RIVERS and JAPAN

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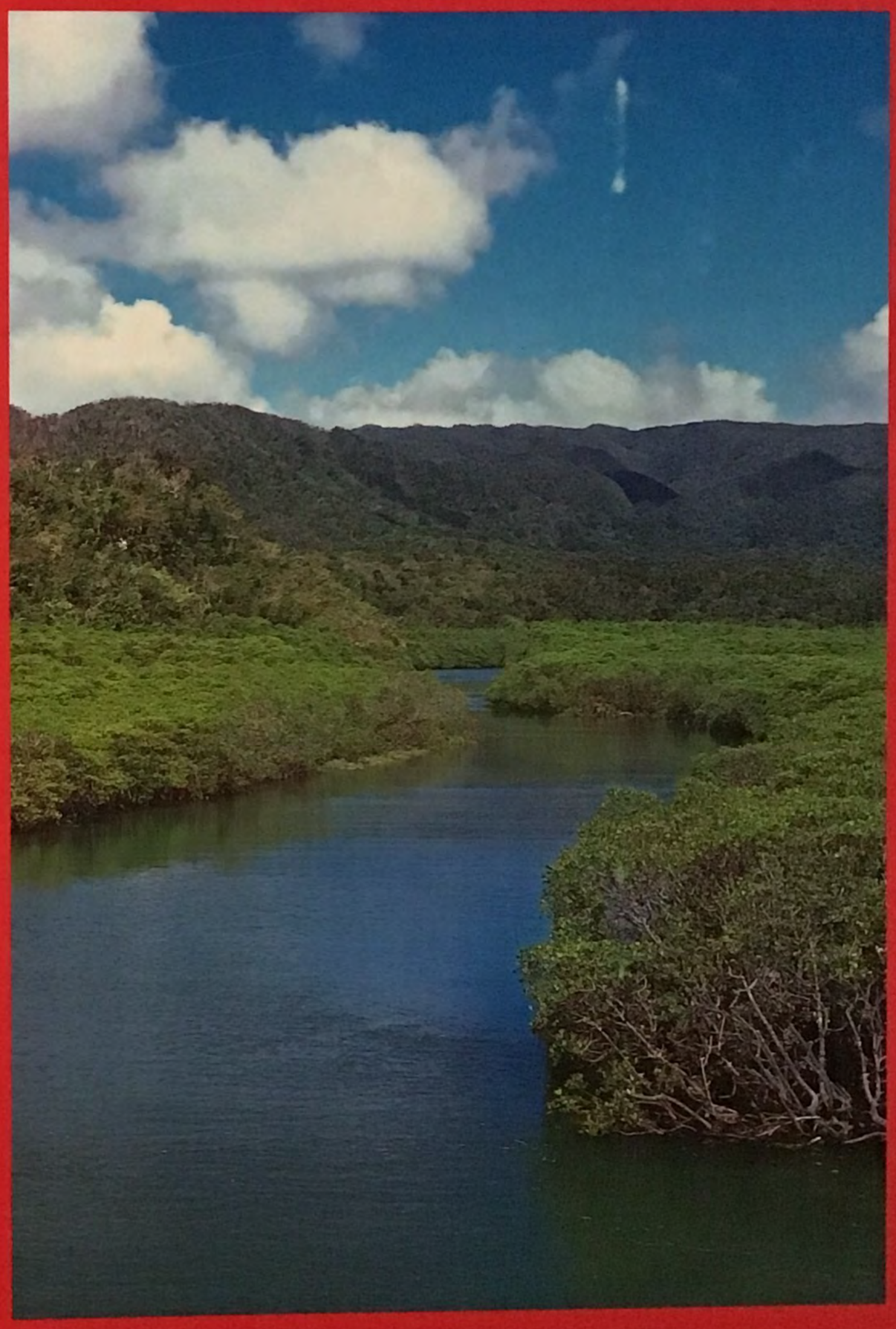

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SEPTEMBER / 1997

RIVERS and JAPAN

Since its inception in 1992, Rivers and Japan has been discussing various aspects of a major dimension of the geography of Japan, its rivers. Japan is a country of rivers, and the Japanese people have learned how to live in harmony with their rivers, loving them and respecting their power.

Starting with this issue, though, we begin to extend our scope: whereas in the past we have focussed on topics revolving around the rivers of the Kanto, an area of primary importance, we now broaden our content to the entire country, taking this window of opportunity to introduce the rivers of other areas of Japan. In fact, our new vision of Rivers and Japan extends even further: in the future this medium will contain not only information concerning the rivers of Japan, but also insights about rivers and river-related life in various parts of the globe.

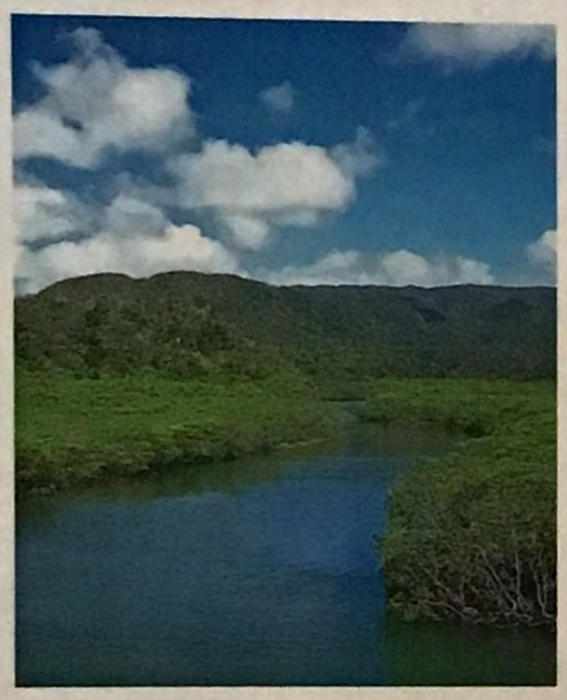
We hope you will join us at Rivers and Japan in our continuing fascination with rivers, humanity and the world.

尾田 栄章

Hideaki Oda
Director-General of River Bureau
The Ministry of Construction

From "The Third Ecological System:
Mangroves, the Forest of the Sea"
(photo by Sigeo Matsuno)

COVER PICTURE



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Editor: A. SEIKE **Art Director**: S. SHIMIZU **Senior Editor**: K. SAWADA **Associate Editors**: J.CARSON/L.HUNTER **Planners**: HAKUHODO INC./SIGMA PLANNING INC.

Inquiries to: River Planning Division, River Bureau, Ministry of Construction, JAPAN 2-1-3, Kasumigaseki Chiyoda-ku 100, Tokyo. Japan Phone: 03-3580-4311

THE THIRD ECOLOGICAL SYSTEM:

MANGROVES, THE FOREST OF THE SEA

BY TAKEHISA NAKAMURA

**Mangroves are impressive for their unique,
comical shapes, yet little is generally known about their true nature.
This essay reveals the curious mechanism that mangroves have
developed in order to grow in a very specific environment,
and unveils the rich life cycle that revolves around mangrove forests.**

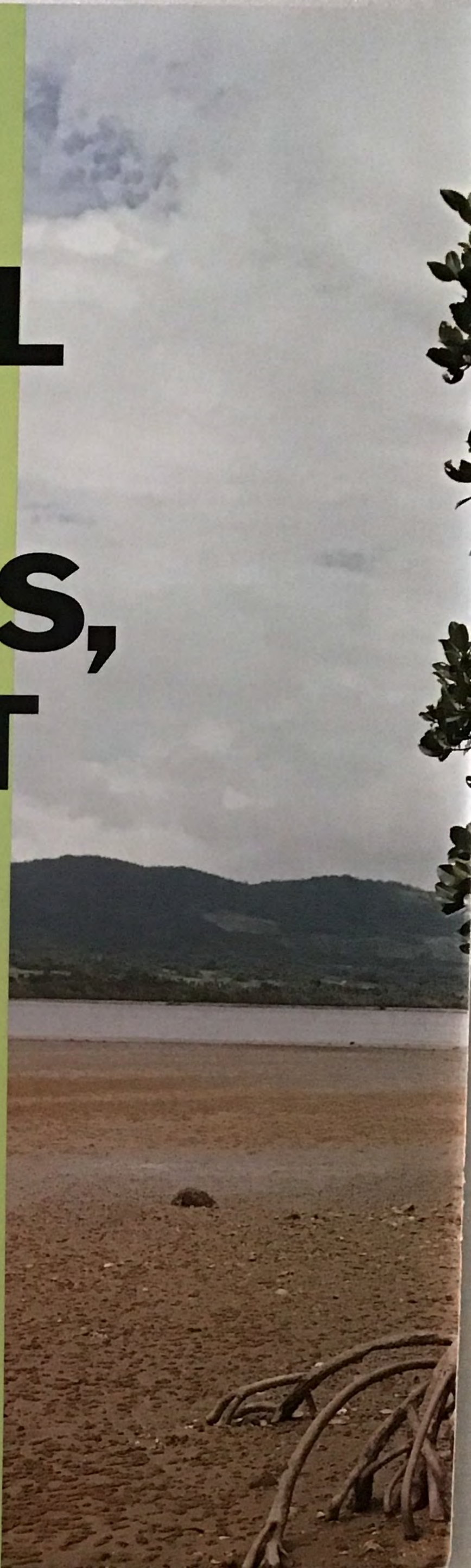


photo by Kazuma Amiya

THE MANGROVE FAMILY IN JAPAN AND AROUND THE WORLD

Although the word "mangrove" is familiar to the general public in Japan these days, very few people knew the meaning of the word when we started our full-scale study of mangroves twenty years ago. That is understandable: only a few mangroves grow naturally in Japan, in Okinawa. There are no genuine natural habitations of mangroves to be found in the main island of Honshu, or on the two large southern islands, Shikoku and Kyushu. There is a small colony of Kandelia candel (one species of mangrove) in Kiire near Ibusuki on Kyushu, but that is a very small habitation of only one variety of mangrove. The Kiire colony is not up to the scale of a typical tropical mangrove forest, which might be called "a forest of the sea". Such a forest is invariably composed of several different species of mangroves. A real mangrove forest should contain several species of mangrove plants, dominated by members of the Rhizophoraceae family, which grow in seawater, in order to be considered a forest. In this light, the colony of Kandelia candel on Kyushu can be referred to as a small mangrove habitation, but it is far from being an authentic mangrove forest.

