

# BANGLADESH LOOKS FOR BETTER USE OF REMOTE SENSING

by Dr. Anwar Hossain

Special to The Daily Star

**For a country very poor, Bangladeshi scientists have achieved a large degree of capability in using remote sensing. This capability would be much improved if Bangladesh could build a ready facility for multi-spectral aerial photography and complete the resource survey ground station.**

Remote sensing is acquisition of information about an object without physical contact. In the simplest case, human eye can be considered a remote sensor, but this usually refers to the gathering and processing of information about the earth's environment through the use of photographs and related data acquired from an aircraft or satellite.

The term 'Remote Sensing' was coined by E. L. Pruitt of USA in 1960 when photographic information was increasingly being collected from high-altitude aircraft and satellites. While aerial photos are being used for direct mapping, two types of satellites were designed for weather forecasting and earth resource survey purposes. The first ones are called meteorological satellites. They can be either geo-stationary (i.e. stationary far above, with respect to a particular point on earth), covering about one-third of the globe or polar-orbiting, in which case, the resolution could be 100m.

The first such satellite was launched in 1960. They are now operational and the photographs taken by them are used for monitoring weather, natural hazards as well as agricultural and hydrological conditions of a place several times a day. The first earth resource satellite was launched by USA in 1972 with capacity for taking multi-spectral imagery and a ground resolution of 100m. Since then the technology has improved considerably and the latest French SPOT Satellite has a resolution of 10m. The data from these satellites are used extensively for getting information in agriculture, forestry, water resources, fisheries, geology etc. Unfortunately the present image-taking devices cannot penetrate the clouds. The images are, however, taken once every two weeks or so, throughout the year. In addition, there are classified/restricted satellites, sky-lab series and re-usable space shuttles which can take very high-resolution photographs which could even trace the movement of troops.

Bangladesh entered the space age and utilized the technology of remote sensing as early as in 1968 when an APT (Automatic Picture Transmission) station was installed in the Atomic Energy Centre, Dhaka. It was here that the movement of devastating cyclone of 1970 was pictured for several days in a row and in fact the advent of it was predicted. The picture of the approaching cyclonic storm taken on the day it struck the coastal areas is shown in Fig 1. Since then, the capacity for receiving cyclone pictures has improved considerably with the availability of high-resolution ground station and associated analysing equipment. Preparation for receiving and analysing resource survey imagery started in Bangladesh even before the launching of the first satellite by USA in 1972. Such satellites were named as ERTS (Earth Resource Technology Satellite), later Landsat. Resource survey satellites have now been launched by several countries, including India and France.

One of the interesting aspects of satellite remote sensing is its multi-spectral, multi-date and multi-stage character. The information thus obtained is a powerful tool for natural resources inventory, management and monitoring. Bangladesh received the imagery from USA free of cost and, through its Landsat Programme, made early observations on land-use, agricultural and hydrological conditions, including coastal areas, and many other sectors. One of the earliest land-use maps of Bangladesh was made in 1979, thanks to the assistance by US NASA and World Bank. The map was prepared by mosaicing 14 successive scenes (Fig 2) and is now widely used by the Government and many other national and international agencies to get an idea of the physical characteristics

of Bangladesh.

In 1980, the programmes on meteorological and resource survey satellites were integrated, with the formation of SPARRSO (Space Research and Remote Sensing Organization). In spite of many difficulties, but with the help of USAID, UNDP, French and other assistance, SPARRSO has now grown to an important scientific establishment, capable of providing information much needed for weather monitoring, preparedness against disaster (including cyclones and floods), survey of the renewable natural resources and obtaining geological information, including drainage pattern, and indication of natural resources like oil and minerals.

For a country considered very poor, Bangladeshi scientists have achieved a large degree of capability in using remote sensing for the above information, much needed for development works. This capability would be much improved if Bangladesh could build a ready facility for multi-spectral aerial photography and complete the resource survey ground station. Aerial surveys, with capability for taking multi-spectral, (including thermal infra-red) photographs and side-looking radar, not only increases the resolution but the radar images can penetrate the clouds. The ground station will enable Bangladesh to take real-time data, much needed for crop estimation and flood monitoring.

