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Feature Story

Keep

INNER **VIEW**

Mr.Atsushi Kanemoto

Assistant General Manager, Natural Environment Management Division, NPO birth

What We Can See after Draining a Pond

～Developing a Framework for Restoring Lost Nature in Urban Environments

Observing Pond Water ～Rion's Plankton Survey

Yuki Ohashi, New Business Promotion Section, Particle Counter Division

Measuring Wind Turbine Noise

～Noise Monitoring To Help Maintain Quiet Environments

Mr.Akinori Fukushima, Representative Director, NEWS Environmental Design

Long-Term Vibration Level Measurement

～Road Traffic Vibration Measurements Made in Accordance with the Manual of Vibration Measurement

Kodai Yamashita, S&V Measuring Instrument Development Group, Technical Development Center

RION CO., LTD.

Atsushi Kanemoto

Born in Ishikawa prefecture in 1980, Mr. Atsushi Kanemoto graduated from the Department of Agriculture of the Tokyo University of Agriculture. In 2007, he completed his studies at the Department of Wildlife Survey of the Tokyo College of Environment and became an employee at a nature experience facility in Tochigi Prefecture, where he took part in surveys of the natural environment. In 2013, he joined NPO birth, a nonprofit organization, where he has since been involved in Tokyo municipal park management activities, environmental education programs, natural environment surveys, and various promotional and public awareness programs undertaken by municipalities, as well as helping to create TV shows. He is a certified Senior Biotope Builder and Senior Biotope Planner and a qualified curator. He appears as an expert on the environment in TV programs covering nature and living creatures.

Mr. Atsushi Kanemoto

Assistant General Manager, Natural Environment Management Division, NPO birth

What We Can See after Draining a Pond

～Developing a Framework for Restoring Lost Nature to Urban Environments

Text by Kaori Hashimoto*1 / Photo by Megumi Yoshitake*2

Some natural environments can only be sustained with human help.
NPO birth is raising awareness and bringing people together to create a city friendly to all living creatures.
(Honorifics will be omitted from the text hereafter.)

"Drain the Pond" Show Popular Among Children

"Drain the Pond" is a popular TV show broadcast by Japanese TV TOKYO. In the show, to see what lies beneath the water, a pond is emptied by a traditional Japanese method known as *kaibori*. This series of documentaries engages viewers by sharing the excitement of uncovering what actually exists beneath the water of a pond, sometimes including the mass proliferation of an unexpected species. Kanemoto appears in the show as a lecturer, offering his expert knowledge on *kaibori*.

"Now," Kanemoto says as he laughs, "even normal kids are accustomed to using the term 'alien species.' I think that's partly due to this show." One of the younger staff members of NPO birth, where Kanemoto works, joined the organization after watching the show and decided he wanted a job associated with *kaibori*. That was when Kanemoto realized media appearances help promote widespread awareness of environmental conservation issues among the public.

Traditionally, *kaibori* was a method for maintaining the water quality of a pond by removing silt deposited on the bottom. Carried out by an entire village during a slack season for farmers, it had to be repeated every three to five years to sustain the ecosystem. Since 2010, NPO birth has been contributing to *kaibori* efforts by local groups and researchers at Inokashira Park and other parks as part of the organization's environmental conservation and environmental education activities. When TV TOKYO came up with the idea for the show, they contacted NPO birth, among a handful of organizations capable of providing professional knowledge on *kaibori*.

"I don't think many people can explain *kaibori* in simple language to a normal audience," Kanemoto remarked. In the show, he avoids technical terms and uses everyday words instead. When explaining the characteristics of an insect, for example, an expert would tend to use technical terms and descriptions. When explaining a diving beetle, an expert might say: "The tips of their legs are covered with dense cilia, structures suitable for swimming." Kanemoto says: "This beetle uses the long hairs on its feet like oars on a boat." Such language helps engage his audience.

