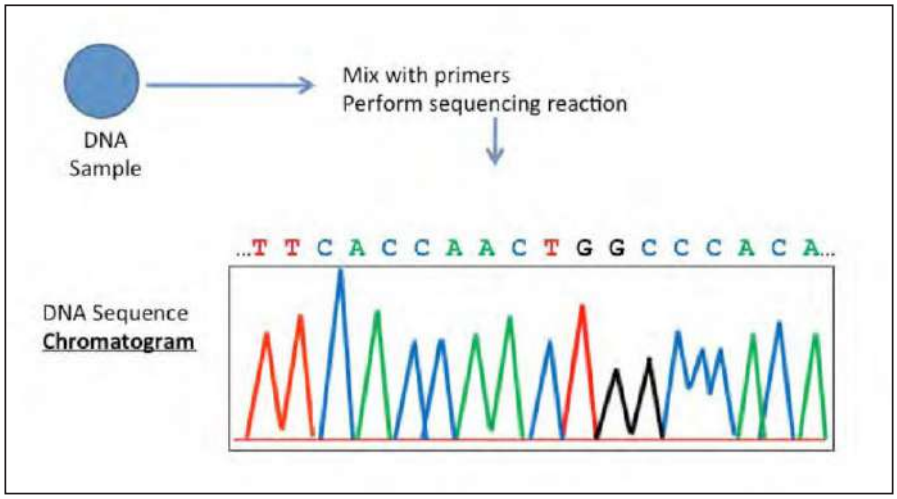


All these changes in the original sequence of DNA can lead to changes in the reading frames and hence producing abnormal proteins or destroying a gene that codes for a vital protein in the normal function of the organism. When occurred in reproductive tissues they carry the risk of being inherited by the offspring. Most of the time treatment has to be at the genetic level to re-correct these mutated DNA sequences. Gene therapy has shown promising results in the treatment of certain genetic disorders.

Genomics and Proteomics

It was known for a long time since the discovery of karyotyping, that just like an organism has a phenotype each of our chromosomes exhibit a phenotype when stained with specific staining dyes. Therefore with advances in microscopy and computer software, each chromosome can be identified with the numbers from 1 to 22, while X and Y have

Overview of DNA Sequencing



Adenine (A) = Green
Thymine (T) = Red
Cytosine (C) = Blue
Guanine (G) = Black

their own looks.But the differences within the similarities were found and revealed by the sequencing of the genome. Although the same location on a chromosome called locus codes for the same trait in the same species,the variation in that same trait comes from the different versions of the same location which are called alleles. Genomics and proteomics together can provide information on evolutionary advanced versions of these traits, hence allowing interfered selection of genes outside natural selection. Though there are many ethical aspects to be considered in manipulating genes as we want, the advantages of these interventions into nature can provide solutions to many modern day problems faced by our planet.

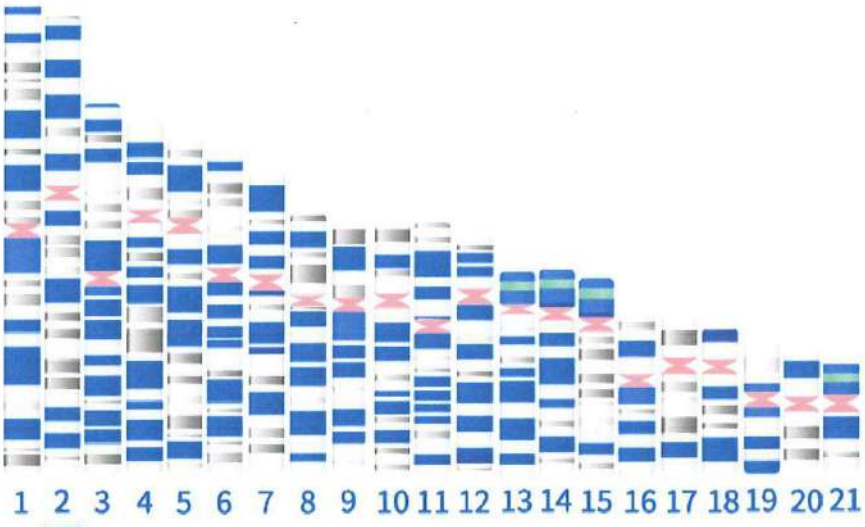
In the DNA chromatogram, each DNA base is represented as a peak of a different color. The DNA sequencing instrument "reads" the concentration measurement for each base and uses that data to determine the most likely identity for each base at each position. Sequencing instruments also produce text files showing the identity and order of all the bases (the DNA sequence).

Studying whole genomes and comparing genomes of different organisms fall into genomics. When human genome sequencing was completed and compared with yeast chromosomes, it was revealed that a reasonable bulk of yeast DNA sequences were found in human genome. Genome wide investigations can help in understanding the ability of humans and other organisms to resist certain diseases caused by different pathogens such as virus, bacteria and parasites.
Genome sequencing helps in mapping the chromosomes and developing complete genome sequences.
Proteomics reveals important details of gene expression during infections and different environmental and other conditions that can trigger changes in the micro environment of cells. Genomics and proteomics combined together shows promising results with the possibility to generate new vaccines and other therapeutic proteins in prevention and treatment of many incurable infectious diseases such as HIV, HCV etc.

