How Life Began on Earth

By Frank Nowikowski

FORGET about primordial sludge or intergalactic dust as the likely origins of life on earth. A new contender is bacteria deep under the surface of the earth. This subterranean life is still there, and its total mass may amount to more than all the life forms on or near the surface, claims a United States scientist.

About 12 years ago, scientists unexpectedly discovered life in the form of bacteria in numerous very hot ocean vents. This life existed independently of solar energy and photosynthesis for its primary energy supply, and independently of all surface circumstances.

Its energy source comes from chemical reactions. Liquids and gasses rising from cracks in the ocean floor combine with substances available in local rocks and in ocean water. At the chemical interface energy is liberated, which sustains life in the form of bacteria.

Such life may represent only the first known examples of life which depends on subterranean energy, says Harvard University astronomy professor Thomas Gold.

Upwellings under land surfaces would be harder to find than those under the ocean, but they may be evidenced by deposits of methane and other hydrocarbons in basement rocks, says Gold. Hydrocarbons have unexpectedly been brought up by drills in the superdeep well of the Kola Peninsula, Russia, and by the German Continental Deep Drilling Project.

Previously unknown, thermophilic, anaerobic microorganisms have been brought up from 67 kilometres deep in the granite rock of Sweden, at an ancient meteorite impact site.

Bacterial molecules are so widespread and ubiquitous in sedimentary rocks that some scientists believe they amount to more than all the organic matter on or near the earth's surface. Gold calculates that the total subterranean bacterial biomass is equivalent to a 15 km layer of living material if it was spread over all the land surface.

Bacteria can live at higher temperatures than any other known organisms: 110° degrees centigrade has been verified. Where pressure is enough to lift the boiling point of water, an upper limit of 150 degrees may be possible.

If we assumed an upper temperature limit of 150 degrees, then a depth limit is reached between five and ten kms in most areas of the earth's crust. Gold suggests that bacteria can get down to that level in less than 1,000 years, assisted by water. Water deep in the earth's surface is subjected to tidal pulls and provides an accelerated transportation system.

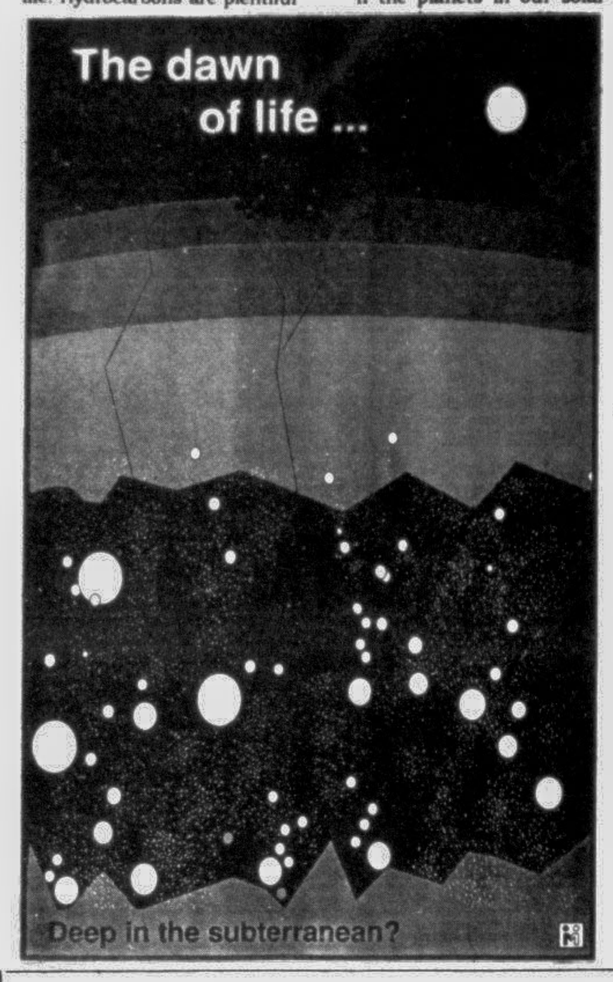
Rocks that have hydrogen, methane and other fluids percolating upwards are prime candidates for the origin of life on earth, claims Gold.

