Super Highways of the Information Age

Satellites Open-up New Horizon for the Common Man

by Ejaz Hossain

SATELLITES were first put into use in the mid 1960's. Today there are about 25 satellites above the United States alone. In October, 1945, a gifted science-fiction writer and mathematician proposed the extraordinary idea that if a stationery satellite could be used high above the equator, it could beam television and other communication signals halfway across the world.

Arthur C Clarke was the first man to realize that because a satellite's speed varies with it's distance from the earth, a geostationary orbit is only possible exactly 22,300 miles directly above the equator. He argued that if it's orbit could be matched with the rotation of the earth, the satellite would appear to remain fixed in one particular spot in the sky.

The concept revealed the fact that a single satellite located above the United States could effectively replace thousands of local transmitting facilities at a fraction of their cost.

In 1957, the Soviets launched the Sputnik, the worlds first artificial satellite. Although it could only transmit a simple radio beacon, it's successful flight had implications that challenged the rest of the world, to develop advanced technology necessary for the exploration of space.

Several additional developments were necessary in order to make satellite communication possible. Photovoltaic cells enabled these remote relay stations to generate their own electricity from the sun, providing the satellite with reliable operating power.

The invention of the transistor, and then the integrated circuits (IC's), allowed technicians to miniaturize all the components, so that a relatively small and light-weight package could be launched high into orbit.

In 1962, the United States launched the Telstar, the world's first satellite used for television programmes. Because satellite launching techniques were still in their infancy, the Telstar could not be put into a geostationary orbit. It's elliptical orbit had to be tracked by ground stations and it was only overhead during a portion of each day.

In 1965, the Early Bird satellite became operational as the world's first commercial geostationary satellite. It relayed telephone calls, telex, facsimile, news and other television programmes from one side of the Atlantic to the other. It could carry 240 telephone conversations and one television channel at a time.

First Canada and then the US and other countries constructed their own domestic satellite systems. America's first domestic communication satellite, Western Union's Westar 1, began operation in 1974. Early TV use of Westar 1 was fairly sporadic; telephone and data transmission constituted the bulk of the traffic relayed.

RCA Communications followed Western Union with the successful launch of it's first satellite for domestic use in 1975. Each new satellite had greater capabilities, expanding our ideas of the technically possible and by mid 1985, there were 25 geostationary satellites over North America.

The average cost of a satellite including the launching rocket involves expenses as high as US$ 200 million. Each satellite has 24 or more transponders in operation, each capable of transmitting one television signal or thousands of simultaneous telephonic conversations. Most long distance calls are now routed via satellites. Many transponders can handle radio network, teletext news, computer information service and other data transmission.

