SUMITONO OUARTER 2001 /02 NO.87





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Around 1890, the newly-modernized Besshi Mine was one of the world's most productive copper mines. To stop heavy smoke damage, the mine's smelter was moved to a remote island and a grand project was undertaken to reforest the hillsides in the mine's vicinity. In this issue we look at the work of Teigo Iba, the man who launched these initiatives.

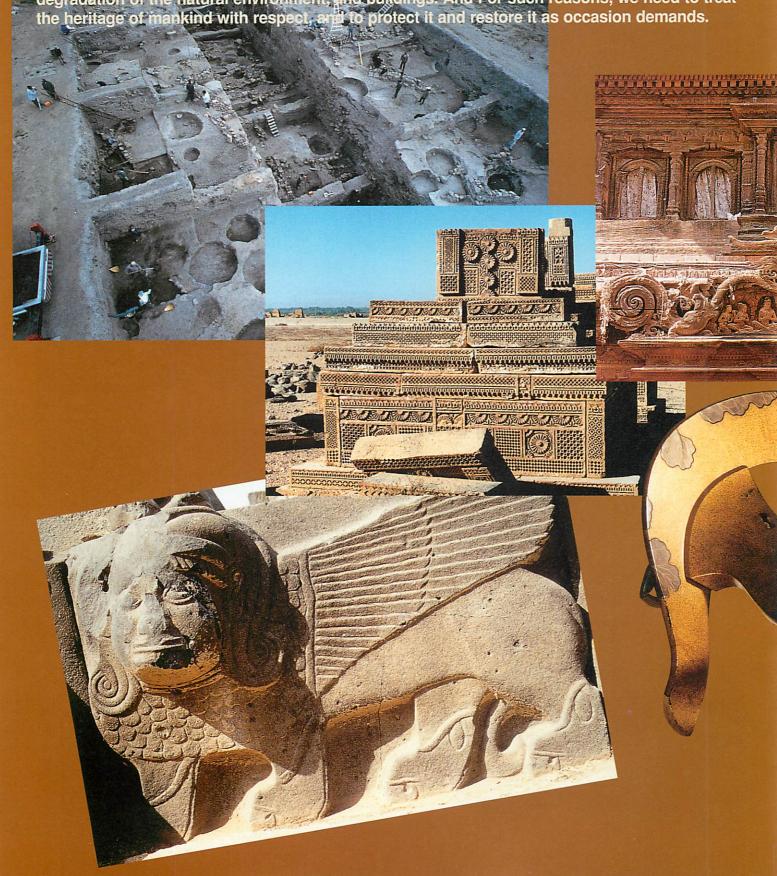
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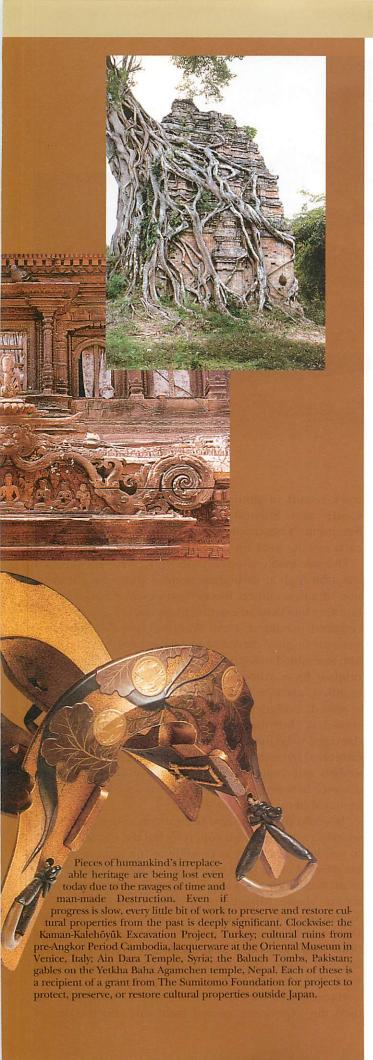
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Passing on the Heritage of Mankind

We are now living in a new century, one that is the product of generation upon generation of human endeavor. Most things on the surface of this Earth, however, are destined to perish if left untended. For example, the habitats of animal and plant species have been destroyed by degradation of the natural environment, and buildings. And For such reasons, we need to treat the heritage of mankind with respect, and to protect it and restore it as occasion demands.





21st Century Castle Building

Three years since restoration work on its stone wall began, and two and a half years since work being an old unit of commenced on the reconstruction of the buildings itself, Kanazawa Castle has been reborn.

The original Kanazawa Castle, located in Kanazawa, Ishikawa Prefecture, was constructed in 1592 as the stronghold of the local feudal lord, but was almost totally destroyed by fire in 1759. Though rebuilt, the castle suffered several further cycles of fire and reconstruction, and the parts reincarnated this time were three structures that were totally destroyed in an 1881 conflagration—two towers, the Hishi-yagura and Hashizumemon Tsuzuki-yagura, and a long storehouse joining them, the Gojikken-nagaya.

"We started planning the construction of the Kanazawa Castle Ruins Park five years ago, when Kanazawa University, a national university built on the site, was moved, and the land was returned to Ishikawa Prefecture," says Takeshi Otani, chief of Ishikawa Prefecture's Public Works Department Building and Repair Section. "The date for a 'greenification fair' at the site had already been fixed for September 2001, and so we set that as the target for completion of the restoration work."

The two towers served as both castle entrances and watchtowers, while the storehouse served as a weapons arsenal stocked with bows and arrows and other weapons, in addition to other goods. It was of course fortified against attack, and had two floors. "Gojikkennagaya" literally means "the long building of fifty ken," a ken length equivalent about 1.8 m, and so the storehouse has a length of over 90m.

Built originally around 1809, the three structures were chosen for reconstruction because the original building plans from that age are best preserved, and because they match other old buildings in the vicinity, such as the Ishikawa-mon, another of the castle's gateways, that were also built in the same period.

Wherever possible, traditional building methods were used for the restoration work. For example, the wooden framework of the towers was assembled without the use of any nails, and with slots cut into the pillars and beams in such a way that they interlock cozily. The walls, too, were made as the originals were, by plastering bamboo latticework with layer upon layer of earth.

However, because people with such skills are now rare, artisans versed in traditional methods were called from Kyoto to provide training workshops for local Ishikawa craftsmen.

At the same time, modern methods were also employed, both to shorten the duration of construction





Takeshi Otani, chief of Ishikawa Prefecture's Public Works Department Building and Repair Section.

Kanazawa Castle restored: the view from the Hishi-yagura looking toward the Gojuken-nagaya and the Hashizumemon Tsuzuki-yagura.

and for safety reasons. For example, Kanazawa has famously changeable weather and a very high rainfall, so to minimize delays in construction work caused by bad weather, a vast temporary roof was erected to cover the whole length of the Gojikken-nagaya. The roof was designed to allow sections to be opened and closed, and beams for the building, the longest of which measured a full 15m, were passed in through the roof using a crane. In other words, this was very much a case of "21st century castle-building," a skillful fusion of traditional methods with the latest technology that enabled the job to be completed in 28 months, as opposed to a minimum of three years had only traditional means been used.

"Coming to the site every day reminded me of my childhood when I often used to play in the ruins," says Otani. "Now we have this splendid castle where, in those days, there was nothing. Kanazawa Castle is a symbol of the region, and I think that everyone in Ishikawa Prefecture is happy and proud that it has been restored."

Stone Wall Renovation, Too

Castle building in Japan involves more than erecting buildings. The stone wall that comprises the foundations for the buildings is also a vital element. The stone wall that supported the Gojikken-nagaya naturally survived the fires unscathed, but it hadn't escaped the effects of rain, burrowing tree roots, and erosion, and was in need of quite extensive repair. This entailed taking it apart and putting it back together in places.

