Geometry of Ever Growing Cosmos

by Shireen Bari

THE first geometric concepts evolved when mankind attempted to explain the world in which they lived. Ancient Egyptians were the first to build the pyramids through the knowledge of geometry.

But the geometry that we are studying now was attained by the Greek mathematician Euclid (about 300 BC). The 'Elements' by Euclid is one of the oldest books and still has the power to perform as a standard school testbook throughout the world.

Geometry is an exact science. It teaches us that the sum of the three angles of Euclidean triangle is equal to 180 degrees, not a fraction more or less. Through the knowledge of geometry Eratosthenes measured the earth. For more than two thousand years the assumption and calculation which Euclid has laid down for geometric relations in space were assumed to be as inviolate as the multiplication table.

But all the Euclids' postulates were valid except the parallel postulate. This postulate can be expressed through a point in a plane. It is always possible to trace one and only one straight line parallel to a given straight line lying in the plane. This parallel postulate is the geometry of a flat plane. If we draw a triangle on a piece of paper which is flat, we always find that the sum of the angles are 180 degrees. So the parallel postulate means that a straight line is the shortest distance between two points and two such lines which are both perpendicular to a third straight line are parallel to one another and never meet at any point. And in our everyday world we use it when we construct a bookshelf, a building or a bridge.

Again if we suppose the existence of a world of two dimensions (according to Euclidean geometry), like we watch pictures on TV or on a cinema screen. So that the people and objects in a two dimensional world have height and width, not depth. And if a straight line is drawn between two persons it would appear to them as a wall. They would be able to walk around either end of it, but they would not be able to step over it. Because their physical existence is limited within two dimensions. If two of them went off in opposite direction, they would never meet. This the most simple geometry that Euclid has shown us through his parallel postulate.

But a German mathematician Karl Friedrich Gauss (1777-1855) realised that it was possible to develop a logically consistent geometrical system based upon an assumption contrary to the parallel postulate. He was a shy person and kept silent about his discovery. Later on, two other mathematician John Biyai and Nikolai Lbachevski individually developed the same geometrical systems that Gauss invented. But one of Gauss's famous disciple, Georg Bernard Riemann (1826-1866), developed a new type of a geometrical system known as *Elliptic Geometry*. The Lobachevski's geometrical system is known as *Hyperbolic Geometry*.

In Euclidean geometry, the world has been shown as flat and infinite, but in Riemanns' method the world has shown as spherical, and there are no parallel lines and the lines are bondless. They are not infinite. Again Polyai and Lobachevski have shown that there are more than one line parallel to a given line through a point not in the line. This can be shown on a surface of a saddle.

At the beginning or before the birth of the universe when matter in the universe was packed into a single gigantic unimaginably dense primordial body, and from this condition suddenly an explosion did all the matter to fly outward to form an expanding universe.

The Riemann type geometry, that is the kind of curvature where the angles of a triangle add up to more than 180 degrees is called positive curvature (living on the surface of a sphere). Again the alternative is less than two right angles in Lbatchevski's geometrical system and is called negative curvature (living in a surface of a saddle).

Now the question is: what is the actual geometry of cosmos and the type of geometry cosmologist are trying to set up? The structure depends for their answers on a deep bond that has formed between macrophysics and microphysics. This bond can be observed in an expanding universe, if extrapolate the expansion backward by between 10 and 20 billion years. The cosmological and microscopic scales being to merge since the structure remaining on the largest scale reflects the imprint of those processes.

In 1917 Einstein revealed the idea of a cylindrical universe in assumption of three-dimensional space, from which rises a straight time-direction. The axis of the cylinder represent the time-direction, and any circular section represent space. At the same time, another physicist, De-Sitter suggested a rival theory that is *The Spherical Universe*. Einstein's idea explains that space curled round on itself, yielding to a finite Riemann universe that is a spatially, closed universe.

And De-Sitters' universe was obtained on the assumption that the world was empty of matter and its time-directions are not parallel and straight. Einstein and De-Sitter's conceptions of universe have been discarded in favour of a third type of universe which is an expanding universe.