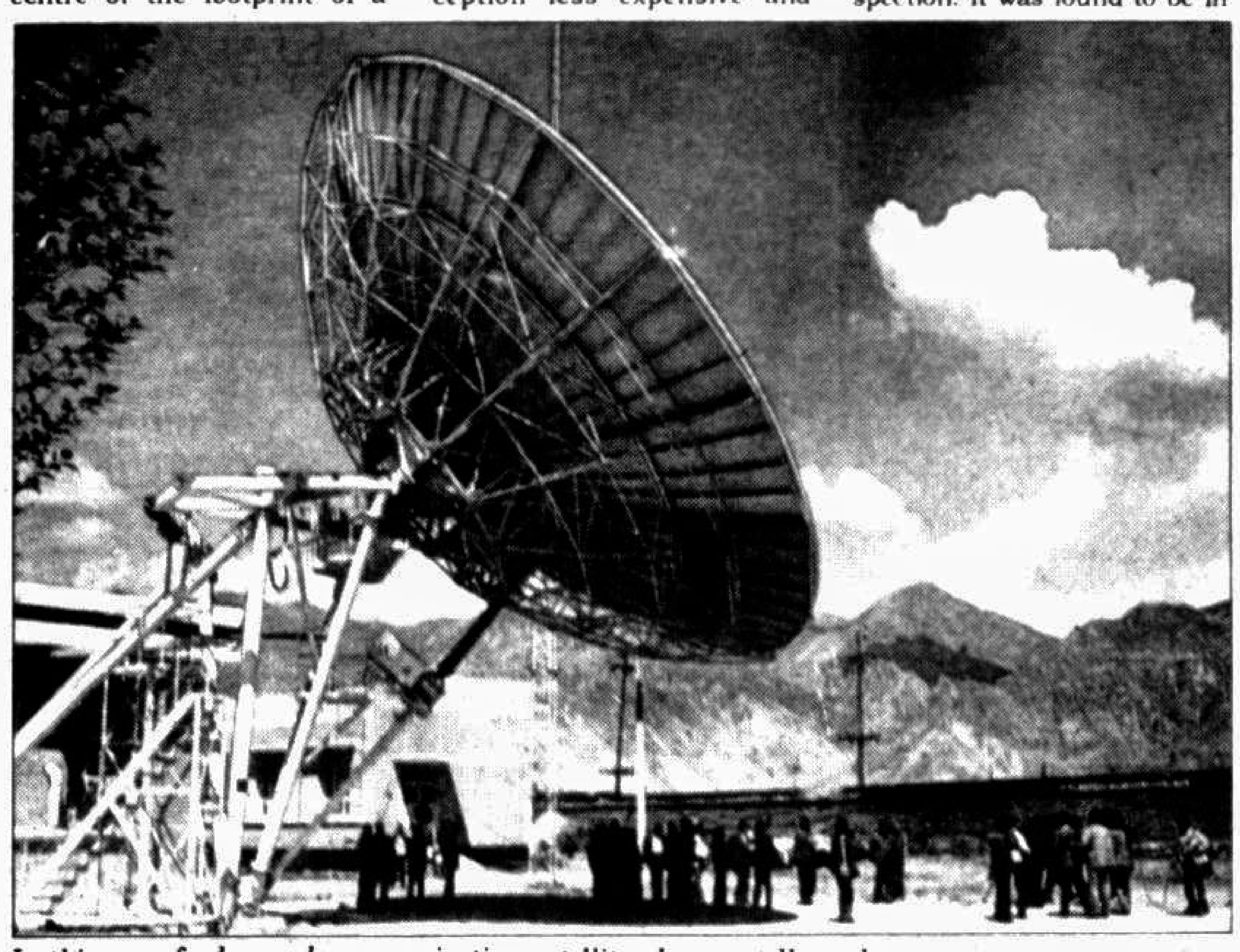
Satellite transponders operate on frequencies high above those used by the regular television channels. Since these super high frequencies are not affected by adverse weather condition or sunspot activity, satellites offer an extremely reliable communication coverage 24 hours a day.

Operating at frequencies of several Giga Hertz; (a Hertz (Hz), is referred to as the number of waves per second of a given signal. 1 Mega Hertz (MHz), is equivalent to 1 million cycles per second (cps) and 1 Giga Hertz (GHz), is a billion cps).

Operating at frequencies of several Giga Hertz, satellite transponders relay their microwave signal via two distinct communication bands. At present time most television services are utilizing the range of frequencies from 3.7 GHz to 4.2 GHz, commonly known as the "C" band.

A new generation of satellites have recently begun operating within a higher frequency spectrum ranging from 11.7 GHz to 12.2 GHz. This spectrum is referred to as the "Ku" band.

A satellite transmits the TV signals in a particular shape called a footprint. Footprints are the area to which a satellite beams it's signals. Each satellite has it's own characteristic footprint, with the signal strongest at the centre and diminishing outward from there. Those who live on the centre of the footprint of a certain satellite can receive the signals on a relatively smaller dish antenna, than those living on the edges.



In this age of advanced communication satellite plays a stellar role.