Restoring such stone walls requires specialized knowledge of their structure, the methods originally used to build them, and the dynamics involved. Having a proven

track record of similar renovation work on Yamagata Castle and Shizuoka Prefecture's Sumpu Castle, Sumitomo Construction Co., Ltd. was contracted to carry out the work on Kanazawa Castle's wall.

The job involved renovation of 1,200m² of wall that was 12m high at its highest point. Unlike the construction of a new edifice, this project involved handling the building blocks of an existing historical relic, and as such required maximum care. Wherever possible, not only were the original carved stone blocks used, but they were also assembled using traditional methods to recreate the original form. Altogether about 3,800 blocks were dismantled, each being labeled with a number as it was removed, and details of its position and orientation recorded. Only those blocks that were too weathered or damaged to be used again were replaced with new blocks fashioned from the same type of stone. The original iron wedges and clamps used for fine adjustment of angle or distance between blocks and so forth were analyzed, and identical items made anew.

"It would probably have been much easier to firm the whole structure up with concrete, but the whole idea was to restore it as closely as possible to the original, and so we avoided using such technology. I have to admit that, as an engineer, this caused me some dilemmas," comments Masao Mizumoto, a deputy section chief in Sumitomo Construction's Construction Design Department, who participated in the project. "On the other hand, I was able to appreciate firsthand how effective and appropriate the construction methods of old were, and gained a lot from the experience."

According to Mizumoto, Sumitomo Construction has used the experience gained from this and the earlier

projects to develop technology for the survey and analysis of castle walls. It can now use a selection of advanced non-destructive measurement methods to investigate various parameters of stone walls in situ, such as lasers to generate 3D positional data, and Rayleigh wave probes to determine the type and strength of the underlying ground, and existence of cavities. Through the results obtained from such techniques, Sumitomo Construction has established the first comprehensive technology package for elucidation of the overall structure of stone walls.

'Over the past few years, the repair and renovation of castle walls has been carried out throughout Japan, and there are more and more cases of castle walls being dismantled and reassembled. In the past the execution of such work tended to depend on past experience alone, but from now on we should be able to plan and carry out projects on the basis of hard scientific data," Mizumoto stresses. "This represents a big step forward in the maintenance and renovation of these stone walls, which are an important part of Japan's cultural heritage."

Good and Bad Corrosion

Meanwhile, at the Sen-oku Hakuko Kan in Kyoto, ancient Chinese bronze vessels are being restored. The

museum boasts over 500 such items which had been collected by the 15th head of the Sumitomo lineage, Kichizaemon Sumitomo, and are known throughout the world as the Sumitomo Collection.



been crafted from over 3,000 years ago implements the worship of the spirits of ancestors, and they are unequalled throughout the

superb quality of casting and their unique shapes. Motivated in part by the fact that Sumitomo was involved in copper mining, Kichizaemon collected most of the pieces in the Japanese antique market. This was at a time, after the collapse of Qing Dynasty in 1912, in which China was in a state of turmoil, and treasures flowed overseas as members of the fallen royalty and nobility sold them to maintain their lifestyles. If Sumitomo hadn't collected the bronzes, the likelihood is that they

would have been scattered throughout the world.

"The Sumitomo Collection is regarded as the most outstanding collection of such bronze vessels outside of China in terms of both quality and quantity. A major characteristic of these vessels is the way they are embellished over their whole surface with various designs that were not sculpted after casting, but rather carved into the original mold," Kiyoshi Toyama, curator of Sen-oku Hakuko Kan explains. "An amazing amount of work was involved, and many of the details of how these bronzes were cast are still a mystery."

A long tradition existed among the literati of China for the appreciation of ancient Chinese bronzes, and most of the items belonging to the Sumitomo Collection had been cherished heirlooms handed down over the centuries. As such, they are in very good condition compared with those that have emerged from post-war archeological excavations. Even so, antiquities that have survived 3,000 years have their share of nicks and cracks, and the corrosion that one would expect of objects containing copper. At the museum, X-rays are used to investigate the condition of the metal and decide on necessary restoration work. Even in an object that looks perfect, X-rays sometimes reveal fissures that had been cemented using lacquer. Actual restoration work is of course left to experts in







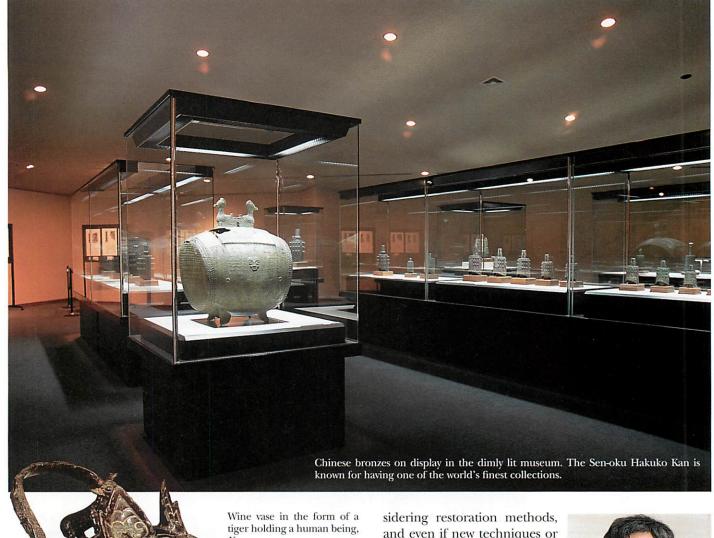


A: The Hishi-yagura and stone fortification walls before the renovation began.

B: Stones were numbered so they could be put back into the right place when the stone wall was rebuilt.

C: A marshalling yard for removed wall stones. The stones were placed back in their original positions after the wall foundations were repaired. D: Stones that were damaged beyond repair were replaced with new stones of the same characteristics fashioned specifically to replace the

E: Cranes and other heavy equipment were used to remove the stones. F: The stones were emplaced in their original positions after repair of the wall foundations



Late Shang or Early Western Zhou period.

the field.

"Nowadays synthetic polymers are used in place of lacquer, but in the future, even more

suitable adhesives might be developed, so we use materials that can be easily removed. You have to think about how things will be one or two hundred years from now when conand even if new techniques or materials become available, it's hard to decide whether they are really suitable," says Toyama.

Among the types of corrosion that one meets in ancient bronzes, there are "bad" types that tend to eat into the metal, and "good" corrosion that coats the whole surface in an attractive patina. Cases of bad corrosion are treated with protective chemicals after dechlorination. Toyama and his colleagues inspect every item,



Kivoshi Toyama, curator of Sen-oku Hakuko Kan.

including warehoused objects, once a year to check on their condition, and it is thanks to such steadfast dedication to preservation that we are able to enjoy the beauty of these masterpieces that date back over 3,000 years.

Support for Conservation of Cultural Properties

Japan also boasts a foundation that supports the preservation and restoration of invaluable cultural properties of both Japan and other nations. The Sumitomo Foundation was established in 1991 with funds donated by 20 companies in the Sumitomo Group. The Foundation provides grants under five different programs, with preservation and restoration of cultural properties throughout the world occupying a major portion of its activities.

The Foundation has so far provided grants for 167 preservation and restoration projects in Japan, and 69 overseas, making for a total of 236 grants to date. The projects funded cover a variety of areas, from restoration of paintings, handicrafts, and buildings to preservation and

restoration of historical remains and objects from archaeological excavations, and research required for planning projects. It has even supported such unique projects as the eradication of termites at Laos's Luang Prabang Museum. Applications are judged on the cultural, historical, and artistic merits of the objects concerned, and the urgency and need for preservation and restoration, but due to the large number of deserving projects, the Foundation apparently exceeds its budget every year.

