

Back into the Future in China's Karstland

by Li Xiguang

Covering 15 per cent of the Earth's surface, karstland provides a unique view of the planet's past and perhaps its future



It was the longest and most ambitious karst trip ever made.

It is the summer of 1991. 71 scientists from Germany, Hungary, Iran, Japan, Thailand, Britain, the United States and China made a 6,700 kilometre trek across China. The expedition passed through subtropical virgin forest, the eastern Tibetan Plateau and the Qinling Mountains.

Karst is characterised by barren rocky grounds, caves, sinkholes, underground rivers and the absence of surface streams and lakes.

Karst is a term originally applied to a limestone area along Yugoslavia's Dalmatian coast. But covering 15 per cent of the earth's surface, it is found in the Cusses of France, the Middle East, China, the Yucatan Peninsula and parts of the US.

It is an important part of tropical and subtropical cash crops. And about 60 per cent of oil and natural gas come from karst regions which are also rich in mineral deposits such as bauxite, lead, zinc, copper, tin and gold.

In China, most of the coal — the country's major energy source — is karst-related. Most of China's hydroelectric power is produced in the southwest which has the world's most extensive karstland.

About a quarter of China's groundwater is from karst aquifer. And not least, fantastic caves and other karst formations are among China's main tourist attractions.

Because karst water and other resources are stored or flow in complex formations of different sizes and forms, they are often difficult to locate, exploit or harness, especially since these areas are frequently subject to drought, flood, deforestation and subsidence.

"Because karstland is related to rainfall and profoundly affected by climate and climatic changes, as well as by changes in human land use, the results of our investigations will not only improve our knowledge on karst formation, but will also constitute a new approach to global environmental changes," says Professor Yuan Daoxian, a scientist from the Institute of Karst Geology, Chinese Academy of Geological Sciences.

Prof Yuan led the international expedition through China's karstland. The expedition was part of the International Geological Correlation Programme (IGCP), a joint venture of the International Union of Geological Sciences and the UN Educational, Scientific and Cultural Organisation (UNESCO).

About 227 scientists in 35 countries are involved in the global project, with 44 areas in 18 countries proposed as representative karst sites. By the end of the project in 1994, scientists hope to establish relationships between karstification processes and geological, climatic and hydrological conditions and relevant mineral resources.

Scientists are also developing a database to help predict future karst processes and assist in the protection of this fragile environment.

During the first stage (1990-91) of the 5-year project in China, technical guidelines were established, followed in July 1991 with a field seminar and expedition — from Gulin in south China, through Guiyang and Qingling Karst in central China to Shandong in the north.

"China is one of the most favourable regions in the world for international correlation on karst," said one participant, commenting on the wide variety of terrain, most of it quite different from other karst regions.

Three major karst types were identified: humid subtropical in south China combining tower karst, deep sinkholes, red soil, surface tufa, big caves and underground streams, many with gigantic speleothem (stalagmites, stalactites and other formations); semi-arid karst in the north composed of mountains, dry valleys, limestone scree with loess cover, small caves, and big springs but little speleothem; high mountain karst in western China characterised by frost denudation, limestone pinnacles, tiny caves with very few speleothem and small springs.

The expedition found that in south China, karst areas are often drought-stricken although most of the territory has an annual rainfall of over 1,000 mm. "Because of leakage of surface water into underground conduits," Yuan explained.

During rainstorms, however, sinkholes and larger depressions called poljens are often flooded when underground conduits are not big enough to carry off excess water. Scientists saw the situation as worsening due to widespread deforestation although they were impressed by small-scale projects to regulate and exploit water resources in the regions' karst conduits.

World geoscientists studying the earth's past have long considered caves and closed depressions as geological dustbins where both inorganic and biological sediments remain over long geological periods without washing away. The study of karst, therefore, is shedding new light on paleoenvironments, while tracing the history of environmental change.

—Depthnews Asia

Kuwait will be Better Equipped With Modern Science

KUWAIT should invest more in education, encouraging its youth to study science and technology. The country also needs to have a clearer vision of what it wants of its higher education and should work out a master plan of what should be done in the future.

These are recommendations made by a group of experts that UNESCO sent to Kuwait to review its higher education and research institutions, and to suggest reforms. In their report, the participants propose five projects to this end.

The mission visited Kuwait during the period from 25 January to 1 February, meeting and discussing with ministers, planners, professors, university managers, teachers and students.

