

# Biotechnology: A new industrial revolution

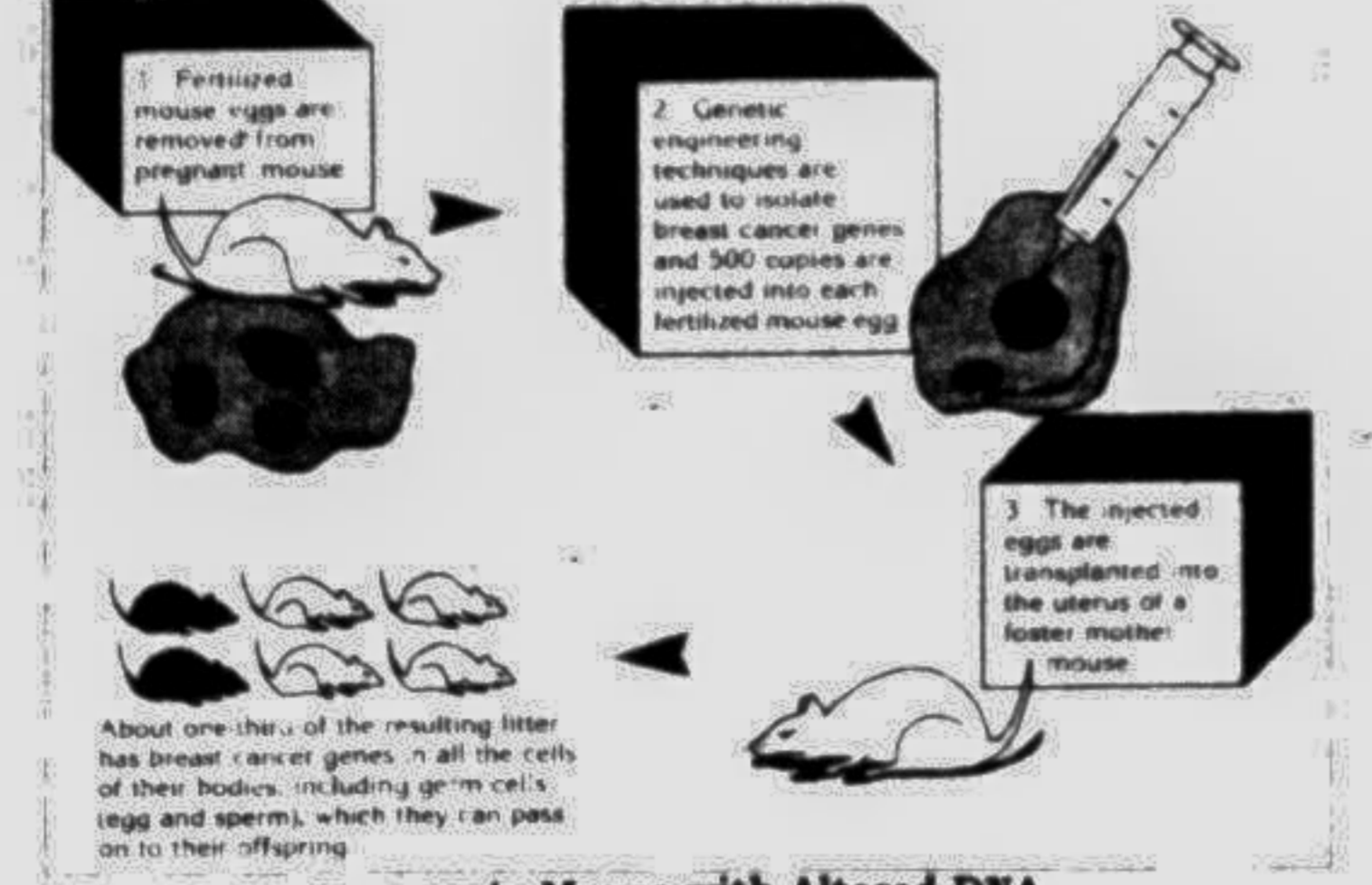
quantities of highly purified products.