A few examples of what has been achieved by SPARRSO scientists are now given. In addition to preparing land-use and other thematic maps, SPARRSO has regularly supplied meteorological satellite photographs for weather forecasting and continuous information on incoming cyclones. In the field of water resources, SPARRSO has conducted a study of total water bodies, both large and small, in the country. Fisheries and Water Resources Departments are making use of the information so obtained. Remote sensing technique has been applied to monitor and prepare change detection maps of the Jamuna, Teesta and Meghna river courses. The report on the Jamuna river has been used for

site selection of Jamuna Bridge. Studies like seasonal variation of water level, mapping of salinity affected areas and river bank erosion have also been made. Observations made in the coastal areas, especially turbidity of water, land erosion and accretion, have helped planning new coastal embankments.

In the field of agriculture, cropping pattern determination, agricultural potentiality rating and soil characteristics of different parts of the country, modelling for crop estimation, vegetation index etc. have been made with the help of data both from meteorological and resource survey satellites.

A detailed study of boro crop acreage in two areas of the country showed results well in agreement with the Agriculture Department. Remote Sensing analysis have given useful information on the ecological imbalance of both low-lying 'haor' areas and the fast degrading Barind tracts.

SPARRSO has been conducting operational programmes in monitoring mangrove afforestation programme of the Forest Department in the coastal regions of Bangladesh. With the help of Landsat imagery, aerial photographs and some ground-based measurements (called 'ground truth' in remote sensing language), changes in forest cover and density have been detected and mapped in some selected forest areas.

With increased spatial and spectral resolution, remote sensing data can be stored and used for local level planning in wide range of areas - from determining the optimum use of land for habitat, agriculture and industry to the use of high resolution topo-maps in planning distribution lines of rural



Fig 2. Land-use map of Bangladesh made by mosaicing 14 Landsat imagery of 1978-79

electrification. Already, some upazilla land-use maps have been made. A more detailed map would be extremely helpful in the development planning of cities.

Some of the activities of SPARRSO and its potential have been discussed. The organization is currently engaged in developing new techniques of interpretation of remote sensing imagery using digitised methods and a new software concept of Geographic Information System (GIS). The combination of remote sensing and GIS will help storage and retrieval of information which will be extremely useful in crop forecasting, early warning for natural disaster and damage assessment, monitoring of

river and coastal morphology, check forest degradation, environmental study and in many other areas.

There is no doubt that for Bangladesh, eager to accelerate the pace of development, information that can be provided by remote sensing will not only be essential and economic, but, in some cases, it will be the only alternative.

About the author: Former Chairman of the Bangladesh Atomic Energy Commission, Dr. Anwar Hossain who also served first as the Director General and then as the Chairman of SPARRSO, has currently joined as a UNDP/FAO Consultant on remote sensing.