Through his role as a lecturer on the show, Kanemoto hopes to raise interest in living organisms—interest that will hopefully become a sense of stewardship. How did Kanemoto grow up to become so passionate about sharing his awareness about environmental conservation?

Working to Visualize an Environmental Crisis That Can't Be Seen

Young Kanemoto was a fervent lover of living things. "When I was about one, my parents started to worry when they saw me suddenly hunched over something on the ground. When they came to me, they noticed I was gazing intently at an ant nest. Growing up as a boy in Saitama Prefecture, he spent his days chasing killifish in streams and catching rhinoceros beetles and stag beetles in coppice forests. His grandfather, a nature lover, would often take Kanemoto fishing and insect collecting.

His love of insects eventually led him to major in entomology in university, where he spent four years studying a genus of small, bright blue-green stag beetles called Platycerus. Platycerus are a genus of stag beetles found only in beech forests 1,000 meters above sea level. "At the time," says Kanemoto, his eyes sparking, "not much was known about these insects—their biology, or what they eat." He preferred fieldwork and venturing out into the world

A magazine article on his research during his university years "BE-KUWA No.24" extra of the Sep. 2007 issue of Gekkan Mushi (Insects Monthly), Mushi-Sha Ltd.

*1 GLOCAL MEDIA Corporation *2 Photographer

over laboratory work. Around this time, he began casting about for a career in environmental fields that would involve fieldwork.

After graduating from university, he worked at a home improvement center for two years to save enough money to study further at college. To secure a career in fieldwork, in addition to environmental education, he needed practical training in biological surveying and analytical methods. After completing his training, he joined a nature experience facility in Tochigi Prefecture, where he spent his time serving as a guide for children's tours and coordinating camp programs.

After the Great East Japan Earthquake in 2011, Kanemoto's life took a turn. To make sure his parents were safe, he returned to his home in Saitama. There, he discovered the countryside had changed completely. The killifish and the frogs he pursued as a boy were gone. "When I had been home during my student years, the killifish were still swimming in the streams. Now they were gone." Kanemoto loved his job working in a village forest surrounded by nature, but to his horror, he found the natural environment where he grew up was on the brink of disappearing. He couldn't let this happen, he decided.

The disappearance of the killifish was mostly due to the lack of people working in agriculture. Farming families were giving up the practice, which had resulted in the loss of rice paddies—prime killifish habitat. Not only that, but farmers who stayed on were forced to prioritize ease of management, which meant lining the irrigation channels with concrete, eliminating the transition from the water to the adjoining banks and the associated ecosystems. These changes were visible elsewhere, too—in the coppice forests, irrigation ponds, and grassy areas—natural environments that had coexisted with humans had changed or were in the process of disappearing altogether due to declining agricultural populations and changing lifestyles. "I have to get this reality out," Kanemoto swore. "I will make this my job." In 2013, he knocked on the doors of NPO birth, where he works to this day.

The Joy of Seeing Living Things Return

Activities at NPO birth are founded on two basic principles: protecting nature and bringing local people together to achieve that goal. Their activities include many types of management in the parks. These involve an array of tasks from green-keeping, ecological surveys, and preparing conservation plans based on survey results, to providing nature tours for schoolchildren and visitors, and coordinating events at the parks. Kanemoto, who is certified as a Senior Biotope Planner, oversees the maintenance of the natural environment at many parks and the preparation of related guidelines.

When they hear the word biotope, most people think of a sample of artificial nature like a miniature garden. Originally, biotope was a German term coined by combining bio, meaning living organisms, and tope, meaning space—a habitat or living space for plants and animals. "In a broad sense, any areas where living creatures exist can be regarded as a biotope."