To explain the expanding universe, first we must look for the definition of expanding universe. In 1920 Edwin Hubble discovered that our universe is expanding. This is due to redshift, that is, distant galaxies show a redshift in the light we receive from them. The light from any object, such as a star or a galaxy can be split into its component colours, the spectrum of the rainbow. and such a spectrum is marked by dark or bright lines which are characteristic of fingerprints and show which elements, which atoms are present in the hot object which is radiating light. As the optical spectrum, the band of light visible to our eyes runs from red to blue with red light having longer wavelengths and blue light shorter wavelengths. The light from our galaxy shows many spectral fingerprints of different elements and the light from distant galaxies shows same fingerprint patterns but shifted toward the red and away from the blue end of the spectrum. That is how the wavelength of the light from distant galaxies has been increased, stretched somehow compared with light from objects in our own galaxy. This is due to that the distant galaxies are moving away from us, and from each other. And the more distant a galaxy is from us the faster it is rushing away. So the distance to any galaxy can be determined by measuring its redshift. This is the picture of our universe in which everything is receding from everything else and we are not at the centre of the universe. Here spacetime itself is expanding carrying along the island of mass-energy (galaxies) with it.

At the beginning or before the birth of the universe when matter in the universe was packed into a single gigantic unimaginably dense primordial body, and from this condition suddenly an explosion did all the matter to fly outward to form an expanding universe. So before setting the geometry of cosmos, the cosmologist first wanted to know how much mass the universe have after the Big Bang. And to their great surprise, they have found that ninety per cent of the mass in the universe essentially is invisible and undetectable to the telescope, that means 90 per cent of the mass in the universe we just do not see at all. So galaxy counting is a poor way to estimate the matter density of our region of spacetime. Again for cosmologists estimating the value of density is now a tough job.

We know that the visible matter in the universe is only of ten per cent and 90 per cent matter is invisible so the value of Omega is a lower limit and it should be bigger than this. But how much bigger is a difficult job for the cosmologists.

Again the cosmological principle — the assumption that the large scale universe in any given epoch looks the same in all direction to all observers requires that any such grand scale curvature must be uniform throughout the cosmos. It will evolve as the universe expand or contracts.

Einstein equation means that this universal curvature depends only on the average mass density. If density parameter is 1, there is no curvature, and space is Euclidean that is flat. The non Euclidean curvature of 3-space is easiest to visualize for density parameter greater than 1, the case in which average density exceeds critical density (This critical 'cloure' density corresponds to about few hydrogen atoms per cubic meter throughout the universe). So according to physicists, if the radius of curvature can be thought of as the radious of the universe, it can be regarded as the 3-dimentional hypersurface of a hypersphere expanding (and ultimately recontracting) in a four-dimensional Euclidean space. In a simple way we can explain this situation. Suppose the earth on which we are conducting our measurement were to swell indefinitely. All the characteristics of Riemanns' geometry which we have discussed would gradually fade away, provided we limited our measurements to the same restricted area of the surface. Our measurement would still yield Riemann results, of course. Since however large our earth had grown, it would still remain spherical. But the result of our measurement over a definite area would approximate more and more to those of Euclidean geometry. The reason is that the greater the volume of the sphere, the more nearly would a given area of its surface approximate to an ordinary plane.

So cosmologists think that unlike the positive curvature case, where the entire universe is of finite volume 'closed', the negative curvature case, with density parameter less than 1, corresponds to an infinite open universe. And in this low density case, the universe never stops expanding, but its ever-increasing curvature parameter can no longer be thought of as its literal radius. For negative curvature the proper distance elements is smaller than its Pythagorean value, as if one were at a saddle point.

And according to physicists, the limiting Euclidean case, with precisely critical density, the universal expansion is never quite reversed, but the expansion rate goes to zero. Space being flat, it loses its role as a radius of curvature, but it retains the role of cosmic scale factor describing the expansion of the universe.

