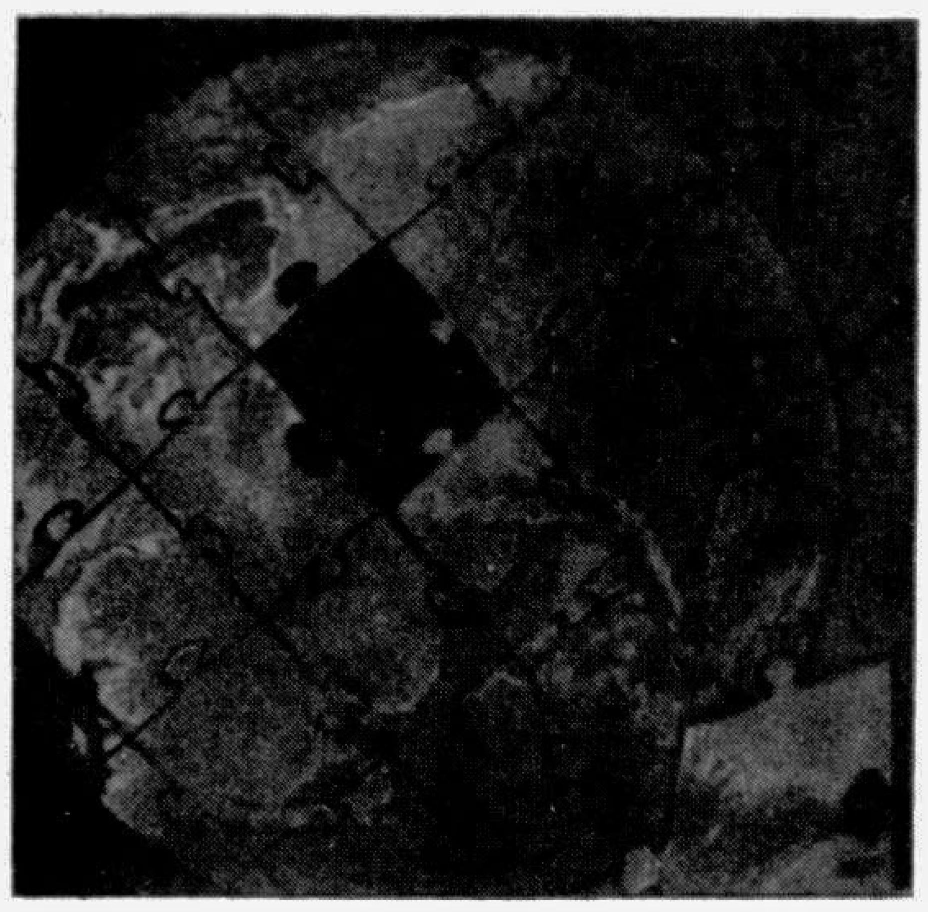
Singularity at the Beginning of Universe is not the Answer!

by Moh d Anisur Rahman

PERHAPS nothing is more intriguing and puzzling than the creation of the universe that we live in. Many ideas have surfaced so far and are still surfacing to unveil this biggest mystery in nature. Amongst all, the generally accepted history of the universe is best described in the 'hot big bang' model. Although this model fairly explains the birth of the universe, the very earliest moment of creation is still elusive. For this model predicts a singularity at the beginning and no physical rules work out in a singularity. So to theorize the creation one has to omit the singularity without which a complete description of the universe is unreachable. While efforts are still on to complete the job, 'no boundary proposal' suggested by Stephen Hawking — one of the prominent scientists of modern times who currently holds the prestigious chair of Lucasian Professor, the same once held by Sir Issac Newton — was got quite a bit of attention from the scientist community. We shall have a look at the basic concepts of that. But before that, let's have a cursory glance at the hot bit bang model.

