

'Synthetic Experience' to Help Prevent Industrial Disasters

by Asif Khan

Madras (India): Past accidents at industrial plants may provide lessons for the future. But those who run the plants do not have to wait for something to go wrong to learn the same lessons.

According to a new book, they can do so by gaining 'synthetic experience' — creating an artificial scenario leading up to an imaginary accident.

The idea is to prevent a possible tragedy involving loss of life and damage to property.

"Synthetic experience makes it almost as easy to spot the faults in design and operation of a plant in prospect as in retrospect," says the book, published by the Commonwealth Science Council (CSC).

It suggests the adoption of HAZOP (hazard and operability studies), a proven method of providing a form of synthetic experience.

The method involves a team whose members visualise possible ways in which a plant can develop a fault or be wrongly operated, leading to an accident. They are given guidelines on how to undertake the exercise.

The book, *Methodologies for Risk and Safety Assessment in Chemical Process Industries*, says: "Learning by experience is expensive in terms of human suffering and financial loss. Some form of synthetic experience appears therefore to be most desirable."

The book is intended as a manual and guide for scientists, managers, industrial engineers, academics and others concerned with safety in chemical processing industries. It covers a wide range of topics — from the nature of hazards to techniques to assess them.

It uses simple language, illustrating points with the help of charts and drawings and facts and figures. Important references and suggestions for further reading are given at the end of each chapter.

The manual notes that many dangerous chemicals are used to make household products — from soaps and detergents to sugar and paint.

"The question uppermost in the minds of people is whether these chemicals present a serious threat to them and the environment, and if so, to what extent." Hence the need to quantify the hazards.

The manual was released at an international workshop on hazard assessment and disaster mitigation in petroleum and chemical processing industries, held in December at the Central Leather Research Institute (CLRI), Madras, South India.

The workshop was arranged by the Commonwealth Science Council in conjunction with the Management Development Programme of the Commonwealth Secretariat and India's

Council of Scientific and Industrial Research (CSIR). It was sponsored by the Commonwealth Fund for Technical Cooperation, the developmental arm of the Secretariat.

Participants came from Bangladesh, Britain, Canada, India, Jamaica, Malaysia, New Zealand, Pakistan, Swaziland, Tanzania, Trinidad and Tobago, Uganda, Zambia and Zimbabwe and two non-Commonwealth countries — Indonesia and Thailand.

An aim of the workshop, the first of its kind, was to enhance awareness of the latest technologies for hazard assessment and accident prevention in petroleum and chemical processing industries.

Dr Srinivasan Varadarajan, a former Director General of CSIR and chief consultant to India's Planning Commission who led the crisis management team at the 1984 Bhopal gas leak disaster in India, released the manual during the opening ceremony of the workshop.

Among those at the ceremony were Mr Surjit Singh Barnala, governor of Tamil Nadu state, of which Madras is the capital, Commonwealth Assistant Secretary-General Moni Malhoutra, Dr A P Mitra, director general, CSIR, Dr Gopalakrishna Thyagarajan, the outgoing secretary of the CSC, now director of CLRI, Mr Bob

Young, a Canadian with the United Nations Environment Programme, Paris, and Mr Chandra Pinnagoda of Sri Lanka, who is with the International Labour Office in Geneva.

The manual was produced by two award-winning Indian scientists, Dr K V Raghavan and Dr Asad Ali Khan, deputy directors respectively of CLRI and the Indian Institute of Chemical Technology, Hyderabad, who were both members of the Bhopal team.

They say: "Increasing public awareness of technological risks has placed a great responsibility on the chemical and allied industries to review and revise their current safety practices to make them safer."

Participants in the workshop, which discussed HAZOP among other subjects, were agreed on the usefulness of the manual and the meeting.

Mr Paul Saunders, a 25-year-old research officer with the Office of Disaster Preparedness, Kingston, Jamaica, said: "I'm most grateful to the CSC for giving me and my country the opportunity to attend the workshop."