The "Asia Sat 1"

The AsiaSat 1, launched into a geostationary orbit 22,300 miles above the equator in the region of 105 to 122 degrees East longitude, has all it's 24 transponders operating in the C band; (3.7 to 4.2 GHz). It provides satellite capacity for high-quality, telecommunications services including telephone, telex, facsimile, high-speed data, television, broadcasting and video conferencing.

AsiaSat's footprint covers China, Korea, India, Pakistan, Bangladesh, Thailand, Hong Kong and the area in between. AsiaSat 1 has three footprints, over China and surrounding countries, over Thailand and also over Pakistan. Concentrating the AsiaSat 1 beam in this way, it will be able to provide signals of higher power levels. Therefore the associated ground stations can be cheaper. Smaller and more rapidly deployed, making reception less expensive and more convenient for viewers.

The satellite serving Asia most, called the "AsiaSat 1" is owned by a consortium, consisting of Cable & Wireless plc, the worldwide communications giant, China International Trust & Investment Corporation, Beijing's state-owned investment corporation, and Hutchison Whampoa Limited, one of Hong Kong's largest and most profitable corporations.

The consortium provides the financial strength and technical expertise required for a successful satellite venture. The consortium partners are committed to providing high-quality satellite communications and support to customers far into the future.

In 1984, a satellite known as the Westar VI was launched by a space shuttle, but the third stage rocket motor failed to deliver it into the correct orbit. As a result the satellite was never used.

A special US Space Shuttle mission retrieved the unused satellite one year later and it was returned to it's manufacturer, Hughes Aircraft, for inspection. It was found to be in excellent condition and fully capable of carrying out the communication tasks for which it was originally designed.

The same satellite has been modified by the consortium and relaunched, by China's Long March 3 rocket, in early 1990, as "AsiaSat 1," Asia's first domestic communication satellite. During the modification schedule, several changes were made to the satellite that increased it's life to ten years. The AsiaSat 1 consortium is already planning other satellites to follow AsiaSat 1, which will ensure uninterrupted, high-quality communication facilities through the year 2000 and beyond.

The TVRO System

Star TV's or rather the AsiaSat's footprint covers a region from Egypt in the west to Japan in the East and from CIS (Russia) in the north to Indonesia in the south.

People living in the borderline mentioned above are under the Star TV footprint and can enjoy all the five channels merely by installing a dish antenna. The signals are floating free in the air waiting to be received, no subscriptions are charged and none of the broadcasts are scrambled.

The Television Receive only System, abbreviated as the TVRO is intended for use by a single household. This system consists of a satellite dish antenna, the feedhorn, the LNB, the satellite receiver and a substantial amount of good quality co-axial cable to connect the LNB to the receiver. It is an ideal system allowing individuals to explore the galaxies, at the touch of a button, sitting in their living room.

The most visible part of the reception system is of course the dish. Mounted over the face of the dish is the feedhorn. The concave dish acts as a mirror and reflects the collected satellite signals up to the feedhorn, which passes them to a small rectangular box called a Low Noise Block downconverter, commonly known as the LNB.

Despite it's complex name, the LNB performs a simple task. It electronically converts the high frequency of the raw satellite signals to a lower frequency enabling them to be processed further as they travel along the chain.

After travelling through the LNB, the signals move down a cable to a satellite receiver, which is the heart of the reception process. The receiver strips down any radio interference in the signals arriving from the LNB, then amplifies them to be powerful enough to produce an image on a TV set.

The SMATV System

The Satellite Master Antenna Television System (SMATV), is probably the most widely used system around the world. It is an ideal way to share the reception of one master dish antenna among many subscribers. People living in big apartment complex or in the same locality can contribute to set up a central control room through which the signals could be carried out to all the subscribers via normal co-axial cables.

If the reception is shared from a normal TVRO system, then the choices of the subscribers will be limited to only one channel to which the receiver is tuned. As the SMATV system employs as many receives as the desired number of channels to be broadcasted, each subscriber will have an independent choice on the desired channel.

The cable that comes from the LNB is connected to a Power Divider which gives out four outputs. Four satellite receivers are connected to all these outputs. Each receiver is tuned to a different programme and their output signals are run through four Channel Modulators.