Genomics is the study of the complete genome of an organism. Proteomics is a branch of molecular biology which studies the complete protein set expressed in a cell in order to understand the structure and function of proteins and how proteins affect the cell processes. Genomics cannot explain the actual conditions of the cells due to the post-translational modifications that occurred during protein synthesis. Hence, proteomics is important to understand the actual conditions and the functions of the cells. This is the difference between genomics and proteomics

Gene therapy

Gene therapy is defined as addition of a functional group or group of genes to a cell by gene insertion,

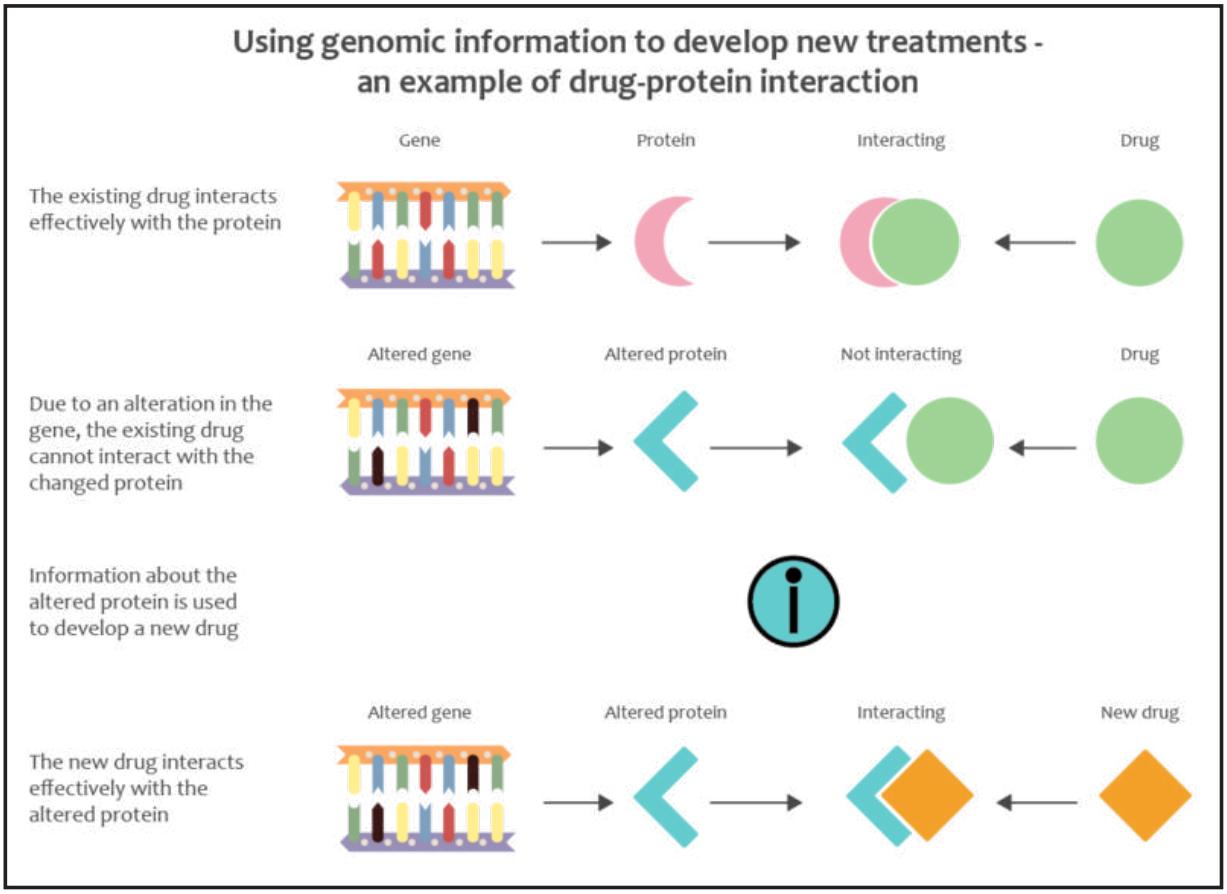


What is hidden inside the Human chromosomes is no longer a mystery.

The human genome project sequenced all three billion base pairs in the human genome. And at the completion of the project it was compared to be an equivalent of placing man on the moon. Today, Gene Editing is far more advanced and would be an equivalent to inhabiting another planet by humans

to correct a hereditary disease. In the early stages of gene therapy research applications, the delivery of the new gene was done by using a vector such as a virus without the ability to infect the person, but has the mechanism to insert the incorporated gene. The very first gene therapy treatment on a human was done on a Sri Lankan girl named Ashanthi de Silva.

Gene therapy has changed dramatically in the last 28 years since the first human gene transfer experiment.
All aspects of the procedure has improved and advanced making it possible for people all over the world to access the knowledge related to these technologies. Identifying a specific genetic defect has become less time consuming, specific and simple to apply. Micro arrays can scan hundreds and



thousands of person's genetic information within minutes to few hours. In a similar manner, micro arrays can scan a large number of patients for the same disease within a very short time with precision and accuracy. Precise detection is the first step in gene therapy and this is becoming more and more reliable and accessible to people.

Once the defect is identified, the correct gene can be synthesized or copied from a healthy chromosome. The polymerase chain reaction (PCR) has been the wonder tool for many years for reproducing large numbers of short DNA fragments with the same base sequence.Since the 1983 discovery of a Nobel Prize winning idea by Karry Mullis, different scientists have added many features to PCR, making it possible to be used in disease diagnostics, DNA finger printing, Forensic DNA technology, genome sequencing, recombinant DNA technology and many more gene technology applications. Since the delivery system is the vital part of the whole treatment procedure, the success of gene therapy has largely been driven by improvements in non-viral and viral gene transfer vectors. An array of physical and chemical non-viral methods have been used to transfer DNA and mRNA to mammalian cells, and a substantial number of these have been developed as clinical stage technologies for gene therapy, both *ex vivo* and *in vivo*.With nanotechnology having a say in every other technology applied today, Nano-bio technology is showing the ability to target deliver genes using Nano particles designed for the purpose. Two different methods are used in delivering the correct gene