WHEN IS A MANGROVE NOT A MANGROVE?

Mangrove forests along coastlines and estuaries in tropical and sub-tropical areas of the world, where tides bring a daily flow of seawater, contain dozens of different species of plants. The plants that make up mangrove forests are called "mangrove plants". Since the term "mangrove" is ambiguous, recently mangroves have been referred to as "mangrove forests" to convey a more realistic impression of the phenomenon. Although the mix of varieties of plants depends on the geographic location, the universally dominant mangrove is Rhizophora mucronata of the Rhizophoraceae family. It is the blend of other varieties of tree and plant in each area that gives each community of mangrove forests its uniqueness.

TERRESTRIAL PLANTS OBLIVIOUS TO SALINITY

Mangrove plants grow in seawater areas that have a salinity in which other land-bound plants could not survive; they possess unique forms and physiological adaptations to be able to grow in such a salty environment. For example, they have mechanisms to halt the absorption of salt beyond the level which is necessary or tolerable to plants. Mangroves can also excrete salt which has entered their systems.

The exact mechanism by which mangroves remove salt from the seawater that they have absorbed through their roots remains unknown, but it is known that the salinity of the water absorbed within the roots is already much lower than that of the water outside of the root system.

One member of the Avicennia family has salt-secreting organs called "salt glands" on the surface of its leaves. These salt glands filter and excrete salinity from the saltwater that has entered the plant's circulatory system. As a result, salt crystals are formed on the surfaces of the leaves, as is clearly evident when you lick a leaf.

Another apparent relationship of mangroves with tidal mud flats is seen in the shape of their roots. The anchor roots that support the trunks of Rhizophora, a major mangrove plant, are of a shape reminiscent of the tentacles of an octopus.

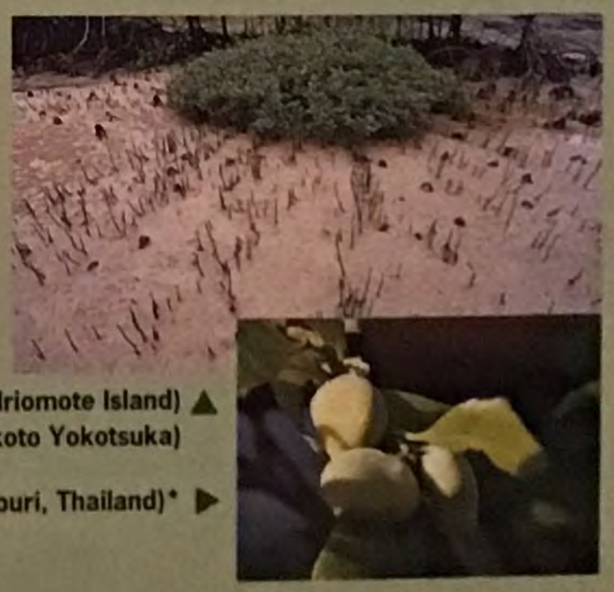
Two other varieties have roots that grow up from the mud to the surface of the water and become aerial roots. Xylocarpus and Bruguiera both form club roots and knee roots in order to spread horizontally by growing in an up and down zigzag, bending here and there, as they extend their range. Those uniquely shaped roots appear to have evolved to allow the roots to breathe in both mud and seawater, and also to provide solid anchoring on unstable soil.

OFFSPRING CLING TO PARENTS

Another major feature of mangrove plants that shows how they adapt well to seawater is that they have a reproductive mechanism called "viviparous

A Flower of Rhizophora apiculata (Ranong,Thailand)
B Flower of Bruguiera gymnorrhiza (Thailand)
C Flowers of Bruguiera cylindrica
D Flower of Bruguiera parviflora
(photo by Makoto Yokotsuka)

E Rhizophora mocronata (Phangnga, Thailand)
F Viviparous seeds (Phangnga, Thailand)
G Sonneratia alba (Iriomote Island)
H fruit of Sonneratia alba (Ponape Island)*
(photo by Makoto Yokotsuka)
I Xylocarpus granatum (Thailand)
J fruit of Xylocarpus granatum (Phangnga, Thailand)



Avicennia marina (Iriomote Island) ▲
(photo by Makoto Yokotsuka)
Fruit of Avicennia marina (Chantaburi, Thailand)* ▶
*photographs taken by the author

Mangroves Mechanisms for survival in salt water

Lenticels of Bruguiera gymnorrhiza
(photo by Sigeyuki Baba)

Lenticels

The trunk surfaces have tiny cracks called lenticels, which are thought to help the mangroves breathe. The lenticels may also function as part of the salt-excreting system.

Cross section of a root of Bruguiera gymnorrhiza
(photo by Sigeyuki Baba)

Roots

Among the mangrove plants that spread their roots in seawater mud, some species filter out unnecessary salinity and absorb water of much lower salinity than that of seawater. Examination of the root tissue shows it to include soft spongy tissue, which is thought to serve to control the intake of salinity.

A leaf with salt crystals on the surface
(photo by Sigeyuki Baba)

A microphotograph of a salt gland
(photo by Yukio Yaguchi)

Salt glands

In general seawater is harmful to plants. How then do mangrove plants, which grow in seawater, fend off the harmful effects of salt ? Members of the family Avicenna have salt glands that excrete salt from the surface of the leaves. The seawater absorbed from the roots is filtered by the salt glands in the leaves to remove salinity. The salt is excreted from the leaf surfaces and forms salt crystals. The crystals will be washed away by rain or licked off by browsing snails.

seeds". Plants normally bear fruit after blooming; then the seeds are fertilized within the fruit, and, once germinated, become new seedlings. Mangrove plants, which grow in seawater, however, cannot lodge their geminated seeds in the mud since the seeds would be washed away by sea currents. Viviparous seeds appear to be designed as a survival mechanism: the pollinated embryos within the fruit grow to form original roots called propagules. Still attached to the parent tree, the infants extend propagules down from the fruit, looking as if the parent were bearing long fruit hanging down from the branches; thus this reproduction system is called viviparous seeds. The size of viviparous seeds varies by species. Each species has reproduction systems that are adapted to the local sea depth and the condition of the mud beds.

LAND PLANTS, SEA PLANTS AND MANGROVES

As described above, mangrove forests are made up of plants with unique forms and physiological mechanisms. Because these plants form communities in seawater, their structures and characteristics are understandably quite different from those of plants found on dry land. For example, mangrove forests, established in seawater, have intricately interlaced networks of roots which provide shelter, nutrition and safe breeding places for fish and many other small animals which live in seawater and mud.

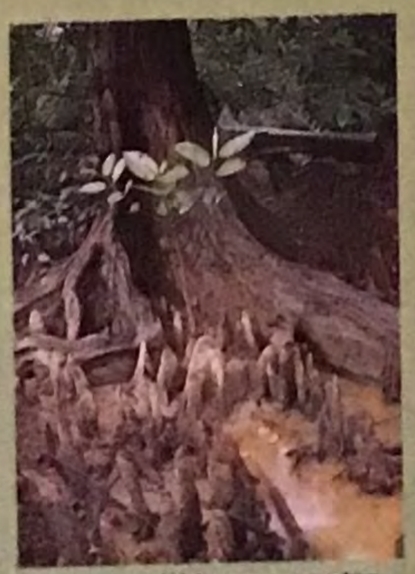
The part of mangrove forests above water has conditions similar to forests on dry land. The mangrove plants produce leaves, flowers, fruits and viviparous seeds. When their function is completed they fall to the water and are consumed by animals and bacteria, eventually decomposing. Many insects and small organisms are attached to the branches and leaves of mangrove plants. Birds and otters, and in some cases monkeys, come to the mangrove forests to feed on such dependent lifeforms. The varied flora and fauna in the mangrove forests are affected by the rise and fall of the tides, and the daily changes in such an environment are considerable. The mangrove environment, packed with diversity, is a closely interrelated, compact ecosystem situated on the margin between the sea and the land. It could be said to be the third ecosystem of the earth, connecting the two main ecosystems, the sea and the land.

Mangrove forests prevent the influence of the sea from reaching the land, and on the other hand they check the influence of the land on the sea. It can be easily argued that the mangrove forests function in this way when we consider the people who live on tropical coast lines and make a safe and stable living on the landward side of the mangrove forests.■

THE AUTHOR'S PROFILE
TAKEHISA NAKAMURA
Born in Nagano in 1932. Graduated from the Faculty of Agriculture, Tokyo University of Agriculture, D.Sc. After teaching at Tokyo University of Agriculture Daiichi High School, Dr. Nakamura became a professor at Tokyo University of Agriculture. Fields of specialization: plant taxonomy, plant ecology, ferns, plants of Southeast Asia and the Pacific Ocean, species ecology of mangroves. Major publications: "Bananaology for Beginners" (Maruzen); "Ponape Island, its Flora and Fauna" (co-authored with Daiichi-hoki Publishing)

Translated from FRONT, April 1997

Anchor roots of Rhizophora apiculata
(Raung, Thailand)



Board roots of Xylocarpus granatum
(Raung, Thailand)

Knee roots of Bruguiera gymnorrhiza
(Ranong, Thailand)

Different types of roots

Mangrove plants grow in mud soaked with seawater. In order to adapt themselves in this unique environment, mangroves have characteristically developed many different, unique types of roots. Anchor roots support the trees in the water and also breathe. Knee roots extend into the shallow mud and breathe through the part exposed to the air. Aerial roots grow up from deep in the mud and into the air to breathe. Board roots firmly support the tree on unstable mud.

(photo by Makoto Yokotsuka)

Aerial roots of Sonneratia alba (Iriomote Island)*

Mangrove
The rich world of the forest of sea
Illustrations

illustrated by Chiho Inatsuki photo by Makoto Yokotsuka

Center: Cormorant perched on a root at the water's edge (Ranong, Thailand)

Above: A big water monitor lizard (Sarawak)

Animals eat small living matter

Many living things form a food chain in the mud at the foot of the mangrove roots. How the system works is not fully known. Birds and monkeys are near the top of the chain. Large mangrove crabs are the prey of human beings.