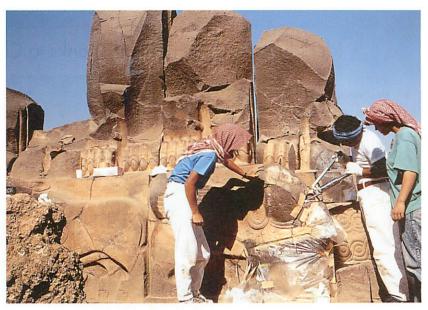
"For Japanese projects, we know where restoration specialists can be found and can estimate the amount of work involved fairly accurately; but where overseas projects are concerned, a lot of unknowns are involved, and we sometimes have to dispatch people from Japan," says the Foundation's executive director, Mutsuo Ishikawa.

One of the projects selected for support in 1991, the first year of the Foundation's activities, was the restoration of lacquerware contained in Oriental Museum in Venice.



Executive Director Mutsuo Ishikawa of The Sumitomo Foundation.

Specialists sent from Japan also trained local restorers in restoration methods while carrying out the restoration work. The same project was again selected for a grant in 2000, but this time it was one of the restorers trained in 1991 who was in charge of the project, a good example of the way in which the Foundation contributes not only to restoration itself, but also to the transfer of restoration and preservation technology.



Work to restore and preserve stone reliefs carved in the walls of the Ain Dara temple in Syria.

Among supported projects are some that have continued for a number of years, such as the conservation of the carved stones of Ain Dara Temple in Syria, and others that have gone on to be registered as World Heritage sites, such as the preservation of the old trading port town of Hoi An in Viet Nam.

"Project managers supervising overseas projects often get introduced in the local press and presented with letters of appreciation and thanks, and such expressions of gratitude make one realize the worthiness of the work done by the Foundation," Ishikawa says. "We'd like to increase the grant budget of the Foundation, but money is tight in the present economic situation. Nevertheless there are many cultural properties throughout the world that are in urgent need of attention, and we will continue to do all within our powers to save them for posterity."

If there are those who work fervently for the preservation of cultural properties, there are also those who destroy them. The Hague Convention drawn up at the end of the 19th and start of the 20th century called for the protection of cultural property, historical and commemorative buildings, and works of art from premeditated plunder, destruction, and vandalism. Though signed by many nations, countless cultural properties and works of art have since suffered damage every time a war or invasion occurs.

However, perhaps the most important heritage that we need at all costs to pass on to future generations is a peaceful and prosperous society that is able to protect the priceless achievements of human endeavor for posterity.

Ideal Butterfly Environment Thanks to Climate Control Technology

People in the 20th century carried out large-scale development and urbanization throughout the world, as a result of which many animal plant species were driven to extinction or continue to survive only under the threat of extinction. Human technology can nevertheless also play a role in preserving those species.

The Itami City Museum of Insects in Itami, Hyogo Prefecture, features a large glass dome filled with the fluttering of hundreds of

Paper Kites (also known as the Large Tree Nymph; Idea leuconoe) and 14 other species of butterfly. The dome is a real butterfly paradise, housing even butter-





Kazutoshi Ohora (left) and Futoshi Miyashita, of Plant & Air-conditioning Department, Sumitomo Densetsu.

flies from
Okinawa and
other regions
that are normally never
seen in Itami.

The facility is fitted with a special climate control system to create and maintain an

ideal environment for butterflies. Panel heaters arranged around the circumference of the dome ensure that indoor temperature does not drop below 18°C in winter. A combination of natural and forced ventilation in conjunction with humidity sensors and windows that open and close automatically as occasion demands ensure that both temperature and humidity remain relatively constant. In the height of summer, air is replaced twenty times every hour.



A temperature-controlled enclosure at the Itami City Museum of Insects. Within the 31m-diameter hemispherical dome, tropical flowers bloom in abundance as anywhere from 800 to 1,000 butterflies fly freely about.

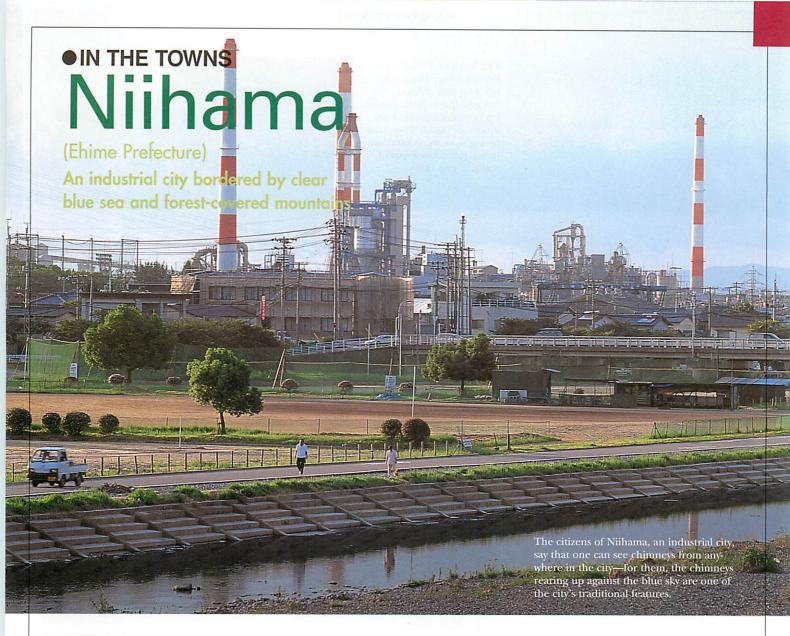
Sumitomo Densetsu Co., Ltd., installed this climate control system. "It was the first insectarsystem that we've ever attempted, and it wasn't easy," says Kazutoshi Ohora of the manager of Plant & Air-Conditioning Department. "Apart from visiting other insectariums and borrowing blueprints, I also asked butterfly aficionados about butterfly ecology and so forth. In the case of buildings for people, which we're used to, we

wouldn't of course need to go to such lengths."

It is also possible to control the movements of butterflies to a certain extent with the air handling system. For example, if air pressure inside of the dome is negative compared with the outside, butterflies will not escape even if the doors are opened. However, the basic design concept was to reproduce natural conditions as closely as possible, and refrain from excessive artificial control.

"If condensation collects on the girders, the butterflies risk getting their wings wet, preventing flight. But too little humidity is also a problem. Moreover, the facility also needs to cater to visitors, and so its environment needs to be not only ideal for butterflies, but also at least reasonably tolerable for human beings too," chief engineer Futoshi Miyashita of the same department comments. "It was very much a matter of trial and error, but seeing the faces of children visiting the museum light up with glee at the sight of the butterflies makes me feel very happy, and proud of the job we did."

Climate control systems for butterflies—yet another technology for the protection of our priceless natural heritage.



Rows of chimneys and oil tanks

The Shiokaze, an express train linking the Honshu and Shikoku islands of Japan, passes through peaceful farmland and along the coast with views of the calm sea, before winding its way through the Setouchi Industrial Region's petrochemical complexes and factories. It's been three hours since we left Osaka, changing en route to the Shiokaze from the Shinkansen, and we find ourselves in a provincial city that, with houses and farms dotting the landscape, at first glance is like any other. Yet many of our fellow passengers leaving the train are businessmen in suits, for we have arrived in Niihama. This is the birthplace of many companies in the Sumitomo Group, which spawned many industries from its beginnings as a mine

operator here.

Driving towards the city center, we soon join a main road. Wide roads with generously proportioned lanes crisscross the downtown area. The excellent road infrastructure tells the story of a city developed in an orderly manner. To the north lies the Seto Inland Sea, where several reclamation sites jut out into the sea as if cradling Niihama Port. This is an industrial area where the plants of Sumitomo Chemical, Sumitomo Heavy Industries, and Sumitomo Metal Mining are located. The noise of trucks going to and fro mingles with the mechanical staccato emitted by the factories. Rows of small white fishing vessels are tied to the wharf adjacent to the industrial zone. Standing on the wharf, you can see fish swimming lazily near the bottom of the clear blue sea. Marine wildlife forms a natural backdrop to



This street is packed with bars, restaurants, and grocery stores that seem to welcome the residents of the seaside industrial belt.

this industrial city.

Precious mine built the town

Making your way from the port along a busy street full of restaurants, you encounter a magnificent view of mountains more than 1,000m high to the south of the city.