In their conclusions from the mission, the experts point out that Kuwait's society and system of education are at a crossroads after the destruction during the war. However, the destruction of Kuwait's institutions makes it possible to rebuild them to answer the future needs of the country, the report said, pointing to the successes of Germany, Japan, Korea, Taiwan, Hong Kong and Singapore.

Developing Kuwait's own human resources is central, the report says, and the work should start in primary school — or even earlier. Children should have a strong foundation in basic skills and English. Parents have an important role to play, in imparting to their children an interest in science and technology.

This is essential, if Kuwait wishes to reduce its dependence on foreign labour. Kuwaiti youth should be attracted to the scientific and technological sectors of the economy, the report says, to answer the needs of the marketplace in a modern techno-

logical society. Also, young Kuwaitis should be encouraged more to work in the productive sectors. The present system provides the greatest incentives for youth to seek comfortable government jobs, and many are reluctant to be brave the competitive environment of the private sector, the report continues.

Careers in science and technology are not popular among Kuwaiti youth; students only want to become doctors

Careers in science and technology are not popular among Kuwaiti youth; students only want to become doctors and engineers because of the prestige of these professions, the report states. Those students who enroll at the faculty of sciences often do so because they could not get into the faculties of medicine, engineering or business, the report said. Students are not aware of the importance and value of science and technology.

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Kuwait University, founded in 1966, suffers from an identity crisis. It still lacks a real campus and a common library, and as a result, has no "heart". Neither does it possess the full extent of intellectual and operational independence that is required for the commonly accepted principle of academic

freedom, the report says. In addition, the team recommended that the University's links with the outside world should be developed and encouraged, as well as those of the Kuwait Institute of Scientific Research (KISR). One way to achieve this would be to exchange staff with institutions abroad; by making use of the UNESCO chairs and twinning programmes, the report says.

To gain more support from the outside world, Kuwait should ensure a wider distribution in the Arab region for its well-known publications, such as Al-Arabi, Alam Al Fikr and the Arabic version of Scientific American. At present, their distribution abroad is subsidised, but the whole demand for these publications is not satisfied.

The five experts UNESCO sent to Kuwait are Marshall Elliott (Assistant Director at the Sunderland Polytechnic), Donald Glower (Vice President for Development at the Ohio State University), A R Kad-doura (Former Assistant Director General for Sciences at UNESCO), David Shirley (Senior Vice President for Research and the Dean of the Graduate School at the Pennsylvania State University) and Ismail Sirageldin, (Professor of Population Dynamics and Economics at the Johns Hopkins University).

Another project concerns the wider distribution of Kuwait's scientific, literary and cultural publications within the Arab region, possibly through local editions in other countries. In the war and the occupation, many foreign staff left Kuwait's institutions of higher education and research — to restore the capacities of the institution, the mission suggested the creation of a programme to attract teachers and researchers from abroad to Kuwait. UNESCO Press

Cuba Fights Blockade to Sell New High-Tech Drugs

by Hilary Clarke

THE swish air-conditioned red brick Centre of Genetic Engineering and Biotechnology on the outskirts of Havana looks like it should be in Sweden rather than a developing country, save for the open roof of the tropical garden in the foyer.

In laboratories furnished with up-to-date high precision equipment imported from Japan and Switzerland, young scientists are working day and night to develop new drugs and tropical plant varieties that the government hopes will save Cuba's vexed economy.

Fidel Castro, who long ago gave up his cigars to encourage Cubans to quit tobacco, continues to set a health example by becoming a convert to the centre's latest development, an all-round drug called PPG.

"PPG cleanses the blood of excess fat and so reduces cholesterol," explains institute researcher Ricardo Rodriguez. The centre claims the drug, which it is trying to market worldwide, also lowers blood pressure, relieves circulatory troubles, improves memory and increases energy.

The Cuban government began to develop biotechnology as an important industry 10

years ago with the development of mass production of a blood product known as interferon, which was found to be a successful treatment for dengue fever. A few months later the same product was used to treat victims of an epidemic on the island of an acute form of the eye disease conjunctivitis.

Sara Mata, legal adviser at the centre, who is charged with surveying commercial vehicles, said: "Half way through we realised that our research could have commercial potential. We are in the vanguard among developing countries in the field of biotechnology."

Since then more than 163 medical and agricultural products have been developed by Cuban scientists, including what is known as Epidemic Growth Factor (EGF), a genetically engineered protein which when applied to burn victims speeds the reproduction of

conjunctivitis. Tourists to Cuba who fall prey to the Caribbean's treacherously hot sun can also benefit from EGF.

