Testing by Technology

TECHNOLOGY plays a vital role today as competitive industries all over the world seek to improve their products — and the way they are produced.

Research teams using very high-tech equipment are being asked to help in the quest. Here, a British-made state-of-the art scanning electron microscope is helping scientists at Loughborough University of Technology, in the English midlands, to examine samples of metals and alloys on behalf of a company manufacturing cutting tools for various industries.

The equipment, designed and made by Cambridge Instruments, is able to look at samples of materials in close detail: down to the 0.03 micron level. Apart from being able to study features in materials, it can also identify elements present and pinpoint unknown impurities that could cause problems later.

A range of high resolution microstructural and microanalytical investigative equipment is used by experts in the university's electron microscope unit. They carry out both long and short term industrial and scientific research for a number of organisations and companies based not only in Britain but in many other parts of the world, including Europe and America.

Metals are able to be checked for corrosion characteristics, wear and friction, porosity, creep and fatigue and many other features. Testing of plastics' samples can give results such as fracture analysis, additive segregation, filler adhesion and particle structure.

With so many industries turning to composites as new and useful materials, it is vital that these too can be thoroughly tested before being used in manufacture. The unit has undertaken studies and analyses of these and of glasses and ceramics, and uses the electron microscope facilities to investigate biological materials such as plants, river debris and human and animal tissue.

Virtually any size, shape or composition of sample can be tested on modern electron optics equipment. Easy sample preparation is a feature of the instrument shown here and it also has large depth of field (10-20 microns), and back scattered electron imaging for atomic number contrast.

As part of a university of technology, the unit is able to call on the knowledge and capabilities of a wide range of scientists in many other departments.

— London Pictures Service

Using modern electron optics equipment

Superconductivity — an Epoch Making Possibility

by Mohammad Ahsan Kabir

THERE is no denying the fact that 'Superconductivity' is now-a-days becoming a major concern for the scientists in the wake of boomingly flourishing power technology. Specially, when renowned scientists J. Georg Bednorz and K. Alex Muller received Noble prize for their remarkable breakthrough in the discovery of superconductivity in ceramic material in 1987, it provided the scientists a moral boost for launching a thorough cerebration towards research works in discovering superconductivity at higher temperature.

Superconductivity is a property of a material for which it possesses zero resistance which means that if electric current is flown through the material it will ensure no power losses. It has also other unique properties like perfect diamagnetism, quantisations of magnet flux and spectacular tunneling phenomena.

Though superconductivity at higher temperature is yet to be discovered, its applications had their break-through in the 1960's; the most important ones lying within fusion research, high energy physics and medical diagnostic.

For detailed imaging of vital organs in human body it is used through MRI (magnetic resonance image). Tunneling phenomena like Joshephson effects in superconducting materials are used in the field of electronics. Fast switches with low power consumption constitute building blocks in memories and logic circuits for super fast computers. Superconducting sensors (SQUIDs) are used in laboratories and for biomagnetic and geophysical investigations.

Moreover as they are extremely sensitive magnetic field detector they can very well study the minute magnetic fields from the human brain. It can further discover ore deposits and magnetic anomalies.

There may arise a simple question in common people's mind — why superconductivity at higher temperature ? The answer is simple. Chemically it is almost impossible to create absolute temperature, for example, O degree kelvin equivalent to —273.15 degree centrigrade.

In a twinkle a magic temperature limit was passed : the temperature of liquid nitrogen (77 degree Kelvin)

For this reason the scientists made a hunt for materials superconducting at higher temperature than the absolute temperature.

The history dates back to 1911 when Dutch physicist Heike Kamerling made an astonishing discovery while measuring the electrical resistance of mercury at low temperature. While conducting the experiment he suddenly observed that the resistance became negligible below 4.2 degree kelvin and with this he discovered the "Superconductivity".

Heike's discovery naturally induced all other leading scientists in searching new superconducting materials at higher temperature.

But the overall turn out showed up poor and the transition temperature was pushed upwards only by about 3 degree kelvine per decade. This continued till 30's when after a series of inventions Niobium was discovered to be a pure element superconducting at 9.2 degree kelvine — the highest temperature so far. Later on, scientists concentrated themselves on finding Niobium compounds for further advancement. In 1973 some scientist discovered a Niobium compound identified as Niobium-Germanium superconducting at 23.3 degree kelvin.