Edwin Loh and Earl Spillar two physicists at Princeton have taken a different track and they together worked out to look directly at the geometry of the cosmos. They have started using the redshifts of "galaxies solely as benchmarks in space to measure the change in expansion with distance and the curvature of space". They have measured redshift of 1000 galaxies in five small patches of sky. By measuring the speed with which universe is expanding and the way that expansion velocity has changed as universe has aged.

These scientists' worked out results have shown that the cosmic geometry thus revealed that density and critical density ratio is 0.9. Both density and critical density decrease as the universe expands, but the ratio of density and critical density that is Omega is less time dependent and rigorously constant. If Omega or density parameter is 1. Again, Big Bang cosmology requires that density parameter equal 1 assuming that the cosmological constant vanishes. If Omega is 1. space on the grand scale is flat (According to Euclidean geometry). And there is no general cosmic curvature. So at present, scientifically calculated results that is probing cosmic geometry suggests the universe is flat.

The Odyssey of the "Astrolabe"

by Jean Chabrier

FROM the early 16th century, merchant vessels have, on numerous occasions, attempted to take the North-East passage in the freezing waters blocked by ice-floes from 8 to 10 months of the year and in terrible climatic conditions. The names of Barents, Beling, Nordenskjold and Amundsen immediately come to mind.

In 1922, the Soviet state banned all passage through this maritime thoroughfare. During the Second World War, it only reluctantly. Then there was the cold war when the whole of the arctic became a Russian-American lake teeming with nuclear submarines from the two countries.

To the great regret of scientists, there was scarcely any information filtering through from that immense region, and this only came from the CIA as the Soviets imposed a complete blackout. Although President Gorbachev proposed re-opening the North East passage, in 1987, to international traffic, the Soviet military took no notice of this.

4-1 — Au cours de son périple du Havre à Yokohama par le passage du Nord-Est, « L'Astrolabe » a étudié le rôle climatique de l'Arctique au niveau de la planète. (photo : Sipa-Press)

So, when, on 27th July 1991, the French vessel "Astrolabe" was able to raise anchor from Le Havre for the North-East passage to Japan, it was just as much in a spirit of scientific community and fellowship as owing to diplomatic procedures.

However, the military had imposed a restriction without appeal : an absolute ban on installing scientific instruments. In exchange for respecting this promise, the voyage would have all the assistance it could wish for and, above all, the help of a nuclear-powered icebreaker called "Russya".

The spectacular success of this new satellite was to completely change navigation conditions in these unfriendly seas.

The "Astrolabe" carries a whole host of scientists, Louis Geli, the geophysicist, JC Gascard, researchers from the French National Scientific Research Centre (CNRS), technicians from the Sea Research Institute (IFREMER), etc. as well as Norwegian scientists.

On 16th August, the "Astrolabe", which is only a simple supply ship for polar bases, was caught up in the ice-floes and a special operation took place for the first time. On 16th July, a European satellite, ERS 1, had been placed in orbit. Its purpose was to watch over the polar ice, thanks to a radar giving pictures with a resolution of 20 metres.

Although it was only in its trial phase, it clearly showed a channel, 50 metres wide, left a few days earlier by an ice-breaker. In the past, the only way to find out such a thing would have been to fly over the area in a helicopter.

The spectacular success of this new satellite was to completely change navigation conditions in these unfriendly seas on the edge of a vast continent with enormous resources which had been poorly or not at all exploited as the Ob and the lenissei had been practically the only two possible channels for transporting them.

In spite of the limitations on their investigations and the short amount of time at their disposal, the scientists were able to collate and important amount of information, while still having considerable new things to find out yet.

The Arctic region is a large reservoir of cold, which acts as a CO pump and this is very important for the balance of the planet.

There are many questions which can be asked about the polar region.

L'Actualiteen/France

Morris Minor to be Reborn Among the Coconuts

by Geoff Ellis

A classic British family car which last rolled off the production lines more than 20 years ago is to make a comeback — in Sri Lanka.

A factory to build the legendary Morris Minor has been set up among the coconut palms in the south of the island. It is already making spare parts both for local use and export to Europe, and complete cars will be turned out within the next couple of years.