### Recombinant DNA Technology

The methods used in rDNA technology are fairly simple. We take, for example, the gene for insulin production in humans and paste it into the DNA of *Escherichia coli*, a bacterium that inhabits the human digestive tract. The bacterial cells divide very rapidly, making billions of copies of themselves, and each bacterium carries in its DNA a faithful replica of the gene for insulin production.

One approach to transfer the gene embodying the instruction for insulin production would be to cut the appropriate gene from human DNA and paste, or splice, it into plasmid DNA, a special kind of DNA that takes a circular form and can be used as a vehicle for this editing job. Our "scissors" are the class of enzymes called restriction enzymes. There are well over a

hundred restriction enzymes, each cutting in a very precise way a specific base sequence of the DNA molecule. With these scissors used singly or in various combinations, the segment of the human DNA molecule that specifies insulin production can be isolated. This segment is "glued" into place using an enzyme called DNA ligase. The result is a recombinant DNA molecule. When this recombinant plasmid DNA is inserted into *E. coli*, the cell will be able to process the instructions to assemble the amino acids for insulin production. More impor-



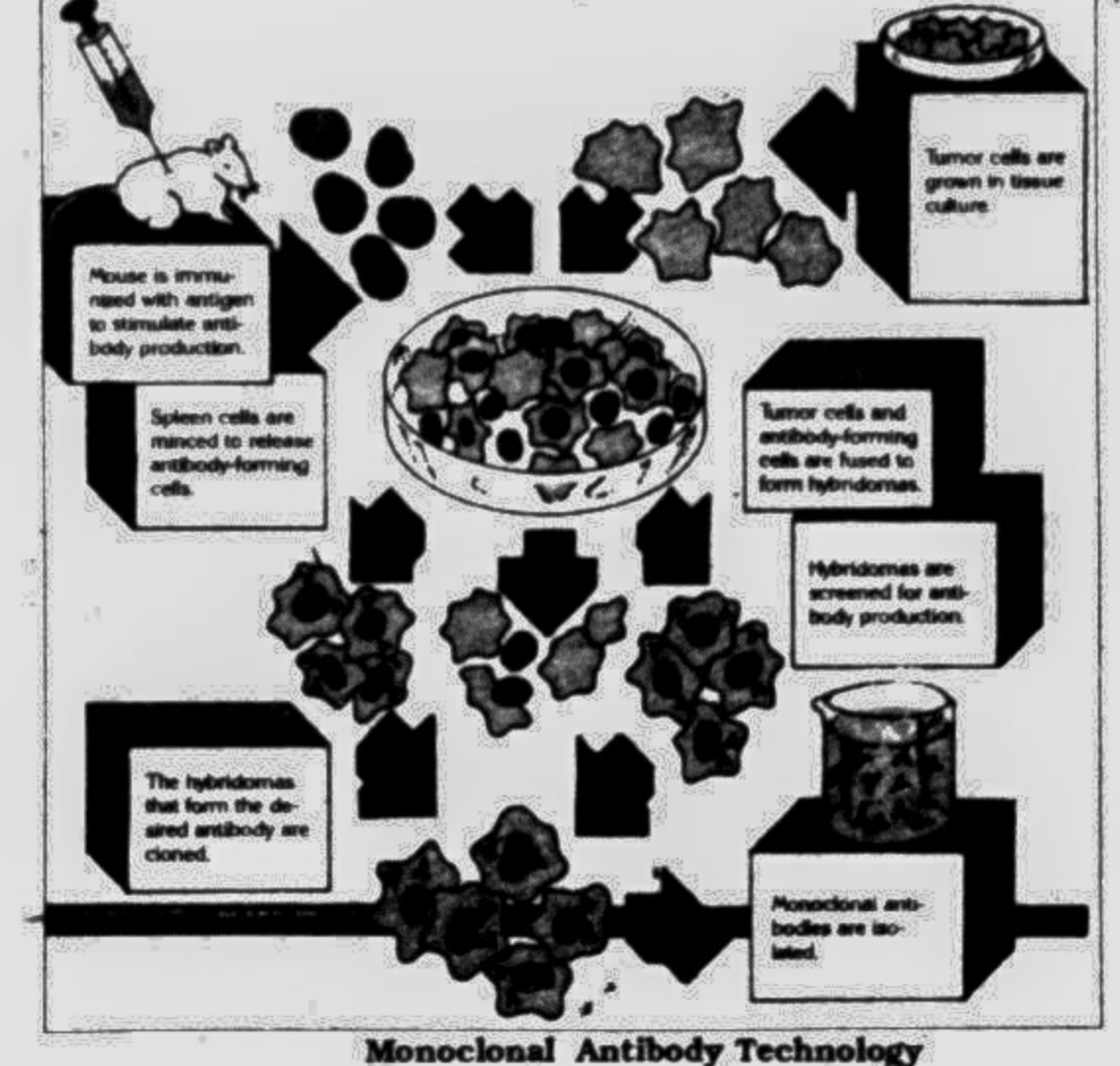
tant, the new instructions are passed along to the next generation of *E. coli* cells in the process known as gene cloning.