The afterward achievements was not that worthmentioning though superconductivity was observed in thousands metal and metallic alloys.

Then at last the turn of the golden age in superconductivity came in 1983 when noble prize winners J. Georg Bednorz and K. Alex Muler launched a joint venture with the purpose of finding materials with superconducting properties at high temperature. During their venture they avoided the classical metal alloys and searched instead among the metallic oxides — the ceramic.

In a ground that in such materials there might be an amplification of the mechanism that makes electrons from electron pairs — a necessary ingredient for superconductivity.

In January 1986 they discovered superconductivity in the system La-Ba-Cu-O. But this was received by the scientists skeptically at initial stage. But it soon turned out they had found a new avenue towards finding superconductivity at high temperature. Unequalled research activity started all over the world, and in the beginning of 1987 superconductivity was found at 92 degree kelvine in the system Y-Ba-Cu-O.

In a twinkle a magic temperature limit was passed: the temperature of liquid nitrogen (77 degree kelvin).

The discovery of superconductivity above the temperature of liquid nitrogen is a breakthrough of great physical and technological significance. Liquid nitrogen is an excellent coolant being easy to produce, use and handle. Thus it became available to everybody resulting in many applications towards science and technology.

Though superconductivity is yet to be an applied science in our daily affairs but scientists believe that one day it will be able to fulfil old dreams: levitated trains, energy storage, power transmission lines without losses, super-fast electronic devices etc.

It is not so far that here in Bangladesh we will be also able to reduce our system losses in power and energy technology with the help of applying the mechanism of superconductivity.

Low-Cost Technology Serve Millions

by Paul Icamina

JUST a million dollars can make all the difference to 18,000 more people without water and sanitation.

Estimates made by the UN Children's Fund (UNICEF) indicate that the current allocation of funds to high-cost and low-cost technology in water and sanitation projects is in the order of 80 per cent and 20 per cent, respectively.

A shift in this ratio of a few percentage points, in favour of low-cost technology, could make a positive contribution to the unserved poor, according to Joseph Christmas and Carel de Rooy of UNICEF's Water and Environmental Sanitation Section.

Their argument: A shift of US$1 million from the high-cost to the low-cost, intermediate technology would provide coverage to an additional 18,000 needy people in rural and peri-urban areas.

Over the next 10 years — through the use of essentially low-cost technologies — about 80 per cent of the unserved population in developing countries can annually be served with water and sanitation facilities at 30 per cent (US$11 billion) of the total annual cost (US$36 billion) of providing such facilities to all of the unserved.

"In other words," they say, "30 per cent of the total cost can service 80 per cent of the unserved, if the low-cost option is emphasised."

Low-cost technology projects in water and sanitation get only about 4 per cent of the estimated total annual external funding of US$3,000 million. But governments are now being convinced of the efficiency of low-cost technology, increasing six-fold their commitments to such projects since 1980.

Parallel with large-scale water resource development in Thailand, medium-scale water projects have been constructed. About 70 per cent of existing medium-scale projects are in Thailand's northern and northeast regions. Because of the scarcity of suitable sites for large-scale reservoirs and strong opposition from local and environmental groups, medium-scale projects have become popular.

Small-scale projects have also been implemented since 1977, with an annual rate of construction of about 500 projects. A medium-scale project involves a storage area less than 15 square kilometres and irrigating less than 12,667 hectares. Small-scale projects are those less than US$400,000 in investment cost.

India and China are encouraging conservation measures such as minor water storages, groundwater recharge, water harvesting, improved farm practices which retain soil moisture and associated small-scale irrigation in upper catchments. Indeed, 50 per cent of irrigation in Asia and the Pacific — which has the world's largest concentration of irrigation system — are small-scale.

Although farmers have been slow in responding, the trend in the region is for crop diversification in irrigated agriculture and shifting away from crops with high water demand. An outstanding development is the rapid expansion of groundwater uses especially in the large irrigation countries — Bangladesh, China, India and Pakistan. India, for example, has an annual target for installing 600,000 pumpsets.