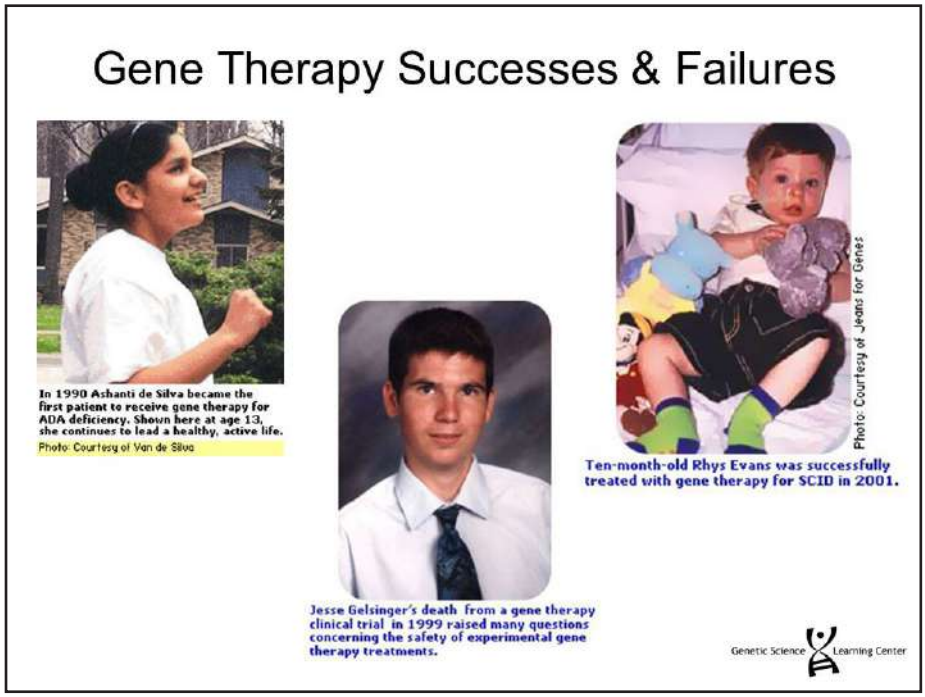
1. Transduction - Transfer via the viral vectors
2. Transfection - Transfer via the non-viral vectors

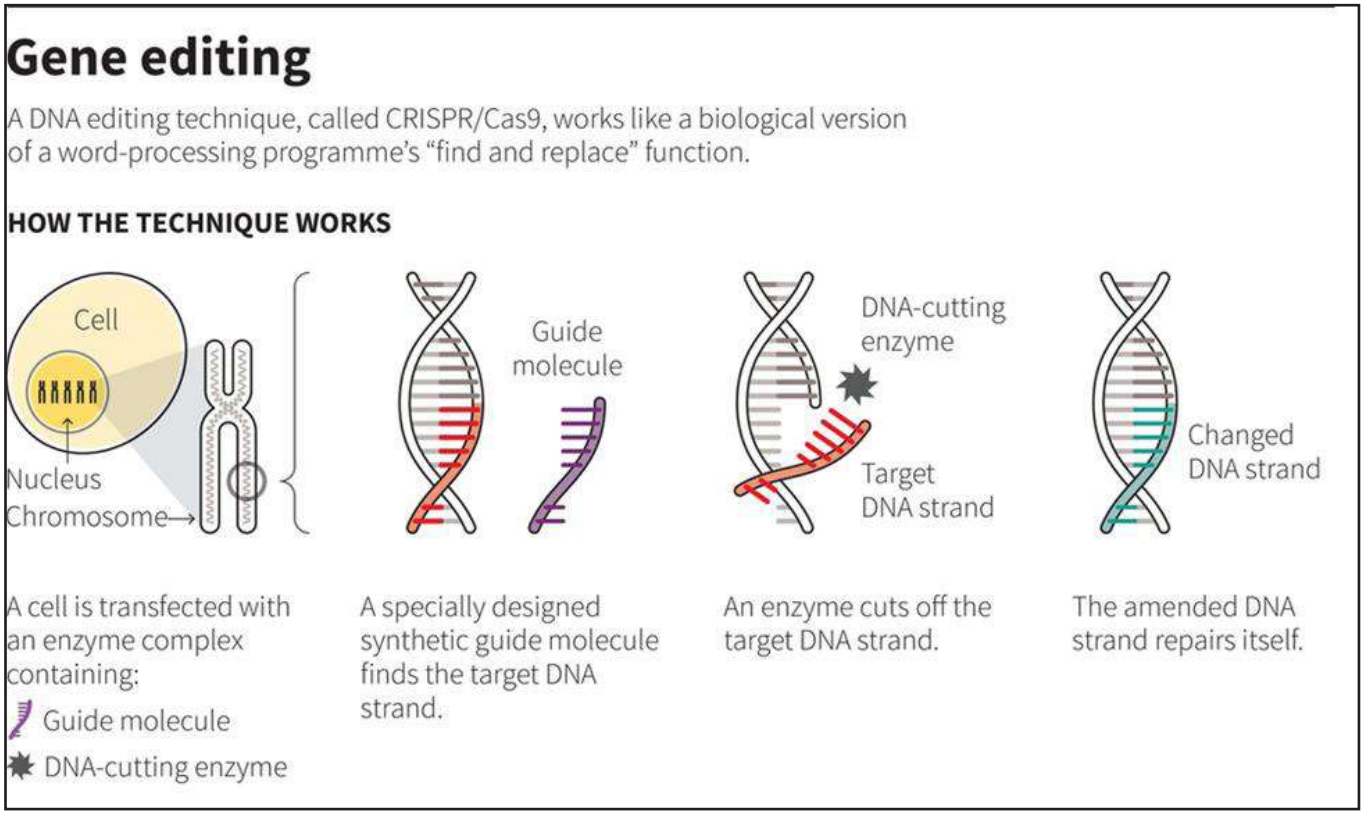
Transduction

Transduction is considered to be the more promising system of gene delivery with various advantages over physical and chemical methods:
Gene transfer is more efficient and specific than physical and chemical methods. Multiple and repeated doses are required in the case of physical and chemical methods, whereas in the case of viral vector, even a single dose is sufficient.
The biggest draw- back is that the vector can harm the patient in certain instances.