This highly simplified description of rDNA technology does not fully convey the enormous complexity or aw-

ful technology, tumor cells that can replicate endlessly are fused with mammalian cells that produce an antibody. The result of this cell fusion is a "hybridoma" that will continually produce antibodies. These antibodies are called monoclonal antibodies because they come from only one type of cell; antibodies produced by conventional methods, on the other hand, are derived from preparations containing many kinds of cells, and hence are called polyclonal. Because the selected hybrid cells produce only one specific antibody, they are more pure than the polyclonal antibodies produced by conventional techniques.

- ### Applications of Monoclonal Antibodies
1. Diagnostic procedures for the early detection of diseases and infectious agents
  2. Quantifying low levels of hormones and peptides
  3. Antirejection agent in organ transplantation
  4. Tissue typing
  5. Tumor location and possibility of selective elimination of tumors

**Bioprocess Technology**  
Bioprocess technology is based on the principle of combining living matter (whole organisms or enzymes) with nutrients under the conditions necessary to make the desired end product.



## Minerals of Billions of Dollars Await Extraction

by Lutfur Rahman

NATURAL gas is the only mineral resource in Bangladesh, according to the Europa World year book 1992. But in 1968 some valuable minerals were found in the Cox's Bazar sea beach and the nearest islands.

To bring the minerals in their pure state is difficult but not impossible. New technology and instruments have been discovered to purify and process these minerals. With modern technology it is also possible to synthesize most minerals including diamond in the laboratory.

Extraction of the minerals does not always need to be profitable. Because these minerals are the sources of metallic minerals. The grade of an ore varies from deposit to deposit. Whether an ore can be mined is a question of costs and metal prices, since both vary. Cost of mining depends to a large extent on the geology and mineralogy, for these largely determine the mining method. Metal price is a function of world conditions and the rarity of the metal or ore.

The money we need for extraction, purification and processing can be arranged from international organisations and the world famous geological surveys. We can get help in the form of cash, technology and expertise. Many poor countries like ours have developed their economies and produced many experts of their own through these organisations.

In the developed world, the market demand for these minerals has matured. We should take necessary steps immediately for extraction separation and utilisation of the minerals. Some Third World governments think they would explore the minerals when they would be financially solvent. This is a wrong idea because many metals or ores go out of favour or improvements in technology or new discoveries favour sources elsewhere. For example mercury has lost its market due to environmental pollution. Optical glass fibres has replaced coppers in telecommunications. We have lost jute market

to synthetics. Moreover, the industrialised developed countries have started recycling process. Metals have a high recycling value which has long been an economic bonus.

These minerals are used in many industries in our country. But it is a matter of great regret that these minerals are imported at a cost of huge foreign currencies every year.