A special after-sun lotion containing EGF is being marketed in all the main tourist outlets.

The centre is currently looking for a commercial partner to help it develop an anti-wrinkle cream. "For the luxury cosmetic market we need help especially in marketing and packaging," said Mata.

The patenting aspects of the products developed by the Havana centre are carried out

by a group of specialists. While penetration of world pharmaceutical markets is difficult for any new entrant because of the domination of a handful of multinationals, HeberBiotec S A as the centre's commercial outfit is known, faces the extra obstacle of the 30-year-old US economic blockade of Cuba.

Any Cuban attempt to market biotech products abroad faces stiff opposition from the island's drug neighbour.

Controversy raged around a contract between Cuba and Brazil a few years ago when Brazil ordered anti-meningitis vaccine from Havana. The United States claimed the vaccine, which undercut similar products made by US transnationals, had not been properly tested.

Contact between Cuban biologists and their colleagues in North America continue, although even intellectual pur-

suits sometimes fall foul of the economic blockade. Last year the US refused visas to 14 Cubans invited to a biotechnology conference in Miami.

Often in science, the art of success is getting the researchers' findings published. The centre in Havana publishes a trimonthly review by the Ibero/Latin American Society for Research in to Interferon and Biotechnology in the health field.

Mata is confident that Cuba's biotechnological industry will succeed. "Cuba is known for its sugar and tobacco, not its pharmaceuticals. But we have many competitive advantages, not least price," she said.

A researcher at the centre is paid around 170 pesos a month. New apartment blocks are being built to house the 400-odd scientists who work there, so they do not waste time travelling to and from work.

Said Mata: "We are not concerned with making money. Cuba has a long history in developing cheap and effective treatment for tropical diseases. We hope to be able to help countries in Africa by producing affordable products."

— Gemini News

Brazil Programmes New Energy

by Patrick Knight

BRAZIL'S pioneering fuel programme, in which four million of the country's cars are powered by alcohol distilled from sugar cane, is in the doldrums.

The fuel programme was set up with great fanfare in the late 1970s, when the high price of oil threatened to bring the country to a standstill.

The sugar-cane fuel sold for three-quarters of the price of petrol and, a couple of years ago, nine out of 10 new cars were fitted with alcohol-burning engines.

But rather than continuing to rise, as seemed likely a decade ago, the price of oil has fallen steadily. While the cost of distilling a barrel of alcohol has been cut from US\$70 to less than US\$50, the price of oil can sometimes dip below US\$20 a barrel.

The sugar-cane industry claims it costs more to produce alcohol from the cane than the government allows it to charge for the result, and production has stagnated.

But the key to reviving the flagging industry could lie in more efficient production of the electricity that is generated from leftover sugar-cane waste.

Demand for the sugar-cane fuel has continued to rise and last year the industry found itself in the embarrassing position of not having enough to meet the need. More than a billion litres of methanol fuel had to be imported to keep the cars running.

To produce the 13 billion litres of alcohol fuel set as a target, as well as to refine the

7 million tonnes of sugar consumed in Brazil each year, close to 30 million hectares are planted with cane each year. This is equivalent to three-quarters of the land on which all of Brazil's soya, maize, rice, cotton and bean crops are grown.

Last year's ideal weather produced a record crop of 235 million tonnes of cane, a third of the world's total. To put that in perspective, the second largest producer, India, grows a little more than 100 million tonnes a year.

Brazil spent about US\$2 billion to set up the alcohol fuel

programme, but the industry has not been able to make enough profit in recent years to pay off its debts.

The widespread use of sugar-cane fuel has been criticised by oil companies. They say that if the money spent on setting up the programme and subsidising the fuel had been spent searching for oil, the country would now be close to

self-sufficiency. Brazil invested in an extensive 10-year exploration programme and now produces more than half the oil it consumes. Major offshore finds of oil mean self-sufficiency could become a reality.

Now, ironically the alcohol programme produces the fuel the country least needs — a substitute for petrol. Because of the alcohol programme, Brazil finds itself exporting large quantities of petrol each year, while importing some diesel fuel to power the country's trucks.

In the process of distilling

tries, or used to feed cattle. However, electricity has also been subsidised and those who generate it privately have been paid only about a third of what it costs to produce. But subsidies are being cut.

To survive without subsidies, the alcohol industry will have to become more efficient. While the development of new varieties of cane and improvements in the refining process have cut the cost of alcohol fuel, it still remains considerably more expensive than oil.