Transfection

Non-viral vectors include naked-DNA and liposomes. They are based on plasmid, which is a closed, circular DNA strand. Therapeutic genes can be inserted directly into the plasmid, and then this recombinant plasmid can be introduced into cells in a variety of ways. For example, it can be injected directly into targeted





tissues as naked-DNA.

They are considered safe, since there is no possibility of recombination that would result in a competent virus that could potentially cause disease. The "gene-gun," does not require the presence of complicated and potentially toxic delivery systems. Gold particles bound to the DNA fragments are shot into the cell under high pressure and speed giving the ability to travel through the cell membrane and nuclear membrane. But has less efficient gene transfer rate than transduction.

Rapidly Improving Tools

The technology is often known as CRISPR/Cas9, pronounced "crisper".

In 1987, Japanese scientists studying E. coli first came across some unusual repeating sequences in the bacteria's DNA. "The biological significance of these sequences," they wrote, "is unknown." Over time, other researchers found similar clusters in the DNA of other bacteria (and archaea). They gave these sequences a name: ***Clustered Regularly Interspaced Short Palindromic Repeats — or CRISPR.***

Later it was found that when bacteria are under constant assault from viruses, they produce enzymes to fight off viral infections. Whenever the bacteria's enzymes manage to kill off an invading virus, other little enzymes will come along, scoop up the remains of the virus's genetic code, cut it into little bits, and then store it in those CRISPR spaces.

The bacteria use the genetic information stored in these CRISPR spaces to fend off future attacks. When a new infection occurs, the bacteria produce special attack enzymes, known as Cas9, that carry around those stored bits of viral genetic code like a mug shot. When these Cas9 enzymes come across a virus, they see if the virus's RNA matches what's in the mug shot. If there's a match, the Cas9 enzyme starts chopping up the virus's DNA to neutralize the threat.

Scientists later discovered they could "fool" the Cas9 protein by feeding it artificial RNA a fake mug shot. When they did that, the enzyme would search for anything with that same code, not just viruses, and start chopping. In a landmark 2012 paper, Doudna, Charpentier, and Martin Jinek showed that they could use this CRISPR/Cas9 system to cut up any genome at any place they wanted

These rapidly improving tools

were discussed in the International Summit on Human Gene Editing, which was started to explore the many questions surrounding the use of gene editing tools in humans. The U.S. National Academy of Sciences, the U.S. National Academy of Medicine, the Royal Society, and the Chinese Academy of Sciences hosted a three-day international summit on December 1-3, 2015, inWashington, DC. In this summit it was pointed out that the new gene editing tools are the product of more than 60 years of fundamental research into the molecular nature of DNA molecules.

Previous technologies using molecules known as zincfinger nucleases and TALENs had made it possible to alter DNA at targeted locations. While these technologies are currently being used in clinical trials, they are cumbersome and difficult to use.

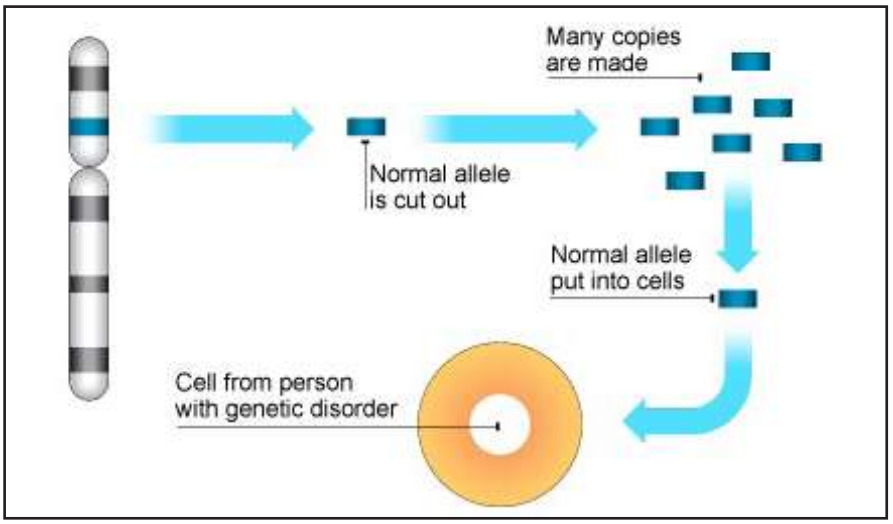
Therefore new and simple ways of altering targeted genes effectively and precisely were needed, and a new technique using a molecular assemblage known as CRISPR-Cas9, which arose out of research into how bacteria protect themselves from viral infection, is simple, inexpensive, and can target DNA sequences with great specificity.



In 2017 alone, researchers reported in Nature that they had successfully used CRISPR in human embryos to fix a mutation that causes a terrible heart muscle disorder called hypertrophic cardiomyopathy.

"The system is so overwhelmingly efficient and specific that it is changing our entire outlook for future gene editing," - Rajewsky.

Still , CRISPR-Cas9 needs to be perfected, as it can alter DNA at locations other than the target leading to inactivation of essential genes, activation of cancer-causing genes or chromosomal rearrangements. Effectiveness of the system may be efficient in certain type of cells but not all, resulting in a mosaic of altered and unaltered cells. Some scientists are cautious that it can generate immune responses if introduced into the body. There are many drugs that are in use which cause off-target effects, but are still effective for the targeted treatment. Similarly the CRISPR-Cas9 system is still undergoing development to reach the level of safety where it could be used in clinical applications and become a safe and approved treatment for currently incurable diseases.



Basic concept in Gene therapy includes identifying the defective gene, finding the correct sequence for it, making large number of copies of the correct gene and delivering the correct gene to the target.
Delivering has been the major concern in application of the technique right through the years.As different vectors sometimes had their own negative impacts on the patients after the treatment.