Behind the scheme is British businessman Charles Ware and a retired Sri Lankan diplomat, Dhanapala Samarasekara, who have formed the Durable Car Company.

While Japanese and western makers prepare for the 21st Century by investing billions in high-tech plants with few human workers, the Sri Lankan factory is heading in a different direction.

"It is made out of coconut trees," said Ware, managing director of the Morris Minor Centre in the British city of Bath.

"Sri Lanka's most important resource is its people, who have one of the highest literacy rates in Asia. Our project is designed to maximise the part they play in the production process."

So robots are out and apprenticeship schemes are in. Instead of costly and energy-hungry machinery, the Durable Car Company relies on manual skills to make the parts that can be sold around the world.

"Essentially we are investing in people, not automation," said Ware.

"It is a way of relating to the Third World in a sensible way. We are not ripping the country off. We pay good wages and we are very concerned that the factory should not cause pollution."

The Morris Minor was designed in 1948 by Sir Alec Issigonis, who went on to design the famous Austin Mini.

Thousands of Minors were exported to countries such as Sri Lanka, India and Pakistan during the Fifties and Sixties, where their rugged construction and basic design kept them on the road for decades.

Indonesia and Malaysia still have plenty of Minors on the road, and there are small numbers in other countries, including Thailand and Singapore. They can also still be found in parts of Africa and Australia.

The original Minors were either exported to Asia complete or in kit form but were not made locally, unlike the Morris Isis. Production of the Isis stopped in Britain after a short run, and the whole assembly line was exported to India to Britain, according to Ware — but makers from countries such as Japan are taking over and cars like the Maruti, based on a Sazuki design, are becoming more common.

Production of the Minor in Britain stopped in 1971 and spares were running out when Ware, a former property developer, started the Morris Minor Centre in Bath to help maintain and restore those still on the road.

In 1983 he was visited by Samarasekara who wanted to open a centre in Sri Lanka, and the joint venture was born.

Their factory in Batadua, Samarasekara's ancestral village in the deep south of the island, eventually will provide around 1,000 jobs in an area with an unemployment rate of 30 per cent.

Components for the local market — Sri Lanka has some 20,000 Minors still running, used mainly for taxis — are sold partly-finished to keep costs down. Those for export to Britain, where around 80,000 Minors are registered, are all highly finished.

The factory will make light commercial vehicles as well as cars, with the aim of making Sri Lanka largely self-sufficient in an important area of its transport system, cutting down on the need to spend hard-earned currency on imported, short-life modern vehicles.

Ware is convinced their low-tech approach makes economic sense. Modern plants may turn out thousands of cars with very few workers, but the huge cost of setting up sophisticated — and soon obsolete — production lines more than offsets the labour savings made.

In the long run, the cost to motorists is also higher because modern cars soon lose much of their value.