"This has brought me up to date with the latest risk assessment methods of which I would otherwise have remained unaware. I shall share the knowledge I acquired here — and the manual with my

colleagues back home."

Mr Tariq Sultan Pasha, 31, a chemist and occupational hygienist with the Government of Punjab in Lahore, Pakistan, said: "We have a lot of factories using chemicals, and our government is preparing a major hazard assessment project to promote safety."

"I am going to make recommendations to the government based on what I learnt at the workshop. It has been a useful and worth-while experience."

Madras was the second in a series of workshops being held by the CSC to help Commonwealth countries minimise the effects of disasters — both natural and man-made.

The first, on floods, was staged in Bangladesh early in 1990 and the third and final in the series, on hurricanes, will take place this year in the Caribbean.

Copies of *Methodologies for Risk and Safety Assessment in Chemical Process Industries* can be obtained by writing to Mr M M Hasan, Project Officer, Commonwealth Science Council, Marlborough House, Pall Mall, London SW1Y 5HX, UK, enclosing a clip of this article. Please state name, place and date of publication.

— Commonwealth Feature.



COMPUTER CONTROLLED CLIMATE AIDS SORGHUM RESEARCH

An experimental system of glasshouses at Nottingham University has enabled researchers to control environmental factors, such as air temperature and humidity, while growing crops in natural soil and daylight. The effects of a single variable, for example soil moisture content, can be monitored and quantified at the crop level.

These facilities, accurately controlled by a central computer, are being used as part of a project funded by the Natural Resources Institute to predict sorghum yields for drought-prone regions, such as Botswana.

Through computer models of crop growth and development and measurements on sorghum, scientists at the university have found good agreement between the predicted yields and actual yields obtained in a range of environments. They believe that computer predictions may form the basis of future plant research and collaboration.

Pictured examining sorghum in a controlled environment are Dr S. N. Azam-All (right), Lecturer in Tropical Agronomy, and Simon McWilliam, an undergraduate.

The Signal that Tells Videos When the Time is Right

PROGRAMMING the video could become much easier in future, thanks to one of Britain's television networks. Early next year, Channel 4 will start transmitting computer codes along with each programme which will automatically switch on video records when a programme begins and off when it ends.

There are already systems where viewers can program their videos using bar codes, similar to those used in supermarkets, printed in programme listings. If the programme is rescheduled, however, the recorder will miss it because it is only following its internal clock. In the new system, the video follows codes transmitted with the programme, so if the programme is moved, the recorder will still be switched on at the correct time.

The success of the idea relies on manufacturers developing a new generation of video cassette recorders. Channel 4 is now talking with all the major companies and hopes the new recorders will go on sale

by Christmas. Market research just completed by the consumer electronics company Ferguson reveals that three out of 10 people have never learnt to set their video recorders to tape programmes while they are out or away. Chris Daubney, Chief Engineer at Channel 4 believes that the real number is much higher. "The market researchers just found the three out of 10 people willing to admit they can't program their VCRs," he says.

The manufacturers' trade body, the British Radio and Electronic Equipment Manufacturers Association (BREMA), likes the idea of automated recording control because it will stimulate flagging sales of video recorders.

The digital codes will be transmitted on screen as part of the conventional Oracle teletext signal. New recorders will incorporate a teletext decoder that recognises the codes and sets the VCR's timer to start recording at the coded time. Older recorders will simply ignore the codes.

Until recently, it has been

illegal for any company in Britain to broadcast codes that aid taping. Any company that did risked being accused of incitement to infringe copyright. However, the new Copyright Designs and Patents Act 1988, which came into force on 1 August last year, allows people to make private recordings of TV programmes to watch things they would otherwise miss.

The fly in the ointment is that there are three rival code systems. West German broadcasters started using a primitive video programming system, VPS, five years ago. In this system, one of the horizontal lines making up the black border at the top of the picture (line 16), which normally carry teletext data at the high rate of 6.9 megabits per second, carries the much slower VPS code. This code, travelling at 2.5 megabits per second, wastes space for teletext data.