A biotope planner is responsible for developing plans suited for the target biotope and for providing appropriate care and maintenance. Take Meiji Shrine, for example, whose design is based on the image of a sacred forest (*chinjyu no mori*). The coppice forest surrounding the main shrine has essentially remained untouched since its founding 100 years ago. Nature has been allowed to hold sway. In contrast is how the coppice forest in the Tokyo Municipal Musashikokubunji Park is managed. "Here, the natural environment is strongly influenced by human activity. Humans use the park, affecting the process of natural transition called 'ecological succession' and introducing an artificial cycle in its place."

In nature, land stripped of life after a volcanic eruption or similar event eventually gains a covering of moss, then becomes a grassy plain where trees begin to grow, and then transforms into a deciduous broad-leaved forest. In the Kanto region, these biotopes ultimately become evergreen forests. A coppice forest is created when humans continually interfere with this cycle at the deciduous broad-leaved forest stage, repeatedly cutting down trees for fuel or to make charcoal or collecting leaves to make fertilizer. Broad-leaved tree species such as the konara oak (*Quercus serrata*) and sawtooth oak (*Quercus acutissima*) can grow new shoots from the stumps after they fall, as long as their roots are alive. The trees can be rejuvenated by cutting once every 20 years or so. This process keeps the coppice forest sustainable for a long time.

In the past, the fallen trees and collected fallen leaves were used for people's daily life as fuel or for agricultural purposes. Now, the number of households with such needs is declining. Neglected coppice woods became unsustainable.

"I want to work with locals and bring together people, schools, and businesses to establish a system for maintaining coppice forests, like the traditional systems we once had. Coppice forests and irrigation ponds flourish in proportion to how much they are being cared for."

Kanemoto gets motivated when he either witnessed the return of living organisms that had once disappeared, or has discovers new species living in areas where they had not been.

Establishing Win-Win Relationships by Bringing People Together

Forming a consensus is a major factor in

environmental conservation. One of the achievements of projects that Kanemoto has worked on is the formulation of the "Management Guidelines for the Conservation of Tokyo Municipal Sengenyama Park." Sengenyama Park is a roughly eight-hectare coppice forest located in Fuchu City, home to many rare and endangered species. When Kanemoto first began working in this park, he learned that while the park already had several conservation groups, the groups weren't working from a comprehensive shared conservation policy.

Each conservation group has own specific goal. One may seek to protect flora; another may want to guard insects; yet another to preserve birds. A group wanting to protect birds might want to keep the shrubs that offer shelter; another group wanting to protect flora might want to clear the shrubs periodically to let sunlight reach the deepest areas of the forest.

"While the groups may have different viewpoints, the ultimate goal of wanting to conserve the environment is the same. So, it should be possible for them to work with each other." Based on this conviction, NPO birth and Kanemoto took on the role of mediators in the "Committee for Sharing Thoughts on Sengenyama Park," coordinating efforts among the groups. He invited new stakeholders, including scholars at universities and representatives from the municipal government. Based on the joint efforts of these groups, he conducted monitoring surveys of the park to establish the basis for consensus formation. Eight years later, he finished formulating the guidelines.

Explaining *kaibori*
on "Drain the Pond" (TV Tokyo)
(photo courtesy of Mr. Kanemoto)

The guidelines divided the park into four zones. Management plans were designed based on current conditions and the conditions targeted 20 years and 30 years into the future. A special focus was on making the issues easy to comprehend. The guidelines were accompanied by numerous illustrations and photographs to allow use in activities aimed at children. Kanemoto believes he has been successful in building a system that gives local residents a way to regard the ecosystem as a single system, and reason and motivation to protect this system. "Even if I were to step away this moment, the project will be passed on to successors as itself. That's one aspect of bringing people together I find especially gratifying."