During the last 25 years there has been no progress in exploration, and marketing of the valuable minerals. The reason is that proper men were not given proper jobs. As for example some people having no previous experience and no training on these fields are wasting time and money every year in the name of research and development.

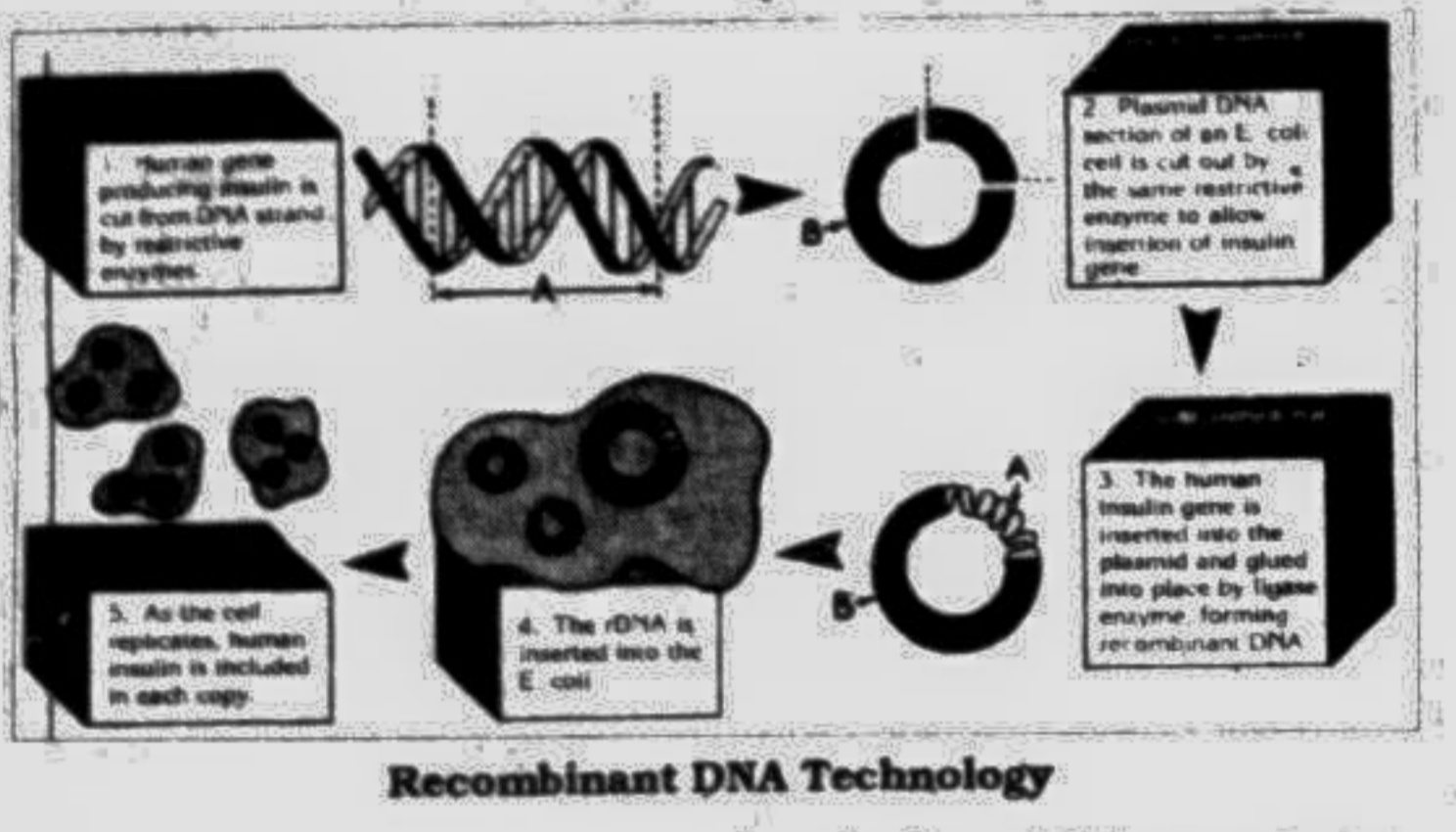
On the otherhand, Bangladeshi experts and skilled persons working abroad in these fields are not coming back due to non-availability of jobs. It is surprising that most of the university students and engineers are not familiar with the valuable minerals available in our country because nobody felt any necessity for informing them about the valuable minerals.