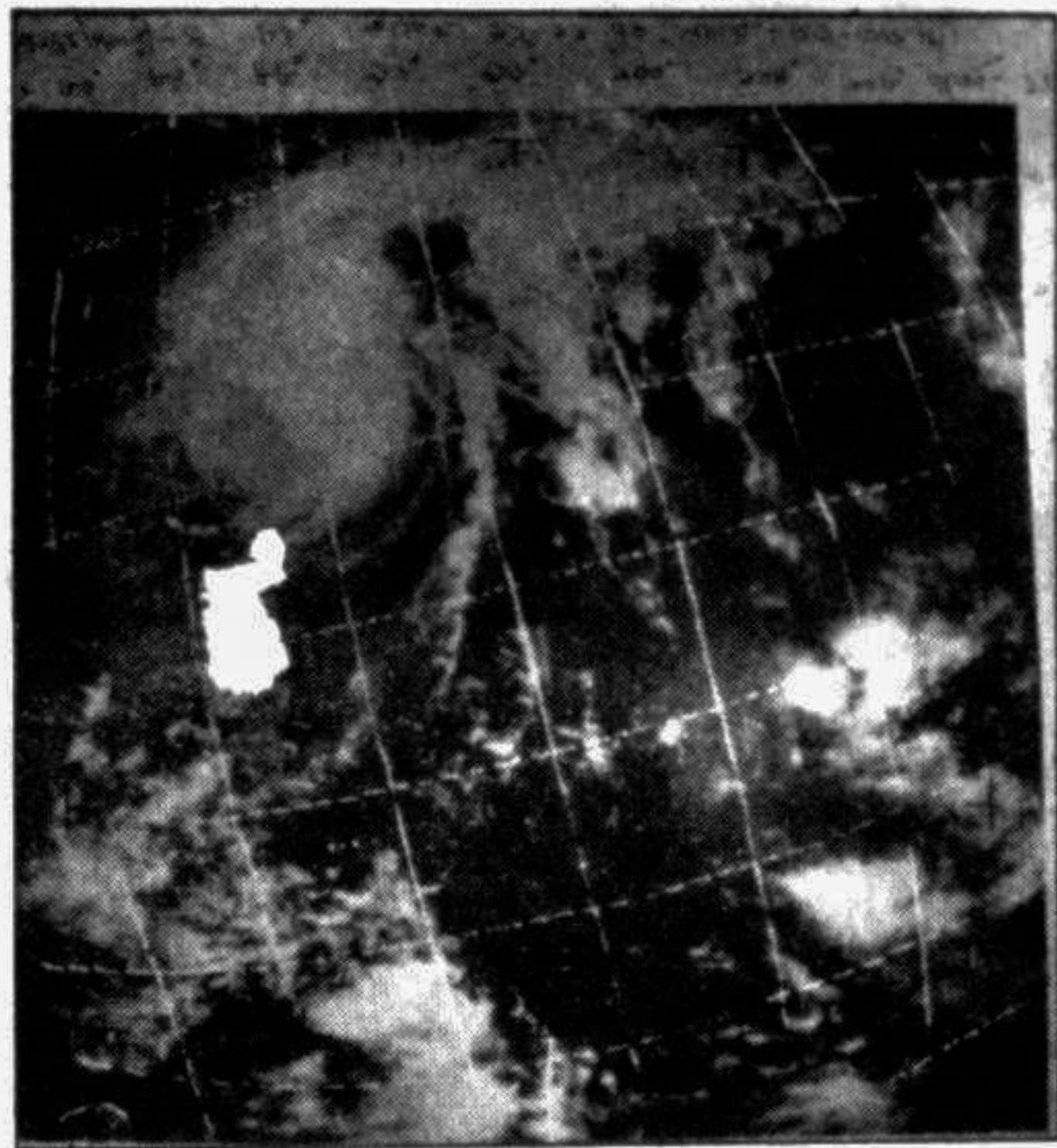


Fig 1. Satellite picture taken on the morning of 12th November, 1970 by the APT station at Dhaka