Kanemoto has also sought to set up joint projects between local businesses and experts. In June 2020, he worked with Rion on a plankton survey of Musashi Pond, an artificial pond in Musashikokubunji Park. When the pond water becomes excessively nutrient-rich—for example, due to an accumulation of fallen leaves—phytoplankton blooms caused by diatoms turn the water murky green. If these blooms were left uncontrolled, the water becomes oxygen-deficient and may cause various forms of life in the pond to asphyxiate and die, resulting in a foul odor. The plankton survey was conducted to analyze the substances present in the water through microbial analysis to prevent such water quality issues and to promote environmental conservation. The survey involved collecting water samples and determining the types and counts of phytoplankton species using Rion's particle-counting technologies.

"On the park management side, when we want local residents to understand and acknowledge current conditions, collaboration among experts both from local businesses and universities can send a powerful message. These projects benefit the experts, too. They expand the boundaries of their research. It's a win-win situation. I will seek relationships like this that benefit both sides will lead to a solid understanding of what local collaborative efforts can be."

"Management Guidelines
for the Conservation of Tokyo
Metropolitan Sengenyama Park"
planning by Mr. Kanemoto

In the Search for a Living Environment That Can Be Shared with Other Living Creatures

The term biodiversity became a household word following COP10 (the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity), held in Nagoya in 2010. Works involving environmental issues began diversifying around the same time. "In recent years, we've been asked by municipal governments for support in park management efforts undertaken jointly with citizens and communities, and also by companies for advice on how they can use their green space site to achieve the SDGs (Sustainable Development Goals)." Among municipal governments, businesses, and local residents, the atmosphere for promoting environmental conservation is growing steadily more conducive.

Kanemoto's dream is to pioneer a path allowing humans to coexist with nature, even in urban areas. "Killifish, rhinoceros beetles, giant water bugs, diving beetles, catfish, racoon dogs—these were all creatures that traditionally lived alongside and flourished with people. I hope to continue exerting an influence that makes many people want to work together to protect these living creatures so that we will find them with us forever."

Feature Story

Keep

Keeping the natural environment, machinery and equipment,
and our daily lives in order entails ceaseless efforts.
Measurement and evaluation are key aspects of these efforts.
Here we introduce people dedicated to realizing a better future.

01 Activity Report

Observing Pond Water
～Rion's Plankton Survey

About a minute's walk from Rion's head office in Kokubunji is the lush greenly of Tokyo Municipal Musashikokubunji Park. Yuki Ohashi of our Particle Counter Division will report on a plankton survey of a pond in the park and provide a background of the survey.

Yuki Ohashi
(New Business Promotion Section,
Particle Counter Division)

Path to Acquiring Plankton Counting Technologies

To date, Rion's picoplankton counter (PPC) has been applied in water quality management at nearly 20 pulification plants throughout Japan, ranging Hokkaido in the north and Okinawa in the south. We believe PPC has the potential to be effective across a wide range of applications that deal with the proliferation, in recent years, of harmful phytoplankton populations associated with climate change, and also the declining numbers of water quality management personnel specializing in microbes.

On the other hand, it remains undeniable that optical microscopes are the most reliable method for counting plankton, and fluorescent microscopes for counting picophytoplankton. While Rion has extensive expertise in counting microparticles in cleanrooms or ultrapure water, we have a long way to go in terms of counting microbes in field habitats like pulification plants and their raw water. To make our new counting instrument, the PPC, more reliable, it's vital for us to learn and understand the counting methods currently regarded as reliable.

To resolve this issue, we welcomed Dr. Satoshi Ichise from the Lake Biwa Environmental Research Institute, an authority on plankton counting, as an advisor to help Rion engineers learn about phytoplankton counting technologies centered around optical microscopes, and thereby improve our technological knowhow. In this way, we hope to accumulate knowledge.

Let's take the case of plankton counting . Figure 1 shows a species of green algae called Pediastrum duplex. Upon close inspection of the photo, you'll see that multiple cells are grouped together and form a colony. In optical microscope observations, they count cells except for the broken cells, so the cell count for the photo shown is 26. On the other hand, the PPC counts it as only one. The photosensitive element captures the scattered light and the fluorescence emitted by biological particles as the laser beam passes through them, and converts the captured light into electric signals. Since a single pulse of the signal is registered as a single particle, the cell count for Pediastrum duplex shown in the photo will be one. This means counts based on optical microscopes and PPCs won't be the same.