In this model it is thought that the entire mass of the universe has originated from a primordial fire-ball of infinite density and infinite temperature some 15 billion years ago. Infinite density necessarily means that the whole mass of the universe had initially been confined to zero or point volume. This point is called 'the big bang singularity'. Such a tiny, hypothetical fire-ball exploded and the matter inside expanded at an astronomical rate. Although what went on at the split second following 'the beginning' is still hazy, scientists working on this line could describe in fairly enough details of everything that happened at later times.

At about one tenth of a second after the beginning the density of the universe had been around 30 million times greater than that of water and temperature — around 30 billion degrees. At this time the universe would have contained mostly elementary particles like photons, electrons, protons, some unstable particles which are created ephemerally out of pure radioactivity and their antiparticles.



As the universe continued expanding and temperature dropping, the elementary particles started to combine under the influence of four forces (strong and weak nuclear, electromagnetic and gravitational force) at different stages which had, initially at very high temperature, been identical or symmetrical. When in course of expansion temperature dropped down to the level of the hottest stars, particles did not have sufficient energy to escape strong nuclear force and started to form nuclei of an atom. once the temperature had dropped down to a few thousand degrees, electron and nuclei hand no longer sufficient energy to overcome electromagnetic force and started to combine to form atoms. Thus formation would go on from simpler to heavier forms and the interplay of the four forces would result in a universe like ours — given sufficient span of time to evolve.

This view falls within the prediction of Einstein's famous General Theory of Relativity. But handling a singularity right at the beginning causes a serious problem to all the mathematicians or physicists. For, all physical laws would break down at it. To believe in such a singularity means, in some way, that the beginning of the universe is beyond our science; that the mystery-door of creation is locked forever. Are we at a loss then! Not really. At least that is what physicists say. A keen observation of the pattern in the universe can easily lead us to the conclusion that there must be some pattern at the beginning too. Einstein also believed that. But, by predicting a singularity, paradoxically, the general theory of relativity predicted its own failure.

The General Theory of Relativity describe the force of gravity and it works accurately with the large scale structure of the universe — satellites, planets, galaxies for instance. But, a curtain is drawn on it when it comes to micro — level application. Quantum mechanics came to rescue then, since it deals with phenomena on extremely small scales, from atomic to subatomic level and so on. At the big bang, gravity could have been so strong that one could not neglect the quantum effects. So the next job to be done is unifying the two great theories of all time — theory of general relativity and quantum mechanics.

Hawking wanted to see what happens if quantum rules were added to the prediction of general relativity. This is not at all an easy task to do. Many physicists are now busy bridging these two fields of study, since it is the only way, as felt by many physicists, in quest for an ultimate theory for everything that has happened, is happening, and will ever happen in the universe. However, restricting himself only to the specific puzzles of how relativity and quantum mechanics interacted at the beginning of time, Hawking was able to make progress to such an extent as to ask the question whether there was a beginning or not. The question emerged because of the fundamental uncertainty principle of quantum mechanics.

The introduction of quantum mechanics has also some other bizarre consequences like empty space is not really empty; it is teemed up with particles and their anti-particles (anti-particles are mirror image of particles — e.g. positron is the counterpart of electron, anti-proton is for proton etc. Just as there are atoms, there could be anti-atoms and if they happen to meet each other, both would vanish emitting a flash of gamma ray photon in accordance to the formula $E=mc^2$, where 'E' is the energy, 'm' is the mass and 'c' is the speed of light). So, in some way, empty space contains some energy, since energy is shed off by the particle pair before vanishing and we got as input same amount of energy to separate them from that 'empty-space'.

Just as there is fundamental uncertainty about the energy content of the vacuum, so there is a fundamental uncertainty about basic measures such as length and time. The size of this uncertainty is determined by Plancks constant, which gives us basic 'quanta' known as Planck's length and Planck's time.

According to quantum rules, not only is it impossible in principle ever to measure any length more accurately than Planck's length which is 10^{-35} of a meter, but also there is no meaning to the concept of a length shorter than this. Similarly, the quantum of time, the smallest interval of time that has any meaning, is 10^{-43} of a second, and there is no such thing as a shorter interval of time.