The eagle dominates the ecosystem (Ranong, Thailand)

A member of the king fisher family (Phangnga,Thailand)

The Role of birds

Many varieties of birds visit mangroves to suck the nectar of the flowers, and some of them help pollinate the mangrove flowers. By eating insects on the branches and leaves, the birds help get rid of insects harmful to the mangroves. Primarily birds feed on the fish, crabs and prawns that are abundant in the seawater around the roots of the mangroves.

A kingfisher perching on a root, searching for fish (Phangnga, Thailand)

Mantis crabs (upogebia major) (Fiji: Photo by Shigeyuki Baba)

Below: Huge mounds built by mantis crabs

Mangroves accumulate mud

The mangroves on the seaward front extend their branches into the water, while the intricate webs of their roots accumulate mud. In the deep forests, mantis crabs build up the mud to build their nests, which in turn helps to accelerate the accumulation of mud.

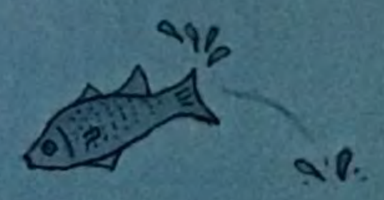
Large mudskippers (All four photographed in Ranong, Thailand)

A male fiddler crab fiddling with its claws.

A crab going into its mud nest.

Animals who live in the mud

Mangroves mostly grow on mud flats. Many varieties of animals, including all types of shellfish, crustacea such as crabs and prawns, and annelida such as lugworms, live in the same mud. Mudskippers, octopi and horseshoe crabs will also be found crawling about in the same environment.



A shellfish eats mangrove leaves (Ranong, Thailand)

Ant nest (Raung, Thailand)

A moth rests on a mangrove tree (Raung, Thailand)

Beehive (Ranong, Thailand)

Flowers and pollination

The flowers of the Rhizophoraceae species of mangrove keeps maintains a pollen sac on its stamen even after it has finished blooming. Birds who come seeking nectar touch the sacs with their beaks, causing the pollen sacs to pops open and spew pollen. The flowers of mangroves are considered to be ornithophilous flowers: their pollination is assisted by small birds. Insects that are attracted to mangrove flowers may also assist with pollination.

Mangrove forests at high tide (Ranong, Thailand)

At high tide, the roots provide shelter for fish.(Iriomote Island)

Rise and fall of the tide

The rise and fall of the tide occurs as the gravity of the moon and the sun exert pulls on the sea, which has an area three times larger than the entire land area of the earth. The influence of the changes in the tides on coastal areas is considerable. The mangroves that grow in areas which have strong tidal influence develop the adaptability to withstand tide-related changes in the environment.

Mangroves and sea fish

At high tide, seawater flows into the channels in the mangrove forests. Fish from the outer sea come into the mangroves with the tides, thus many fish inhabit the mangroves, an ideal protective environment with rich food supplies.

Decomposition of organic matter and the food chain

Even in seawater, the growth of mangroves with adequate water is not slow. Some grow four meters in three years. They have large thick leaves and a voluminous reproduction system called viviparous seeds. When the leaves and fruit fall from the trees, they are eaten by animals, broken down, digested and excreted. Small animals and micro-organisms that live in the mud of the sea bottom decompose this waste, and finally return it to the soil and to the seawater which are the foundation of the mangrove ecosystem. The reason why mangrove forests are called "a compact ecosystem" is because there is a well balanced food chain established among the living creatures inhabiting the system.

The mangroves extend the reach of the land

Because of the intricate webs of mangrove roots, mud tends to accumulate in the mangrove forests. When a mangrove forest grows large, the mud piled high in the deep forests gradually turns into dry land. The variety of seedlings that have lodged in the deep seawater on the seaward side further extend the mangrove forests into the sea. In this way mangroves extend the reach of the land into the sea.

A shell fisherman (Phangnga Bay, Thailand)

A school of fish in the sea near a mangrove forest (Sipadang Island, Borneo)

A dolphin wanders into a river in the mangrove forest (Sarawak River, Borneo)

Translated from FRONT, April 1997

MANGROVE GROVE GROWS GRADUALLY GREAT

- Biodiversification on South Izu's Yumigahama Beach

BY MIEKO TAKEZAWA

▲ An artificially planted colony of kandelia is submerged at high tide.

◀ The young mangroves are visible at low tide.

photographs taken by the author

THE TROPICS SEE GROVES VANISH

Just at a time when the ecologically crucial species, the mangrove, is disappearing at a rapid rate from its original tropical habitats around the world, it has taken hold and is flourishing in an out-of-the-way corner of what seems an unlikely country: Japan.

Mangroves, the quirky, strangely beautiful trees that grow near the ocean in tropical areas, are vitally important to their surroundings; yet by all reports mangroves are disappearing worldwide. The mangrove is a keystone in coastal tropical ecological systems: mangrove roots help stabilize land that would otherwise easily erode; the root networks of mangroves serve as breeding grounds for shell-fish and many other ocean species; migratory birds sometimes make their homes in mangroves -- where they feed on the shrimp that live among the roots. In recent years coasts inhabited by mangroves have often been converted to agricultural development. areas Dikes have been built to keep salt water out so that more profitable crops, such as rice, can be grown in their place. Some of the heaviest losses are in poorer countries, where the coastal areas that are home to mangroves are also densely populated. Mangrove trees, vital to the health of land and marine life worldwide, are endangered.

UNEXPECTED SHELTER FOR A HARRIED SPECIES

However in one rather special case, the threatened mangrove has found a new home. Few people, other than specialized scholars, realize that the northernmost limit of the range of the mangrove is Shizuoka Prefecture. Many people would be surprised to discover that there is a tropical mangrove forest not far from Tokyo. The story of this tiny mangrove forest in Izu Peninsula dates back 40 years.

In 1959, Mr. Takeshita, who was then the director of Shizuoka Prefecture Agricultural Botanical Garden, and his researcher, Mr. Noguchi, brought some kandelia (a species of mangrove) saplings back to Shizuoka from Tanegashima, an island in southern Japan. They succeeded in transplanting them after some trial and error. The site of their planting experiments was near the mouth of the Aono River at Yumigahama Beach, South Izu Town. The tiny group of mangroves has now grown into a huge forest of 1500 trees, partly because it was surrounded and protected by an extensive growth of hibiscus hamabo, a natural treasure. Some of the mangroves have grown very tall with thick trunks and branches.

TIDAL PUSH AND PULL OF PLAN AND PROTEST

However, the location of the mangrove forest has been a large ongoing problem. There were three huge floods of the Aono River in the past and the people living near the river suffered each time, so the construction of flood prevention embankments began some 15 years ago. The plan, however, called for the embankment to be constructed so as to cut through the forest. The people who planted the trees, along with researchers from several universities, sent a petition to the government in order to preserve the precious forest, while in opposition five hundred local people demanded that the trees be felled in order to allow for the construction of the embankment as soon as possible. Thus the tiny mangrove forest has been the center of human controversy.

The argument in favor of the embankment construction is a compelling one: I myself have had several terrible experiences when I lived in the Shimogamo Basin. One time the embankment was destroyed and a muddy stream 100 meters wide spewed through the basin at a furious speed. I saw cars rolling in the torrent, and a number of poultry huts with many chickens inside were swept away by the flood. From that time I came to understand the importance of the construction of embankments in that area, as well as the local people's demand for flood prevention measures. The local residents have been struggling to find a solution acceptable to both sides of the controversy, but it is difficult to satisfy both camps. The construction of the embankment was completed, all except one section planned to cut through the mangrove forest area, and the problem has been left on the shelf for fifteen years.

Meanwhile, on the other hand, forty-five hamabo, a natural treasure plant, were carefully transplanted to the opposite bank of the river, and it became a hamabo park. Finally, just at the very moment the workers were about to start felling the mangroves, officials halted the plan in order to preserve the precious plants and move them. This behavior in accord with a recently flourishing environment-conscious world trend came to nought in the end: the embankment was eventually constructed.

The plan for moving the mangroves was to first transplant fifty mangroves from the upper part of the river bank down to the edge, then to move the embankment further up the natural bank. In order to protect forest soil which had already been eroded somewhat, workers surrounded the forest with a wall of large stones wrapped in steel mesh, located so that the area would be submerged at high tide and would only be visible at low tide. After such hard work as obtaining the land, planting and caring for the trees after relocating them, the construction was finally finished in 1996. Moving the mangroves was not a simple matter. Some sections of the soil were swept away by the current. Several of the larger mangroves died after transplanting, and now only several hundred young mangroves are left.

The construction of embankments will start again after a re-examination of the situation this year. This work will be very important not only as a source of precious data for studying mangrove ecosystems but also as a useful example of river system engineering that is compatible with the preservation of nature.

This tiny mangrove forest, even though it was artificially planted, is important because it lies at the most northern end of its species biorange. Hopefully the embankments can be successfully constructed, and at the same time people will come to understand the importance of mangrove ecosystems. And perhaps there may come a time when this little biological preserve may serve as a resource for those who wish to reconstruct the devastated coastal habitats in other parts of the world.■

THE AUTHOR'S PROFILE
MIEKO TAKEZAWA
Born in Shizuoka Prefecture and a graduate of Kyoritsu Women's University, Ms. Takezawa originated 'Alga-Art', using algae, and since 1979, she has had many solo exhibitions. As she loves the sea of South Izu, she lives at Yumigahama Beach where she operates Villa Yumigahama.