Underground temperature, pressure and chemical surroundings are constant for geologically long periods of time. Deep underground organisms would be protected from high, fluctuating levels of ionising radiation or ultraviolet light. Photosynthesis is a relatively complex process and would have evolved later..

In his book The Life Puzzle, AG Cairns-Smith, writing about the origin of life, pointed out that once self-replicating adaptive systems have been formed that may well adapt gradually and change to a totally different chemistry.

Gold suggests that underground life may also be found on other planets where surface conditions are inhospitable for life. Hydrocarbons are plentiful on all the gaseous and solid planets and satellites and on numerous asteroids, comets and meteorites.

If the planets in our solar system were formed from the same solar matter, the interiors of the solid planetary bodies may not be too different from the earth's interior. Similar conditions to those of the earth at a depth of 10 km will be found at greater depths in the other solid planetary bodies — because they are smaller.



Gold suggests that the search for life in the solar system should not end with the negative results obtained from the surfaces of the moon and Mars. Future space missions could look deep under the surface of these and other bodies.

Deep drilling on distant planets is beyond the scope of present space exploration programmes, but there are other options.

Geological forces have brought material from several kilometres underground, up to the surface of the Martnera Rift Valley on Mars. Samples from there, and from relatively recent craters on the moon and other bodies, says Gold, may turn up microbial molecules, the remains of life in the past — and imply the continuing presence of sub-surface life.

Gold does not suggest, nor rule out, the possibility that life can begin in widely separated points in the universe. But he believes that the sheer number of rocks which crash into each other and onto major planets and moons, may provide a mechanism for life to disseminate across space.

Chemical processes in the deep, hot interior of the earth and other planets — even though it is too hot to support life as we define it — may nonetheless, be of interest to biologists, suggests Gold.

If 150 degrees centigrade represents the likely upper temperature limits for bacterial life, then this limit is reached at a depth of a few kms. But chemical reactions which may be the precursors of life can occur at much higher temperatures — indeed some require temperatures in excess of 1000 degrees. As an example of a pre-life form, Gold points to the self-replicating properties of crystals.

Gold rejects the theory that fossil fuels such as coal and petroleum may have a microbial origin, as has been suggested by others who found bacterial molecule remains in deposits.

None of these fuels is free of bacterial alteration and contamination, but bacterial remains occur only where there is enough oxygen for bacteria to have survived, says Gold.

Gold believes that fossil fuels are not the remains of biological organisms, as current theory olds. He believes that oil and gas stream up almost everywhere from hundreds of miles down in the earth's mantle. As an example, he gives the Persian Gulf area where oil and gas fields representing more than 50 per cent of the world's recoverable reserves, are found in an area 500 miles long, or less than two per cent of the earth's surface.

The earth's surface is thinner in the Gulf region and the hot mantle is closer to the surface. Fluids and gasses arising in the mantle rise to the highest point where they pool — and that happens to be the Gulf area. Biological molecules are from subterranean bacteria which feed on the oil. —

— GEMINI NEWS

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Ancient Malaria Remedy Hailed as Breakthrough

AN ancient Chinese traditional remedy for the treatment of malaria is being heralded as the biggest medical breakthrough of the century.

Artemisinin and its analogues are derived from a native Chinese plant called Qing Hao. As an antimalarial agent, Qing Hao was first described in 341 AD. The drug was rediscovered in 1971 when scientists isolated the active crystalline "qinghaosu," or artemisinin, from the leaves of the wormwood Arternmisia annua.

Artemisinin is insoluble in water and oil and is difficult to administer, but it has been found to be highly effective in the treatment of malaria, including the highly resistant Plamosdium falciparum strain.

In the early 1980s, scientists successfully synthesized the drug and, in the process, came across other effective compounds. The soluble derivative or artemisinin, artensuate, can be injected or taken in tablet form. Two more potent analogues - artemether and arteether - are oil soluble and can be made with about one-third of the Qing Hao needed to produce artemisinin.

Artemether was developed in China and is now being distributed by the Chinese, but arteether is still in the clinical trial stage.