So quantum theory tells us that we cannot go back beyond the Planck time and to the concept of a volume with diameter less than Planck length. Which eventually leads to the conclusion that there is no meaning to a point of zero volume and infinite density. Thus we can omit the unwholesome singularity and start off with a staggeringly high, but not infinite, density fire-ball at the beginning. Once this is done, we can at least hope of finding a set of equation to describe the origin of the universe.

Potato Farms Take Root in Vietnam

by Rodolfo A Fernandez

A lull in the Paris peace talks in the 1970s proved to be a boon to Vietnam's potato industry.

Potato is now the second biggest food crop, next to rice, of that once war-torn country.I n fact, Vietnam exported 15,000 tons of potato in 1987 alone.

And potato production continues to expand, says Dr Trinh Zuan Vu, Vice Rector of the Ho Chin Minh City University of Agriculture and Forestry.

He told DEPTHNEWS that potato is now a second crop to rice in both the Red River delta in the Hanoi area and in the Mekong River delta in the south. Vietnam's main potato region is Dalat in the southern highlands, some 300 kilometres from Ho Chi Minh City (formerly Saigon).

Dr Vu was in this university town recently to visit agriculture research and institutions of the University of the Philippines, Los Banos campus.

Aside from rice and potato, Vietnam's other major crops are peanuts, corn, sweet potato and cassava. Dr Vu traces the tremendous growth of potato faring to the Paris peace talks when United States and Vietnamese government negotiators met in an attempt to end the war.

During a lull in the negotiations, a member of the Vietnamese delegation who was an agriculturist, visited a French tissue culture laboratory and learned the technique of propagating vegetables in test tubes (in vitro).

When the war was over, the official was assigned to an agricultural research station near Dalat, a former French resort town. What evolved was what Dr John H Dodds of the Lima, Peru-based International Potato Centre (CIP) called "a remarkable backyard biotechnology" for the long-term preservation and rapid propagation of new potato varieties.

Dr Dodds, who is head of CIP's genetic resources, says "it was a perfect example of trickle down technology. Here we have a handful of poor but enterprising Vietnamese farm families who have adapted relatively sophisticated tissue culture techniques in a remarkably rustic and home-grown way."

The potato, locally called "western root" or "French tuber," was originally taken to Dalat in the late 1800s. The Dalat region has about 1,200 hectares of workable land producing cabbage, cauliflower, carrot, lettuce, onion, strawberries, flowers and potatoes.

Potato production in Dalat had always been carried out with European seeds. However, owing to high costs and the war, the supply of European seeds all but disappeared.

By 1978, farmers had been discouraged with their crops because of disease, small tubers, and low yields as the European cultivars degenerated. In 1980, the Vietnamese Centre for Experimental Biology asked CIP for newly developed genetic material in an attempt to revitalise potato production in the area. CIP forwarded 16 in vitro plantlets.

In vitro plantlets are an attractive medium for potato propagation for two reason. First, the seedling cultivar arrives in sterile condition. Second, plantlets can be maintained virtually forever, producing new planting material each year.

Farmers do not need to save part of one year's crop for next year's planting. And all of the crop can be used as food.

Vietnam's experience shows that if in vitro technology is simplified, not only sophisticated laboratories but also farmers can enjoy achievements in biotechnology

The varieties from CIP were multiplied using in vitro cuttings to provide plantlets for field evaluation and seed tuber production.

Three clones — two of Mexican origin and one from Argentina — proved outstanding for late blight resistance and yield. Based on these preliminary results and farmer demand, a rapid multiplication scheme was developed for 10 families to provide plantlets to commercial growers.

Learning about tissue culture technology from the diplomat-turned-extension agent and others, farmers immediately went about setting up small-scale potato seedling factories. They created makeshift laboratories in their bedrooms and backyards where they used the tissue culture techniques to propagate potato plants in test tubes bought from a local hospital and the research centre.

The gelatin media used for growing the potato tissue was sterilised in pressure cookers made from discarded US Army gas canisters. Hundreds of thousands of biodegradable seedling pots were painstakingly fashioned out of banana leaves.