The European Broadcasting Union has proposed two ways of hiding the codes in conventional teletext. The first proposal called Format 1, adds an

extra packet of data which identifies the TV programme by name, transmission time and date. Each programme would have an identifying number published in the press. The user finds the number, then enters the number on the video recorder.

But Channel 4, backed by the manufacturers, favours the more elaborate Format 2 proposed last year by the European Broadcasting Union. Programmes will be labelled in the same way as in Format 1, but TV stations will transmit their advance programming schedules as teletext pages. All the viewer has to do is call up the listing on screen and move a cursor onto the programme to be recorded. This automatically stores the code in the VCR, which sits waiting until the matching code is transmitted at the beginning of the programme. At this point, it starts recording. So the user does not have to look up and enter codes from published listings. Channel 4 has also proposed that the same system be used to switch on TV sets automatically as programmes begin.

Natural Chemical Attack on Mosquitoes

A substance whose perfume attracts Culex mosquitoes, which carry diseases including elephantiasis and encephalitis, has been produced by British scientists and is being evaluated worldwide for commercial production.

It could gradually reduce the world's mosquito population in an environmentally friendly way by luring the females to chosen sites where their larvae can be destroyed by safe insecticides.

Culex mosquitoes lay their eggs on water, and as the eggs mature they produce the chemical signal which attracts other egg-laying females to the site. This chemical, a pheromone described as a fatty-acid-like material, has been identified and synthesised at Institute of Arable Crops Research (IACR) laboratories in Rothamsted, north of London, and incorporated in effervescent tablets which release the compound when dropped into water.

Field Tests

In field trials undertaken north east of Kenya's Lake Victoria, scientists from the IACR incorporated a juvenile hormone-type insecticide into the tablets so that larvae were destroyed as they hatched. More than 80% of all the eggs were laid in water treated with the attractant.

The field tests of the tablets, which were produced after five years IACR research, were undertaken in collaboration with the London School of Hygiene and Tropical Medicine and the International Centre of Insect Physiology and Ecology in Nairobi.

CHINA'S first manned helium airship has taken off. After more than a year of plans and testing by the Huahang Airship Development Group, the Fukong-4 non-rigid airship made its first demonstration flight recently.

Near Beijing, it soared, circled, turned, hovered, halted in the air and finally floated down like a helicopter.

Although limited in size and capacity, experts here believe development of the airship is a breakthrough for China where vast spaces and rugged natural conditions in some areas are a challenge to road construction, transportation and exploration of natural resources.

In these conditions, experts believe, airships can be economical and handy tools. In the rugged Taklimakan Desert, for example, oil resources are being developed. Heavy loading airships could save transportation costs by 28 to 30 per cent and shorten exploration time by half.

Airships are cheaper to produce than railroads for mountainous regions. They are useful for detecting fish along the coasts. In forests, they can haul timber and help in fire prevention.

Airships are also cheaper to design and produce than airplanes of the same loading capacity. They use only 5-7 per cent of the fuel consumed by a helicopter hovering in the air. Under special circumstances, airships have the advantages planes do not have. Airships can stay in the air for as long as several months, serving as a stable and even platform in the air.

They can make low-level flights at a rather low speed and do not need a long runway as they make vertical takeoffs.

China's first helium airship was developed after experts in four research institutes — including the Hydroplane Research Institute under the Ministry of Aerospace Industry and two factories — became aware of the practical use of airships. In 1989, they formed a conglomerate, the Huahang Airship Development Group, to design and manufacture the airship.

The main problem for the conglomerate was lack of money. "Huahang is non-official," said Shen Yongming, senior engineer of the Hydroplane Research Institute and general designer of the airship. "The money we needed was a headache. The ministry couldn't supply funds."

Shen said the airship project cost 3 million yuan (US\$638,300), all of which was supplied by enterprises that designed or supplied parts for the airship.

The most important component of an airship is its airbag which contains the lighter-than-air gas that creates the buoyancy needed to keep the ship afloat.