The output of the modulators is connected to a Video Mixer. This Mixer mixes the different frequencies together so that all the frequencies can be carried out through one single co-axial cable. Depending on the number of TV sets in use and the length of the cable additional Line Amplifiers or Power Amplifiers may be installed to give proper signal strength to each TV set.

Unlike the TVRO system, where the TV set is tuned to one particular frequency and different channels are changed on the receiver to view different programmes, the SMATV subscriber has to change the TV channels on his own TV set to tune different programmes.

Dish Antenna

Consumers of the dish antenna should make sure that their installers are experienced and conduct an initial survey of the site prior to installation. Satellite signals are microwaves that exhibit most of the characteristics of light, except visibility. Like visible light, they travel in a straight path along the line of sight.

Since all geostationary satellites are stationed above the equator, and as we wish to receive them from the northern hemisphere, our antennas should have an unobstructed view of the southern sky. Consumers should ensure that there are no tall buildings, trees, power poles, or other substantial obstacles to prevent the signals from reaching the dish. Future construction plans of neighbours should also be seriously considered.

Consumers should first make sure that the satellite receivers being supplied is compatible to the PANDA 1 system, irrespective of the make, origin, looks, or other features. Hong Kong's Star TV is broadcasting their programmes on the PANDA 1 system and people trying to tune these signals with a non PANDA 1 compatible set will never get a proper stereo reception even if their receiver is stereo.

Prices of satellite receivers vary on the features being offered. Consumers should order according to their requirements. Among the many features, the following are vital:

1) With or without polarizer.

2) With or without positioner.

3) Remote controlled or manual tuned.

4) PANDA 1 compatibility.

5) Audio mode in Stereo or Mono.

6) Country of origin.

7) Warrantee being offered by the importers should include free replacement of any or all parts for a minimum period of one year.

8) The receiver, dish and the LNB should be designed to receive the C-Band. Most equipments available in Dhaka are designed for dual band frequencies, but consumers should not go for an expensive system unless they are interested in the Ku band also.

(9) Most importers ask for an advance payment and consumers have to wait for a month or so to receive their equipment. It is always advisable to buy from agencies who are in a position to deliver from ready stock.

This paper is the result of data collection from many different books, periodicals and magazines, (most of them published before 1986). It is very difficult to obtain latest information as recently published materials are not readily available in Dhaka.

The writer deals in communication gadgets.

Body Armour Goes Plastic

by G V Joshi

BODY armour for warriors started with turtle skis gave way to iron rings and now to the marvel of the 20th century — plastics.

Introduction of recent plastic technologies is specially relevant to India where the army and paramilitary forces are combating terrorism.

The first body armours in Europe were worn by the horsemen of Charlemagne in the 8th century AD. Earlier they used shields made of turtle skin or bronze.

Chainmail — armours of interlaced rings or overlapping plates — came much later. Chainmail was made from rings of iron wire riveted or welded together and shaped to cover the arms, feet and head. They had the twin advantages of flexibility and strength.

By the 14th century, plate armour, originally a reinforcement for chainmail, was beginning to take its place. The shield was also in use by infantry soldiers.

Much of the credit for inventing body armours made out of glass fibres and synthetic materials goes to the research wing of the American armed forces. During World War I British soldiers, much to their surprise, had discovered that a thin layer of natural silk garment could stop low-velocity sharpnels from hand grenades.

The body armour made of plastics followed the invention of fibre glass and nylon. When Du-Pont Chemists invented nylon in 1935, it was found to be considerably stronger than silk. Nylon fabrics could be made four to five times stronger than steel, but much lighter, and nylon jackets used in World War II are reported to have saved nearly 50 per cent of casualties among the Allies.

Doron and nylon were the materials favoured by the American armed forces. Doron, named in honour of Col Doriot of the US Army, consisted of layers of fibre glass filaments which were laminated (bonded together with resins under high pressure) to form a thin sheet.