Since 1979, artemisinin and its analogues have been successfully used on thousands of patients in China, Vietnam, Myanmar and Thailand.

That these drugs have not been made widely available is due largely to the reluctance of WHO and the western nations to accept the validity of Chinese clinical trials. However, many of the Chinese toxicology studies have since been repeated.

Side effects from the artemisinin series of drugs were mild and transient, but neutropenia was noted in 27% of the 472 patients involved in the clinical trial in Bangkok.

While WHO has focused its attention on artemether (because it had the potential to be available sooner) arteether is still in the pipeline. Both artemether and arteether are expected to be included in the WHO's essential drug list.

SOURCE: MEDICAL POST

Architecture of Bangladesh
Problems and Prospects of Old Dhaka Street

By Fariel Khan

THE famous architect L Z Kaha said, "If you think of the street as a meeting place, if you think of a street as being really a community inn that just doesn't have a roof and if you think of a meeting hall, it is just a street with roof on it.

In old Dhaka all the above characteristics of a street is physically present. Even a stranger, will not feel "out of place" or "lost" in old Dhaka. Its environment espouses a degree of belonging on a person to give him a feeling of a "home" or "as a part of that place". Its street environment is totally different from rest of the city. The life style pattern of old Dhaka people innovates this special environment.

On the street different activities are happening simultaneously. Streets are the gathering and meeting place of the people. It is a place of interaction of different people for different purposes. Again it is a common place for children's play area, vendor's business area, festivals, gossip place, rickshaw and taxi/tempo stand, service of water supply, loading and unloading of goods, parking whimsically, not according to the need of the day.

In 1939 Dr Taylor said, "The road network of old Dhaka was meant for carriage, horsecarts and pedestrian only". The road's width then was considered quite adequate.

S N H Rizer noted in 1905 — "streets and lanes are extraordinarily narrow, there are neither side walks and nor room for them and as the foot passengers wander at will all over the roadways, continuous ringing of bell is required to clean a passage for wheeled vehicle."

The road became congested due to: Dramatic change of the types and the volume of traffic, population pressure, misuse of circulation area and loading and unloading of goods in shop fronts.

Chawk Circular Road can be a very good example to explain all these aspects. It is the most significant and busy road of this locality. It is 41' (feet) wide which is quite adequate for smooth circulation of vehicles but due to unauthorised possession on both sides of the roads by the vendors, hawkers etc the available space for circulation has been narrowed and made difficult for smooth and easy circulation.

So we can see that, there is no alternative but to adopt a central planning to make a free flowing traffic pattern of old Dhaka. At the same time, planning is needed to revive the lost and almost forgotten street heritage of old Dhaka — now overpressurised due to the rush of people and vehicles.

This is the first article of a series on Old Dhaka. More articles on architecture of the country will follow. These are contributed by the **Post Graduate Centre**, Department of Architecture, Bangladesh University of Engineering and Technology, Dhaka.

Paint Peels and Pipes Rust in Science Cities

By Zhores Medvedev

HIGH on the list of Russian assets clamouring for rescue from the West is "big science," Western scientists visiting the former Soviet Union today find a landscape of ghosts.

The list starts with secret cities built from 1946 onwards to develop nuclear weapons. In 1990 two of the earliest, Cheliabinsk-40 and Cheliabinsk-60, in the Urals, still had 83,000 inhabitants. Arzamas-16, near Gorky, had 83,000, Tomsk-7, in Siberia, 107,000.

Atzamas-16 was dedicated to controlled thermo-nuclear fusion reactions. Its pride was the world's largest plasma reactor, Iskra-5, housed in a huge five-story building and capable of heating plasma to a temperature of 100 million degrees.

For each pulse, 122 powerful lasers, each 250 metres long, required 10 trillion watts of electric energy, accumulated in special condensers. Under Soviet control, the city received free electricity. With the Soviet collapse, its controlling body, Miradesh, disappeared. Experiments were closed, and like other "atomic cities" Arzamas-16 was simply forgotten.

The Soviet break-up also put an end to the atomgrad scientists' highly privileged food and other supplies, which made them dependent for pay and consumer goods on poor regional and local authorities.