It has been calculated that the cane could produce as much as 10 per cent of Brazil's

electricity, some 4,000 megawatts (MW), if all the 55 million tonnes of bagasse were burnt in the most efficient boilers available.

And if the industry was paid a proper price for it, it could earn up to \$1 billion a year — more than half the industry's current earnings.

At the moment, standing sugar cane is burnt in the fields to remove its sharp leaves and kill pests. This reduces its weight by a quarter, with half its calorific value going up in smoke. Burning cane makes manual cutting, which employs 750,000 workers, far safer than if unburnt cane were used.

Even without the possibility of generating electricity, there is already a great deal of interest in Brazil's alcohol from sugar cane programme among the oil-scarce countries around the world that possess the large areas of land on which cane could be grown.

Now, as new technology is developed, the third by-product of sugar cane — electricity — makes the crop even more attractive.

— PANOS

Artificial Reefs to Lure Fish

THE use of artificial underwater structures to attract fish is ancient; but in recent times it has spawned a specialised branch of marine technology called artificial reef development.

Although artificial aquatic habitats were in use for centuries, scientific description of their function and impact has been done only recently.

Several fishes are known to gather near submerged objects such as reefs, logs, shipwrecks and rock outcrops where plants and benthic animals flourish. The submerged objects also provide shelter and even spawning grounds to the fish.

While fishermen living in areas naturally or otherwise endowed with such submerged objects get a big catch, others in adjoining areas free of such structures have to content themselves with smaller hauls.

This prompted the creation of artificial reefs in seas to attract fish and enhance fisheries.

The first artificial reef was built before 1790 in Japan by commercial fishermen at depths of 70 to 1300 metres below surface, with the 150-300 metres deep zone with a

Murugappa Chettiar Research Centre developing a synthetic fish aggregating device cum artificial reef, and the Central Marine Fisheries Research Institute (CMFRI) installing an artificial reef made of automobile tyres attached to a reinforced cement concrete base by rods at Minicoy.

Artificial reefs and fish aggregating devices are frequently used to create fishing areas near artisanal villages in several nations. In India traditional fish aggregating devices are being used in some places along the Bay of Bengal and Tamil Nadu coast.

CMFRI scientists in Cochin recently conducted studies on some artificial reefs constructed by fishermen along the Kerala coast.

The fishermen generally constructed these reefs in the sandy region at a depth of five to 27 metres, with granite stones forming a circular or rectangular ridge at the site of

November to April, and that too during daytime. The fishermen used only non-mechanised hooks and lines, unlike their counterparts in a neighbouring reef region where fishing was done throughout the year with the aid of a variety of gears.

Subsequent monitoring of the aggregating nature of the artificial reefs and their age by P P Pillai and T M Yohannan, scientists at the Minicoy Research Centre of CMFRI revealed that within 15 days of reef age, filamentous algae and zooplankton such as mysids and copepods started accumulating profusely on and around the reef structure.

Colonisation of the reef structure by fishes such as *Cascio pisang*, *Dascyllus aruanus*, *D trimaculatus*, *Abudufduf sefaciatus*, *Cheateodon auriga* and *Thalassoma umbrostigma* started from the 35th day of reef age.

Recent introduction of *Chromis caeruleus*, a resident bait species to the artificial reefs was found to be successful, thereby proving the effectiveness of CMFRI's attempt in this line of technology.

Encouraged by these results, the artificial reef development and deployment have been taken up as priority programmes of the institute at selected centres, according to a report.

Studies in the United States suggest that the reef site is more important than the design of the reef. Among the precautions to be taken are that the artificial reef should not be close to a commercial fishing area, and should be at least one km away from a natural reef.

Sites with strong tidal currents should be avoided because the current will cause erosion around the reef so should mouths of rivers where siltation is heavy and may bury the reef.