Tests demonstrated that a 3-mm-thick sheet of doron could stop and partially flatten a bullet coming from a distant enemy. Without an armour the skin could be pierced by a sharpnel. But no harm results if the impact is spread over a sufficiently large area and that is what doron plates did. They offered enough resistance to absorb the energy of these missiles so that they spent themselves at the point of impact.

A 12-ply spot laminated basket-weave nylon presented a less rigid surface and entangled the missiles in a mesh of strong nylon fibres, each of which contributed its bit towards total resistance that smothered the velocity of these flying objects.

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The first tests on humans were carried out by two doctors, Webster and Corey of the US Army, using a 45-calibre pistol. Webster fired it from a distance of six metres on Corey's hand covered with a doron or nylon glove. Corey experienced no injury or discomfort. Another test with a life jacket confirmed its utility.

After the end of World War II, body armour research was resumed in 1947. It was proved beyond doubt that a 3-mm-doron and 12-ply nylon could stop most fragments from grenades.

In the summer of 1951, a new body arm vest consisting overlapping curved doron plates with flexible pads of 12-ply basket-weave nylon was perfected. It could stop a .45-calibre or submachine gun bullet coming from a moderate distance, all the fragments of a hand grenade at one metre, 75 per cent of 81-mm mortar at three metres and the full thrust of a bayonet. In the Korean War, frontline American soldiers wore vests made of nylon or doron.

These armours, however, did have their limitations. They could not stop a direct close range hit from a rifle or machine gun and would not hold off all shell fragments.

Chemists were on the look-out for a new plastic of lighter weight but with better ballistic resistance than doron and nylon. Their search led them to tamper with the molecular structure of nylon which is essentially a polymer. The found that the polymer units could be stiffened with the addition of one or more aromatic groups or molecules of benzene.

The research resulted in the invention of Kevlar by Drs Stephanie Kwolek and Herbert Blades at the DuPont research laboratories. The process is a closely guarded secret. The aromatic polymers, called aramid by DuPong, could not be melted and spun into fibres.

The next breakthrough came in 1965 when Dr. Kwolek found a solvent that dissolved Kevlar. Spun into fibre, it was stiffer than glass and very hard to cut even with a pair of scissors. The solvent is another DuPont secret.

Kevlar was originally developed to replace steel cord used in making belted steel radial tyres. In 1971, a lawyer suggested that it might make an excellent body armour.

Samples of vests were made and in a trial, 100 goats dressed in Kevlar vest were shot with .22 and .38 calibre pistols. Only one of the goats suffered a broken rib, but all of them were alive after the test.

Army researchers were surprised to find that so light and pliable a plastic can halt a streaking piece of lead in a bullet. Kevlar revolutionised the science of making armours for soldiers as well as dignitaries.

Kevlar does not char until about 425 degrees Celsius and can withstand brief contacts with materials as hot as 760 degrees Celsius, which makes it an ideal substitute for asbestos, a material considered dangerous as it causes lung diseases. Kevlar is so light and flexible that it can be sewn even into ordinary clothes. One can buy a complete line of bullet-proof clothes conforming to the latest fashions in the United States. The price, however, depends upon the desired protection. Even vests plated with gold have been ordered by some dignitaries.

Multi-layered structures of Kevlar clothing help distribute and dissipate the energy in a speeding bullet. Even then a person using them will feel the impact. The experience is something like being hit with a blunt hammer.

Kevlar bullet-proof vests worn by the US police weigh about 1.5 kg. The vests meant for soldiers and guards attached to VIPs are superior to these. They can stop even a high-velocity rifle bullet. Even fencers use them.

Kevlar is also used in making security blankets for defusing bombs. A Kevlar blanket thrown over a bomb can smother it and prevent splinters and sharpnels from flying in the air in all directions.

Plastic technologists have come out with another material that is 10 times stronger than steel and 35 times stronger than Kevlar.