A year ago the West promised nearly $100 million to set up a Moscow-based International Research and Technology Centre, to help the redundant atomgrad experts transfer their skills to the civilian sector.

Nothing has yet been received by way of research grants. Scientists and engineers are declassifying their work and going in search of humbler jobs. Arzamas-16 is little more than a museum.

In 1987-91 the biggest construction project in the Soviet Union was neither a new hydroelectric station nor an oil pipeline. It was a huge proton accelerator being built in Protvino, a small science town about 100 kilometres from Moscow.

By 1991 engineers completed a 21 km-long circular tunnel, and were working round the clock to assemble a big vacuum chamber into which they were to install 2,000 bending and focusing superconductor magnets, each weighing many tons.

A special factory to make the magnate had been built in the nearby industrial city of Serpukhov; and a helium liquefying plant — the largest in the world — was being constructed to supply the accelerator with coolant.

The accelerator was due to begin experiments in 1993 — six years before its nearest United States rival. But towards the end of 1991 work on the project slowed down, and last year ground to a complete halt. Another victim of the end of Soviet funding is the huge ring-type accelerator of Dubna, 120 kms north of Moscow, described by the Guinness Book of Records as incorporating the world's heaviest magnet — 36,000 tons. It, too, has now stopped operating for want of funds.

In 1992 the world's most elevated cosmic ray station (3,340 metres above sea level, in the Tien Shan mountains) was taken over by Kazakhstan. Another astrophysics station, on Mount Arafat, was taken over by Armenia, and has since closed as a result of the republic's preoccupation with the fighting in Nagorno-Karabakh. A third station, in the Pamirs, has become part of the Tajikistani war zone.

A similar fate has overtaken the world's largest laboratory for detecting neutrinos (ultra-small particles resulting from the collapse of stars). Its giant telescope, sited in a four-km-long tunnel in the northern Caucasus, now in the war zone between Georgia and its netghbours.

In 1990, Akademgorodk, the "academic city" in the Siberian taiga, 25 kms from Novosibirsk, had a population of 200,000, 120 research institutes and a university. With other science towns, it had survived an eclipse in the 1970s, when the Soviet oil boom gave birth to newer research centres in Moscow, Leningrad and other capitals.

The Soviet break-up dealt a harsher blow. Today it is a city of peeling paint and rusty plumbing.

By contrast, Western visitors are still surprised by the extravagance of the later centres, like Moscow's Institute of Bio-Organic Chemistry, with its marble floors, opera-style conference halls, sauna, swimming pool and winter garden, all constructed over 10 years by Finnish contractors at cost of $150 million.

In the late 1980s, the Presidium of the USSR Academy of Sciences, already comfortably housed in a park-enclosed aristocratic mansion, decided to build an ostentatious 26-storey skyscraper on the banks of the Moscow river. In 1990 the bureaucratic move-in had not yet been completed when the Soviet collapse obliged the Academy to beg for money to survive.

Now the new institutes are striving to make up their income by letting space in their monumental buildings to foreign firms. This is no solution in the remote science towns, where redundant staff find few opportunities for alternative work.

Academies have indicated that if they must choose between a costly research programme and caring for their workforce, the priority will be towards their staff.

Cracks on the Earth's Surface Surprise Scientists

By Zephania Ubwani

SCIENTISTS in Tanzania are baffled by deep cracks in the Great Rift Valley basin that cuts through the country from north to south and suggest that it may be an indication of the widening of the rift.

In the last two years numerous cracks, known to geologists as fissures, have been spotted along the 150 kilometre stretch between lakes Manyara and Natron in the northern part of the country.

A team of geologists from the University of Dar as Salaam, studying the problem, noted that the cracks have already started causing havoc on the roads, tracks, buildings and river systems in the area, and could lead to disasters in the future. Cattle and goats have been reported drowned in water in some fissures.

And the cracks have scared residents of the area, the predominantly pastoral Maasai people.

One of the major fissures observed at Mto Wa Mbu cut through a road from Arusha leading to the world famous wildlife sanctuaries of Serengeti and Ngorongoro and the Olduvai gorge - a site of prehistoric human remains.