The Niihama *Taiko* (Drum) Festival, where huge, 5.4m-tall, 11m-long, 2.5-ton mikoshi (palanquins) consisting of a platform and huge drums are paraded out, competing to be the boldest and finest. (photo courtesty of Niihama City Hall)





The home of Saihei Hirose (1828–1914), the first "Director General" of the Sumitomo enterprise and a father of modern Japanese industry, has been preserved in its original state. Together with the adjacent heritage museum, it tells the story of his achievements.



The origins of the Ichigu Shrine go back to the eighth century. A large crowd descends on the shrine, encircled by 90 camphor trees, for the harvest festival.



The 10km stretch of valley upstream from the red bridge is known as the Besshi Line. Visitors enjoy the varied scenery and clean water of the river.

The Besshi Copper Mine is located in these lush, forest-covered mountains, productive for 283 years between 1691 and 1973. Not only did the mine produce around 720,000 tonnes of copper, but it also spawned a diverse range of industries that grew



A petrochemical complex



Employees of Sumitomo Group plants rushing home at the end of a shift—a familiar sight in Niihama.

out of the process from mining through smelting. Wire and rolled copper products were made with copper from the mine, forestry developed as a result of cutting trees to make charcoal used in smelting and timbering to support galleries (tunnels), and the machinery industry grew from the manufacture of excavation equipment. In this way,

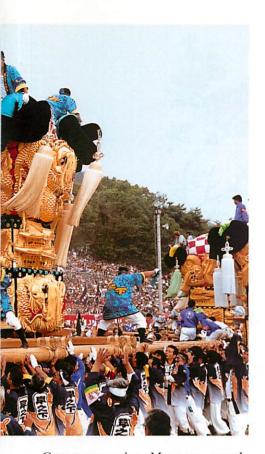




Mine Topia Besshi is a mine converted into a major tourist attraction that opened in 1991. Tourists can take a tunnel trail to learn about the history of the mine depicted by dolls and models, and on video.

the mine laid the foundations of modern heavy and chemical industries. The Besshi Copper Mine that Sumitomo managed from beginning to end was a treasure-house that powered the growth of the Sumitomo Group as we know it today.

Although the mine is now closed, the Besshi Copper Mine



Commemorative Museum stands grounds of the within the Ohyamazumi Shrine, venerated since the mine first opened as its guardian deity. The museum's exhibits concern mining technology from the mine's early years to the present, and feature the history of the mine, including the lives of its workers. Kiichi Uegaki is the museum's fifth director and a former mine employee. "You could say that the history of the mine is synonymous with the history of Sumitomo, because it was under Sumitomo's management from its beginning until it closed. The museum is of great value to historians, because we've managed to keep all historical documents and artifacts together,"

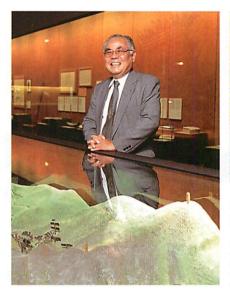


From the top of a hill near the coast, you can see the Seto Inland Sea islands, the port of Niihama, and lush green hills nearby. (photo courtesty of Niihama City Hall)



Profile of Niihama City (as of November 2001) Population: 128,882 Households: 51,614

Area: 161.30km²





(above) The Besshi Copper Mine Commemorative Museum built in 1975 to pass on to future generations the history and significance of the mine. (left) Kiichi Uegaki, director of the Besshi Copper Mine Commemorative Museum, which displays historical records and other artifacts concerning life and technology since the mine first opened. Admission is free.

says Uegaki.

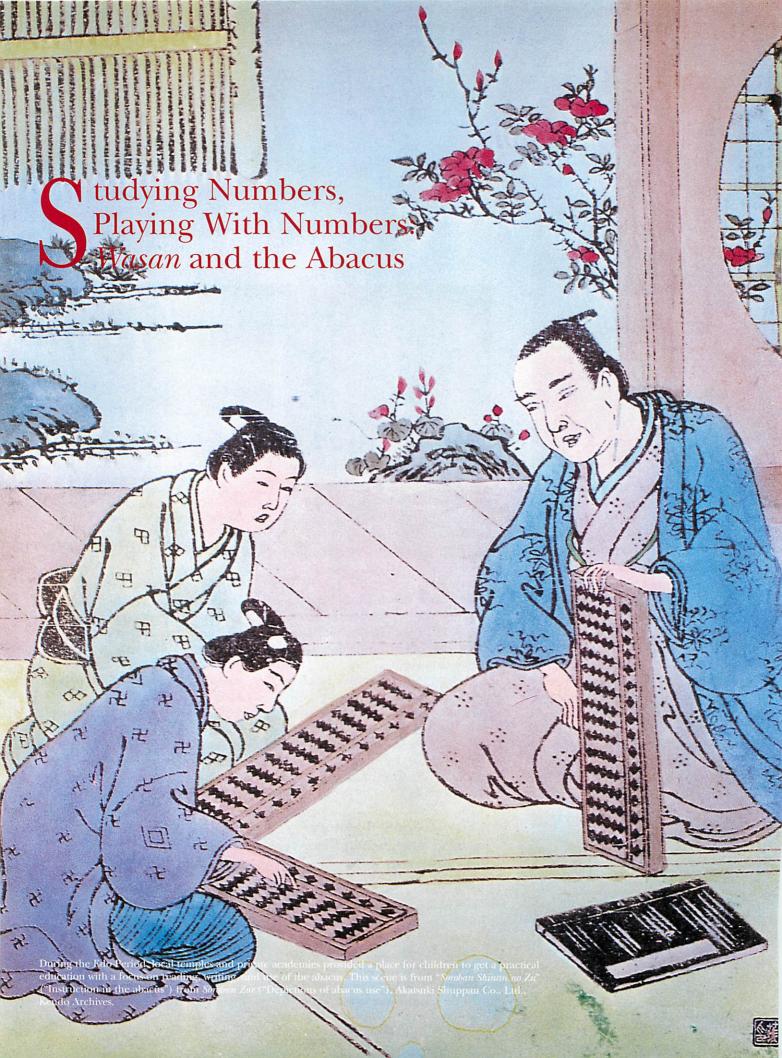
As a place that built the foundations of modern science and technology in Japan, the Besshi Copper Mine has been designated an Industrial Heritage site by the Agency of Cultural Affairs. In addition to members of the public, Sumitomo Group company employees visit the museum, which provides a wealth of material about the mine's history, to participate in executive seminars and freshman training courses.

A city steeped in history, making progress in the here and now

The mine that nurtured the Sumitomo Group also shaped the town. People came to live in Niihama where roads were built, rail services began, and goods were delivered by sea. Houses went up, followed by many public facilities such as schools and hospitals, and the town grew into the city of Niihama. Declaring itself a city that "creates industry and culture," Niihama is developing streets lined with buildings and structures made from copper materials, as well as cultural and recreational facilities and walking trails that blend in with the natural environment.

The citizens of Niihama enjoy a relaxed and quiet lifestyle. They go to work in the morning and enjoy spending time with their families in the evening. Sometimes parents play baseball with the kids; families go to the brand new shopping mall on weekends. In the fall, friends get together to harvest vegetables and taro to make imodaki, a seasonal local speciality cooked in a handmade pot, and pay tribute to local tradition at the Niihama Taiko (Drum) Festival.

Before the city lies the sea and its links to the rest of the world, and to its rear looms the great Besshi Copper Mine, which brought industry and prosperity to Niihama and keeps silent watch over its future.



Stalled inheritance

Mention math nowadays, and it's π (pi) and the equations of Western mathematics that come to mind just about anywhere in the world. But long before the penetration of Western influences, other parts of the world—such as China and the Indian sub-continent—already had their own distinctive mathematics. Japan, too, was no exception, boasting a well-developed body of mathematics known as *wasan*.