## Space Tiles

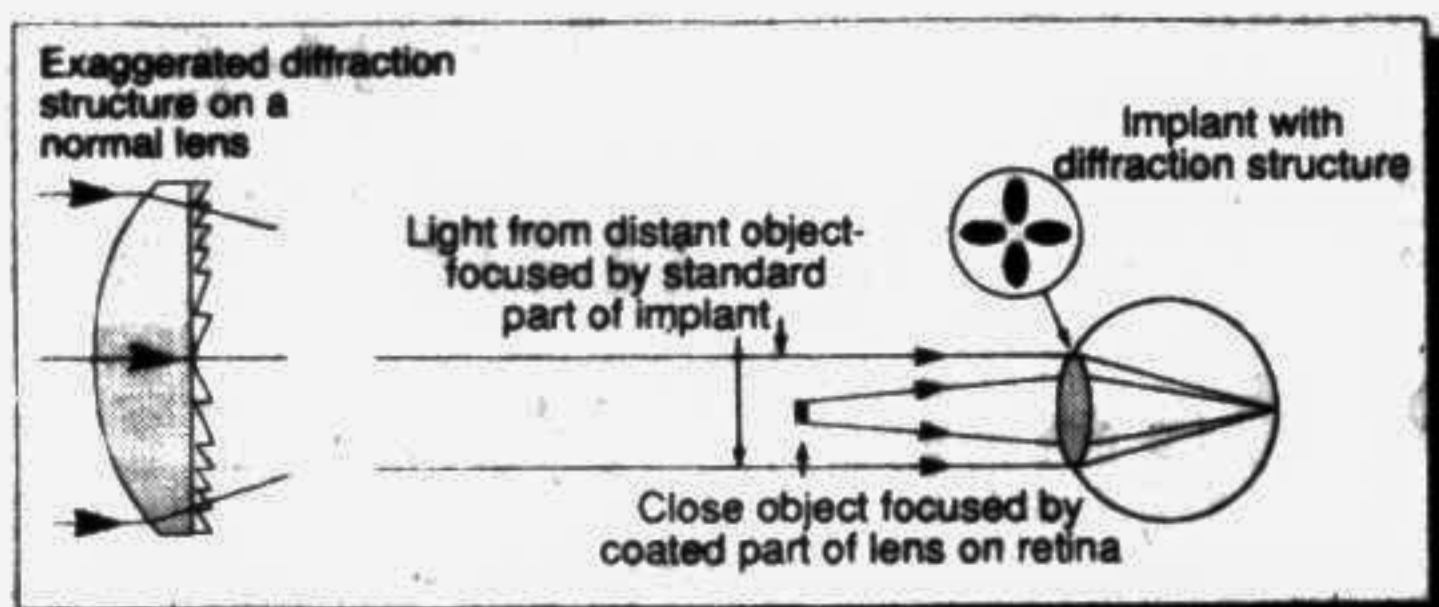
The adoption of natural construction principles, such as the fibre structures of leaves and grass, for the design of new materials has led to the development of a completely new silicon carbide composite material which meets the highly specialized demands of space flight.

When, at the end of the nineties, the European space shuttle Hermes glides back to earth out of the cold reaches of nearby space, its nose is going to need special shock protection. The designers have calculated that the outer skin of the spacecraft will reach temperatures of up to 1,700 degrees Celsius when reentering the atmosphere. The load-bearing components, however, should not become hotter than 200 degrees Celsius. That is why the surfaces at the nose and wings of the spacecraft must be equipped with a specially designed heat shield.

The company MAN Technologie AG in Munich has now developed a composite material especially for this prestigious European space flight project. In this material, silicon carbide is reinforced with itself. To produce this so-called Sic-Sic ceramic, carbon fibre mats are embedded in a silicon carbide matrix by means of a special vapour process. This solid matrix is obtained from an organic silicon compound in liquid form, which is boiled and then mixed with hydrogen as the carrier gas and catalyst. The carbon vapour is then heated to a temperature of around 1,100 degrees Celsius (the exact temperature is a secret) and passed through a pile of carbon fibre mats, which in this stage, are still fragile. At this high temperature, the carbon components of the gas mixture are "baked" into the mats. Thus the solid carbon composite material is created.

The finished material for the heat shield tiles is a typical ceramic. Although it is an unattractive grey-black in color, it resists the thermal loads and withstands even extreme mechanical stresses. This material possesses all the properties of the currently available heat insulation offered by a French manufacturer, but will be, in the final analysis, fifty to one hundred times cheaper" declares Dr. Hermann Koberle, project Manager. The reason for the reduction in brittleness is revealed by a strain test and a look at the break surface through the electron microscope. A break in current composite ceramics does not stop at the limits of the fibres, but rather cuts them cleanly. The fibres of the Sic-Sic ceramic, on the other hand, are pulled a little way out of the break plane before tearing. This so-called pull-out effect is what gives the material its optimum tensile strength.