The disappointing performance of large irrigation projects and the environmental damage they have caused now focus attention on small-scale schemes and low-cost technology

Tubewell development in China started in the late 1950s. By 1985 there were 2.37 million tubewells for agriculture in the whole country. Well irrigation served 11.13 million hectares, or 23 per cent of the country's irrigated area.

Tubewell irrigation is mainly concentrated in the Huang-Huai-Hai plains, east of the Taihand mountains and the Funiu mountain. In Hebai, Shandong and Henan provinces, areas irrigated by tubewells account for 78 per cent, 49 per cent and 56 per cent of irrigated area of each province, respectively.

As a result of waterlogging and salinisation, some 125,000 hectares of irrigated land worldwide become uncultivable annually. If this rate of loss continues, according to the UN Food and Agriculture Organisation, over 2 million hectares of irrigated land would become completely unproductive by the year 2000.

During the International Conference on Water and Development here, FAO presented an international action programme on water and sustainable agricultural development. It is a 10-year plan to promote wiser use of water, tackling problems like inefficient use, salinisation and waterlogging, drainage and pollution.

Priority is given to small-scale development projects that help farmers and local communities develop water supplies and build small-scale irrigation projects.

The disappointing performance of some large irrigation projects and the environmental damage they have caused, have focused attention on small-scale irrigation and the need for low-cost technology adapted to the specific needs of farmers.

In Egypt, 60 per cent of crop production is at risk because of inefficient irrigation. The government, with FAO assistance, has installed tile drains, collectors and pumping stations across a vast area.

In Pakistan, some 30 to 50 per cent of agricultural land is suffering from salinisation. FAO has helped operate a salinity control and reclamation project. In Iraq, some 40,000 hectares in the Greater Mussayib Area have been rehabilitated through low-cost technology.

During the international water conference — convened by FAO, the UN Development Programme and the World Meteorological Organisation — some 500 delegates called for "fundamental new approaches to the assessment, development and management of freshwater resources."

In a Dublin Statement, the conference noted that irrigated agriculture, which accounts for about 80 per cent of water withdrawals worldwide, loses up to 60 per cent of the water on its way to the plant. "More efficient irrigation practices will lead to substantial freshwater savings," the Dublin Statement noted.

"Combined savings in agriculture, industry and domestic water supplies could significantly defer investment in costly new water resource development and have enormous impact on the sustainability of future supplies."

— Depthnews Asia

Beneficiaries use water supply facilities. —Photo:UN

Transnationals Size up a Giant Telecome Pie

by A J Singh

India's state-run telecom industry is up for grabs. Like other industries it, too, is experiencing the impact of liberalisation and dismantling of controls. In the next five years India intends spending $16 billion to expand and modernise its telecommunication systems, triggering transnational interest in the potentially vast market.

NEWS that India is dismantling its 40-year-old system of industrial licences and opening its doors to foreign investors has brought the global telecom-munication giants sniffing at this large telecom pie.

Over the next five years the government intends spending $16 billion to expand, upgrade and modernise its telecommunication systems. Massive investment plans have been drawn by the Department of Telecommunication (DOT).

"Today, I can choose foreign technology," says Rajesh Pilot, Minister of State for Communications. "Frankly, this is the first time such a thing (transnationals wooing India) is happening in India."

Rajesh Pilot — a former air force pilot by profession as well as in name — is pushing telephone lines into the countryside. His aim is to bring telephone connections to another 100 panchayats (village assemblies) every month.

Until last year India had more than four million telephone subscribers, with 1.5 million on the waiting list. Sudhir Dhar's case is typical. He had to wait eight years for a line. "It takes at least five to seven years to get a phone," he says.

All this may soon change. Prodded by the new industrial policy and deregulatory moves, India's top telecom executives are thinking big. They want to jerk the antiquated telephone system out of obsolescence and spread the network wide.

The $16 billion investment plan, according to telecom experts George Skaria and Sundeep Khanna is "a 400 per cent increase over the outlay in the previous Five Year Plan. In terms of Physical capacity, DOT's targets are almost as ambitions: a 137 per cent jump in switching capacity (telephone exchange lines), adding 9.3 million lines to the 6.7 million level planned by March 1992."