Illustrations depicting how to do calculations from a wasan textbook. From top to bottom: mamakodate ("orphan counting," an elimination game similar to the Josephus problem), indexan (nesting), and nezumizan ("mouse multiplication": geometric progressions). Familiar

objects from people's daily lives—things like mice and pots and pans—were used in the examples. These illustrations are from *Chieguruma Taizen* ("Wheel of wisdom encyclopedia," published sometime between 1624 and 1643) and *Somban Zue* ("Depictions of abacus use"), Akatsuki Shuppan Co., Ltd., Kendo Archives.



The Jinkoki, a book that provided an impetus for the popularization of wasan. First published in 1627, it was revised and even reworked for re-issue in several editions. Shown here is a depiction of the 1641 edition reproduced in Gendai Katsujiban

Jinkoki (The Jinkoki in contemporary type, Wasan Kenkyujo [research institute], ed., 2000).

Japan as an academic discipline in the sixth century and is said to have been brought from Paekche (*Jpn*: Kudara) in Korea.

During the Nara Period (710–784), when a university system to train officials involved in tax collection, construction, and the creation of calendars and almanacs was introduced from China, mathematics was one of the subjects included in the curriculum. At the time, it was mostly very practical calculations such as simple and quadratic equations, formulas for calculating area and volume, and measurement methods that were taught.

Such devices as *sangi* ("counting rods": pieces of wood about a few cm in length that were arranged in rows for calculation purposes) and *ku-ku* (literally "9 x 9," the Eastern equivalent of the multiplication tables) were also introduced, but for a long time afterwards little progress was made in mathematical theory, undoubtedly due in large part to the fact that neither commerce nor urbanization were at a sufficient level to fuel its development.

The birth of wasan

A few centuries later, during the Muromachi Period (1392–1573), hostilities between a number of powerful feudal lords seeking to expand their hegemony provided the impetus for advances in a variety of areas—particularly military technologies, castle construction, and the minting of coins—which resulted in a growing need for mathematical expertise. The Azuchi-Momoyama Period (1568–1600) saw a vast increase in commerce and the

flow of people and goods between regions, heralding the establishment of an urban economy as cities that served the role of economic hubs emerged in each region.

It was again to China that Japan turned for the new mathematical knowledge and technology required by the age, importing not only mathematical tomes, but also a new calculation tool, the abacus.

An abacus is composed of a rectangular frame, between the long sides of which a number of parallel spokes are affixed, like the rungs of a ladder, with five lozenge-shaped beads on each spoke. By sliding the beads up or down the spokes in relation to each other, one can carry out not only addition, subtraction, multiplication and division, but also calculate square and cube roots and even simple equations. The abacus, which anyone could use with just a little practice, spread throughout the country. The oldest mathematical text in Japan, the San'yoki (written around 1600, author unknown), was in fact written as a training manual for the abacus.

With the advent of the Edo Period (1603–1867), a period of relative calm, mathematics began to be regarded as an academic discipline. A great many mathematical treatises were published, the most notable of which was Yoshida Mitsuyoshi's *Jinkoki* (first edition 1627), which did much to popularize the subject.

Like the *Sanyoki*, the *Jinkoki* was also a text for the learning of arithmetic using an abacus, but Yoshida went out of his way to stimulate the interest of readers, using such everyday events as the buying and selling of rice, or providing change from a large denomination coin, and other examples that adapted the calculation methods imported from China to suit the situation in Japan.

For example, Yoshida used the all too familiar mouse as an example,



The education ministry's current school curriculum calls for only six hours of instruction on the abacus-for third graders. But the abacus is known to be a perfect tool for helping children develop concentration, learn to do sums in their head, and otherwise acquire the basics of mathematical skills. More recently, some abacus schools have been implementing methods that have children practice doing sums in their head by using their fingers to do abacus problems displayed by a PC program. These children attend the Iwasaki Soroban Gakuen, a private tutorial school for learning to use the abacus in Tsubame, Niigata.





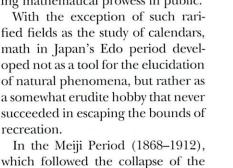
Math as performance?



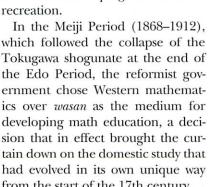
nally presented their sangaku to ing mathematical prowess in public. With the exception of such rari-



writing:



If a pair of mice produce 12 offspring every month, and those offspring also produce 12 offspring every month, how many mice will there be in one year's time?



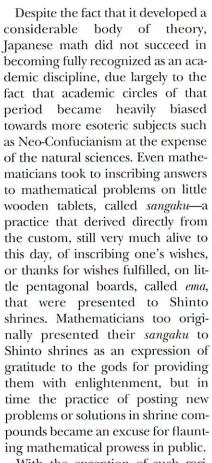
This is just one of many examples that Yoshida used to demonstrate the prevalence of mathematical elements in everyday life. The Jinkoki, after going through

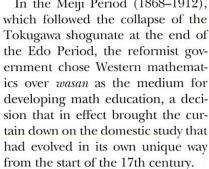
> user places white and black beads into grooves in the wooden frame to do calculations. This specimen was reproduced according to descriptions in the Shushu Jiyi (Jpn: Sujutsu Kii), a mathematics tome dating from China's Han Dynasty (ca. 202 B.C.-A.D. 220). Wasan Kenkyujo archive.

An ancient Chinese abacus said to repre-

sent the prototype of today's abacuses. The

several reprints, came out in a new edition in 1641 that used the even more novel device of not providing the answers to the difficult problems carried in its pages, a practice that later came to be known as idai keisho, literally "handing down problems." The 1641 edition made a tremendous contribution to the advance of Japanese math, the idai keisho innovation sparking a rush of publications by Edo mathematicians of books of solutions, and of further problems ad infinitum.



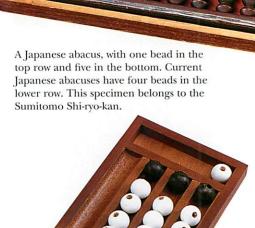


Wasan nevertheless played an important role, not only in popularizing the arithmetic for which the



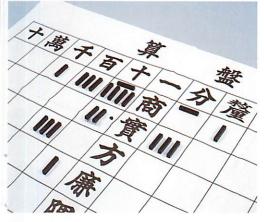












Sangi (counting rods) like these came to Japan from China during the Nara Period, when the Chinese legal system and other influences also came to the country. Rods of several centimeters in length are laid on a paper partitioned into positions for tens, hundreds, and thousands to do calculations. This method can be used to solve high-degree algebraic equations as well as to do simple addition and subtraction. These sangi belong to the Wasan Kenkyujo archive.

abacus was used, but also in laying the mathematical foundations for the understanding and absorption of the natural sciences and engineering technology that began to penetrate the isolated island nation from the West, and as such could be said to have made a big contribution to Japan's industrial and economic development since the start of the Meiji Period.

The allure of the abacus

Although wasan faded with the dawning of the Meiji Period, the abacus, while undergoing innovations that made it even easier to use, continued to be widely employed as a convenient calculation tool—no doubt because, despite the fact that it is a fairly primitive tool, it enables very rapid and accurate calculations once mastered.

The abacus works on the principle of recording simple additions, subtractions, multiplications and divisions first carried out in one's head on the panel of beads, by moving the beads up or down. The abacus creates a deep enough impression on the minds of people who have mastered it that they apparently envisage an abacus when they carry out mental calculations.

With the spread of electronic calculators, the abacus is an increasingly rare sight in everyday life. It is, however, attracting attention in the field of education for the way it can nurture powers of concentration enhance the development of the right side of the brain, and abacus classes are now part of the educational curriculum of primary schools in America, Europe, and also Southeast Asian countries such as Thailand. One Japanese abacus manufacturer says that its products are now used in 48 countries throughout the world.