## DUAL VISION LENSES GIVE A BETTER VIEW



The attraction of diffraction: coated implant lenses aid sight

restored vision to cataract sufferers by replacing cloudy natural lenses. However, unlike natural lenses, an implant cannot change its shape to shift the eye's focal distance. Standard implants are designed for distant vision, so patients need bifocals or reading glasses for close work. The 3M lens avoids this by covering half the surface of the implant with a series of stepped ridges no more than two micrometres high. This

structure combines with the refractive power of the lens to focus light from nearby objects onto the retina. Other uncoated areas of the lens focus light from distant objects. The brain ignores the out-of-focus light reaching the retina, just as it does not notice squashed insects on the windshield of a car while you are driving. Bill Isaacson, head of the 3M Vision Care programme, says European authorities have approved the new implants.

but he does not expect final approval from the Food and Drug Administration in the US until next year. About 15,000 of the new lenses have been implanted in 50 countries since tests began in November 1987. He says that tests have not found any medical effects in changing single-vision lenses to the new lenses, adding that patients show a much greater range of focus.

Researchers in the US, Germany and Japan are studying other uses of diffractive optics, including infrared night vision systems for military use, reading heads for optical disc players and scanners for laser printers. Researchers hope that surface diffractive patterns can be mass produced by pressing them into plastic. Purely diffractive optics could be very thin and light in weight. Much of the US research has been done at the Lincoln Laboratory in Lexington, Massachusetts.

Wilfried Veldkamp, leader of the laboratory's binary optics programme, says diffractive structures can correct for aberrations present in refractive optics, and split or combine beams. Developers have overcome the fact that diffractive optics is dependent on the wavelength by having refraction do most of the work.

(By arrangement with New Scientist.)

## WINDOW WINDERS WITH TRAVELLING WAVE

Quiet as a whisper, slow and with a high torque, several discs, each the size of the palm of your hand are rotating in Frankfurt at the former AEO Research Institute which now belongs to Daimler-Benz AG. Two thin leads per device disclose the nature of the power driving these prototypes, which are meant to function as motors: it is an alternating voltage oscillating at an extremely high rate, which is converted inside the motors into mechanical motion of a very special kind.

This motion is generated in the heart of the new drive motors, the stator, which is a fixed, flat disc, on the edges of which piezo-ceramic material is subjected to tiny, deformatory oscillations by the high-frequency voltage. The electrical input signal is transferred to the individual piezo-ceramic segments in such an ingenious manner that the superposition of two so-called stationary waves results in a "travelling wave" which rotates around the disc. The tiny wave crests could be compared to the cogs on a gearwheel.

The rotating motion of this travelling wave is now transferred to a rotor which is mounted on top of this rigid disc, and which is pressed

against the wave crests with such tremendous force that it is "dragged" along with them. However, since slippage arises during this process, the rotor rotates ten-100 times slower than the travelling wave itself, which races through the ceramic material at nearly 2000 oscillations per second (Hertz). But it is exactly this which proves to be an important advantage: the novel mo-

operating noise: the piezo-ceramic fundamental oscillation generates that much more "noise" in the ultrasonic range and in this respect, it exceeds the allowable specifications at present. But the engineers are confident that this shortcoming of the new drive inaudible for human beings will soon be remedied.

A second field with further research possibilities is opened

**Piezo-ceramic materials which in some lighters can ignite the sparks at the press of a thumb, are now opening the way to developing completely novel electric motors.**

tor, by nature, develops such high power at low r.p.m. so as to render a step-down gear unit superfluous. Moreover, its r.p.m. is infinitely variable and its direction of rotation can be reversed almost instantaneously. Apart from offering these advantages, the piezomotor has a low weight and an extremely flat design.

In addition, the piezomotor is insensitive to electromagnetic interference and is extremely quiet. However, one problem is concealed by the observation that the motor "does not make any audible

up on the materials side. Highly specialized materials play a decisive role in the realization of this drive principle", emphasizes head of development Gerhard Schadebrodt.

"The drive behavior is decisively determined by material characteristics on the boundary layer between the oscillating stator and the rotor which is being moved. The piezo-ceramic material we use consists of a lead-zirconium-titanate together with an aggregate amounting to approximately 1 percent." However, the substances comprising the aggregate

are as secret as the exact composition of the polymer coating; this also contains admixtures of metals, glass and hard fibres and is pressed on to the ceramic material of the rotor, ensuring the largely loss-free transfer of the travelling oscillation to the movable part of the motor.

Of course, the inexact specifications are also an indication of the leeway which is still available for making mixtures of even better materials.