Unable to afford advanced technology from other countries, the researchers used their own ingenuity to devise the airbag. Qu Jianzhi, an engineer at the Beijing Aircraft Materials Research Institute, spent six months on the design.

Airships are cheaper to design and produce than airplanes of the same loading capacity

by Zhang Dan

Beijing Flies First Airship

After much trial and error, he overlaid three sheets of materials, an outer and inner sheet that protected the bag from being eroded and breaking with gas pressure from inside, and a middle sheet, the crux of the bag because it prevents the gas from leaking.

But Qu was unable to find a satisfactory polyester film in China for making the middle sheet and unable to afford to buy such film from overseas.

His answer was to press a very thin sheet of aluminum foil on polyester film available in China.

Qu succeeded finally. His finished product released only 0.7 litres of gas per sq. m. every 24 hours, compared with world standard airbag material that releases 0.5 litres.

"Designing and making the airbag was the most remarkable breakthrough achieved on this occasion," said Chen

Jichang, senior engineer and director of the Civil Aircraft System Engineering Bureau of MASI. "The cloth's quality has come in up to world standard."

But problems remain. Although the airbag model is a success and gas leakage in the laboratory is small, leakage of the actual airbag is greater than expected. The airship's engine power of 60 kilometres an hour is not strong enough for rapid propulsion, critics said. And the ship can hold only three or four passengers.

"These problems must be solved before this airship is practically used," said Zhang Hongying, deputy chief of Airworthiness Engineering Division of the Civil Aviation Administration of China, whose job is to judge if an aircraft is fit to fly.

According to Zhang, an airship needs powerful engines to produce the required speed when it meets a sudden gust of

strong wind in the air. He said the Fukong-4 airship should be able to run as fast as 74 kilometres an hour to escape a current of strong wind.

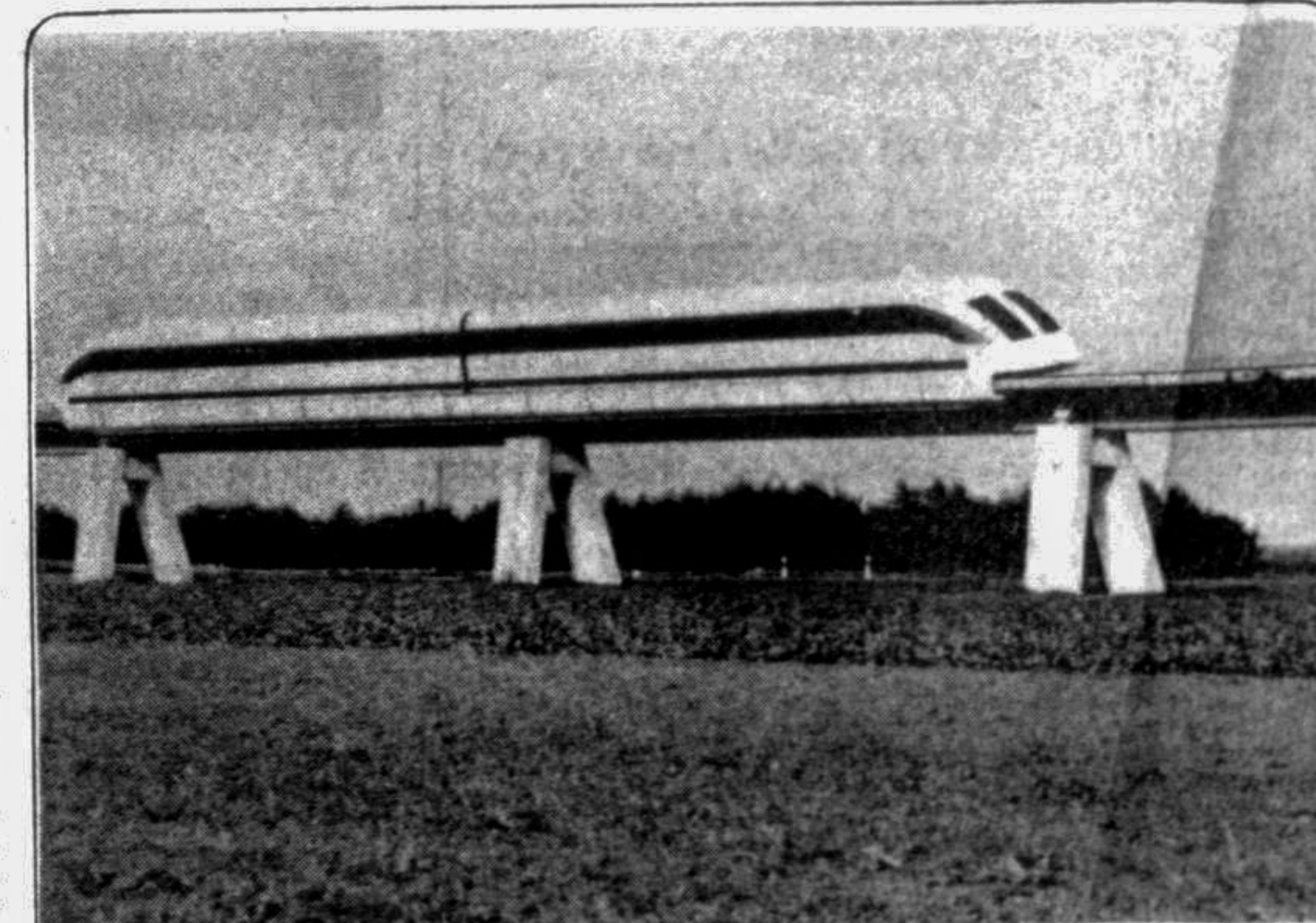
Even if the airship is perfect, the practical use of airships in China is still a problem. The biggest obstacle is the limited supply of helium gas in the country.