Using an abacus is a technique that, even if learned, tends to fade if not put to use for some time. Considering





The Japanese abacus finds enthusiastic users throughout the world. The "Let's send abacuses to Thailand" project organized by Yokota-cho, Shimane Prefecture (Japan's premiere producer of abacuses) and the Minsai Center, a non-government organization, presents abacuses to the children of Roi Et, Thailand. The program is designed to help the people of Roi Et help themselves out of poverty through the acquisition of basic mathematical skills.

the contribution it can make to the development of the mental abilities of children, one can only hope that the abacus, with a long history that parallels the evolution of mathematics, will continue to enjoy increased utilization as an educational tool.

The editors wish to thank the Wasan Kenkyujo, Kendo Archives, Iwasaki Soroban Gakuen, Niigata; and Minsai Center.

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Someone Special

Golf Club Developer

Determination. Intense effort. Breakthrough. Whether in the world of business or the world of hobbies and sports, people who strive to actualize their potential shine. In this series, we feature outstanding individuals within the Sumitomo Group.

Sumitomo Rubber Industries, Ltd. (Dunlop Japan Limited) Tetsuo Yamaguchi



Known Worldwide for the Yamaguchi Patent

The XXIO (pronounced zeck-si-oh) brand of golf clubs launched by Sumitomo Rubber Industries in February 2000 sold 160,000 woods in the first year, a phenomenal record for the company. XXIO clubs are a hit because they deliver improved distance, directional accuracy, and feel that every golfer dreams of. The man who has played a major part in the development of XXIO's basic technology is Tetsuo Yamaguchi.

I think XXIO's success is the result of an effective blend of the 4Ps—product, price, promotion, and place.

The strong appeal of new product itself combined with effective marketing and promotion that was seamlessly coordinated with production and sales. This generated excitement that filtered all the way down to end sales channels and paved the way for XXIO, which the company's future depended on, to make a stunning entry into the market. It also benefited from exposure by professional golfer Shingo Katayama, a staff player for Sumitomo Rubber who was the leader in prize earnings in 2000 and gave an outstanding performance in the US PGA Championship this year, finishing in fourth place.

I've been working in research since I joined the company until a few years ago. I started out supervising industrial product development and got involved in golf club development about 20 years ago. At that time, analytical techniques utilizing computer technology hadn't developed to the extent that they could be used practically for golf club R&D, so we had to rely on trial and error. That meant a repeated process of making a club, testing it, modifying the design, and making it over again. In the past few years it's been like a dream come true to be able to use super computers to see how the club works internally at the moment of impact with the ball.

During his research in collaboration with a university, Yamaguchi made an important discovery. The theory of "impedance matching," patented by Yamaguchi,











enabled manufacture of a golf club that provides so much extra distance that a controversy developed in the United States over its regulation. Now the theory has entered the mainstream, but initially Dunlop was its sole advocate. Impedance matching is a perfect example of innovation by using an approach the stands conventional wisdom on its head.

Previously, it was a foregone conclusion that the harder the club head was the more repulsive force it had and the farther the ball would fly. Actually, with a softer head that approaches the degree of hardness of the ball, repulsive force is higher and you can drive the ball a greater distance. The progression in raw materials used to make the head—originally persimmon wood soaked with resin to harden it, then carbon, duralumin, metal, and finally titanium—substantiates that thinking. It was a case of reality proving the theory.

XXIO incorporates several technical innovations including a "thin perimeter face" that utilizes the impedance theory to deliver extra distance and "autoturn" design that places the center of gravity to match the loft angle, allowing golfers to achieve square impact with the ball. The driver also produces a pleasant sound when the head strikes the ball. This is probably what gave us the most trouble. You know, that high, resonant sound that's so satisfying. We did an in-depth analysis of the wave frequencies of a variety of sounds produced by the head and by analyzing all of the data, we were able to pin down the pleasure zone. Since golf clubs are used by people, you can't depend on theory alone. "Feeling" is an important part of the equation.

Naturally, Yamaguchi enjoys playing golf in his leisure time. And he tries out new products by other companies. But golf is his work. When he really wants to relax, Yamaguchi opts for tennis. He plays at the neighborhood tennis club once a week. "I have to admit, beer tastes better after a game of tennis," he smiles.

What makes my research so rewarding are the new discoveries I make. In the Development Planning Department, it's always satisfying when a product sells well. My next ambition is to develop products that succeed in the global market. That's a tall order, but I'm set for the challenge.

SUMITOMO TOPICS

Mitsui Sumitomo Insurance Employees Shine in World Sports

Mitsui Sumitomo Insurance Company, Limited, has been emphasizing athletics as a way to enhance its business activities and to provide its employees with a venue for self-expression. Since the company's launch in October 2001 with the merger of Sumitomo Marine & Fire and Mitsui Marine & Fire, some of its employees have done quite well in international sports competitions.

At the 19th Deaf World Games held in Rome from July 22 to August 1, Mitsui Sumitomo Insurance member Kiyomi Hashimoto placed fourth in the 10,000-meter race for women on July 25. She followed that with a gold medal in the Women's Marathon on August 1.

Next. Mitsui Sumitomo Insurance women's judo team members Masae Ueno (to-70kg) and Yuki Yokosawa (to-52kg), competing in the 2001 World Judo Championships held in Munich, Germany from July 26 to 29, finished first and fifth in their respective weight classes. Ueno's gold was particularly significant because her weight class is noted for its many strong competitors, and Ueno was in fact the first Japanese woman to become world champion in that class. She faced extremely tough opponents in both her semi-final and final matches. Although at the start of the final match she said she felt confident about winning, she was still "very delighted" to have actually won.

Finally, track and marathon team member Reiko Tosa took the silver in the Women's Marathon on Sunday, August 12, at the 8th IAAF World Championships in Athletics in Edmonton, Canada. Yoko Shibui placed fourth. The Japanese women's marathon team took home the first place prize for the third straight year in the team competition in Edmonton.



Sumitomo Metals Wins Steel Plate Order for Shell Oil Deepwater Development Project



Sumitomo Metal Industries, Ltd. has won an order for 17,000 t of thick steel plate from Hyundai Heavy Industries Co., Ltd. (HHI), of Korea. The steel plate will be used in a state-of-the-art floating development and production host facility ("Floating Production System") to be built for the Na Kika Subsea Development, a joint oil exploration project of Shell Oil and British Petroleum. The project is located in the Mississippi Canyon area of the Gulf of Mexico in water depths of up to 6,500 ft (ca. 2,000 m). The Na Kika fields are expected to yield some 300 million barrels of oil.

Sumitomo Metals and Shell Oil have had close business ties for many years. To date, Sumitomo Metals has supplied Shell with over 70,000 t of thick steel plate for use in tension leg platforms (TLPs), floating structures able to withstand the rigorous requirements of offshore oil development at water depths of 500–1,500 m. When material for large-diameter pipe is included, Sumitomo Metals has sold some 110,000 t of steel plate to Shell Oil, making it Shell's largest supplier of this product.

The impetus for Sumitomo Metals' development of steel plate for use in TLPs came from a request by Shell Oil, and the material had to meet very tough specifications set by Shell. Besides having excellent safety characteristics, the steel plate had to be highly weldable and produced on short delivery notice. The new

order from HHI for steel plate to be used in the Na Kika TLP is attributable to Sumitomo Metals' close business ties with Shell Oil and the long-term relationship of trust developed between Sumitomo Metals and HHI.

As offshore oil platforms become larger, the steel used in their construction will face more rigorous requirements, such as for greater strength and toughness. Sumitomo Metals has extensive experience in supplying high-grade steel plate for use in critical members in some of the world's largest offshore structures, so it has complete confidence in its ability to meet whatever those changing requirements might be.

Sumitomo Construction Machinery Exhibits at Asia's Largest Construction Machinery Show



Sumitomo Construction Machinery Co., Ltd., participated in the International Exhibition for Construction Equipment & Technology (Conet 2001). One of the world's biggest largest construction machinery shows, the exhibition was visited by some 50,000 people during its run from September 19 to 22, 2001, at the Tokyo Big Site fair grounds.