The Germans' darling, the automobile, presents itself as a field of application. Modern, luxury passenger cars are "packed" with electric motors which move windshield wipers, wind windows and operate automatic fuel-injection units, among many other things.

This is where the quiet, direct drive almost thrusts itself upon us as an advantageous alternative. Thus the researchers in Frankfurt did not miss the opportunity to construct a prototype of a car window winder driven by their piezomotor. Maybe soon, a lot of car windows will glide up and down on travelling waves-

## Plastic Print Changes Pages on the Run

A PLASTIC which can change its properties at the touch of an electric pulse may revolutionise the printing industry. The plastic, being developed in Germany, can be used to make printing plates for presses on which the image on the plate can be altered electronically while the press is running. At the moment, printers have to make a whole new plate, stop the press and change the plates.

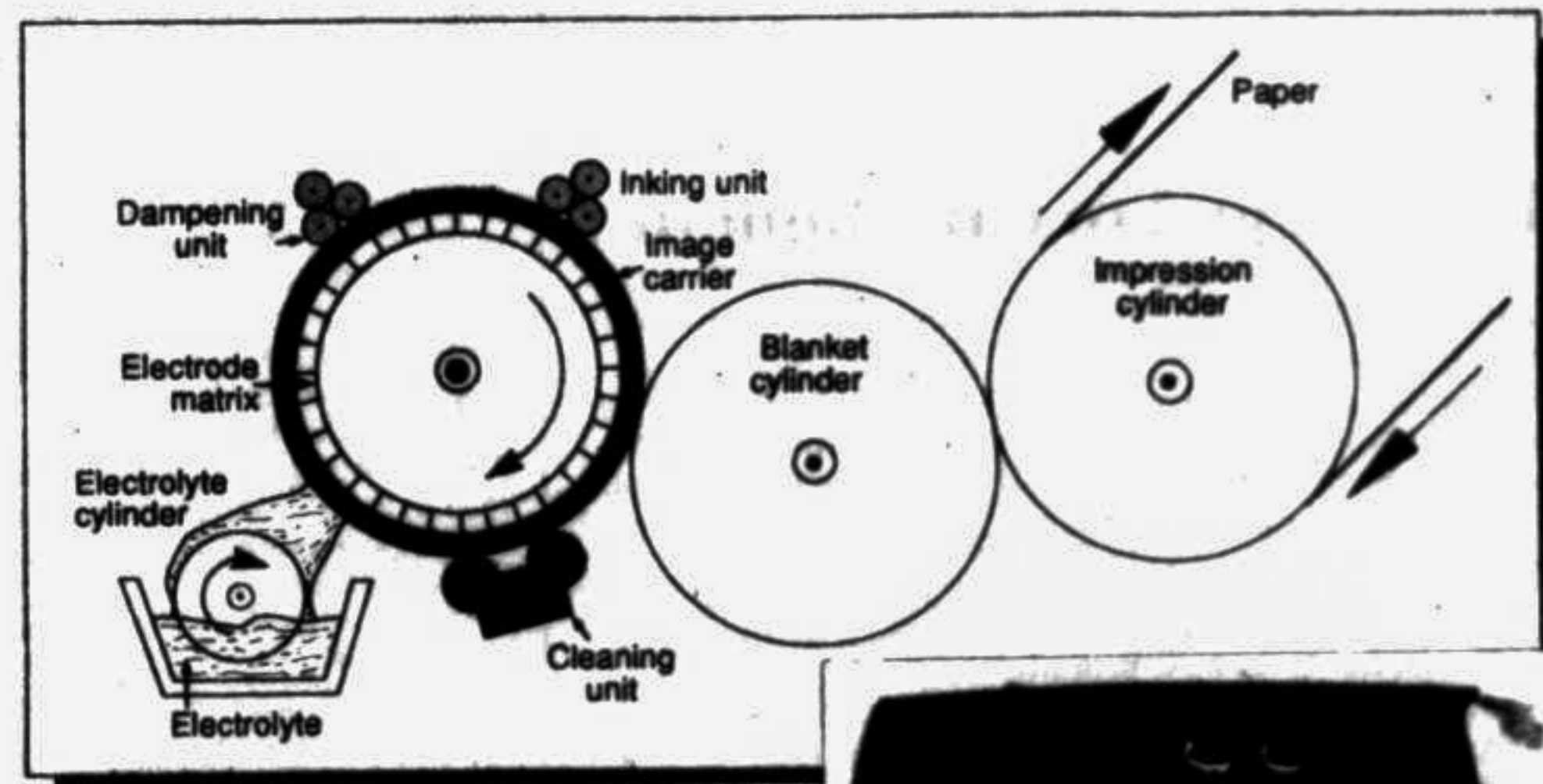
Changing plates on a full colour press can take anything up to an hour. Using the new plates would allow newspapers to alter or replace stories on their pages instantly, direct from computer work stations in the editorial office.