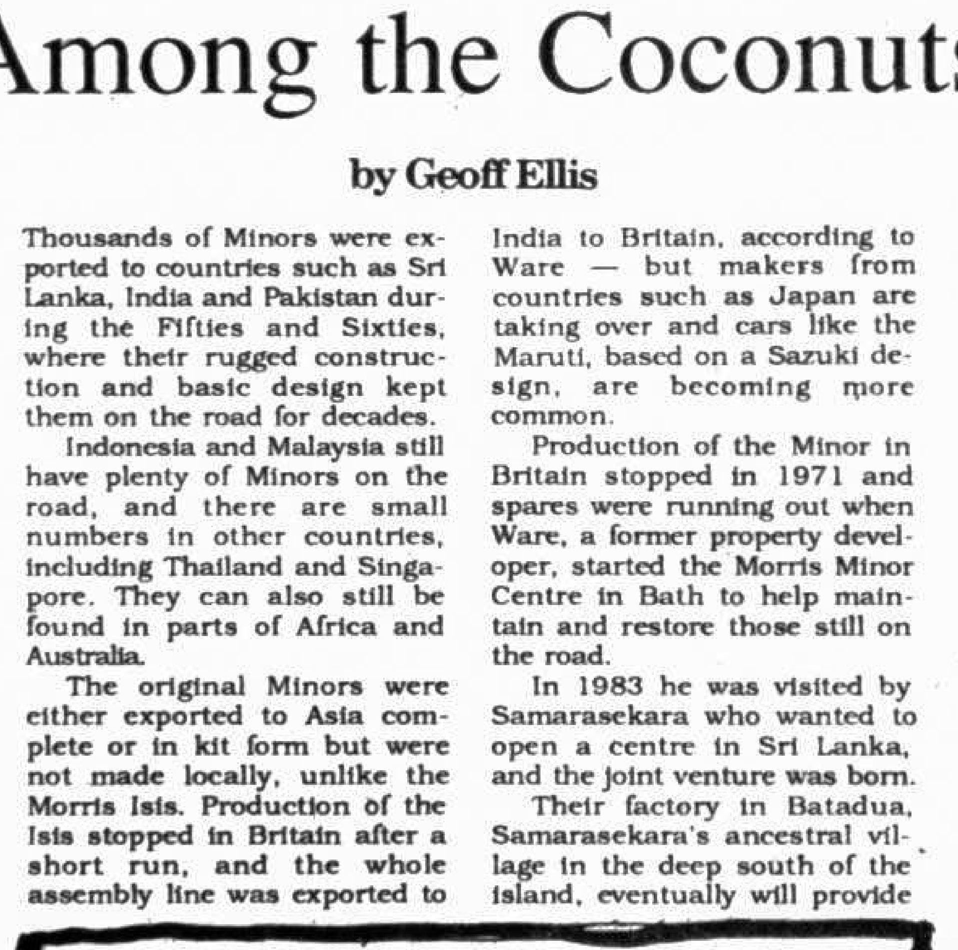
The industry is making "more and more cars, which fall apart quicker and quicker, with fewer and fewer people, so we are building structural unemployment into the system," says Ware, who believes the new factory could become a model for other developing countries to follow.

"I want to see us making a quarter of the cars with four times as many people, but to be able to offer an anti-rust guarantee of 25 years because the cars will last.

"I would like to see a car with 900 human hours in its construction rather than the handful of hours manufacturers are heading for."

— Gemini News

Geoff Ellis is a British journalist who writes on the Asian community in Europe.



Proud owner of the new Morris Coconut

Taiwan Scientist Scores in China

by Zhou Meiyue

A native of Taiwan is the youngest member of the Chinese Academy of Sciences (CAS).

Dr Zhao Yufen, 43, is amused that she started her academic career in Tasinghua University at Xinzhu, Taiwan, and now works at the Chemistry Department of Tsinghua University in Beijing.

In a way, she took the long way home. From Taiwan, she earned a scholarship to the United States where she studied in the 1970s for her doctorate. It was only in 1978s for her doctorate. It was only in 1978 when she visited mainland China, her birthplace which she left while barely one year old.

"Isn't that significant," smiles the newest member of the snooty and prestigious Academy. Membership in the CAS is the highest academic title for a scientist in China.

"She deserves it," says Professor Wu Guosi, dean of the chemistry department where she teaches. "We decided to employ her three years ago because we were sure she was one of the most promising chemists in our country. And she has lived up to our expectations."

The recent augmentation of CAS membership was a highly competitive process. Among the 1,079 primary candidates, only 210 were finally conferred the title. Dr Zhao was one of the few who won by consensus.

"Her accomplishment was obvious," said one specialist on the screening panel. "She was the first scientist in the world who proposed that the phosphoryl group is the functional centre of all the life substances, and that each exchange of information, energy and substances between the three biochemicals — nucleic acid, protein and carbon hydrate — is related to phosphorus."

All these years, Dr Zhao has focused her attention on organic phosphorous chemistry. Comparing the role of the phosphoryl group to that of the central regulation office in an airport, she explains that the phosphoryl group is actually the "centre of adjusting, controlling, stimulating and transferring between life substances."

Though many research workers had noted that phosphorus is an indispensable component of biomolecules, they "neglected the important role that phosphorus played in them," says Dr Zhao who discovered this role.