"The key to the entire scheme was simplicity and low cost," noted Dr Dodds, who has visited the enterprising Dalat programme.

The families received two to three CIP test tube plantlets from the research stations, which they multiplied in vitro and maintained in their houses. After a month the test tube plantlets were out into single node units and rooted in seedbeds.

Cutting from seedbed plantings were then rooted in seedbeds containing 50 per cent subsoil and 50 per cent manure. Later cuttings were taken from the seedbed and replanted in biodegradable pots made from banana leaves. In 15 days the potato plantlets were rooted and sold to farmers who transplanted directly into the field.

Dr Dodds said three test tube plants produced enough planning materials for one hectare of potatoes. One family produced about 200,000 seedling plants a year, selling them at a half cent each, or at a profit of a third of a cent each.

Today, the use of tissue culture for potato seed production is well established at Dalat, but much of the output for the six million plants used annually now comes from government centres rather than from so-called "family satellites." Farm families, however, have adapted their tissue culture techniques to produce disease — and pest-resistant vegetable seedlings.

The Dalat experience has shown that if in vitro technology is simplified to a certain level, not only sophisticated laboratories but also farmers can enjoy achievements in bio-technology, says Nguyen Van Uyen, a Vietnamese scientist with the biology centre in Ho Chi Minh City.

"Without much financial investment, farmers themselves can take part in the rapid diffusion of a super variety. The technique has formed the basis of an informal but highly effective seed production programme by Dalat farmers. This should serve as a good example of what can be done elsewhere in the developing world." — *Depthnews Asia.*

Materials Made to Order

by TV Padma

MATERIAL scientists are concocting newer and newermaterials to suit their needs, patiently creating them atom by atom and molecule by molecule.

They can now design and build amazing new materials from the scratch and decide exactly what properties are needed in the material they are making.

Yesterday's material makers were mainly metallurgists who blended metal to form alloys with different properties. Today, they are also chemists, ceramicists, engineers and physicists.

Creating materials is nothing new. The art was discovered accidentally some 13,000 years ago when villagers in Japan found that if one cooked a clay vessel. It hardened into an entirely new substance — ceramic pottery.

Material making became a recognised science near the end of the nineteenth century after a geologist discovered a way to see the crystalline structure of steel — by polishing the surface and etching it with acid. The advent of x-rays later helped gain an even clearer insight into the structure of materials.

A major gain for materials science and engineering came in the 1930s when quantum mechanics began to explain how electrons behave in solids, and showed scientists how to manipulate electricity in silicon chips to produce semiconducting materials.

Today the material that started the whole story, ceramics, is making headlines. Light in weight and resistant to heat and corrosion, ceramics holds promise for widespread use, inspite of its limiting brittleness which scientists are trying to overcome.

In the United States, the driving drams is now a ceramic engine. The country is funding programmes for designing a ceramic automobile that will be powered, not by pistons, but by two gas turbines of silicon nitride.

The car, with other ceramic parts for the high-temperature zones, is expected to run at a hot 1370 degrees Celsius, promising fuel efficiency and emission reductions.

In the last two decades, engineers have devised methods to build new materials with the desired properties atom by atom. They can also now produce materials in bulk quantities through technologies such as plasma deposition and chemical vapour deposition.

Advances in newly engineered materials occurred more rapidly with organic materials than with metals. The new range of manufactured materials include synthetic polymer fibres and plastics, metal alloys, high-strength ceramics and composites.

The introduction of new structural materials and production approaches is already making its impact in aerospace technology which is aiming at improved engines for military aircraft, supersonic civiltransport, and quieter, cleaner and fuel-efficient subsonic aircraft.

The new structural materials, notably composites and intermetallic materials, are expected to enhance engine performance, reduce engine weight and help design new aircraft systems.

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Modern turbine engines, which basically convert fuel into thrust for propulsion, operate at a high temperature and stress and engine parts are often subject to damaging corrosion, oxidation and erosion.