Translated from FRONT, April 1997

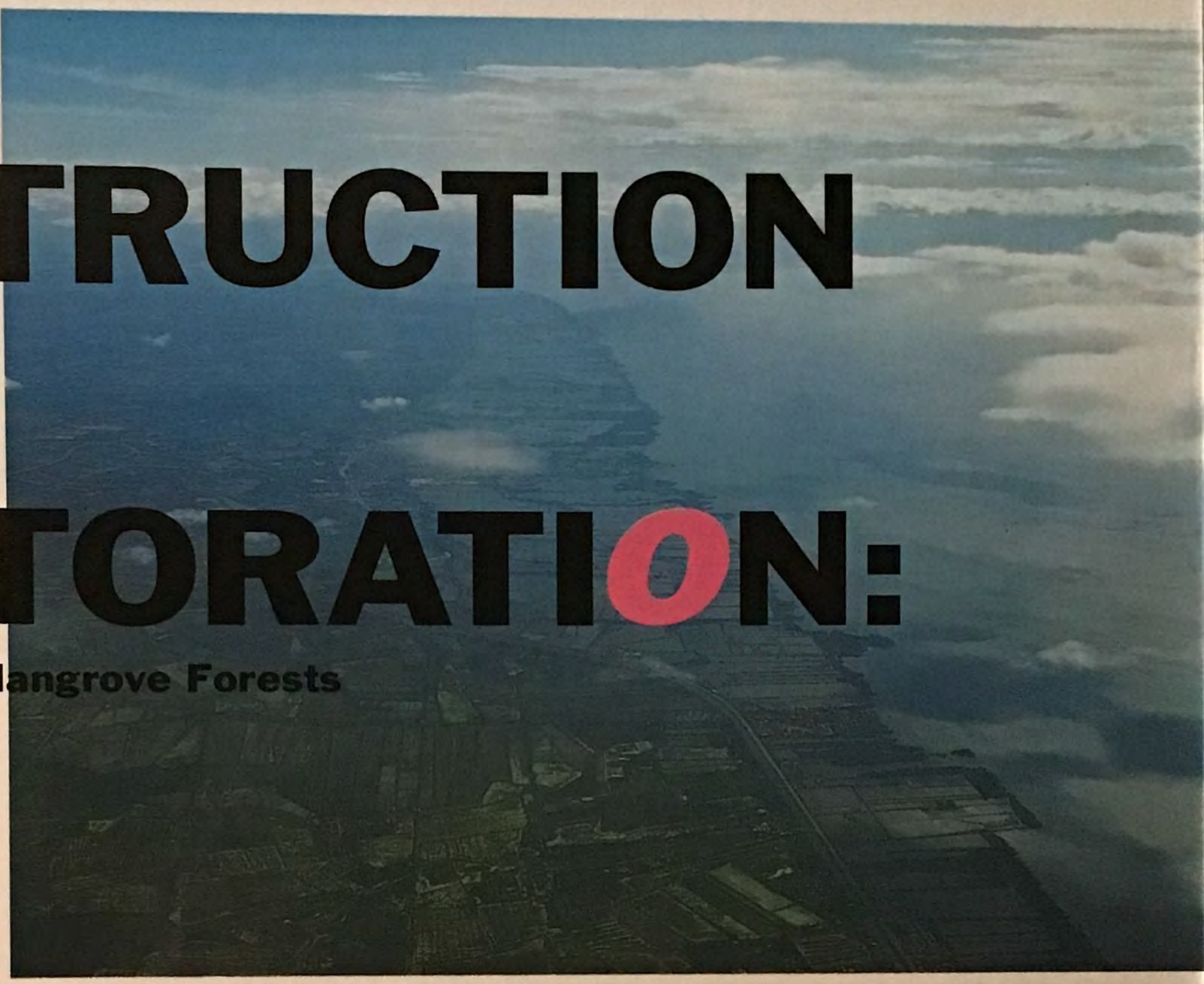
▼ Transplanting of the mangroves at their new home

DESTRUCTION AND RESTORATION:

The Plight of the Mangrove Forests

BY SIGERU KATO

photo by Makoto Yokotsuka



▲ A pond for cultivating prawns spread like paddy fields in the northern part of the Gulf of Thailand (above)

While people are becoming increasingly aware of the threat facing the world's tropical rain forests, there seems to be little written about mangrove forests. These forests, growing along tropical beaches, have been as much victimized as the world's rain forests. Despite this, the increasingly environmentally-aware public still lacks concrete knowledge about the plight of the mangrove forests. The lack of information about mangrove forests might be, in part, due to their relatively small size. Limited to the earth's tropical and subtropical zones, these forests covered only about 17 million hectares as of 1995. Yet mangrove forests are as vital to the global environment as the rain forests. A closer look at how necessary mangrove forests are, as well as how they are being endangered, should push this issue to a place where it belongs: at the forefront of public consciousness.

THE CRISIS IN TROPICAL FORESTS

At one time, long before human beings began destroying them, forests covered an estimated 43 % of the earth's land. More than 50% of this, or about 3.2 billion hectares (all figures in this essay are approximate) was tropical forests. Yet, according to the FAO (Food and Agriculture Organization of the United Nations) and UNEP (the United Nation Environment Program), the earth's remaining forests had, by the late 1980's, been reduced to about only 1.9 billion hectares.

While some might argue that this is an inevitable consequence of modern life and the population explosion, this destruction poses myriad problems for the earth. In the tropical forests, biological systems are more active than anywhere else in the world. This is due to the size of the biomass, the volume of living things existing in a given space. In fact, 60~65% of the earth's land-based organic production originates in forests, with 30~40% of this coming from rain forests. Thus, the large-scale destruction of the world's tropical forests is expected to have large-scale ramifications for the climate and environment of the entire planet. In losing these forests, we lose something we cannot replace.

THE BENEFITS OF THE MANGROVE

A popular misconception seems to be that mangrove forests - indeed anything in the natural world - offer only scenic value. This leads to the erroneous assumption that preserving such things is purely for aesthetic purposes. Yet nothing could further from the truth. In the areas where mangrove forests are allowed to flourish, they provide numerous benefits to the surrounding area, not to mention the environment as a whole.

First, and most obviously, mangroves provide resources for the people in those areas. Among the many resources provided are fuel, building materials, feed for livestock, and plants for medicinal purposes. Used carefully, these resources are replenishable. Moreover, the mangrove areas contribute to marine life, saving the sea from becoming barren. Spread along the seashore, mangrove forests provide a natural cradle for fish, prawns, crabs, and assorted shellfish. In fact, the bio-productivity of these areas is enormous. When we include coral

▲ A pond for cultivating prawns. The motor is used for supplying oxygen to this pond. This concentrated method, in which great output is promised in the short term, requires a lot of feed and antibiotic materials.

reefs, a mangrove forests productivity is said to be 25 to 49 times higher than that of typical marine areas. According to one American biologist, 25~30 percent of the world's fish catch is found in mangrove forests.

And aside from the tangible products of the mangrove forest areas, it's important to recognize their quiet benefits. These areas protect us in two ways. First, they protect coastal areas, sheltering human lives and homes by preventing high waves and the invasion of sea water. Mangrove forests act as break walls. This is of particular benefit in areas where cyclones and typhoons pass regularly. Moreover, mangrove forests contribute to the stability of the natural environment. Through active photosynthesis, they reduce global warming. Indeed, they are even thought to improve the local weather conditions through transpiration. So it seems somehow ludicrous that man should continue to destroy something that offers so much.

The destruction of mangroves is carried out in numerous ways, for various reasons. They inchide everything from hotel construction on tropical beaches to defoliating during the Vietnam War. As most people are aware, a lot of forests are destroyed in the pursuit of timber, pulp, and material for firewood and charcoal. Yet another common reason mangrove forests are destroyed is the development of land for other areas. Whole forests have been destroyed, for example, and replaced with prawn farms. On a larger scale, forests have been destroyed to make way for coastal developments such as factories, residences, roads, harbors, and airports.

Yet while these developments offer short-term benefits to people, or a quick profit, they can also create disastrous long-term consequences. Destroying forests results in environmental changes that can wreak havoc on an area, creating problems that have no solution. Already we can find examples of these consequences throughout Asia.

THAILAND'S VANISHING FORESTS

One such example can be found in Thailand. Once a staple of the Thai landscape, Thailand's mangrove forests have been hard hit in the last three decades. While Thailand boasted a whopping 368,000 hectares of mangrove forest in 1961, this figure had decreased to 174,000 hectares by 1993. Over the years, on average, about 6,000 hectares have disappeared annually. During the period from 1986 to 1993, this figure escalated to 13,500 hectares per year. The mangrove forests which once covered the coastal areas of eastern Thailand have been all but destroyed; the remaining forests are concentrated only in the southern part of Thailand, the southern peninsula.

The main culprit in this destruction has been the prawn industry. A once lucrative business, prawns have been cultivated in artificial ponds. In order to allow for more space for ponds, mangrove forests have been converted into cultivating ponds. As this business has grown, by leaps and bounds, the mangrove forests have disappeared accordingly. In 1976, the prawn industry consisted of 13,000 hectares of ponds and 1500 workers. By 1990, this business had increased to 65,000 hectares of ponds and 15,000 workers. In that year, the industry produced a whopping 120,000 tons of prawns. By 1995, this figure reached 180,000 tons.

However, booming figures aside, the prawn industry seems to have peaked, reaching a turning point last year. Due to overproduction, prawn prices have fallen. In addition, disease is becoming a prevalent problem in these ponds, reducing productivity. Without the mangrove forests around, these ponds have been dependent upon outside sources for nutrition. Since an unnatural environment cannot sustain itself, there has been a need for chemicals, once again upsetting the balance of nature. As time goes on, ponds with low productivity will be abandoned, thus leaving neither mangrove forests nor business in their place. Thus, ultimately, the mangroves were destroyed for nothing more than a short-term profit.

Along with the prawn industry, other business are equally culpable.

Mangrove forests have been felled in the pursuit of firewood, charcoal, and timber. In 1970, Thailand's firewood and charcoal output was 200,000 tons; by 1984, this figure had increased to 270,000 tons, 60% of which is consumed in Thailand. Before the felling of mangrove forests was banned, the Thai government had predicted that, by the year 2,000, 530,000 tons of firewood and charcoal would be produced annually.

Thailand is not alone in its use of charcoal. In developing countries, the demand for charcoal is high. In Yangon, the capital of Myanmar, for example, people use over 1 million tons of charcoal per year, more than 60% of which comes from mangrove

forests. Moreover, large areas of mangrove forest have been destroyed by the mining industry. In the Malay peninsula, tin deposits have been mined at the expense of the mangrove forests. Once the mining is complete, and these former forests are abandoned amid heaps of gravel, the soil's nutrients are lost, making the revival of the mangrove forest all but impossible.
In Thailand, commonage, which had been permitted by tender, was returned to the government in 1996. And, finally, the felling of mangrove was prohibited. However, the problems are by no means solved. At present, for example, people are promoting rubber plantations and other forests next to the prawn farms. Putting water into these ponds has begun causing new problems to the remaining mangrove forests. Like a vicious circle, there seems to be no end to the problems created by the destruction of the mangrove.