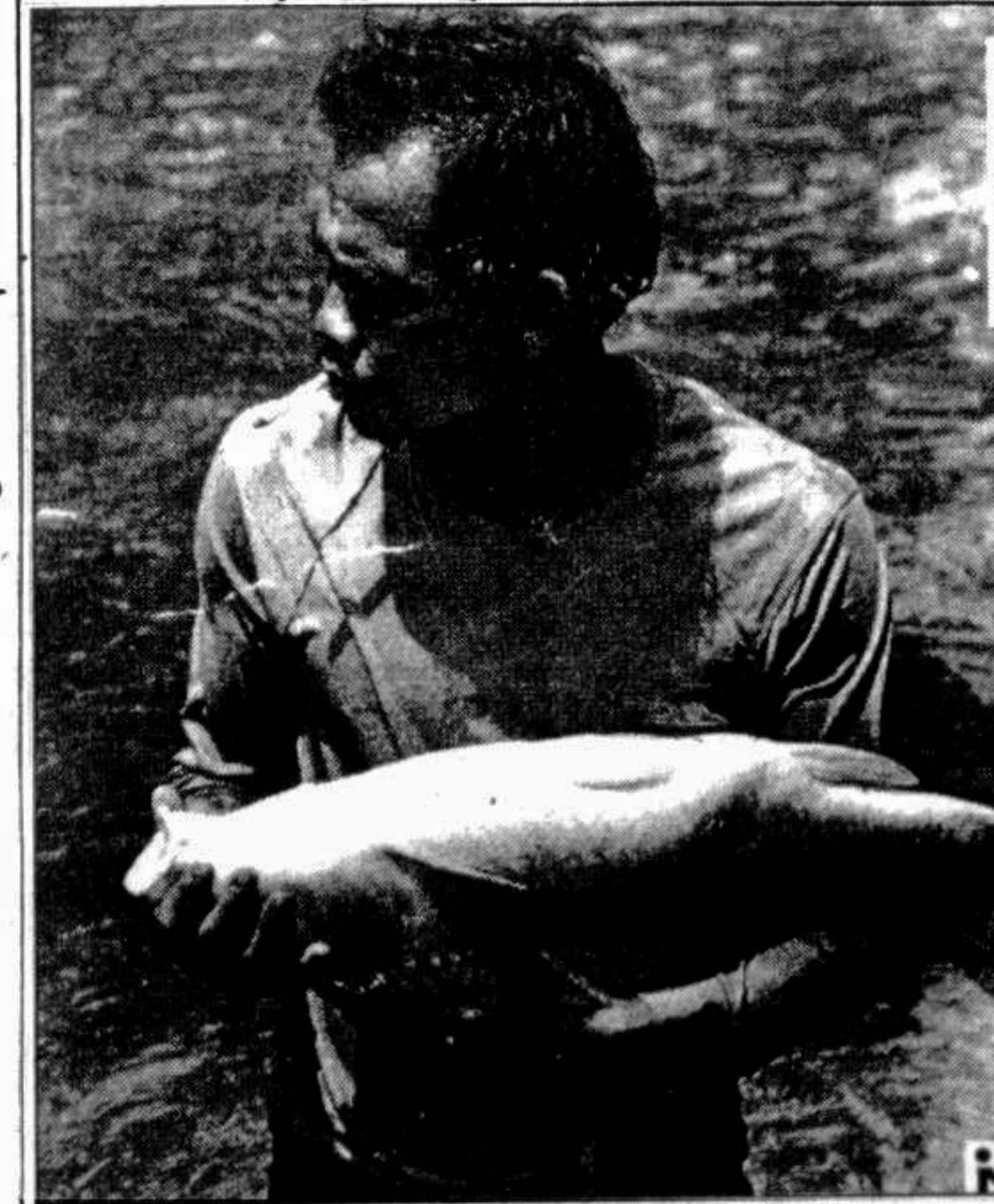
The long axis of the reef should be perpendicular to the prevailing current and along fish migratory patterns, and all high wave energy locations and areas with seasonally shifting sand should not be considered.

Japanese scientists suggest that artificial reefs should have a hierarchical arrangement, with several "modules" forming a "set", 10-20 set-forming a "group" and several groups, forming a "complex" in different parts of the world.

In Central Africa, boxes full of leaves are placed at the bottom of lakes and estuaries. Ivory Coast fishermen place coconut palm fronds in shallow waters to attract shrimps.

"Mangrove fisheries" using mangrove branches are used in protected areas inside bay on the south coast of Cuba, while special "Brush Parks" have been developed to provide shelter and spawning grounds for fish in the Philippines.

(PTI Science Service)



Picture: Peyton Johnson

hard bottom of coarse sand, mud or shells proving to be the most ideal.

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Scientific institutions too are pitching in with the

reef building. The fishermen placed concrete rings over these ridges, and added any locally available unwanted cheap material like broken concrete slabs, worn-out rubber tyres, empty barrels, uprooted coconut tree stumps and leaves, and screw pine plants in a disorderly manner to provide shade and shelter to the fish.

In this reef environment, fishing was done only during the calm season from