The fissure was traced by geologists over a distance of three kilometres from Esilalei village southwards. The local people reported that the fissure continues into lake Manyara (about 3.5 kms from the road) and beyond.

Said Prof. Nanyaro, of the University of Dar as Salaam: "The depth of fissures and trenches could not be measured as their bottoms were not seen due to inaccessible depths. We can only conclude that these fissures are very deep."

The Engaruka and Ngaresero fissures measured only about 200 metres in length. Some of them are not visible on the surface because they are covered by thick soil. Their existence can be detected by the drum-like trembling sound produced when one steps hard on the ground.

The geologists say all fissures observed were generally narrow - five to 100 centimetres wide. In some places the walls have collapsed, forming trenches of width up to five metres.

The immediate danger posed by the fissures is to the pastoralists and their animals. They can fall in unknowingly, especially during the rainy season when the fissures are covered by grass.

A perennial river used for irrigation at Engaruka dried up after its upper course was overdeepened or diverted by a fissure after a 1990 earthquake in the area.

After an intensive survey of the region geologists confirmed that the fissures could have been caused by deep-level processes within the earth's crust.

The scale of these geo-hazards was minor, according to team leader Professor Japhet Nanyaro of the Geology Department, who coordinates studies on Rift Valleys.

However, he argued that the geo-hazards and their effects must continue to be monitored closely and, where necessary, steps must be taken to avert disasters because the entire Rift Valley basin was geologically active, and unstable.

The Manyara-Natron Rift Valley system is the southern continuation of the Great Eastern Africa Rift Valley, a giant geological feature which stretches across the African continent, from the Red Sea in Israel as far as Mozambique.

The rift started developing some 50 million years ago and, according to geologists, the process continues today in the form of volcanic activity and fissuring.

The Rift Valley consists of two major parts: a downfaulted block forms the valley floor some 600 to 900 metres above sea level and then there are the uplifted eastern and western margins, rising up to 3,000 metres.

According to Prof. Nanyaro the Manyara-Natron rift basin was the last to evolve in the valley system. Tectonic studies (which look at the movements of huge 'tectonic plates' in the earth's crust), supported by age determination data, demonstrate the gradual evolution of the rift southwards.

The Ethiopian Rift is the oldest, followed by the Turkana Rift and the Gregory Rift that stretches from the central Kenyan highlands to northern Tanzania. Both were formed during the "quaternary" period - a recent geological era which began only two million years ago (a very short time in geological terms).

Said Prof Nanyaro: "The Gregory Rift part of Manyara-Natron is still active. Volcanism, faulting, fissuring and earthquakes are continuing."

The only active volcano in the area, Oldoinyo Lengai, whose last serious eruption was in 1968, was observed in July 1992 bubbling with magma (hot metled rock) in one of its craters.

The volcano, which in the Maasai vernacular means "mountain of god," also experienced a small fresh lava flow on the small spout of the crater in 1992. It lies midway between lakes Manyara and Natron.

During the geological team's visit few signs of volcanic activity were observed, except for some lava bubbling at the mountain crater. But the team did find numerous hot springs in the southern part of lake Natron which, according to them, suggest the presence of hot magma close to the surface.

Other fissures which have developed during the period have been attributed to earthquakes and earth tremours, which hit the area frequently.

Geological records have indicated that in northern Tanzania's Rift Valley about 30 earthquakes, with magnitudes ranging from 0.5 to 3.5 on the Richter Scale, occur every day.

Local people interviewed confirmed that Mto Wa Mbu, Engaruka and Ngaresero locations, where the fissures were concentrated, experienced "frequent tremours, some of which have caused damages to buildings."

Earthquakes are also said to be responsible for several landslides reported on the western slopes of the Lake Manyara-Natron rift escarpment.

The experts said that fissures were common since the Rift Valleys are known to be controlled by forces which pull them apart.

What is uncommon, however, is that although the rate of separation in the eastern Africa rift valley was a few millimetres per year, the Manyara-Natron fissures expanded at the rate of 10 centimetres in a year or two.

The widening valley

Geologists say new deep cracks are appearing in the Great Rift Valley basin in northern Tanzania