ROAD TO REVIVAL

Until recently, people have failed to recognize the importance of preserving the world's mangrove forests. In the past, neither advanced nor developing countries gave much thought to mangrove forests. Moreover, any thoughts about afforestation were hampered by insufficient international aid, as well as such technical problems as how to plant new trees effectively.
Yet gradually, as the consequences of the destruction of mangrove forests have become apparent, in such things as a reduced fish catch, and flood damage in Bangladesh, people have begun to recognize the necessity of these forests. A reduced fish catch, for example, stems from the shrinking mangrove forest, as does incredible flood damage in Bangladesh. Slowly but surely, people have begun to feel the effects of mangrove destruction. As a result, the mangrove forests have influenced politics and economics.
In response to this increased awareness, steps have been taken towards reversing the damage, or at least preventing further destruction. At the Earth Summit of 1992, 'Agenda 21' was adopted, officially recognizing the vital need for preserving forest areas.
Even more encouraging is the fact that, as early as the 1980's, the afforestation of mangrove forests had already begun in some areas.
International organizations like the FAO and UNDP (United Nations Develpment Program) initiated afforestation projects. These projects were aimed at providing necessary living materials, long-term, for local people. In Bangladesh, for example, between 1980 and 1990 about 80,000 hectares were afforested with money borrowed from the World Bank.
In Japan, the Japan Mangrove Association(JAM)and the International Society for Mangrove Ecosystem (ISME), with headquarters in Okinawa, have started research and restoration projects. These projects, along with others now underway in Southeast Asia, offer a glimmer of hope for the world's mangrove forests. Even though most of the world has only recently become aware of the situation regarding mangroves, there is no limit to what they can do with this knowledge. Hopefully, by working together, people can ensure that the mangrove forests of the world are able to thrive throughout the 21st century.■

THE AUTHOR'S PROFILE
SHIGERU KATO
Doctor of Agriculture. Born in Tokushima Prefecture in 1947 and a graduate of the Tokyo University of Agriculture. After doing research at the National Institute of Hygiene in the United States, he is now a
professor at the Tokyo University of Agriculture. Since 1980, he has been participating in the investigation of mangroves in Southeast Asia, and studying physiological chemistry. Along with his studies, he is actively involved with a 10 year afforestation project in Thailand.

Translated from FRONT, April 1997

▲ A new system in Indonesia that combines afforestation and cultivating ponds in the same area in order to make economic activity compatible with ecosystem. (photo by Motohiko Kogo)

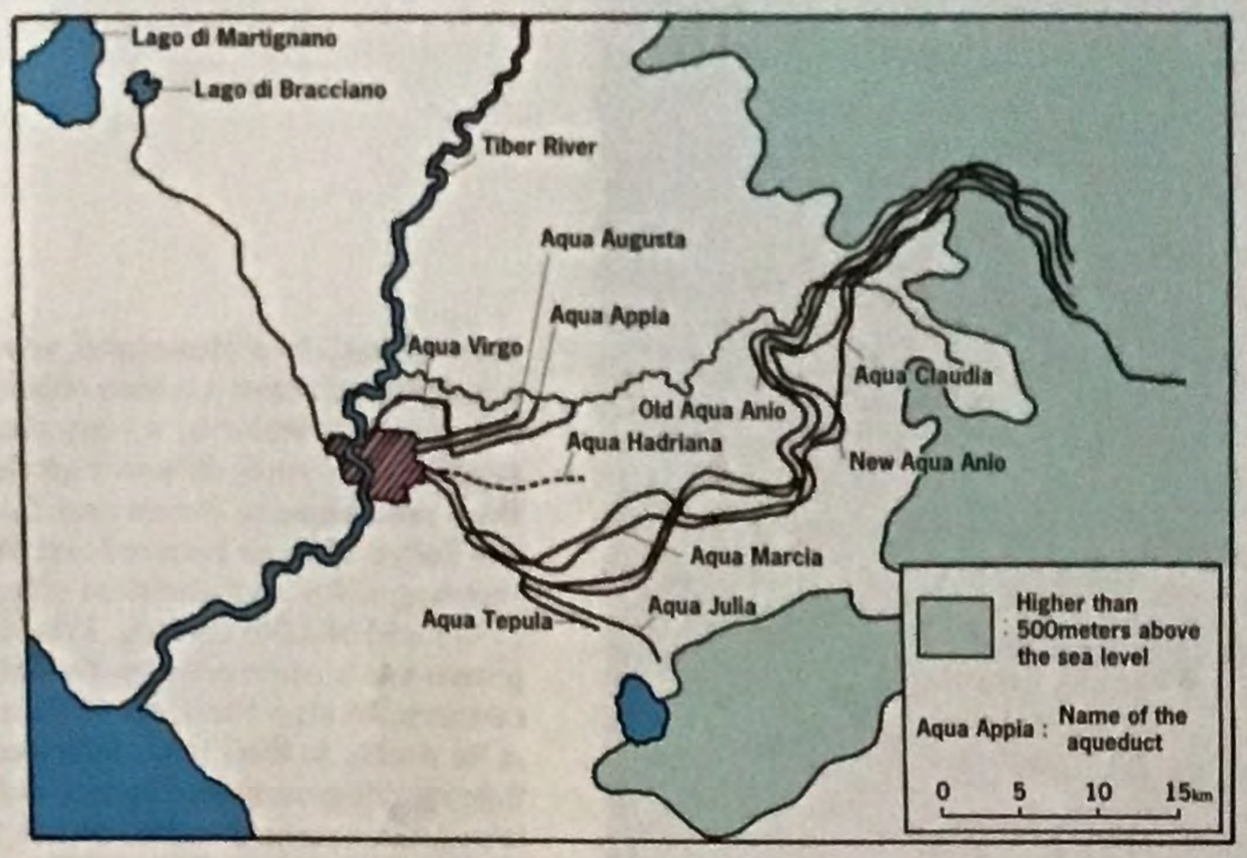
◀ The ruins of a tin mining site in Ranong, Thailand. The soil is still devastated, although crabs, gobies and some kinds of tropical bird are seen there.

▲ Inogashira Pond, the water source of the Kanda Waterworks, which is considered the first of its kind in Japan.

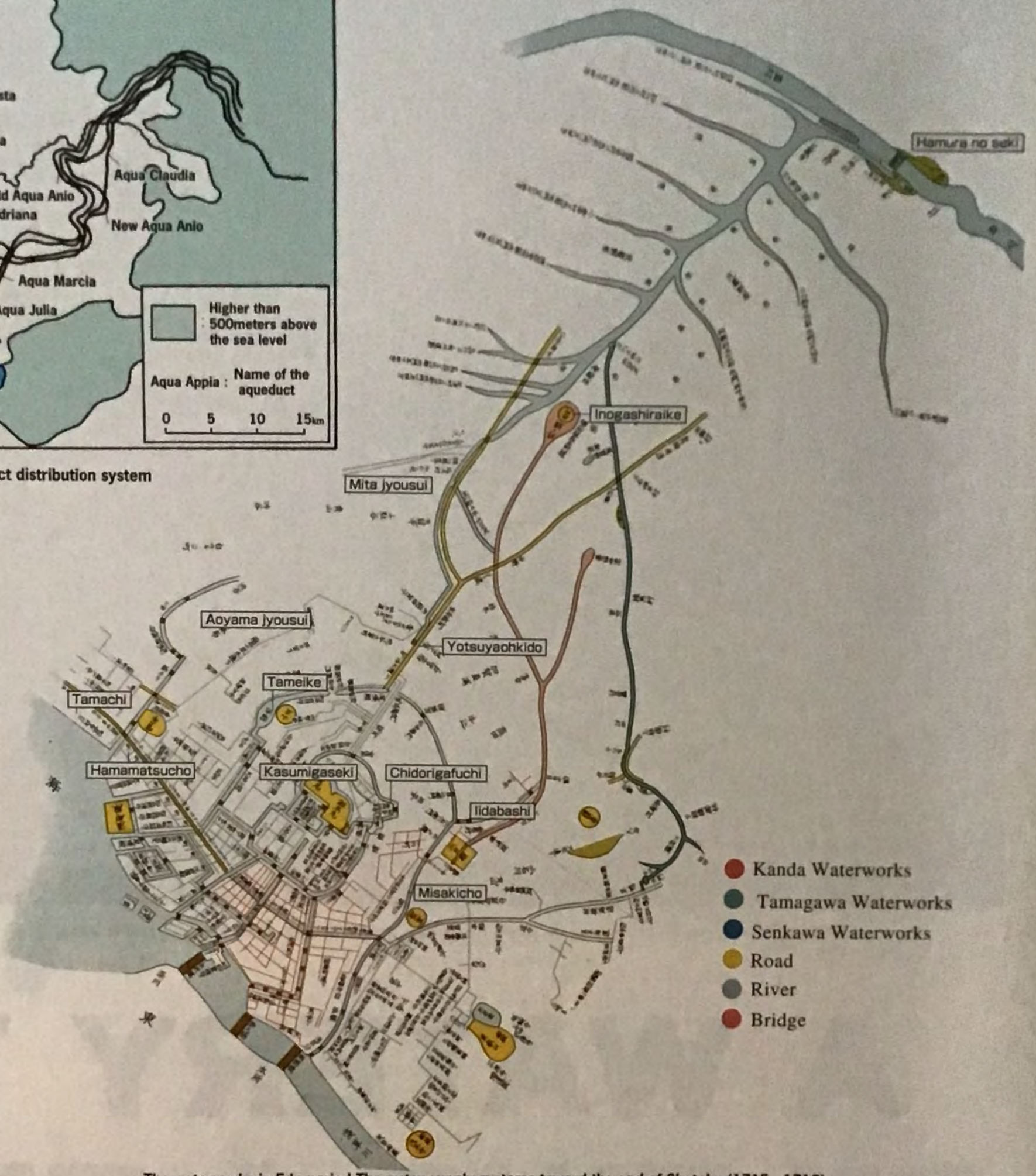
Two cities, two thousand years apart: in each case a million citizens provided with water by a centralized system. But what different stories they are, ancient Rome and Edo, the Tokyo of three hundred and fifty years ago. An impoverished village at the end of 16th century, Edo had grown into a metropolis by the 18th century, in size the rival of Rome at its zenith. In their time, both were thriving cities supported by well-maintained waterworks. Similarities are to be found, but the differences are fascinating.