New important materials enable new technologies to develop which result in new industries and an increase in national wealth and employment.

At present the total market price of all the minerals in the pure state is approximately 10 to 15 lakh crore which means if the amount is distributed among the people of Bangladesh every body should get at least one lakh taka. This is a fact and it is scientifically and technologically proved.

For proper utilisation of these valuable minerals, a national policy has to be formulated. Local scientists, experts and engineers must be given necessary supports to be equal to the task. With help from abroad the right kind of technology has to be adopted for commercial extraction of the valuable minerals.

A former electronics engineer, United States Geological Survey and member of the National Committee for Mineral Resources.



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### Applications of Recombinant DNA Technology

1. Gene mapping — e.g. map of human genome
2. DNA probes — detection of genetic disorders — diagnosis of infectious diseases — crime-solving by DNA finger probes — detection of microorganisms that cause food poisoning
3. Gene replacement — gene therapy, e.g. in Cystic fibrosis
4. Genetically altered microorganisms with the ability to produce foreign proteins, e.g. vaccine, insulin, growth hormone, erythropoietin
5. Genetically improved crops, e.g. resistance to disease and pests
6. Genetically altered animals (transgenic animals): — animals that produce useful human proteins

## Satellites Deliver the Message

by Michael Adams

THE benefits of radiopaging are frequently obscured by the success enjoyed by cellular telephones in many countries across the world. However, radiopaging offers major advantages, both to the operator and the user, in getting information to people who are out of reach of a telephone.

Recent developments in the United Kingdom in applying satellite technology to radiopaging provide improved performance and reduced costs, and have particular advantages where the telecommunications infrastructure is already overstretched.

The accelerating tempo of

time firemen or lifeboat men can be "bleeped" when an emergency occurs.

### Fundamental Difference

Pagers were originally developed as a means of getting medical staff at St Thomas's Hospital in London to contact the switchboard or their own department. Since then the concept has been developed to encompass both "private" and "public" systems, with a choice of numeric, voice, and alpha-numeric pagers that are much smaller than a packet of cigarettes and can be easily carried in a pocket or handbag or even clipped to one's belt.

### Landline Difficulties

As can be appreciated, a pager can only respond when it is within range of the transmitter. Consequently, in order to increase the service

details of the request into the paging control system. The paging transmitter then broadcasts a unique code (address), to identify the pager being called, followed by a message, which may be a simple alert, a telephone number, or even a quite detailed message of up to, say, 50 words. Every pager ignores messages except those uniquely addressed to it.

### Error-Free Transmission

This new satellite technology ensures that transmissions to the ground stations are synchronised to within microseconds and messages can be transmitted error-free. Each VSAT is relatively easy and quick to install, so it is a simple, cost-efficient matter to extend coverage. Furthermore, it is even feasible to provide temporary paging coverage for a special event such as a major sports tournament.

The Compondex system comprises hub and outstation equipment, the former in two parts: the network control unit (NCU) and the uplink hub. The NCU is next to the paging switch, at the control centre, while the uplink hub is sited in the user's chosen uplink facility (such as at the PTT's satellite earth station). The outstations each consist of the paging transmitters (which are required irrespective of how the interconnection is made) and the VSAT receiver and demultiplexer to take the signals received from the satellite and convert them to a suitable form for the normal paging transmitter equipment.