Inflationary pressures at home mean raising this kind of investment from indigenous sources is almost impossible. Liberalisation of the economy offers great opportunities for the transnationals. Crowded markets and cracked cartels mean some transnationals face reduced profitability in the industrialised countries.

The biggest attraction is the switching systems and connected equipment. Nearly 60 per cent of investment in the next five years will go to this sector.

Currently, India meets 68 per cent of switching system needs domestically. These systems have been developed by the Centre for Development of Telemetrics (C-DOT). The rest are imported.

Telephone exchanges have also been imported from Japanese and Western-based transnationals such as Fujitsu, NEC, AT&T and Ericsson. Most transnationals interested in the switching systems have offered to set up manufacturing facilities in India.

Experts consider this a good sign. Contracts to buy switching systems will go to transnationals depending on price, the technology offered, and its capacity to interface with existing switching systems.

Indian performance in producing telephone exchanges compares well with the world's big players. C-DOT's Max — a 10,000-line exchange — was developed and delivered in seven years. The United States giant AT&T took 15 years to deliver.

Now C-DOT is working on its Max-XL exchange with a capacity to handle 40,000 lines. Since this system may not be delivered till 1994, India is keen to import exchanges in the meantime.

Says Bishnu Pradhan, executive director of C-DOT : "We're still in our infancy while others like AT&T have had 100-year monopolies in their countries."

Transnationals are adopting different strategies in India to test the changed market conditions. Some, like Alcatel, Fujitsu and Siemens, have offered C-DOT free exchange lines. They are also willing to accept payment in local currency to help India save foreign exchange.

Some have offered a mix of hard and soft credit. Siemens says it will give $330 million credit to C-DOT for importing exchange lines.

Alcatel, Siemens and others are linking up with Indian firms to make switching systems and facsimile machines.

"The broader game plan of the bigger players is clear," says an expert. "They will offer many products, but to handle the biggest market of all — switching systems — they will tie-up with Indian partners for manufacturing operations."

New Delhi's new policies of letting foreign companies hold up to 51 per cent equity in new joint ventures and putting telecom in the automatic licensing area is a result of increasing public pressure to extend telephone services all over the country.

That is why manufacturing in switching, transmission equipment and value-added-services (car phones and paging) have been opened up, although partially, to the private sector.

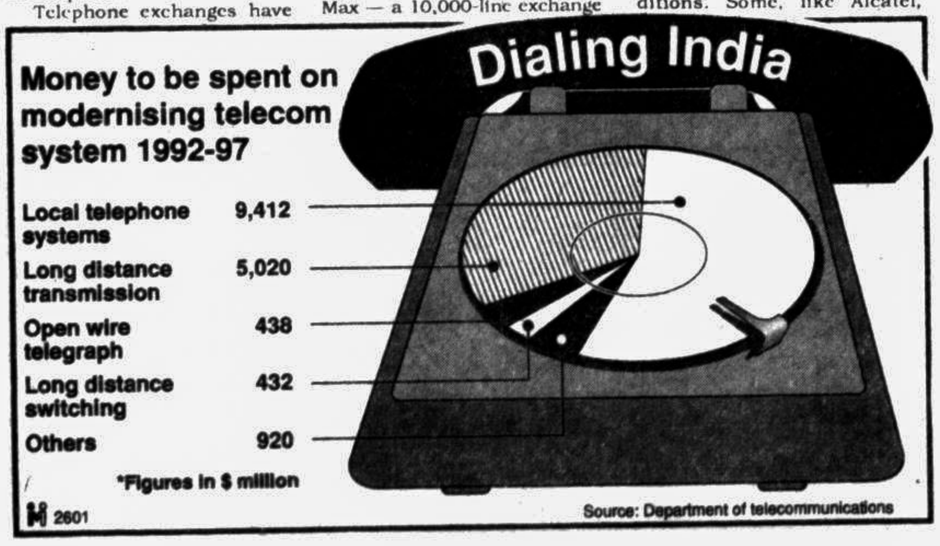
In fact, the government had no choice. India's telecom infrastructure is in bad shape — outdated, antiquated and inadequate to meet the ever-growing needs of the powerful middle class.

As yet, there is no flood of foreign investment into India. Many transnationals are uncertain how long the policy changes will stay in place. Although New Delhi repeatedly says they are irreversible, doubts remain. The transnationals want to move with caution. The old problems remain.