As we will see, the Edo waterworks, their design benefiting from centuries of human experience, were more egalitarian, more articulated, and essentially more hygienic than the Roman; as well, the maintenance concept of the two systems differed fundamentally.

A WATERY TALE OF TWO *CI*TIES: ROMA AND EDO



The ancient Roman aqueduct distribution system



The waterworks in Edo period The water supply systems toward the end of Shotoku (1715 -1718)

WATERWORKS AS ARTIFACTS: ROME

The Roman waterworks consisted of massive stone conduits (aqueducts) above ground, and now, 2000 or so years later, main parts of the aqueduct system are still to be seen; these are considered cultural and architectural treasures. The first supply system, Aqua Appia, was constructed in 312 B.C. By the third century B.C., eleven aqueduct networks had been built to serve the people of Rome.

However, the Roman waterworks did not serve the Romans all that well. Even though the total length of the Roman aqueducts was 578 kilometers, and estimates indicate that the system could provide 500 liters per person per day, there were only 1352 water tanks and fountains in the entire city. Piping water to each house for private use was prohibited until about the beginning of the Christian era. This was partly because construction and maintenance of water supply networks could not keep pace with the increase in Rome's population.

Although there were an extensive and well-maintained water supply network in ancient Rome, the Romans (actually the servants) had to walk to public wells, a heavy task, in order to fetch water. This delivery problem was not the result of technical difficulty or limited water resources but rather a matter of resource allocation: in ancient Rome, 17% of the whole water supply was allotted to the emperor, 24% for officials, 39% for rich families and industry, while ordinary citizens were entitled to only 13%.

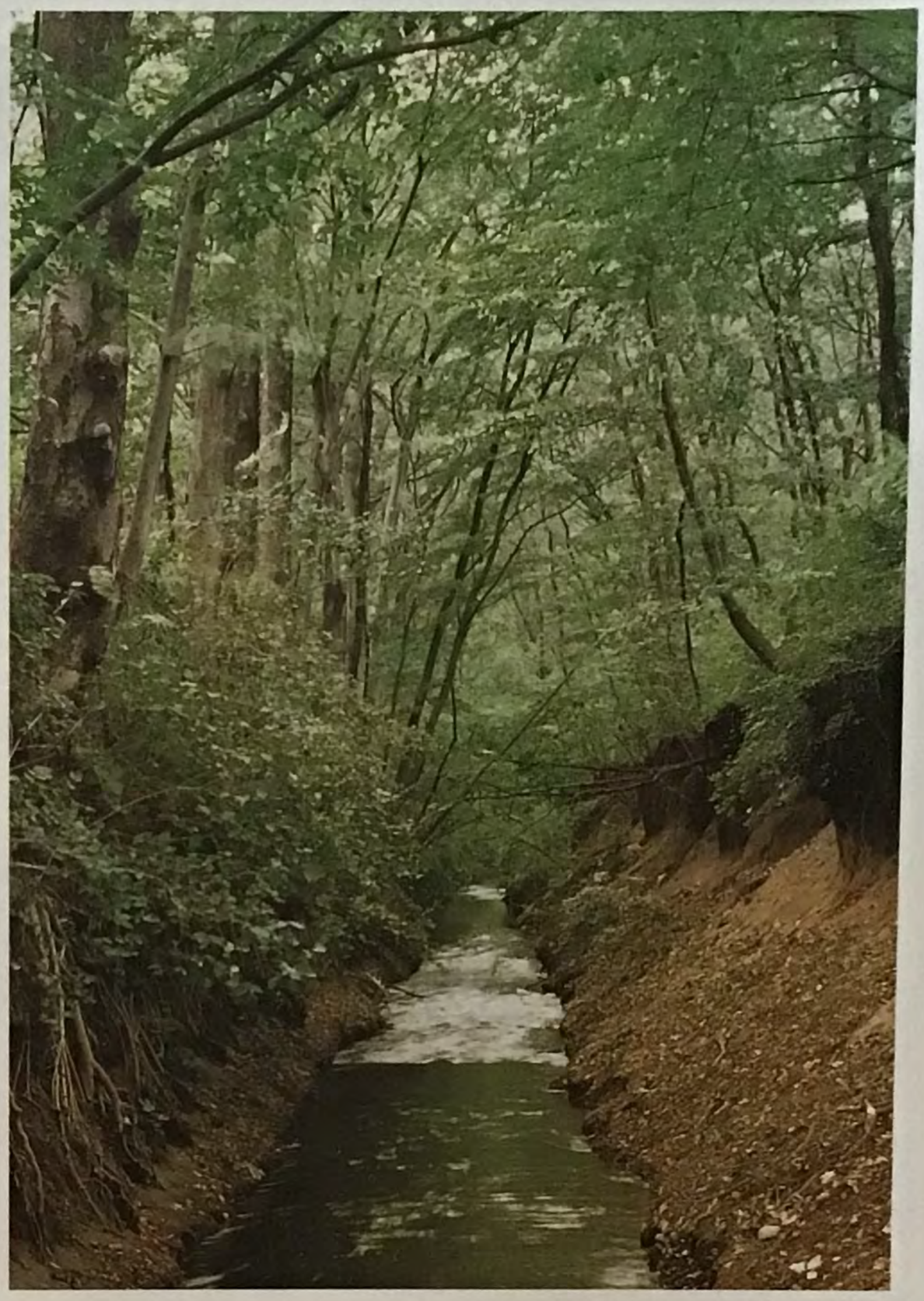
WATERWORKS AS EGALITARIAN SERVICE: EDO

Throughout history, waterworks have been built to support the life of the inhabitants. The fundamental principles of waterworks are usually the provision of high quality water and maximized distribution to the consumers. Reflecting this typical thinking, in Edo, which was the first city in Japan who had a drinking water supply system, the network of water pipes branched through much of the city to supply water to almost 100% of the densely populated downtown area, and to 70% of greater Edo, equal to about 70% of Tokyo's modern day 23 wards. Water sources were close to the houses, too. Compared to the 1352 wells of Rome, the Kanda waterworks system alone, serving just the north-eastern section of Edo, had 3612 tanks. Perhaps this reflects a profound dif-

▲ Instead of drawing water from the Tiber flowing through the city, the ancient Romans turned the river to a sewer.This is par

Water from the Tama River was drawn to Edo along the ridges of the Musashino Heights. ▶
(The Tamagawa waterworks)

A network of underground wooden pipes was laid to distribute water. Though made of wood, the pipes held water surprisingly well,and much safer than those made of lead or iron.
(A wooden pipe unearthed inTokyo)



ference between the two cities:while Roman society was essentially military in its focus, Edo society was built around strong families, including samurai families, and as such was much more articulated. This is paralleled by the structure of the two cities' water supply systems: while the Roman water system consisted of the famous stone aqueducts, the Edo waterworks was a network of underground wooden pipes, spread much more finely throughout the city than the Roman conduits.
It is also interesting to note that while the aqueducts in ancient Rome were not used for irrigation, the Edo waterworks provided water for fire prevention, irrigation and development of new agricultural land in areas such as Musashino as well as for human consumption.

A CAPITAL OPENER: EDO

Construction of the Koishikawa waterworks, the first water supply system in Edo, began in 1590. This was not a full-scale facility; rather, it was built hastily and make-shift in order to be completed in time for the entry of Ieyasu Tokugawa, the first shogun, into the capital. Construction consisted simply of the digging of canals, and took only three months. After Ieyasu opened the capital in 1603, the building of the city began in earnest, and the Koishikawa waterworks could no longer adequately serve the city. The facility was expanded, this time using wooden pipes, and the Koishikawa waterworks became the much larger Kanda waterworks in 1630.
In 1654, a larger facility, the Tamagawa waterworks, was completed, drawing water from the Tama River, which flowed through the western suburbs of the city. By the end of the 17th century a number of other waterworks had been constructed to create a large water supply network for Edo. At that time, the total length of underground water mains in Edo was about 150 kilometers. Wooden pipes were laid and wells were established on important sweet corners. Water was drawn from wells and shared in each community. Some people piped water from wells to their homes.
It was said that the construction was so carefully done that not even main pipes were exposed; this technique was more advanced than that used in London at the same time. Remaining in service until 1901, except for the Tamagawa waterworks, which remained in use until 1945, the Edo water system supported life in Edo for almost 300 years.

WATERWORKS AS OF A POWER SYMBOL: ROME

How could the Romans build so many long aqueducts at such an enormous cost? The driving force behind the construction of aqueducts was war and the governance of other races. The Aqua Anio, completed in 269 B.C., was funded with the plunder from the defeat of King Pyrrhus of Epirus, in the north of Greece. Likewise, the Aqua Marcia was built in 130 B.C. with the spoils of wars with Corinth and Carthage.
A stronger force behind the construc-

▲ Comparing to the spectacular aqueducts in Rome, local cities had to contend with much simpler water systems. This characteristically tells how the ancient Romans saw their aqueducts as a symbol of power.(In Pompeii)

▲ The water piped from the underground water main was kept in a well like tank and drawn from there. Rich households built stones around the well as shown in the photo to keep sewage from flowing into it.

◀ The ancient Romans constructed aqueducts not only in Italy but in other regions such as France and Spain they had conquered as a symbol of the high civilization of the Roman Empire. (The aqueduct bridges of the ancient Rome in Segovia, Spain)

tion of long, costly aqueducts was the control of other races by means of the force of civilization. The ancient Romans constructed aqueducts in many of the regions they occupied as a symbol of the high civilization of the Roman Empire. As a director of the Roman waterworks once proudly asked, " How can the Roman aqueducts be compared with the pyramids, which are conspicuous but useless, or with the ancient Greek writings, which are famous but not practical?" The construction of longer aqueducts and more massive aqueduct bridges was a display of the greatness of the Roman Empire. The cost was obviously not prohibitive to the Romans.