tened onto a drum which rotates at high speed. As it spins, the surface of the plate passes under an inking unit which covers the hydrophobic areas with a thin layer of oil-based ink and leaves the hydrophilic areas clean. The surface comes into contact with the "blanket" cylinder which lifts the ink image completely off the plate. The blanket cylinder presses the image onto a continuous strip of paper, called the web, which is later cut and folded.

In the new system, the plate is replaced by a cylindrical sheet of polythiophene, known as the image carrier, which besides being able to switch from hydrophobic to hydrophilic, can also conduct electricity. Inside this cylinder is a matrix of electrodes which

drags up an electrolyte, a conducting liquid, into the space between the cylinders so that a current can flow through the resulting sandwich from the electrode matrix behind the image carrier, through the polythiophene image carrier and the electrolyte, and into the electrode cylinder. In this way, as each minute electrode in the matrix passes the electrode cylinder it can reconfigure its dot of the image with a pulse of electricity on the instructions of the typesetting computer.

Steven Warner, technical director of the printing firm Warners near Peterborough, said that such a system would lead to considerable savings in printing costs. Their



Fast-changing image: the plastic image carrier on the press can switch to accept or reject water. A sample of the plastic (right) shows both states

Gerhard Kossmehl, Detlef kabbeck Kupjat and Matthias Niemitz are developing the plastic, known as polythiophene, at the Free University of Berlin. Polythiophene is able to switch from being water repelling (hydrophobic) to water attracting (hydrophilic), and back again when subjected to an electric pulse. Their work is being supported by MAN Rotad, the world's largest manufacturer of web offset presses, the type of press that will make use of the new plates.

Traditional plates for a web offset press consist of a metal sheet which is coated with a layer of chemicals. A hydrophobic chemical covers the areas of the image which are to be inked and a hydrophilic chemical covers the areas which are to be blank. The plates are produced by a photochemical process and baked to harden the surface. To print, the plate is fast-

correspond to the minute dots that make up a printed image. For high quality printing, these dots are less than a tenth of a millimetre across. Each electrode controls one dot of the image by switching the plastic above it from hydrophobic to hydrophilic or vice versa.

The electrodes themselves are controlled by microprocessor chips inside the cylinder. The developers suggest that each square centimetre of electrodes could be controlled by one microprocessor. The microprocessors are in turn controlled by a computer typesetting machine external to the press.

In order for the electrodes to switch the plastic from one state to another, a circuit must be set up through the plastic to carry the electric pulse. When printers want to change the image on the plate they set up this circuit by bringing a separate unit, known as the 'electrode chandler, very close to the spinning cylinder of polythiophene.

presses cost them up to £250 per hour whether running or idle. Change-overs between jobs can take up to an hour, which adds a lot to the price of a short run.

A researcher into printing technology highlighted a number of problems that the new system would have to overcome, such as achieving fine enough detail, controlling the image and creating an image on the image carrier that is tough enough to withstand the continual friction of the blanket cylinder. If it could provide an ideal answer to many printing problems.

By reducing the time to change plates between jobs, the system makes short-run newspapers and magazines more feasible. "A designer can go straight through from idea to product with one work station," he said. It would probably help to regionalise publishing and open up new markets, he added, rather than putting people out of work.