The first network in the world to use this type of equipment was launched in Britain in April by Mercury Communications. The paging signals (using 512, 600 and 1200 bit/s protocols) is transmitted by one of Mercury's main satellite ground stations in London's Docklands to a Eutelsat satellite. From there, the messages are transmitted back to earth-

## New Severn Bridge Highlights European Cooperation

by Alan Peterson

EUROPEAN cooperation may, in some instances, seem fragile, but cross-border ventures between Europe's contractors and engineers are fast becoming the norm. A prime example is the Second Severn Bridge Crossing in the UK, where British and French contractors and engineers are working side by side to complete what will become Britain's largest project for decades.

The \$430 million (£300 million) crossing will be 5.2 km long and comprise two multi-span approach viaducts running across the Severn estuary from the Avon (England) and Gwent (Wales) shores to the main bridge spanning the navigation channel. The central spans will be carried on cables from two H-frame pylons rising 148 m above water level.

On either side of the estuary, construction yards are rumbling with activity as the concrete caissons and viaduct and bridge spans are formed. It is with the intention of minimising work off-shore in the face of the extreme tides racing up and down the estuary on each side of the river, that the huge concrete precasting yards are operating.

### Relieve Pressure

The project was conceived to boost transport links between England and Wales and relieve pressure on the existing Severn Bridge. Building will take four-years and is being carried out to a design, build and operate basis by Laing-GTM Entrepren[?] as contractors, and Halcrow-SEEE (Societe de Etudes et d'Equipements) who have responsibility for the overall design.

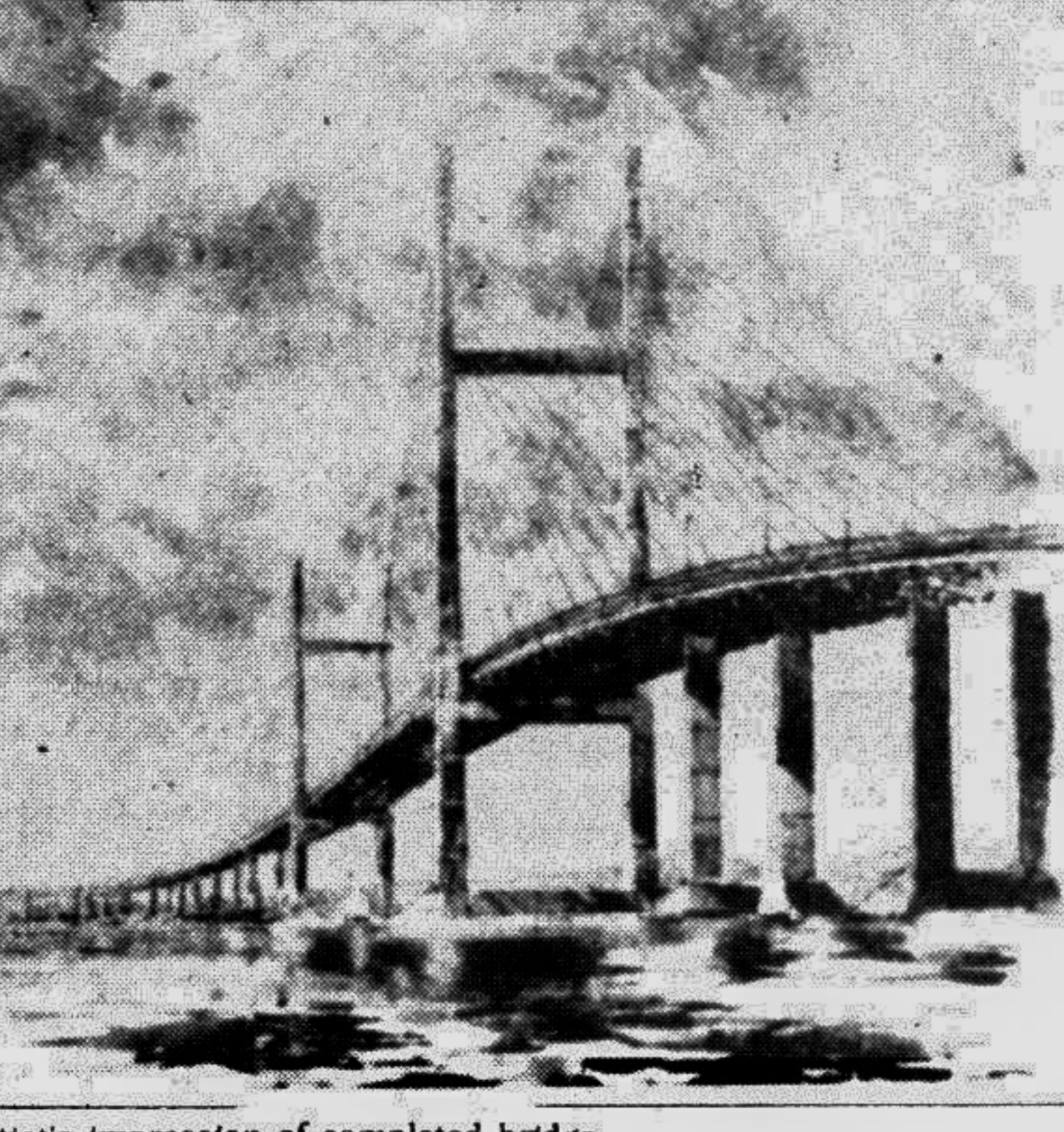
Both French companies have considerable bridge experience. SEEE is the design company within GTM. Its experience in cable-stayed multi-span designs ranges from the Evipos bridge and Rion Antirion fixed link crossing, in Greece, to the Honfleur bridge (main span 856 m — a world record), over the River Seine in France.