With the liberalised economic policy, it is time some Indian businessman puts up a factory to manufacture Kevlar and Spectra with appropriate collaboration. There is an assured market for the army and paramilitary forces fighting terrorism.

— PTI Science Service

Tapping Sunlight Could Offset the Energy Crunch

by David Spark

HELP developing countries use solar energy and do not try to put arbitrary limits on their use of carbon-emitting fuels such as coal and oil, advises economist Dennis Anderson in a new book published by the Overseas Development Institute in London.

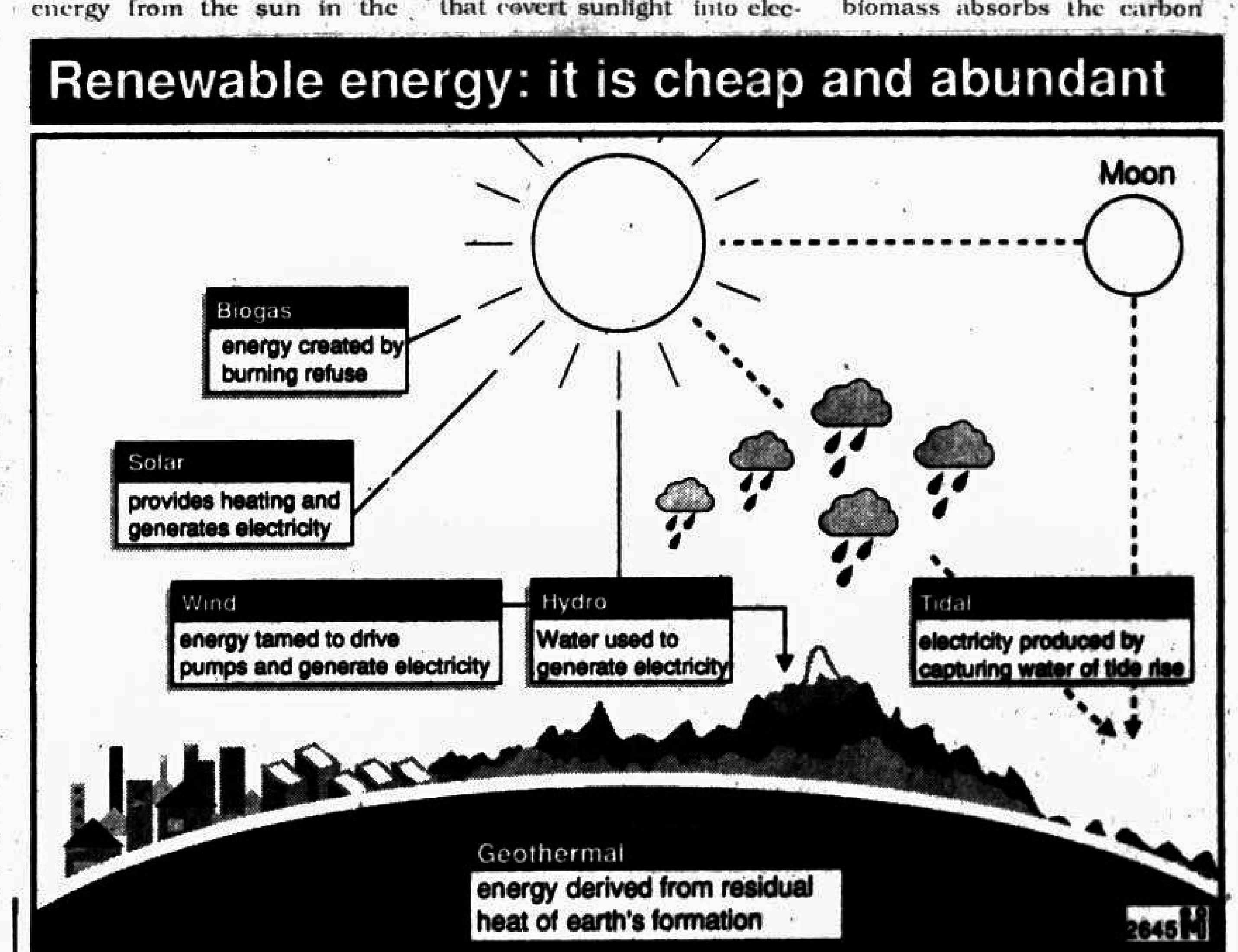
Anderson points out that the Third World is on the threshold of a dramatic increase in its use of commercial energy. In 1989 it used the equivalent of 2,110 million tons of oil.