As public pressure on the government to modernise the telecom system is mounting by the day it looks certain to happen sooner rather than later.

— Gemini News

A J Singh is a freelance Indian journalist.



Science Briefs

Photocatalyst Decomposes Water

RESEARCHERS at the Tokyo Institute of Technology, jointly with Nikon, have developed a new type of photocatalyst to decompose water into hydrogen and oxygen with the aid of light from the sun, reports the journal *TechnoJapan*.

The new catalyst is made of a complex oxide of potassium niobate in which lead is incorporated and characterised by a layered structure. It triggers redox reactions when placed in water and irradiated with visible rays, with the electrons moving between the layers, as a result of which hydrogen and oxygen are formed at the different layers.

The researchers have also confirmed that potassium niobate breaks up water efficiently when irradiated with ultraviolet rays, and believe that it can decompose water with visible rays, when partly substituted by lead.

In the test; lg of the new catalyst was placed in an aqueous solution in a beaker consisting of 20 ml of water and 50 ml of methanol as the reducing agent. After an exposure to visible rays emitted from a lamp, the formation of about 30 mmols of hydrogen was observed in one hour.

The same quantity of oxygen was formed by a similar procedure where methanol was replaced by silver nitrate as the oxidiser.

New Catalyst for Ethylene from Methanol

A research group at Kyoto University in Japan has developed a new catalyst for hydrocarbon synthesis to produce ethylene at a high yield of 90 per cent from methanol, reports the journal *TechnoJapan*.

The catalyst consists of tetraethyl ammonium hydroxide as the template material, which is heated after being mixed with colloidal silica, nickel nitrate, phosphoric acid and aluminium isopropoxide.

Acidity of the catalyst surface is properly decreased by controlling the nickel content. Methanol vapour, diluted with steam, is converted into ethylene at a high yield of 90 per cent, when passed over this catalyst packed in a reactor.

Ethylene, a basic material for the petrochemical industry, has been produced mainly from naptha in Japan. Scientists are now trying to replace naptha by natural gas or coal, and hydrocarbon synthesis catalyst is the key to the successful replacement.

The conventional catalyst tends to produce propylene more than any other hydrocarbon compound and is very low in selectivity for production of ethylene because ethylene yield is somewhere around 10 per cent.

Another major problem involved in the conventional catalyst is production of aromatics as byproducts which become tarry on the catalyst surface and reduce its activity.

Artificial Feed for Silkworms

SCIENTISTS at the Institute of Sericulture and Insectology and the Dainippon Raw Silk Foundation in Japan have jointly developed artificial feed for silk worms which is less expensive and easy to handle, reports *TechnoJapan*.

Conventional artificial fed could be used only for worms one to two years of age, while the new feed can be used stably for worms upto three to four years of age. This is likely to increase the frequency of the annual production of cocoons from the current 3 to 4 times to upto 10 times.

The feed, costing 30 to 40 per cent less than its natural counterpart, is offered in the form of dry feed 10 mm in diameter and 20 mm long by processing with extruder soybean powder, corn, rapeseed meal, vitamins and mineral.

The feed is damped with water before it is fed to the silkworms. A new variety called Asagiri suitable for this feed has also been developed and, the report said, good results have been obtained by combining the two.

New Recyclable Polyethylene

SCIENTISTS at the Tokyo Institute of Technology have developed a new type of polyethylene which decomposes easily when treated with alkali at room temperature for reuse, reports the journal *TechnoJapan*.

The new material consists of polyethylene blocks of relatively low molecular weights, bonded to each other via low-molecular-weight compounds through ester bonds, the journal said.

About 90 per cent of the starting polyethylene can be recovered when it is decomposed with alkali. The polyethylene is expected to be in great demand as a highly recyclable plastic material, once sufficiently improved with respect to durability and strength, by the plastic industry now burdened with the problem of plastic waste.

The researchers are planning to study polymer strength and fabricability, to decide whether it can replace conventional polyethylene.

Common block copolymers are formed by the process where polymer chains successively react and require a long reaction time, while the new polymer is prepared in a shorter time because the blocks with active termina's react with one another.