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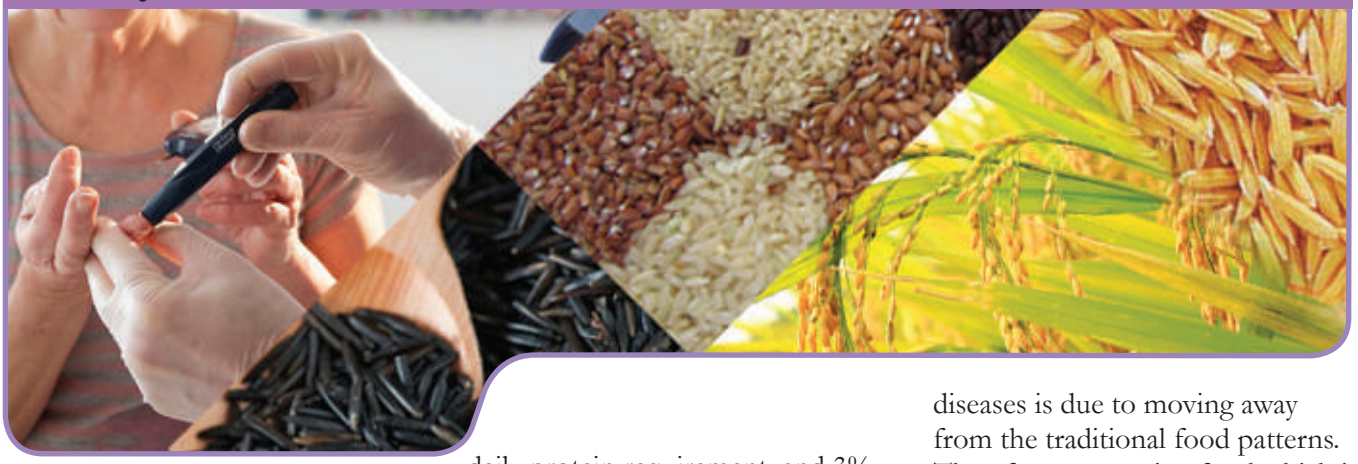
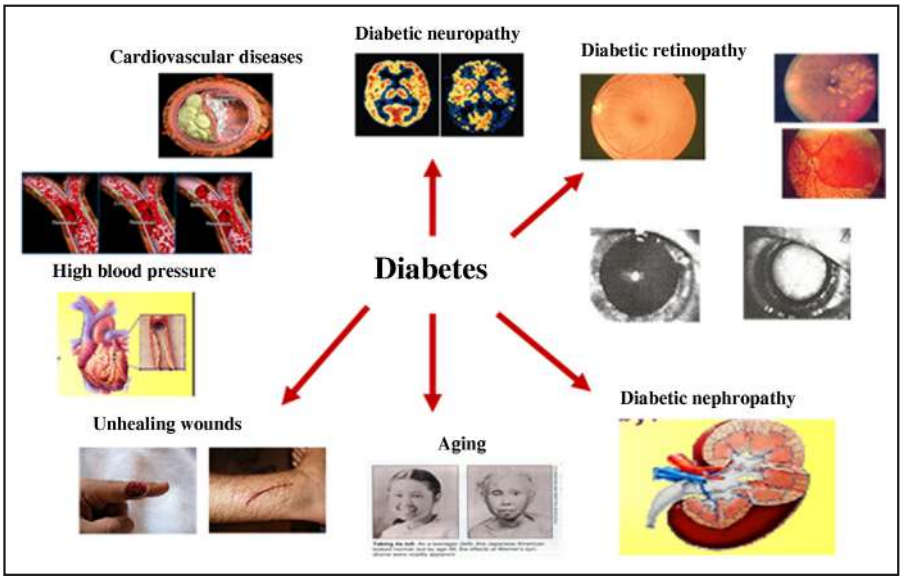
Our traditional rice varieties will make the nation healthy

Dr Sirimal Premakumara & Dr Kanchana Abeysekera



We have heard that our ancestors were a generation of active and healthy people. But the present generation is very busy and is subjected to many non-communicable diseases. Now the time has come for us to take stepes to rid ourselves of non-communicable diseases and produce a healthy generation. It is the wrong type of food pattern that has invited many of these non communicable diseases. Research conducted by Dr Sirimal Premakumara who is a senior Lecturer at the University of Colombo (and formerly the Director General of ITI (Institute of Technology), and Dr Kanchana Abeysekera, formerly a research officer at ITI on nutritional and medicinal properties of the traditional rice varieties of Sri Lanka, has revealed that the solution for many non-communicable diseases could be the consumption of indigenous and traditional rice varieties.

Rice is cultivated in about 100 countries world wide. Rice is the staple diet of about half the world population. 27% of the daily energy requirement, 20% of the daily protein requirement, and 3% of the daily fat requirement are provided by rice in the developing countries. In Sri Lanka too the staple food is rice, and the per capita consumption of rice is approximately 110kg per year. Our country has been self sufficient in rice since 2005 and presently produces rice even for export to other countries. The department of Agriculture has introduced about 50 improved varieties of rice for this purpose. According to the 2002 Annual Report of the World Health Organization, the main cause for the rapid increase of non communicable diseases is due to moving away from the traditional food patterns. Therefore consuming food which is nutritional and functional helps to prevent and control these diseases. Fuctional foods are those foods containing proteins, carbohydrates, fats, minerals and vitamins as the main components. In addition functional foods have other chemical substances which would improve the nutritional status and health. Therefore by consuming functional foods replete with nutrients help to control and prevent such diseases. In countries where the staple food is rice, by identifying the rice varieties containing the functional components with more mutritional



value, it is possible to control and prevent the occurence of non-communicable diseases. There is evidence that in Sri Lanka there were about 2000 varieties of rice which were indigenous and traditional.

Given below are a few traditional rice varieties of Sri Lanka with their nutrient and medicinal properties.