Sumitomo Construction Machinery showcased a range of equipment including road-building and maintenance machinery, the industry's first "IT Crane" system, and the SH225X super-shortradius rear-end excavator, which is designed to provide maximum stability during operation. The manufacturer's biggest attentiongetter, though, was its SS180RG Garaxy self-propelled crusher. For use in demolition work, this especially environmentally-friendly machine allows on-site processing of old concrete and asphalt into recyclable material while generating minimal noise, vibration, and dust.

Sumitomo Construction Machinery has been moving forward under its Pax New Frontier (New century, new company, new machinery, new experience) theme to differentiate its product

line from those of its competitors and enhance its profitability. The company has built production infrastructures specialized for each of its excavator, road construction and maintenance equipment, and crane businesses. The equipment models exhibited were intended to epitomize the concept and spirit of the new company. Visitors reacted with comments like "The new models seemed to symbolize Sumitomo Construction Machinery's new vitality and youthfulness" and "It was interesting to see types of equipment on display that one rarely gets a chance to see."

Sumitomo Chemical Develops New Manufacturing Method for Methionine

After many years of research effort, Sumitomo Chemical Co., Ltd., has achieved success in developing a new technology for manufacturing liquid methionine analog (LMA), an additive chiefly used in chicken feed.

The new manufacturing method produces LMA that is of clearer color and higher quality than currently available LMA. Taking into account recycling measures, the method is an environmentally friendly process as well as highly cost competitive.

Engaged in the manufacture and marketing of power DL-methionine for many years, Sumitomo Chemical has positioned feed additives as one of its core business. Demand for raising chicken feed, in which methionine is mainly used, is expected to grow hand-inhand with the burgeoning demand for white meat as populations rise in developing economies and health food trends advance in developed economies. Sumitomo Chemical's current annual production capacity for methionine is approximately 40 thousand metric tons. In order to fulfill needs for both liquid and powder methionine, the company is planning to build a new LMA plant with an annual production capacity in the several tens of thousands of tons as well as adding to the DL-methionine capacity. For the new plant, Sumitomo Chemical is further exploring the possibilities of business alliances, including commissioned production for other companies or co-production.

Sumitomo Chemical is the world's only fully integrated manufacturer of DL-methionine, which is made with special raw materials including acrolein, hydrocyanic acid, and methyl mercaptan. Thanks to its manufacturing capability of covering all stages from raw materials processing to final manufacture, Sumitomo Chemical's product is highly competitive in the global marketplace.

Sumitomo Metal Mining Launches Nickel Joint Project in the Philippines

Sumitomo Metal Mining Co., Ltd., is moving to build a plant in the Philippines for producing an intermediate product for nickel refining using the high-pressure acid leaching (HPAL) method. The operation will be a joint venture with Nissho-Iwai, Mitsui&Co and a local firm Rio Tuba Nickel Mining Corporation (RTN).

HPAL will allow the low-cost recovery of nickel from the low-grade laterite ores mined at RTN's Rio Tuba Mine located on Palawan Island in the southwest of the Philippine archipelago. Some 16 million tons of laterite—enough to supply raw materi-

al for about 20 years of operation—are stockpiled on a tract next to the planned plant site.

Construction will begin as soon as necessary approvals obtained from the Philippine environmental oversight authorities, and the plant is scheduled to come on stream sometime around summer 2004. The intermediate that plant will produce, nickel/cobalt mixed sulfide, will be shipped to Sumitomo Mining's Niihama Nickel Refinery in Ehime, Japan, for processing into electrolytic nickel and electrolytic cobalt using the world's most advanced matte chlorine leach electrowinning (MCLE) technology.

Through this project Sumitomo Metal Mining aimes to further refine its technology for processing nickel oxide ores and its engineering technology, thus ensuring it a rock-solid position as a world-class player in the nickel refining industry. Sumitomo Metal Mining's successful development of HPAL enables it to cost-effectively recover nickel from laterite, a low-grade oxide ore, whereas currently most nickel-resource operations concentrate on extracting the mineral from sulfide ores and garnierite, a high-grade oxide ore.

We've launched a Website!

The Sumitomo Group Public Affairs Committee has launched an English Website. In addition to links to the Websites of Sumitomo Group member companies, it also features articles about the Group's guiding principles and major activities, as well as the story of our nearly 400-year history. We invite you stop by for a visit at http://www.sumitomo.gr.jp/english/

You'll be able to get to know us better and learn about the latest in what's happening at Sumitomo.

NEC, MEI, MCI Cooperate in Advanced Mobile Handsets

On August 21, 2001, NEC, Matsushita Electric Industrial Co., Ltd. (MEI), and Matsushita Communication Industrial Co., Ltd. (MCI), announced alliance for cooperative development of mobile handsets, designed to help them strengthen their global position in that area.

The integration of traditional cellular services with email and the Internet, combined with increasing transmission speeds and greater bandwidth, are adding new aspect to the mobile telephone market. Taking in a wide variety of new media and new technologies from music and video to broadcasting, the "mobile multimedia market" is spawning new businesses as its pop-

ularity grows.

Amid these developments, mobile handsets are beginning to look like the ultimate "Internet access tool," boasting new features and a concentration of various technologies. Such handsets are quickly becoming essential as the device able to accommodate a multitude of media possibilities and technologies.

The NEC-MEI-MCI alliance is meant to spur innovation by stepping up the pace of development to bring reliable, high-quality handsets to a global market. NEC and Matsushita are world-class industry leaders in the technical development and practical application of mobile Internet technology and third-generation (3G) (W-CDMA) handsets. Their tripartite agreement covers four key aspects: work

to design common specifications and architectures for 3G mobile handsets and joint development of application software for them; joint development of mobile terminals for new markets resulting from the integration of multimedia into mobile devices; cooperation in quality validation testing for new products; and the possible OEM supply of products ranging from 2.5G GSM/GPRS to 3G devices. The alliance also includes plans to make development results available to other manufacturers.

Sumitomo Bakelite Builds Plants in Macao and Vietnam

Sumitomo Bakelite Co., Ltd., is to build a plant in Macao, China, to produce epoxy-resin, copperclad laminates, and another plant near Hanoi, Vietnam, to produce flexible high-density printed circuit boards (PCBs). The company expects construction of both to be completed by the end of 2002.

The epoxy-resin, copper-clad laminate to be produced in Macao will serve as raw material for PCBs used in personal computers, communications equipment, digital home appliances, and game machines. The laminate business is robust and demand is expanding toward high-quality, multi-layered products. Macao was selected as the site for the plant because of the cost competitiveness it promises and because it is close to the

Asian market where demand is particularly strong. As a wholly-owned subsidiary of Sumitomo Bakelite, the plant will be capable of producing 300,000m² of laminate monthly, and at full capacity that will rise to 600,000m².

The IT industry's rapid growth, meanwhile, has caused a surge in demand for flexible PCBs, with demand in Japan alone growing steadily at 10% or more a year. Most of this is driven by the trend toward smaller, lighter, and multifunctional devices and equipment, from cell phones, mobile devices, and notebook computers to LCDs and digital home appliances. In addition, demand promises to rise all the more for substrates used for high-density PCBs.

Sumitomo Bakelite is now making flexible high-density PCBs at two plants, one in Japan and one in the Philippines. It decided to build a third production site to keep up with expanding demand. Reasons for choosing Vietnam include attractive tax incentives and an excellent supporting infrastructure. As in Macao, the plant in Vietnam will be wholly owned by Sumitomo Bakelite.

When the new Vietnam plant comes on stream, Sumitomo Bakelite's flexible PCB business will consist of its domestic plant in Akita, which will undertake manufacturing and development of advanced technology, and its overseas production facilities in the Philippines and Vietnam.

Sumitomo Electric to Construct Flat Cable Plant in Hungary

Sumitomo Electric Industries (SEI), Ltd., built a flexible flat cable (FFC) plant at its subsidiary SEI Interconnect Products (Hungary) and integrated its European flat cable production in Hungary.