Take another case of assessing count results, for example, of phytoplankton. Phytoplankton are the primary producers in the food chain of the ecosystem, and their populations might greatly increase or decrease, depending on the populations of zooplankton that eat them. Any discussion of the results of phytoplankton counts must be based on a broad range of knowledge in biology, including the zooplankton species

and the small fish species that eat the zooplankton. Our group is experiencing the challenges and fun of learning how to handle microbes and how this differs from the way microparticles are handled.

Plankton Counting and Contributions to Local Communities

To expand on this knowledge, we examined ways in which plankton counting could be tried in fields besides water treatment plants. It was our great good luck to become acquainted with the Musashi Pond Rebirth Project led by Mr. Atsushi Kanemoto of NPO birth (see page 2 of this issue), which was part of a project run by Seibu/Musashino Partners, who were commissioned to handle the management duties of Tokyo Municipal Musashikokubunji Park near our head office.

Since 2018, our company has participated in volunteer activities to clean Musashikokubunji Park as part of our efforts to keep the local environment well. Our encounter with Mr. Kanemoto's project proved to be the perfect opportunity to put our plankton counting technology to good use, allowing us to contribute to the environment and to our local community. Since then, we've carried out plankton surveys on a regular basis and submitted the results to the park (Fig. 2).

*Seibu/Musashino Partners is a consortium for managing the eight municipal parks in the Musashino area. It is comprised of four organizations, including NPO birth, of which Mr. Atsushi Kanemoto is a member.

Musashi Pond,
Tokyo Municipal Musashikokubunji Park
Photo by Megumi Yoshitake

Water Quality Survey of a Pond in Musashikokubunji Park

Musashi Pond in Musashikokubunji Park is an artificial pond constructed in the middle of the park and an important pond habitat for wildlife. Thanks to the efforts of the aforementioned Musashi Pond Rebirth Project, the alien species population of the pond is diminishing, while habitats for the native species are recovering.

Continuous rain or extremely hot weather can lead to mass phytoplankton blooms in the pond, producing a phenomenon called green water, in which the pond water turns green and murky. The water quality is significantly reduced. In some cases, this can affect fish habitat. Our plankton survey analyzes and identifies the zooplankton and phytoplankton colonies that cause green water and determines the species composition. The condition of the water is examined at the same time to contribute to water quality management.

In the future, as part of our efforts to cultivate new business, we hope to apply our plankton counting technologies both our ongoing environmental conservation efforts and in our local and social contributions.

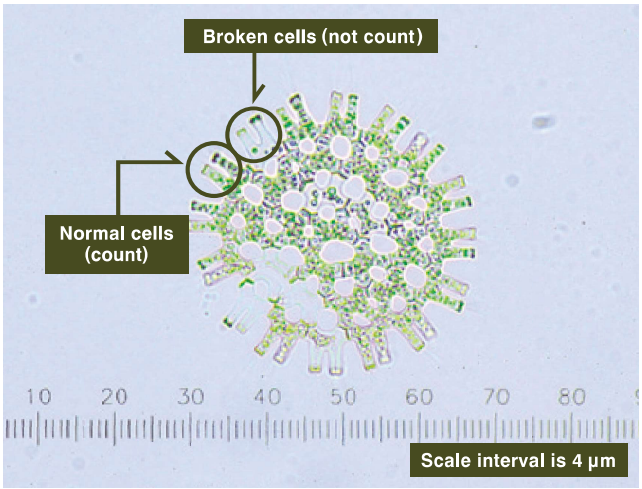


Fig. 1. Example of green algae
Scientific name : *Pediastrum duplex* / Date of sampling : Aug. 20, 2020
Location of sampling : Musashi Pond,
Tokyo Municipal Musashikokubunji Park Photo by M. Yamagishi

Fig. 2. Sampling plankton (top) and observation (bottom)

Movie of sampling plankton

02 Research Introduction

Measuring Wind Turbine Noise
～Noise Monitoring To Help Maintain Quiet Environments

Despite the expectations for wind power generation as a natural energy source, the problem of people complaining about wind turbine noise can't be ignored. Here's an interview with Mr. Akinori Fukushima, the representative director at NEWS Environmental Design, who participated in a national survey of field measurements of wind turbine noise.