FROM MOATS TO THE PEOPLE'S WISH: EDO

Whereas the Romans spent lavishly on their aqueducts, the people of Edo were sensitive about the cost of waterworks construction. For example, the Tamagawa waterworks was completed with funds acquired through repeated petitions by a couple of townsmen, the Tamagawa brothers. The government gave them only 7000 ryo, the equivalent of today's 1.5 billion yen, which was nowhere near sufficient for such a large construction project. Funds ran out when the construction was only half completed. The Tamagawa brothers even sold their own mansion to raise the funds to continue the project. The Tamagawa waterworks was completed as a joint national and private undertaking because the people themselves were conscientious and cooperative in order to have a waterworks system.

TRANSITION FROM WAR TO PEACE

While the Romans built waterworks as a display of power, the people of Edo applied military technology to domestic waterworks engineering.
During the Edo period (1603 - 1868), thirty-two waterworks, supplying water for drinking and irrigation, were completed in various parts of Japan; twenty-five of these were constructed in the 17th century. This became possible when the protracted disturbance of war ended and the people shifted the focus of their energies to the construction of cities.
During the Age of Warring States, a period of about one hundred years, roughly the 16 century, the feudal lords of each region actively used water for their warfare. Perhaps the most famous example of this was when Hideyoshi Toyotomi (1536 - 1598), a feudal lord and later the ruler of the whole nation, succeeded in the siege of an enemy castle by means of a crafty inundation tactic. Hideyoshi quickly and carefully designed and built an earthen wall to encircle the castle, calculated precisely so as to be able to draw water from the nearby river and flood the castle environs, driving out the enemy. With the advent of peace, this kind of technology was applied to the construction of waterworks, and the huge labor force required for the construction was created with ex-soldiers, avoiding unemployment problems during the period of transition from a wartime economy to a peacetime economy.

INFRASTRUCTURE DESIGN'S IMPACT ON WATER QUALITY

There are a number of anomalies in the design of the Roman aqueducts. Why did all eleven aqueducts in Rome draw their water from distant sources, mostly natural springs, and not the Tiber River, which flows through the city? The city of Rome was founded on an island in the Tiber River. Many drains were dug in the marshes at the riverside in order to make the land drier., and the city of Rome was built there. The drainage from the marshes issued into the Tiber River. Later these drains were used for sewers, for example the Cloaca Maxima sewer. The Romans came to regard the Tiber River as a receptacle for untreated sewage. Later, small towns were built near Rome and the inhabitants used nearby rivers as sewers too. As a result the water from rivers were not suitable for drinking and spring water was the only sanitary water source. Because all the water sources were distant from the city, the Romans built long aqueducts and many stone bridges to span the valleys. The water from one spring was not sufficient to meet the demand of the city: a total of eleven waterworks were necessary to meet the demand for water. Since many of the springs were in a limestone area, potassium carbonate deposits formed in the aqueducts, resulting in poor tasting water and calling for frequent cleaning of the conduits.
In Edo, however, as excrement was used for fertilizing the fields, the rivers were not so contaminated. As well, there was no need to invest heavily in a sewage system.

PLAGUED BY CHOLERA

The ancient Roman idea of using the water from springs can still be seen in modern Europe. Nowadays many countries in Europe tend to avoid the use of surface water in their water supply systems, depending rather on ground water. Some countries make ground water artificially to compensate for a shortage of natural ground water. The Europeans started to depend on ground water in the 19th century. By the mid-19th century, London and Paris, using river water as their water source, found the river water to be contaminated by city sewage. There was no method of purifying water except precipitation (settling). It was not until the late 19th century that the sand filtering system was found to be effective. Asian cholera hit Europe repeatedly, with a mortality rate of more than 50% of cases. In Paris alone, deaths from cholera were about 100,000 in 1849 and 150,000 between 1854 and 1855. At that time, though the cause of cholera was not known, people came to distrust river water and discovered anew the merit of the ancient Roman use of ground water. At the same time in Rome a hot debate over water and sewage raged between one faction, which argued that sewer construction was most urgent, and another, which favored the immediate construction of waterworks using ground water, not river water. The authorities decided to promote both projects, despite the enormous costs. It was only after World War II that both drinking water and sewage facilities were finally extended so as to cover every corner of the city of Rome. Until then, the Romans were constantly exposed to the threat of epidemics.
Japan also suffered from spreading cholera when the country ended its self-imposed period of several centuries of isolation from the rest of the world. In order to prevent an epidemic the government of Edo focused on the provision of a safe water supply, rather than on the construction of the more costly option, a sewage system, because the existing night soil system did not pollute rivers so much.

◀ **Thanks to the network of water supply system spread throughout the city, the people of Edo could pipe water to their homes.**

Not all of the ancient Romans received the full benefits of the aqueducts. Many had to walk to public wells in order to fetch water. (The Trevi Fountain reconstructed from the ancient Roman waterworks) ▶

THE REFINED WATER CULTURE OF EDO

As far as waterworks go, Edo was far more sophisticated than ancient Rome. This is not a result of the different times in which the two cities existed: the difference can be traced to the people's social and cultural attitudes toward waterworks and rivers. For the rulers of ancient Rome, the network of aqueducts was a power symbol as well as a means to supply water to the city; as well, the Romans weren't much concerned about the convenience of their water system, as their slaves did the hard labor of fetching water from the fountains. On the other hand, for the people of Edo the waterworks were a key component of their way of life. Although the samurai class governed society, the common people who formed the grassroots support of Edo society had a strong say in how their communities would be managed. Self-governance based on community-wide accountability helped nurture a strong awareness of the rivers in the environment and of the water the people used. Looking at their rivers, the people of Edo saw and appreciated various aspects that enriched their lives, and developed many ways of using the rivers to their advantage. It was a totally different way of thinking from that of the Romans, who treated their rivers as mere sewers.

CALL FOR A NEW VIEW

In this era, when human coexistence with nature (and association with rivers) is being so widely touted, we can see the inherent wisdom in the Edo water infrastructure, based on rivers as a clean water supply. Of course the source of the policy behind that Edo infrastructure, the traditional use of human excreta as fertilizer rather than dumping sewage into rivers, is no longer in practice. However, we can appreciate the Edo sense that the waterworks are for the people, and that the destruction of nature is to be avoided. European countries, once so destructive of their environments, are now focusing on restoration of the environment. Ironically they, and to some extent modern Japan as well, are still looking at rivers with Roman eyes. We should shake ourselves free from the ancient Roman way if we would like to promote environmental protection. ■

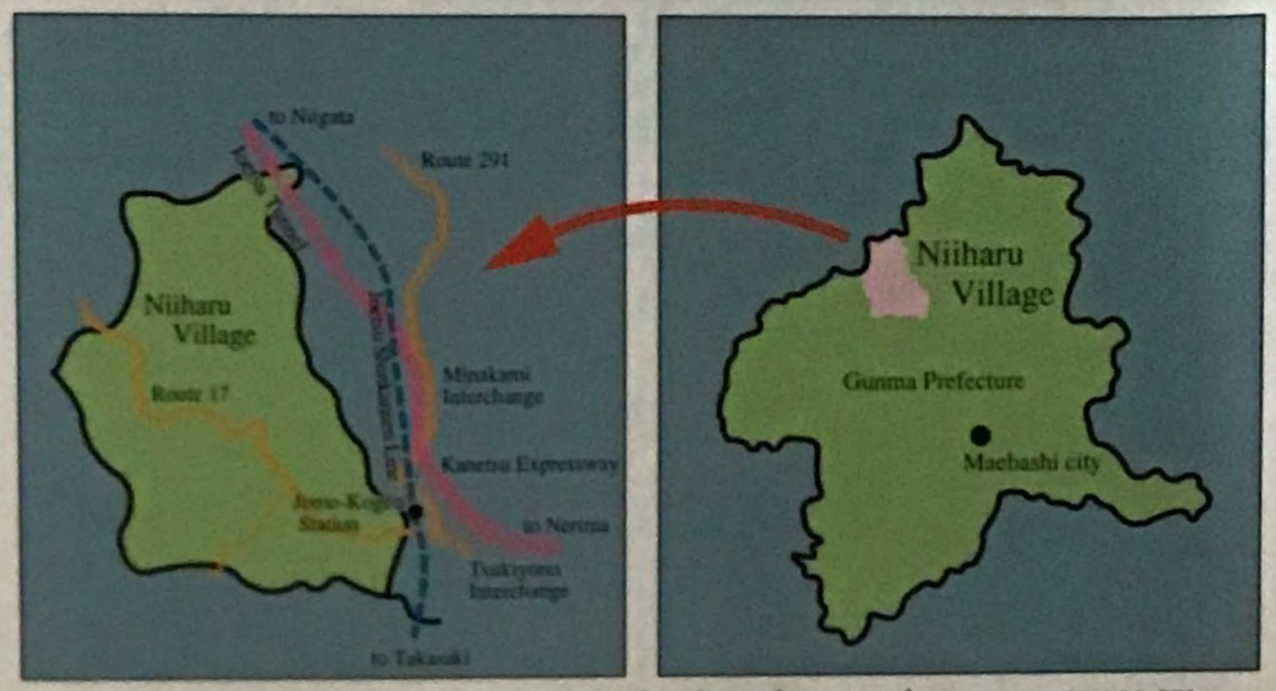
DYING VILLAGE R
VILLAGE HEADMA
SPORTY INNOVAT

Throughout Japan, rural areas of Japan are becoming depopulated as a result of industrialization and centralization. In every corner of the country, the residents of shrinking communities are confronting the dilemma of how to revive their villages, how to keep the local population strong. The quiet mountain village of Niiharu in northern Gunma Prefecture stands out as an example of highly successful innovative revitalization based on the creative use of water resources and painstaking publicity.