Formerly, most of the flat cables have been produced at SEI Interconnect Products (Europe) UK and been exported to other European countries. The decision was made to follow up our main customers who are expanding their production capacity in Hungary.

SEI Interconnect Products (Europe) will continue its operation as a European marketing and sales company.

Flat cables are suitable for internal wiring of computers and electronic equipment due to their excellent flexibility, smooth connectivity and minimized thickness. In addition to the electronic field demand, the European flat cable market is underpinned by new applications in the automotive fields such as flat wire harnesses, which can reduce weight and save wiring space compared with the conventional round wire harnesses, and we aim to lead this field which is anticipated to expand.

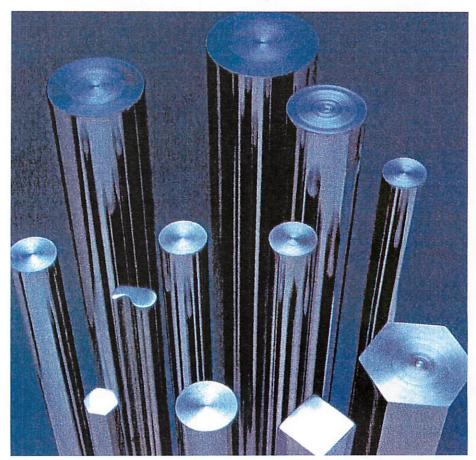
Sumitomo Metals (Kokura) to manufacture and distribute Cold Finished Steel Bars in Thailand

Sumitomo Metals (Kokura), Ltd., positioned long Steel Processing (Thailand) Co., Ltd. (SP), its subsidiary in Rayong Province, Thailand, as a secondary processor of special steels involved in manufacturing and distributing steel wire for cold heading and cold forging. Sumitomo Metals (Kokura) is now moving to invest new capital to enable SP to produce and distribute top-of-the-line cold finished bar steel.

The new investment comes because of steady growth in the automotive and electric machinery industries in the ASEAN area. Parts manufacturers in these industries currently import most of their cold finished steel bars from Japan; but due to requirements for a higher proportion of local content, parts manufacturers have begun asking for locally produced top-quality cold finished bar steel.

SP's new capacity is scheduled to start in September 2002 and will give Sumitomo Metals (Kokura) the infrastructure for supplying products to the world's automotive and electric machinery manufacturers operating in both Japan and the fast-growing ASEAN markets.

Sumitomo Metals (Kokura) spun off from Sumitomo Metal Industries, Ltd., in April 2000, making it an independent blast furnace operator manufacturing specialty steel products. It is also a leading shareholder of SP with a 50% equity stake.



Far-reaching plans

In any age, the ups and downs of business and of companies provide a window on how people live and even on society itself. In this series, we present moments from the past that we hope will demonstrate the business spirit of Sumitomo through the dynamic unfolding of history.

In Part VIII, we look at Sumitomo's early environmental work and its entry into new businesses at the close of the 19th century.



The impact of three innovations

The late 19th century renewal of the Besshi Mine—annual production from which had fallen to just 430 tonnes—was made possible by technological innovations in all three of mining's essential components: extraction, smelting, and transport. The adoption in 1882 of dynamite to blast open mine shafts dramatically accelerated progress, while the introduction in 1891 of a rock drill enabled the extraction of large quantities of ore. Steam provided the compressed air to power the rock drills of this era, which meant operation was hardly easy. But when contrasted with the hand-wielded hammers that Besshi miners used during the mine's first 177 years (from its 1691 opening), this rock

drill was truly revolutionary. In 1888, Sumitomo completed a western-style smelter at Niihama, which overlooks the Seto Inland Sea, to smelt large quantities of ore, and in 1893 the company opened a dedicated rail line to connect the mine with the new smelter.

In the years surrounding the Besshi mine's 200th anniversary, it re-emerged as one of the largest copper mines in the world, with annual copper production exceeding 2,000 tonnes.

Restoring the environment

Spurred on by such innovations, Sumitomo acquired mining rights to a large number of additional lots, multiplying the land area it had mining rights to by over 40



times in just 20 years. Such expansion, however, entailed a price—before long almost all of the trees in the vicinity of the mines had been cut down. Trees were required to reinforce mine shafts to protect miners, and no matter how many were cut, there were never enough. And the need for large quantities of charcoal and firewood exacerbated the wood shortage. To make matters worse, smelter smoke damaged both crops and trees.

Seeing the impact the mines were having on their surroundings, Teigo Iba (1847–1926), who became general manager of Besshi in 1894, initiated a massive tree-planting program. Sumitomo had planted no more than 50,000 trees in the five years prior to Iba's appointment. In contrast, in Iba's first year alone, the company planted no fewer than 110,000. In 1897, it planted 1.2 million, the first time the



company had ever planted over a million trees in a single year. In the first decade of the 20th century-the peak of this effortthe company planted million trees and started

11.9 million seedlings—an average of 5,700 tree plantings and 3,260 seedling starts a day. Considering that the people of the time had not yet so much as imagined the mechanization of tree planting and that workers were planting Japanese cypress and cedar seedlings with care so that the trees could take root and flourish—and were doing so on steep, uneven ground—those are astonishing numbers.

Late in life, Iba—looking out over the vast stretches of forest that his project had brought back to Besshi—said, "If you want to know what my real work has been, this is it." His words tell us of the conviction with which he undertook this task.

Launching related businesses

Iba also took steps to address the smoke damage from the expansion of Sumitomo's smelting operations. Despite the many challenges Sumitomo faced in the aftermath of the first Sino-Japanese War (1894–1895)—particularly inflation, which dramatically increased expenses and forced revisions to business plans—Iba oversaw the completion of a smelter on an isolated island some 20 km off the coast of Niihama.

Iba also worked to transform Sumitomo's overall business structure and organization. To bring the intentions of Sumitomo's various business units into alignment, the top-level decision-making function was unified under the directors of the House of Sumitomo and, in 1895, Iba and five other directors held the company's first board of directors meeting. At this historic meeting, the directors set the long-term direction for the company in a number of areas including the founding of Sumitomo Bank, the expansion of foreign trade, entry into the coal business, and employment reform. With the capital Sumitomo raised in the boom that came after the first Sino-Japanese war, the company branched out into a number of related businesses through both start-ups and acquisitions.

In 1899, floods devastated the Besshi mine and worker's quarters. As the 20th century dawned, Sumitomo moved its businesses from the mountains of Besshi to the coast at Niihama. Just as Japan was joining the club of the world's advanced countries, Sumitomo was also poised to launch into a new period of its own history.

Preparation of this article was overseen and photos provided by the Sumitomo Shi-ryo-kan.



Sumitomo Group Public Affairs Committee

Sumitomo Chemical Sumitomo Heavy Industries Sumitomo Mitsui Banking Corporation Sumitomo Metals Sumitomo Metal Mining Sumitomo Corporation Sumitomo Trust & Banking Sumitomo Life Insurance Sumitomo Coal Mining Sumitomo Warehouse Sumitomo Electric Mitsui Sumitomo Insurance Nippon Sheet Glass **NEC** Sumitomo Realty & Development Sumitomo Osaka Cement Sumitomo Light Metal Sumitomo Construction Sumitomo Bakelite Sumitomo Forestry Sumitomo Mitsui Card Company Sumitomo Construction Machinery Sumitomo Rubber Sumitomo Seika Chemicals Sumitomo Precision Products Sumitomo Pharmaceuticals Sumitomo Densetsu Sumitomo Wiring Systems Sumitomo Special Metals SMBC Leasing Japan Research Institute Meiko National Securities Kokura Enterprise Sumikin Bussan Daikin Sumisho Computer Systems Sumisho Lease Izumi Securities Eisen Realty Tokai Rubber Nissin Electric Meidensha Nippon Electric Glass

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Tsutsunaka Plastic