Mawee - controls diabetes, constipation, obesity. Improves body strength.
Suwandel - Supports body growth, and is suitable for controlling diabetes.
Kalu Heenetti - Improves body growth, and reduces toxins in the body.
Pokkali - Suitable for controlling diabetes, and for prevention of nerve and skin diseases.
Dahanata - Suitable for control of kidney diseases and cancer.
Kurulu Thuda - Suitable for control of urinany diseases, and improves body strength.
Hetada Wee - Suitable for control of constipation.
Madathawalu - Suitable for control of diabetes and ailments arising due to the three types of *doshas* (disorders) *Vatha, Pitha* and *Kapha*

Described below are some investigations carried out by Dr Kanchana Abeysekera and Dr Sirimal Premakumara on the nutritional and medicinal properties of some traditional rice varieties in Sri Lanka.

Diabetes is a non-communicable disease which is developing rapidly in Sri Lanka. Given below are some data regarding diabetes in Sri Lanka:

•Diabetes 10%
•Future probability for developing diabetes 11.5% :
In urban areas - 16.4%
In rural areas - 8.7%

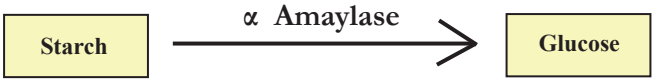
Research carried out on diabetes

•Activity of the enzyme α - amylase
•Protein glycation reaction
•Ability to reverse the Protein glycation reaction
•Glycemic Index
•Activity of the enzyme Choline esterase
•Research carried out administering extract to rats

Activity of the enzyme α - amylase

Amaylase is one of the main enzymes involved in the digestion of starch.

Scientific research has shown



that chemical compunds which can reduce the activity of the enzyme amylase can reduce the rate of starch digestion. Research conducted using the extracts from the bran of traditional rice varieties has confirmed that the rice bran contains active ingredients which can reduce the activity of the enzyme amylase. This properly is much higher in the red rice varieties when compared with white rice. Of the red rice varieties *Masuran, Sudu Heenetti, Dik Wee* and *Goda Heenetti* have been shown to exhibit this property at a much higher level.

Protein Glycation reaction

When the blood sugar level increases in diabetic patients a reaction takes place between the sugar and proteins. This is called the millar reaction. This is not an enzyme catalyzed reaction. The end products of the reaction are compounds known as Advanced Glycation end products - AGES.

The formation of these products takes place slowly inside the body. Scientific research has shown that these products are directly associated with the side effects of diabetes such as kidney diseases, nerve diseases and heart diseases. It has been shown that of the rice varieties tested *Sudu Heenetti, Goda Heenetti, Masuran* and *Dik Wee* have the highest ability to prevent these disease conditions developing.

Protein Glycation reversing ability

The identification of chemical compunds which can reverse the formation of advanced Glycation end products is useful in the control of diabetes.

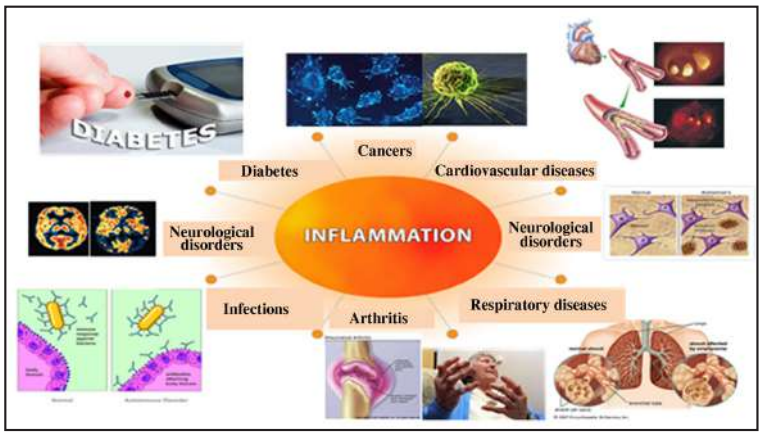
This ability to reverse protein glycation is shown to a high extent by *Sudu Heenetti, Goda Heenetti, Masuran* and *Dik Wee*.

Glycemic Index

This is an index indicating the level of blood sugar content when starch is digested. The value of this index is given relative to that of white bread and glucose.

Low glycemic index < 55
Mediam glycemic index 55-69
High glycemic index > 70

By experiments carried out, it has been found that the rice varieties



masuran, Sudu Heenetti and *Dik Wee* show a low rate of starch digestion relative to white bread.

Activity of the enzyme choline esterase

Chemical compounds which can reduce the activity of choline esterase help in the control of diabetes. Among the rice varieties studied *Sudu Heenetti, Goda Heenetti, Masuran* and *Dik Wee* have a high value for this property.

Research carried out administering extracts to rats

By these experiments it has been shown that the rice variety *masuran* is specially suitable to prevent the increase in blood glucose level.

Research regarding cancer

Cancer is a disease inflicting people irrespective of age. The research conducted has shown that rice varieties *Sudu Heenetti, Goda Heenetti, Masuran* and *Dik Wee* are suitable to inhibit or reduce cancers such as breast cancer, stomach cancer, cancers of the alimentary tract, lung cancer and womb cancer.

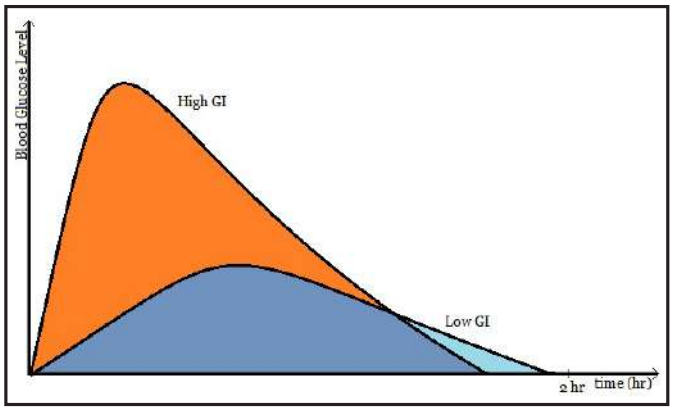
Research carried out regarding inflammatory diseases

During inflammatory diseases free radicles with high activity are formed.