Engineers first used titanium because of its lightness, in jet engines or gas turbines, and later switched to superalloys of nickel and cobalt to handle fierce temperatures.

Currently, super-alloys can be used at temperatures greater than 1200 degrees Celsius, but scientists are predicting even stronger and safer materials with the development of more intermetallic and composite materials.

Composites are materials such as fibreglass, in which a glass and a polymer are mixed to exploit the dual benefits — strength of glass and flexibility of plastic.

Scientist are creating newer composites, taking clues from natural composites, for example, a tree that is now being described as a magnificent natural composite of flexible cellulose fibres in a matrix of rigid lignin.

Scientists say the process of making composites is simple. Taka a polymer resin, add some tough fibres and cook for a while, and you have composites far stronger than steel and very light.

An added advantage is that fibres added to make composites prevent cracking in otherwise brittle materials.

The United States has already witnessed the all-composite Voyager that circled the globe without refuelling in 1986, and an all-composite corporate plane.

One class of new materials that has spurred an almost frenzied pace of research is superconductors, with the Japanese taking the lead in making superconducting materials with practical applications.

Japanese scientists have devised a superconducting magnetic shield that cuts extraneous magnetic filed from power lines, household appliances, elevators and electric trains by a factor of half a million.

They have succeeded in making good-quality superconducting wires that are nearly 100 metres long by adopting a new fabrication technique. The wires are a considerable improvement over the earlier wires that were only tens of metres long, and are nearer to the kilometre length required for practical application.

In the new Japanese method, the bismuth-based superconducting compound is sheathed in a silver tube and rolled flat.

In this composite wire, the supercoductor carries the current, while the silver coating protects the superconductor from degrading and makes it more flexible.

Another Japanese technique, called melt-power-melt-growth (MPMG), yields a yttrium-barium-copper-oxide superconductor peppered with non-superconducting particles that trap any magnetic flux.

The method has enabled researchers to increase the material's current-carrying capacity to 100,000 amperes per square centimetre at 77 degrees K — high enough for practical application, reports Science.

Technologies for bulk-production of new materials are also cropping up. Decade-long research in Russia has led to new microreactors which are already generating chemicals and commodity polymers such as polyvinyl chloride near Moscow.

Microreactors have their advantages: They are cheaper to run, produce fewer byproducts and yield a product with essentially no contaminants. But their drawback is that they can handle reactions that take place in a minute or two only — though these include many commercially important products.

Also, different reactions need different types of microreactors and they need to run at higher volumes in pilot plants.

Another Russian technique, called the self-propagating high temperature synthesis (SHS) method, could open the way to hundreds of new and often improved ceramics, metallic alloys and ceramic-metallic alloys known as cermets.

In a typical SHS reaction, engineers mix ceramic and/or metallic powders, pack the mixture in to a mould in the shape of the final product, for example, an armour plate or engine part, and then ignite with an electric spark or heat. What can be achieved in materials science and engineering today seems almost miraculous. Scientist can extrude polymer fibres as strong as steel for use in bullet-proof vests and helicopter blades.

They can create acoustical transmitters by designing crystals that produce sound vibrations when small voltages are applied and build semiconductor lasers atom by atom.

Computer graphics is also chipping in with help, enabling materials scientist to study a complex molecule on a screen, rotate its atom and select where to place an additional atom for a desired effect.

— *PTI Science Service*

Indian Software in Fast Track

THE international electronics industry's largest firms are taking a closer look at India. Among them is IBM. In 1977 IBM was asked to bring down its equity holding in its Indian subsidiary to 40 per cent. IBM was, however, not prepared for this and closed down its operations. Now IBM is back in a new investor-friendly environment.

It was fitting that IBM's was the first proposal cleared after the new policy was announced. It is setting up a joint venture with India's leading business house-the Tatas. This time IBM has asked for 10 per cent royalty as per global company policy. The government's fast-track Foreign Investment Promotion Board (FIPB) agreed to this even though the policy was to allow only 5 per cent royalty.