According to the Ministry of the Aerospace Industry, helium gas contained in the natural gas produced in Weyuan county in Sichuan Province, Southwest China, is the only exploitable helium resource found so far in China.

Its helium content is 0.2 per cent. In America and Poland, the figure is 2 to 4 per cent, or 10 to 20 times higher. The deposit of helium gas in Weyuan is estimated to be 80 to 100 million cubic metres, which will probably be exhausted in 20 years.

The Weyuan Chemical Industry Plant provided all the gas Fukong-4 used. As one cubic metre of helium gas sells 150 yuan (US\$32) in China, filling its 2,000-cubic-metre airbag costs 300,000 yuan (US\$63,800).

"It's not satisfactory, mainly because of the leaking airbag and small motors. But if we have adequate money, creating a top-class helium airship wouldn't be a hard nut to crack." — *Depthnews Science*



Super trains to compete with road, air travel.

Jet on Wheels

BEGINNING in 1991, the German Bundesbahn rail service plans to supplement the trains servicing more than fifty cities in the Federal Republic of Germany with hourly connections, the so-called Intercity (IC) system operational since 1979, with advanced and comfortable high-speed trains.

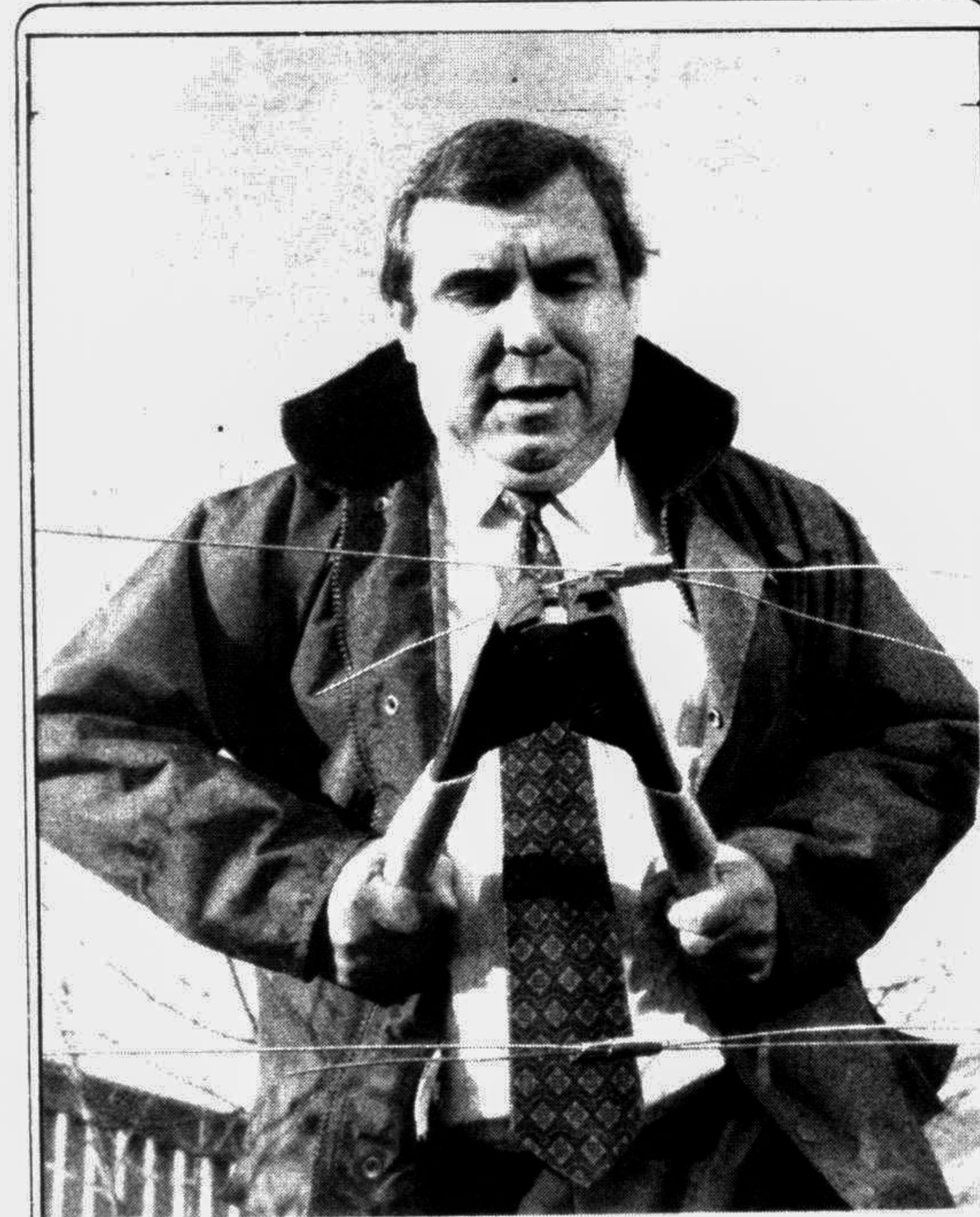
The first deployments involve 41 ICE (Intercity-Express) trains, each with

twelve passenger cars, to cover the runs between Hamburg, Wurzburg, and Munich, and between Hamburg, Frankfurt, Stuttgart, and Munich.

The engines of the ICE trains, which in test runs reached the speed of 406 kilometres per hour (252 mph)—the fastest ever for a rail vehicle, employ three-phase power technology. The train sports brake combinations whose precision coordination required the manufac-

ture of ICE-specific microprocessor elements.

This "jet on wheels," which can accommodate 600 passengers, have a width of 3.02 meters, improving seat comfort by 20 centimeters. All the cars are air-conditioned. The Intercity-Express also has on-board phones and a special service car with a quality restaurant and snack bar. Skylight windows in the carriage roof are just another special feature of ICE travel.



A GRIPING IDEA: The 'Grippler', an exceptionally powerful wire joining device is winning a UK company international awards. Pictured are a tensioning tool and the system's inventor, Hugh Facey.