The relationship of inflammatory diseases with other diseases

When the ability to neutralize the free radicals and reduce the formation of cytokinins when inflammation occurs was investigated, it was found that these effects were high in *Sudu Heenetti, Goda Heenetti, Masuran* and *Dik Wee.*

Research conducted regarding antioxidant properties



Compounds with oxidizing properties are produced in our bodies. These compunds with antioxidant properties are neutralized by emymes and by compounds possessing antioxidant properties. During disease conditions the rate of production of compounds with oxidizing properties is more than the rate at which these compounds are neutralized. Scientific research has shown that this is the reason for the development of non-communicable diseases.

Therefore providing compounds with antioxidant properties through diet is beneficial in controlling non-communicable diseases. Of the rice varieties tested *Sudu Heenetti, Goda Heenetti, Masuran* and *Dik Wee* have high values for these properties.

Accordingly if we tend for consume our indigenous traditional rice varieties it may be possible to avoid being subjected to many non-communicable diseases.

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Professor Stephen William Hawking - Scientist with an iconic status

Mr Thusitha Malalasekara



Scientist with an iconic status

"Intelligence is the capacity one has to accept challenge" - Hawking

A great scientist of modern times, who developed new theories around Black-hole, Hawking's radiation (Black hole radiation), Quantum mechanics and gravity which are the greatest challenges facing theoretical physics even today.

Author of many scientific texts, including " The large scale structure of space time". (ê George Ellis), " General relativity:an Einstein centenary survey" (ê.W.Israel) 300 years of gravitation (ê.W.Israel)

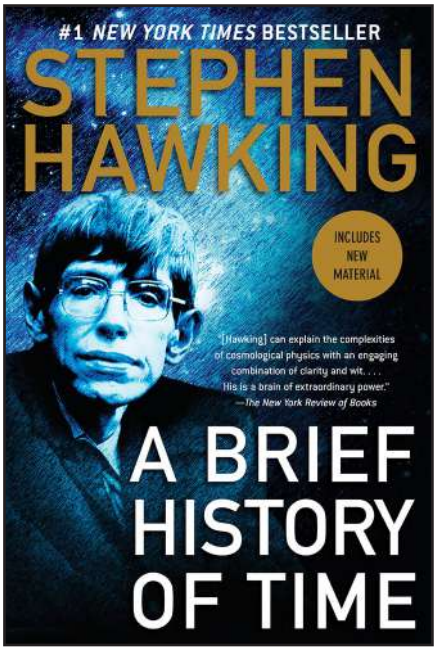
Popular Science writer, His works included "A brief history of time (1988), copies of which were sold to more than 10 million people around the world, and translated to more than 15 languages. It not only raised Hawking to stardom, but also gave a fresh face to theoretical physics. His other popular publications are "Black holes and baby universe", and other essays, "The universe in a nut shell","The grand design and my brief history".

Freelance Science writer, who contributed to a number of international scientific magazines and newspapers.

Excellent Broadcaster, conducting and participating in many radio programmes of BBC and other popular international radio channels, providing his views and explanations.

Versatile Television Personality, appearing in "Star Trek" "The next generation." "The Big Bang Theory" and also in the cartoon series titled "The Simpsons" In some of these programmes he acted the character of Hawking. He also conducted and participated in many TV programmes produced by B.B.C. , C.N.N and other reputed TV stations.







being it can be no one other than Professor Stephen Hawking.

Though his cultural status amplified by his disability and the media storm it involved, often over shadowed his scientific legacy. However he was the most recognizable scientist of our era. He had an endearing source of humour and a super human mind.

Stephen Hawking was born on 8th January 1942 in Oxford in England. It was exactly the date of the 300th death anniversary of Gallilio. When he was 8 years old, his family moved to St.Albans where he got his primary education. He entered the University College, Oxford in 1952. Though his father wanted Stephen to study Medicine, his preference was mathematics. Unfortunately mathematics was not available as a subject in the university college, where he pursued Physics, and at the end of 3 years he was awarded a first degree in Natural Science.

In October 1962 Stephen Hawking entered the Department of Applied Mathematics and Theoratical Physics (DAMTP) at the University of Cambridge.

His intention was to study, and to conduct research in Cosmology under the famous astrophysicist, Fred Hoyle. But his wish could not be fulfilled due to the selection of the full compliment of students to work under Hoyle was finalised by then. Stephen Hawking had to study under Physicist, Dennis Sciama. Fred Hoyle was a popular scientist, who used to travel widely delivering lectures, attending seminars and workshops inside and outside the country. Therefore he was seldom available for the students in the department. But Sciama was available around for guidance, and to stimulate the research students.



Contributed to the cinema industry, through the "Theory of Everything" in which his early life was the subject. This 2014 production made its main actor Eddie Redmayne an Oscar winner.
Consultant to universities, institutions, organizations and media, on Black-holes, time travel, cosmic happenings, quantum theory, artificial intelligence, alien life as well as on the health facilities of the country.

If all this and many other multi-skills were present in one human





Hawking's distinguished academic career earned him the doctoral degree in 1965, and was a Research fellow, (1965). Subsequently he became a Fellow of Distinction in Science (1969), and won the Adams prize as well as many other qualifications. Finally he was appointed as Professor of Gravitational Physics (1977) at the DAMTP. From 1979-2009 he held the Lucasian Professorship of Mathematics at the university. This chair was founded in 1663 from the money left by Rev. Henry Lucas in his last will, which was earlier held by famous scientists such as Issac Barrow and Isaac Newton. From 2009 onwards he was the Director of Research in a affiliated institution of DAMTP.



Professor Hawking in his life time had received 13 honorary degrees. He also won many awards, medals and prizes including CBE (1962), Companion of Honour (1989), Presidential Medal of Freedom (2009), Fundamental Physics Prize (2013), Copley Medal (2006) and the Wolf Foundation Prize (1988).
He was a Fellow of the Royal Society, The U.S.National Academy of Science, and Pontifical Academy of Science.