Apart from IBM, there are many companies in the electronics field which have already established bases here. Texas Instruments, Digital, Hewlett Packard, Cirti Corp are a few. Marching in are Motorola, Hughes, Systems, Bull and Apple.

In the telecommunication sector also, there is a surge in investment proposals. Vying with each other for the Indian market are Siemens, AT&T, Ericsson, Alcatel, Motorola etc. The cellular phone tender floated recently by the government has evoked a glut of investment proposals. The list includes Bell South, Cable South, Cable and Wireless, France Telecom, Singapore Telecom, Hutchinson (Hongkong), Siemens, AT&T, Alcatel, Motorola, Ericsson etc.

So can anybody ignore the potential market in India and as the Sony chief Akio Morita said : "We have our eyes open."

More and more foreign companies are raising their stakes in their Indian partner companies. Like Digital Equipment Corporation (DEC) of the USA. The company has planned to raise its stake from the present 40 per cent in its Bangalore-based Indian counterpart company — the Rs 80 million (Rs 80 crore) Digital Equipment India Limited (DEIL). There is the AT&T tie-up with Tata Telecom for the manufacture of the latest transmission systems. AT&T will hold a 50 per cent equity in the Rs 1.5 million (Rs 15 lakh) joint venture, trans India Network Systems Pvt Limited.

A World Bank study on inter-country vendor preferences has put India in the numero uno slot. The comparison was with seven countries. Vendores based in the USA and Japan were asked to rank India on three categories.

- A source of software developers working on their site.
- The site of remote software development centre.
- The site of remote support services centre.

In the test, India and Ireland were clearly the top two choices in all three categories.

In Original Equipment Manufacturers (OEM) professional software also, India and Ireland were ahead or all others. The reputation is largely based upon their expertise in this segment and the dominance in terms of export revenue.

India also scored high in the categories of labour cost and labour supply. In India the former are substantially lower than in the competing countries.

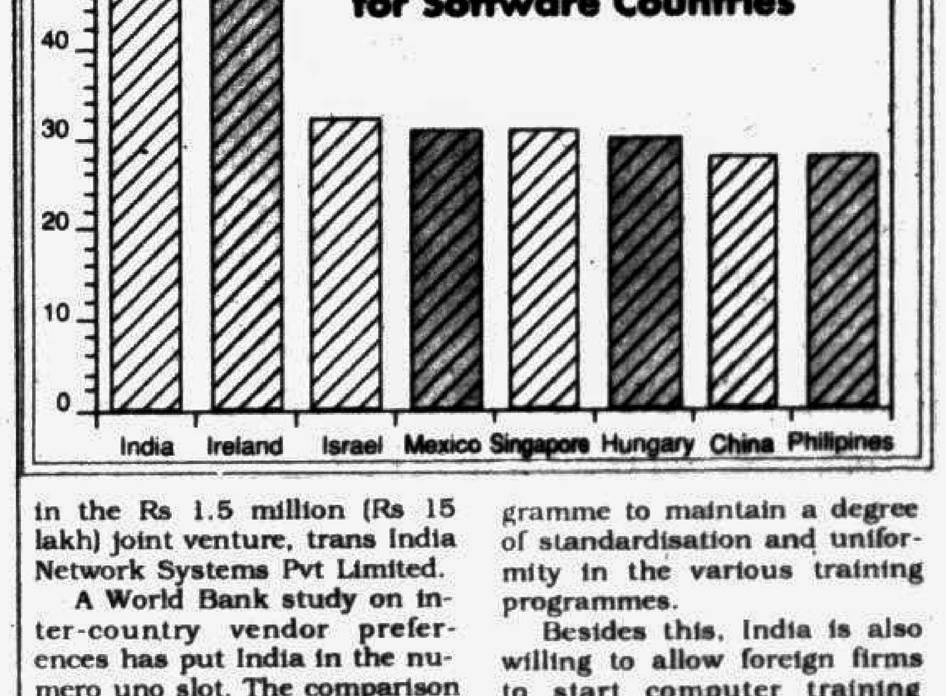
Apart from all this, India is a gigantic market of 870 million people, with a very large number of English-speaking people. There is no short supply of computer professionals which is about 100,000 at present. The total employment generated by the electronics industry in 1988-89 was about 520,000. The projection for 1994-95 is 1.4 million.