Many scientists claim that Dr Zhao's theory provides a new clue to the principles of life chemistry. Joseph Bnnet, a world famous chemist from the University of California at Santa Cruz, in the United States, called her idea "significant" to both basic sciences and bio-engineering and predicted that she "will be a great scientist."

"Having grown up in a rustic environment seems to have endowed her with unusual endurance," says Zhu Lilan, vice minister of the State Science and Technology Commission and former director of the CAS Chemistry Institute where Zhao worked for nine years. "She is especially persevering in her academic pursuits."

Dr Zhao herself attributes her achievements largely to perseverance. The eldest daughter of a bedridden father and a working mother, she helped her mother raise five younger siblings.

"My father passed away when I was 16 and my youngest sister was four," she says. Life was extremely hard for the family, but the girl managed to be a good help to her mother as well as a top student at school.

She first became interested in chemistry when she was in high school in Zhanghua, Taiwan. "A woman chemistry teacher made the course so intriguing that I made up my mind to explore the mystery in the kingdom of chemistry," Prof Zhao recalls.

In 1967, she entered Tasinghua University at Xinzhu, Taiwan, majoring in chemistry. Four years later, she won a scholarship and went to the United States for her doctorate on organic chemistry at the State University of New York (SUNY) at Stony Brook.

Her mentor was Prof. Fausto Ramirez, a world known organic chemist. Dr Zhao distinguished herself by her doctorate dissertation on the mechanism involving the Adension Triphosthate (ATP) reaction, confirming the reaction pattern of biochemistry.

"Prof Ramirez cultivated my mode of thinking and remains the most influential figure to me academically," says Dr Zhao.

After she obtained her doctorate in 1971 Dr Zhao went on with her post-doctorate studies in the fields of organo-phosphorous, organometallic and nucleic acid chemistry, first at SINY, then at New York University. By then she had presented several papers at international conferences and began to show bright prospects in the field of chemistry.

A visit in 1978 to mainland China, her birthplace which she had never seen since she left when she was barely one year old, was a turning point in her career. She met her grandfather and visited research institutions in Beijing, Shanghai and Tianjin before deciding to settle down in Beijing.

"I felt that the many research institutions in Beijing would facilitate cooperations between colleagues as well as the exchanges of scientific ideas," she recalls.

"Another advantage of working in Beijing," she says "is you may stick to one domain for as long as possible rather than change your subject just in order to get more funds, as is often the case when working abroad." She says this is very important because "a chemist is unlikely to get anywhere unless one adheres to one field for dozens of years."

Prof Zhao worked with the Institute of Chemistry under CAS in Beijing, first as an associate professor, then as a full professor until 1988 when she left the institute and joined the faculty of the Chemistry Department of Tsinghua University in Beijing.

As a woman scientist, Dr Zhao believes that perseverance, confidence and open-mindedness are critical to success. "Sometimes," she says, "a curious phenomenon emerged in the test quite beyond my expectation. And a hardly-sought compound was too changeable to control."

That is a critical point where someone would give up and waste all previous efforts. But Dr Zhao held on. "Finally I found out the law governing the changes," she says.

That is why she stands for a school education which puts stress on psychological training, and sent her 11-year-old daughter to a boarding school so the girl would "develop a strong and independent character from her childhood." Dr Zhoa's efforts paid off when her daughter got full marks for her arithmetic in the final examinations last semester.

Tutor of eight students doing their master's degree, nine doing doctorate and three pursuing their post-doctorate studies, Dr Zhao enjoys the love and esteem of her students.

"She is strict with me," says Li Yanmei, 27, who is pursuing her doctorate degree. "She never permits me to leave today's work unfinished for tomorrow. On the other hand, she is encouraging. She affirms each achievement I've made, no matter how minor it is. And she keeps a sharp eye out the frontier of the domain while she has the guts to challenge the conventional ideas."

Chen Yi, another student, admires Dr Zhao's versatile talents. "She loves music and gardening," she says, "and she also has a graceful taste for fashion. She is successful in career but very womanly in life. It's only natural that we are all overwhelmed with admiration for her."

— Depthnews Asia.