He achieved all there accolades while being iniflicted with a progressive disability which was diagnosed shortly after his 21st birthday in 1963. As a patient suffering from "Amyotropic Lateral Sclerosis-ALS" a degenerative motor neuron disease that quickly deteriorate the ability of voluntary muscles, doctors gave him 2 years to live, with disability to communicate and moving around.

Although Hawking's body may have weekened by the disease, his mind and intellect remained sharp. Inspite of being wheel chair bound and dependent on a computerized voice system for communication, Stephen Hawking continued to combine his family life (He was married to Jane Wilde and had 3 children, Robert, Lucy and Tim) with his research into Theoretical Physics until his death.

Professor Stephen William Hawking died on 14th March 2018.

Mr Thusitha Malalasekara
Writer is an author, journalist, editor, broadcaster and TV programme moderator with experience of nearly 40 years and has won several national awards. He edited the magazines "Sapatha" and "Vidya".

He worked in Health Education Bureau and as an assistant consultant in formulating communication strategies for reproductive health for UNFPA. He is also a member of the Science Popularization Committee of the NSF and editor of Vidurava (Sinhala).
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Nobel Prize winners of 2017

Mr Thusitha Malalasekara



Following scientists won the Nobel Prize in 2017 as per their respective disciplines

Physiology and Medicine

2017 Nobel Prize for Physiology and Medicine was awarded to 3 American scientists for their research and discoveries regarding the daily rhythms of the human body.

These three scientists are Jeffrey C.Hall, Michael Rosbash and Michel W.Young. Research conducted by them aimed to answer the questions about sleep and the body's need to perform certain biological activities. According to these researches not only humans, but animals and plants are all constantly trying to perceive the changes in the environment that surrounds them and to adapt accordingly.

They were able to isolate a gene that controls the normal daily biological rhythms of human body. Through their research they were able to "look" inside the biological clock of humans and to get an understanding of its inner workings.

They described that every moment and with every change of the environment a hormonal flow takes place inside the body. This is what fundamentally helps the biological processes such as sleeping, resting, getting rid of waste, that takes place in accordance to the clock of the each organ or part.

These researches were working on this field since 1984. And their findings will help to understand sleep patterns, food habits, hormonal activities, blood pressure, body temperature. Eventually these findings will go a long way to combat illnesses caused by the sudden changes of the biological system.

Chemistry

Two Americans and one Swiss scientist won the 2017-Nobel Prize for Chemistry.

Their research that led to the development of the Cryo-Electron Microscopy is expected to move biochemistry in to a new era. The developments made by these three scientists will simplify and improve the imaging of biomolecules according to the Royal Swidish Academy of Science. The names of the three nobel laureates are Jacques Dubochet, Jochim Franck and Richard Hendarson. According to the communique issued by the Royal Swidish Academy of sciences states that developing Cryorelectron microscopy for



Jeffrey C.Hall



Michael Rosbash



Michel W.Young

the high resolution structure determination of biomoleculers in solution, these three scientists need nobel recognition.

Physics

Three scientists have proved that there are gravitational waves in space. This discovery is expected to help a better understanding of Black holes and may pave the way for the discovery of life beyond earth.
The three Nobel Laureates who won the 2017 Physics Award are the scientists Rainer Weiss, Barry Barish and Kip Thorne.

The Royal Swedish Academy for Sciences, awarding the nobel prize for this decisive contribution in the observation of gravitational waves said that " This is something new and different, opening up unseen worlds".

Literature

Japanese born British author Kazuo Ishiguro won the 2017 Nobel Prize in Literature.

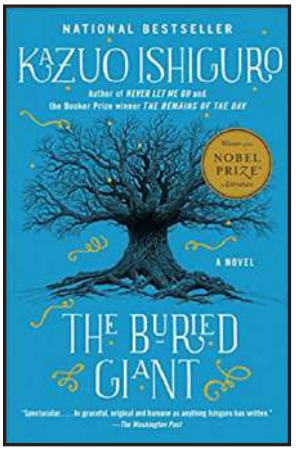
He has written 8 books and has written scripts for Television and film productions. Most of the themes that Kazuo selected were associated with time, memory and self-disillusionment. His latest novel is "The Buried giant". The novel that was published in 2015 explores how memory relates to oblivion history to the present, and fantasy to reality.



Kazuo Ishiguro

Economics

Richard H Thalar an American economist was awarded the 2017 Nobel Prize in Economic Sciences. Thalar tried to bridge the gap between Economics and Psychology through his research. His findings are expected to help understand the Pshychology of people belonging to all sectos and clases. These are expected to facilitate economic planning considering their Psychology. The Nobel Prize was awarded to him for his contribution to behavioural economics. He has used his concepts of behaviorval economics in his book "Nudge" (2008) which was a global best seller.

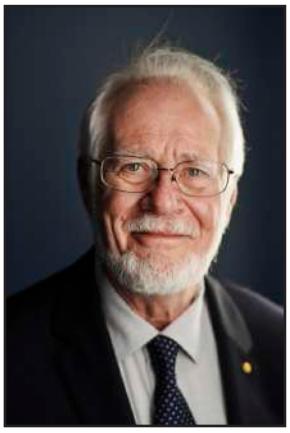




Jochim Franck



Richard Hendarson



Jacques Dubochet

Peace

International campaign to abolish Nuclear Wepons (ican) which is a coalition of non governmental organisations from around 100 different countries of the world was awarded the Nobel Peace Prize for 2017 by the Norwegian Nobel committee. The Ican organization repeatedly highlights the catastrophic humanitarian consequences of using nuclear wepons. They are pressuring the world leaders to formulate a treaty based on Prohibition of such weapons. The organization wants the leaders to understand the economic threats and environmental issues apart from the human misery if world endures in to nuclear arms prolification.

Mr Thusitha Malalasekara