Halcrow, which traces its roots back to 1868, has designed hundreds of bridges, including the Orwell bridge near Ipswich, in eastern England, which, at 190 m, has the longest concrete span in Britain. The company was also

involved as design consultant for the 2.7-km Dartford Bridge crossing (SW England), and for Hong Kong's Lanlau crossing.

### Joint Initiative

The joint Halcrow-SEEE initiative has assembled some 480 engineers and other specialists to deal with the complexities of the structure, while the on-site staff consists of equal numbers of French



Artist's impression of completed bridge.

and British, plus other secondments and exchanges. According to project director, John Haste, the scheme "is the most exciting challenge for all involved", while David Mizon, Halcrow's man on site, has praise for both, with British practicality and French theoretical expertise complementing one another.

Initial attention in early 1992 was focused underground. Site investigations, conducted during 1989-90, provided data for the detailed design. The crossing's two approach viaducts comprise concrete box sections with slender cantilevered decks. They will rise, on a series of twin piers, to the main 912m-long cable-stayed bridge, the centrepiece of the crossing.

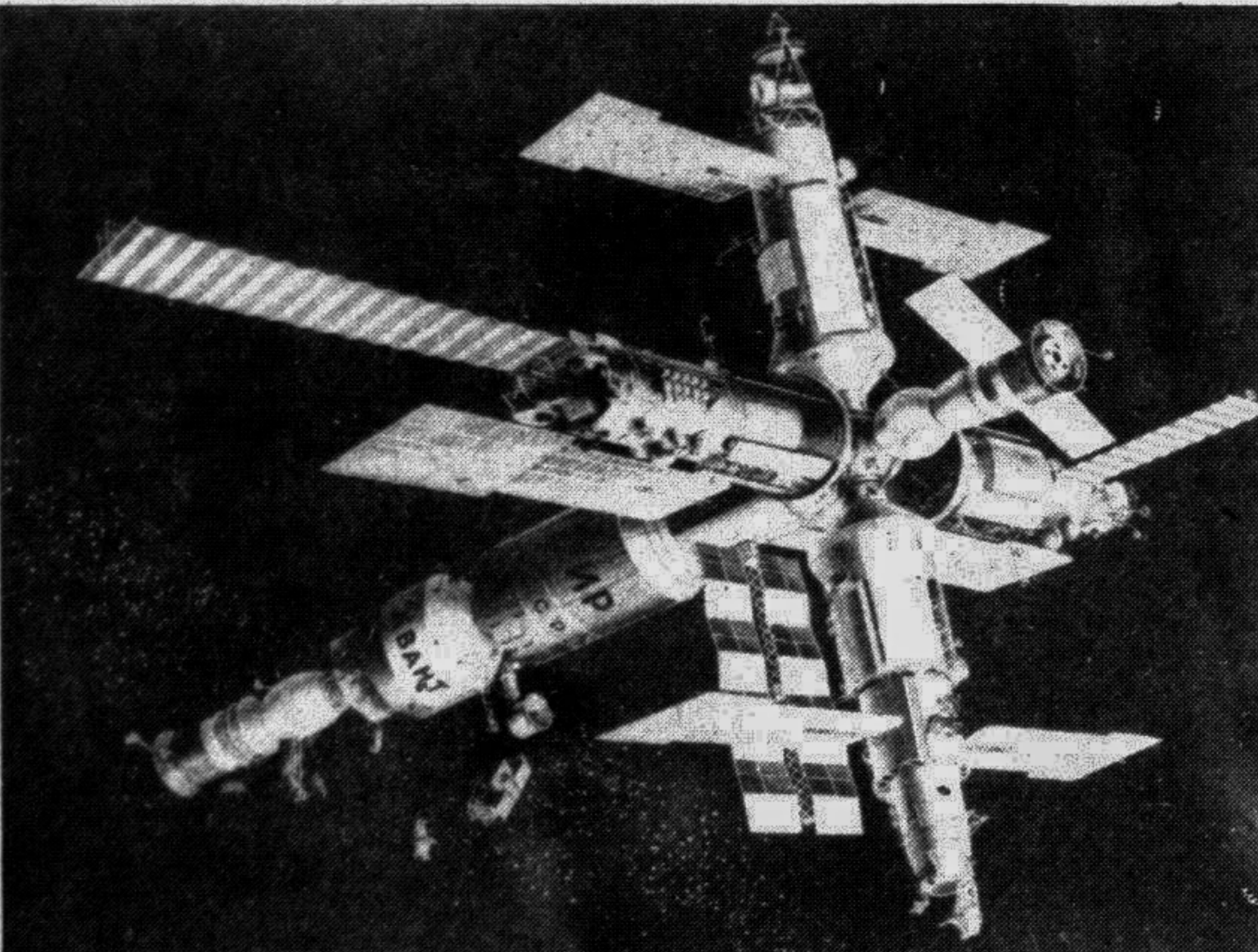
The statistics are impressive: there are over 27 approach spans on the Gwent