Training in computer applications and software development is also well developed with over 300 institutions in India. The department of electronics (DoE) has introduced an accreditation programme to maintain a degree of standardisation and uniformity in the various training programmes.

Besides this, India is also willing to allow foreign firms to start computer training units. An empowered panel set up to assess the industry's requirements has estimateed that a minimum of 300,000 trained personnel will be needed to support the US$ 1 billion (Rs 100 crore) computer software export business by the end of the Eighth Plan.

In the Indian electronics industry software is the fastest-growing segment. Irrespective of the overall decline in the industry in 1991-92, software registered a sharp increase of 35 per cent in dollar terms. Being one of the extreme focus areas, software gets priority over others.

(India Update)



Scientists Develop Acoustic Flow Meters

The flow meter, termed DFM 90 in short, is not only highly mobile but also has the advantage of not affecting flow rates, as opposed to meters which are fitted inside pipe systems.

Acoustic flow meters monitor pipe systems of coolant and lubrication networks on ships, in water extraction and water supply facilities for the brown coal industry and at agricultural irrigation and drainage installations. These devices can be fitted easily and quickly almost everywhere because they take measurements from outside; in other words, without any intervention. This technique was made possible through the utilization of sound waves to measure flow quantities and rates.

For this purpose, researchers led by Professor Otto Fiedle from the department of electrical engineering at the University of Rostock, developed acoustic clamp-on flow meters. Using two ultrasonic oscillating heads clamped to the outside of the pipe, these meters determine flow rates and quantities based on the transit time of acoustic signals.

Both ultrasonic transducers serve alternatively as the transmitter or the receiver, depending on the direction of measurement. Upon leaving the transmitter, the bundle of sound waves enters the pipe on one side, travels through the fluid, comes out again on the other side and is then picked up by the receiver. The ultrasonic beams cross the pipe at an angle. Most substances used to make pipewalls, such as steel, plastic and glass, are pervious to sound waves, thus allowing the pair of transducers to be attached to the outside of the pipe. A single-chip processor reverses the direction of travel of the signal pulses along the measurement stretch and monitors the evaluation of the received pulses and the time measurement.

The flow meter, termed DFM 90 in short, is not only highly mobile but also has the advantage of not affecting flow rates, as opposed to meters which are fitted inside pipe systems. Furthermore the clamp-on technique allows the device to be attached to any section of piping, irrespective of its nominal width. Even dirty liquids can be measured providing their acoustic transmission factor is sufficiently high. Solid coatings, corrosion and deposits do not lead to errors in measurement either, as long as their thickness is known.

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Another type of acoustic flow meter, also developed at the University of Rostock, can be employed directly in open waters. These devices consist of an ultrasonic probe with an electronic compass and a portable surface display unit. Both elements are connected to each other by means of a shielded cable. In the submerged unit, ultrasonic waves are sent by a transmitter to a reflector and then bounced back to a receiver. The device calculates the speed of the water which has flowed between the transmitter, reflector and the receiver. The measured value is displayed as a vector, indicating the quantity and direction of flow.

This unit is very suitable for measuring flow rates in open waters, for example, ditches, brooks, lakes, rivers, canals and reservoirs. Special versions of the acoustic transducer can also be sued for measurements in deep waters. The flow rate is displayed immediately after measurement, and elaborate analysis of the acquired data is not necessary. Such units are already being operated on the Baltic Sea coast, in the docks of Stralsund, the train-ferry docks of SaBnitz and on the Peene bridge. Future versions of the submerged probe and the electronic compass will be smaller while retaining the same degree of efficiency. Plans have also been made to shorten the measurement stretch, reduce the power consumption and introduce battery-operated units. — (German Research Service)