Niiharu, with a population of 8100, has revived. Like many villages, Niiharu had two obvious resources for the restoration of the village, its rich natural environment and its traditional handicrafts. As well, after the Aimata Dam was constructed in the center of Niiharu town, the people who lived in the area inundated by the waters above the dam found new ways of making a living, such as operating hot springs hotels. Uniquely, though, Mr. Kazuo Suzuki, who has been Niiharu's village chief for three terms, saw the town's dam and reservoir as a wonderful new resource and developed its recreation potential to great advantage. Now each year more than 1.1 million people come to Niiharu from Tokyo and the surrounding area to see 'a long forgotten farming village landscape' and to enjoy innovative water sports as participants and spectators. The secret at the heart of the success of the village's revival was the village chief's persistent efforts, supported by experts in various fields, and by the residents of Niiharu.

Niiharu Village's local specialty: kayak polo. It is much harder than it looks because balance is so precarious.

EVIVED: N'S ION



Niiharu Village. 182 square kilometers in size, its main economic revenue sources are agriculture and tourism. There are six hot springs, famous as venues loved by well-known writers and poets in the village. More than one million tourists visit this village each year. Niiharu is 160 kilometers away from Tokyo but transportation is quite convenient. Niiharu is also very close to an interchange of the Kanetsu Expressway and to Jomo-Kogen station on the Joetsu Shinkansen Line.

INDUSTRIALIZATION THREATENS VILLAGE LIFE

In times long past, Niiharu was a thriving post town on the Mikuniroad, the main route between the city of Edo (now called Tokyo) and the important district of Echigo on the Japan Sea coast. In the late 1950's, Japan began its long period of recovery from the setbacks of World War II. People excitedly helped to prepare for the 1964 Tokyo Olympics. That was the beginning of the high-growth period of the Japanese economy. Someone had to pay the price for such development, and farming villages fell victim; young people, who should have taken over their parents' farming businesses, migrated to the big cities in search of more lucrative jobs. Niiharu Village was no exception.

LOVE AND SERVICE KEEP ELDEST SON HOME

Refusing to follow the urban migration trend, Mr.Suzuki, the eldest son in his family, remained in the village after graduating from high school, working for a local company as well as farming his family's land. Like his peers, he felt drawn towards work in Tokyo, but traditionally the eldest son is expected to take over the family business. A second factor which held Mr. Suzuki in Niiharu was his strong but then not so articulate feeling that there was something special in the village which couldn't be found in Tokyo. Although he could see that his village was beautiful with its dam, its river and its forests, at the time he could not identify any particular thing that might make the place unique.

Meanwhile, Mr. Suzuki's friends left the village one after another and the village lost its vitality. Mr. Suzuki grew apprehensive, fearing that the village could well disappear if no prompt action were taken. At just thirty years old, he decided to enter politics and do something for the village. In 1976 he was promoted to director of the village council, largely because of his positive attitude towards village political activity and his animated opinions.

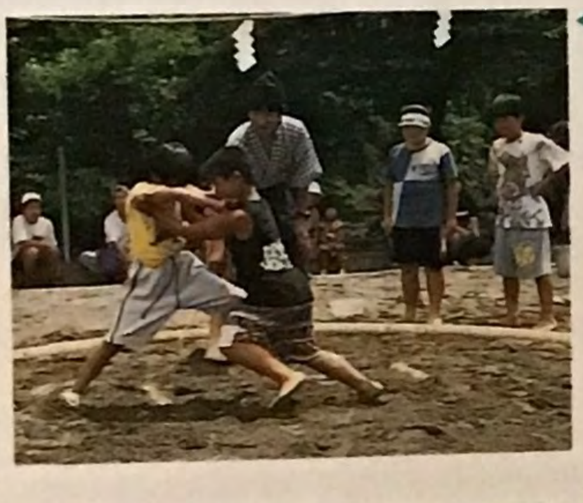
In 1987 Mr. Suzuki resigned his position after serving sixteen years because he thought that as a single member of the assembly he did not have enough power to alleviate the many problems faced by the village. He wanted to activate the village. The villagers were strongly concerned about the stagnation of the village but no concrete measures were ever proposed. The politicians focused on constructing roads and bridges as if that were their ultimate purpose, but they failed to consider specifically how that infrastructure could serve to activate the village. Mr. Suzuki decided to run for the position of village chief in order to devote the rest of his life to the mission of restoring the village. He wanted to make Niiharu a village where young people could live successfully, a place the villagers could be proud of. Mr. Suzuki ran in the 1988 election and was elected chief of the village.

KAYAK POLO UTILIZES NEGLECTED WATER RESOURCE

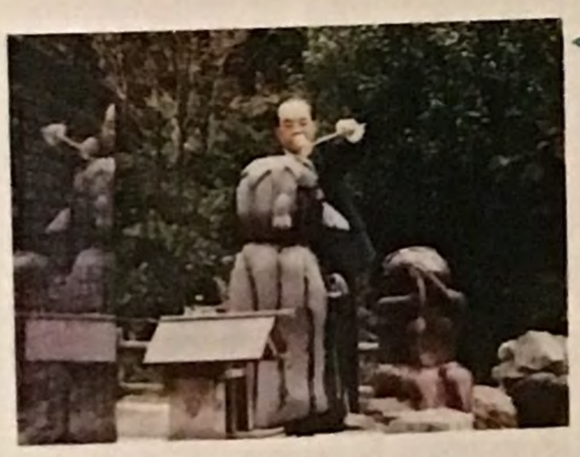
When Mr. Suzuki set about to restore the village in his capacity as the chief, the people from Regional Exchange Center suggested utilizing of the surface of the reservoir above the dam. He realized that although people tend to think that a dam destroys the natural environment, if they see the dam as a matrix for activating the village, used for such things as sports. His idea was finally put into action with the support and understanding of the villagers and the people from the Ministry of Construction, who had also been looking for inroads to extending the dam's original designed function and making it a multi-purpose resource.

The next question was, what kind of sport would be most suitable for the

▲ In Niiharu Village, the people made good use of the dam for tourism, rather than blin-dly opposing the construction of the dam. The riverside pa-rk blends in with the surro-unding scenery.



◀ Children play in the rich environment.



◀ Mr. Suzuki sprinkles water on the statue of Kappa, a river sprite, the namesake of the Kappa Festival.

dam? It should be something unique so as to draw the attention of people across the nation. After many discussions, the planners came up with the idea of kayak polo. The original game of polo is a traditional English sport. Kayak polo, in which kayaks are used instead of horses, is becoming popular among university students and the young generation in general. It is indeed a new sport, well suited to the surface of Niiharu's reservoir.

At the same time, Mr. Suzuki planned to build a recreational facility along the edge of the reservoir, containing such things as public walks, tennis courts, a campsite and playing fields. As his first step, Mr. Suzuki succeeded in soliciting the cooperation of the Ministry of Construction in constructing a special two hectare lake with four kayak polo courts and an artificial beach inside Lake Akatani. Now people can enjoy kayaking all year round regardless of the level of the water in the reservoir.

OTHER VILLAGES REACT TO NIIHARU'S SUCCESSFUL EXAMPLE

After this preparation, Mr. Suzuki declared his village to be Japan's national kayak polo village. Many delegations from other local governments around the country visited Niiharu in order to study the elements of Niiharu's success. Mr. Suzuki's declaration drew particularly strong attention from many local governments of areas which had their own dams. Subsequently twenty local governments, which endorsed such development, founded the Dam and Reservoir Exchange Association, and since 1993 association member governments have taken turns hosting an annual Dam and Reservoir Festival The first director of the association was, of course, Mr. Suzuki. This year the festival will be held near the Kanayama Dam in Furano Town,

▲ Mr. Suzuki is sure that the village's young people will return if the village can combine its beautiful natural resources with inventive innovation.

The village used to suffer from depopulation but it is successful in tourism now, thanks to the promotion of water sports and other events near the dam, the reactivation of traditional handicrafts and of course the beautiful natural environment.
The E Boat Festival in Lake Akatani (left). Children enjoying smashing a watermelon in the Kappa Festival (right).

Hokkaido. Niiharu is also planning exchange matches with the local governments in the three sections of the Tone River, the upper reaches, the middle and the lower reaches.
Through these interchanges, each self-governing body can be revitalized by making full use of the resources created by its local dam. As a result, the national kayak polo championship, the national student kayak polo championship and a dragon boat race called the "E Boat Race" are held in various localities.

MORE INNOVATION ON THE WAY

The work of Mr. Suzuki is not finished yet, however; in cooperation with the Ministry of Construction, he is promoting a five-year project for the maintenance of rivers and forests in order to protect the village from floods and landslides. Furthermore, he plans to build a river resort that takes advantage of the natural environment. And there is even a plan in the works for another dam nearby, to be called the Kawafuru Dam.
Mr. Suzuki's goal is to develop the village in harmony with agriculture and industry, and to revive nature by letting water flow in the Akatani River while at the same time maintaining the volume of reservoir water. He has a three-prong plan of attack: first, to create an agricultural park, which combines agriculture and tourism. An example of this would be a "Fruit Park" where people could enjoy picking, buying or eating fruit, all in the same place, or experience farming, or staying in a bed and breakfast farm house. Second, there is a call to create a village of welfare and culture; third, to create a sports village. Health and sports will be very important focus points for the emerging aging society: as Mr. Suzuki said, "Health is God's greatest gift". Niiharu Village has also opened a craft center called "Takumi no sato" where visitors can experience thirteen kinds of traditional handicrafts such as washi (Japanese paper), woodwork, and dyeing.
Of course, Mr. Suzuki has not been the only person to afford new ideas for revival of the village. An extensive group of people, including Professor Mizoh of Rikkyo University, the staff of the Regional Exchange Center in Tokyo, eleven staff from the village hall and eight thousand villagers, have contributed valuable advice.

PHILOSOPHY INSPIRES

Mr. Suzuki thinks that the village should be beautiful in order to attract visitors, and that he stage should be set in Niiharu so that not only farmers and industrial workers from the nearby area, but also city people from Tokyo will visit the village to take a rest and get refreshed. Towards this end, the people of Niiharu are seriously confronting environmental issues such as the establishment of a power generating garbage incineration system.
Niiharu village has a pioneering government that has developed a good, harmonious relationship with its dam. Starting with one man's idea, the move to revive the village by utilizing its water resources is now expanding, thanks to the advice and support of many people. The success of the village's reactivation is inspiring a great number of villages around the country. ■

We use re-cycled paper for this magazine.