side, and 25 on the Avon side; 42 foundations in the caissons. The total volume of concrete required will be 320,000 m<sup>3</sup>; plus over 30,000 tonnes of reinforcing steel and over 150,000 m of prestressing steel. The number of cable stays in the bridge will be 184. Over 1000 men will be employed, many from local areas of unemployment, before completion and 30 m long, will straddle the tunnel, spanning it diagonally to its axis, and coming to within 10 m of the tunnel wall.

### Rail Tunnel

Cased for the top 23 m with a 2-m-internal-diameter, 16-mm-thick walled tube, the latter is treated with a bitumastic slip to prevent any future load transfer to the ground in the region of the rail tunnel. The pier loads will be transferred to the sandstone by the piles which toe in some 2 m.

Operations are supervised in the dry, behind bunds, and from large jack-up or lifting barge. On both sides, direct founding on rock is not possible for all bridge piers, so the piles carry loads down through the alluvium into the underlying rock.



Mir station — scientific and production modules cluster.

today's society makes it increasingly important to be able to make contact with people on the move. Pagers provide a convenient and cost-effective solution to this problem in general.

In eastern Europe, where there is a shortage of telephones, pagers can provide a very valuable tool. Not only can they be used to contact individuals, but to provide an information update. In Britain, for example, message pagers are being used to provide up-to-the-minute stock exchange prices or a news service in a manner that is virtually unique. A "group call" is used to enable the same information to be sent to a whole group of pagers. Group call has many other uses; for example, part-