By the year 2020 he expects this figure to have more than trebled and to represent more than half of the world's energy use. This is because poor people greatly increase their use of fuel as they grow richer or move into cities and industrial work.

In the immediate future, coal, oil and gas will meet most of the growing demand. It is pointless to pay countries to restrict their use, even though they emit carbon and contribute to global warming.

Third World countries face many other environmental problems such as unsafe water, urban congestion, industrial pollution, deforestation and soil erosion, for which they require Western aid and expertise.

But Anderson argues that it makes sense to invest aid money in promoting the use of energy from the sun in the Third World, thereby eventually cutting the use of carbon fuels.



Anderson, now working for the World Bank, points out that it is the accumulation of carbon in the stratosphere that is believed to cause global warming, not the amount emitted in any given year.

He calculates that, from the year 2020, solar-generated electricity could be cheaper in the Third world than that generated by oil and coal.

Solar electricity is coming into increasing use for telephone systems, water pumps and village lighting. However, you need double the area of solar panels in order to doublet the output of electricity; so solar power is expensive for larger tasks.

But Anderson argues that solar costs have already come down a long way and will come down further, especially when solar power is more widely used. He also thinks the panels that covert sunlight into electricity will become more efficient.

Sunlight is something the developing countries have a great deal of. Generating solar power takes less space than hydro-electricity, and that solar power can be desert or of no agricultural use.

Aid, suggests Anderson, could be channeled to promote the uses of solar power and to finance some power stations and more research. He also says that a tax on carbon fuels would be an easy way to raise revenue. In addition, it would encourage private investment in alternative sources of energy.

The other alternative he recommends is biomass — economist's jargon for trees, bushes and plants. It is the best-proven alternative, he says, for coal and oil.

Biomass can be turned into gas and this can be used to generate power. It can also be turned into liquid fuel, although this will be more expensive than oil fuels. Growing biomass absorbs the carbon emitted when the previous biomass was burned, so there is no addition to the carbon in the stratosphere.

Moreover, biomass has the advantage over solar power that it can be stored: you do not burn it if you do not need to. Its disadvantage is that it needs good land to grow on.

Anderson calculates that it would take up to 75 years for solar power and biomass to take over from coal and oil on a large scale.

But carbon-absorption would be a useful advantage of growing trees for the other purposes of timber, controlling soil-erosion, and landscape improvement. He also recommends that a greater portion of aid should go toward forestation.

— Gemini News

Science Brief

Hybrid Wastewater Treatment Method Developed

A new wastewater treatment technique is ready for full-scale introduction into international markets, the journal *Chemical and Engineering News* reports, quoting Roy Larson, chief executive officer of a US company that developed it.

The hybrid process from Minneapolis based Separation Dynamics International employs cylindrical modules containing hollow fibres of the company's Extran membrane — fibres extruded from natural regenerated cellulose by a proprietary process and having hollow centres with diametres of 400 micrometres and wall thicknesses of 30 micrometres.

They are teamed with commercially available nanofiltration membranes and activated carbon filters. Following removal of coarse suspended solids, waste water is passed through Extran modules to remove essentially all insoluble hydrocarbons as well as a portion of the soluble ones.

Nanofiltration membranes remove the majority of what soluble hydrocarbons are left, and activated carbon takes out virtually all remaining soluble hydrocarbons. The initial market seen by Separation Dynamics includes tank water bottoms, oily wastewaters contaminated with polychlorinated byphenyls, and offshore — produced water associated with oil and gas production.