———Wind turbine noise is a relatively new noise problem, isn't it?

Yes. It was around the year 2000 that construction began on large wind turbines for wind power generation, a renewable energy source. And the problem of wind turbine noise came up. The mass media reported on the problem as an infrasound issue.

———You were a part of the team surveying the effects of noise and low frequency sound* caused by wind turbines.

Yes, the research project titled "Research on the Evaluation of Human Impact of Low Frequency Noise from Wind Turbine Generators[1]" was a three-year project funded by the Ministry of the Environment, starting in FY2010. Measurements were taken at 34 wind power generation facilities around Japan. I was in charge of field measurements in western Japan area and of compiling the measurement data taken from all areas of Japan[2].

*Low frequency sound and ultra-low frequency sound refer to sound at frequencies below 100 Hz and 20 Hz, respectively. (The human ear can hear the sound in the range of approximately 20 Hz to 20,000 Hz.)

———What were your findings?

In short, we found that sound waves at frequencies below 20 Hz were being generated, but at levels not perceivable by humans at distances where residential households were located (Fig.1). The problem wasn't infrasound, but sound that could be detected by our ears (audible sound).

——— What are the characteristics of wind turbine noise?

One resident described it as the sound you hear when you swing a bamboo pole around. Most people wouldn't have experience with such dynamically pulsating sounds in their everyday lives. Wind turbines are generally constructed in quiet surroundings, in which even small sounds are noticeable. In some measurements, the baseline sound level of the area (residual noise level) was even lower than 20 dB. When a wind turbine operates in such environments, even small noises from wind turbines, even slightly over 20 dB, are clearly audible.The pulsing of the sound makes it worse, since most people find pulsating sounds annoying, even at low levels.

———Do you mean the sound fluctuates?

It's called an amplitude-modulated tone. A typical wind turbine will have three blades that turn 20 times per minute. That means a blade will slice through the air once every second, making a swishing sound each time. Besides this pulsation, longer-period fluctuations are also

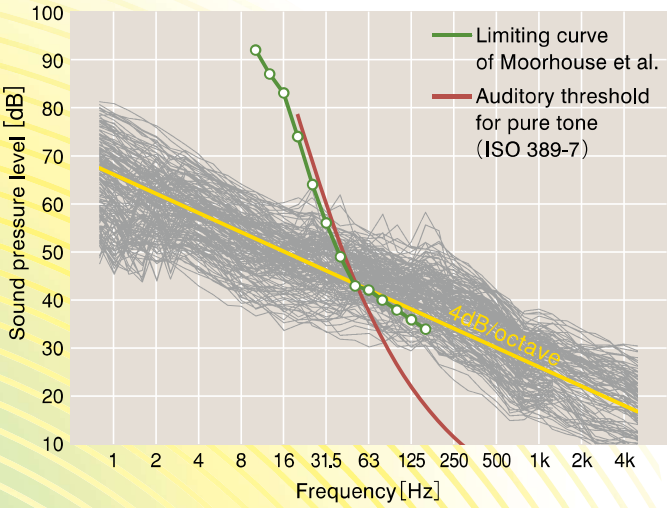


Fig 1. Frequency characteristics of the 1/3 octave band of the wind turbine [3]
The gray lines are the frequency characteristics for each measurement. Humans are incapable of hearing sound below the auditory threshold (red line).

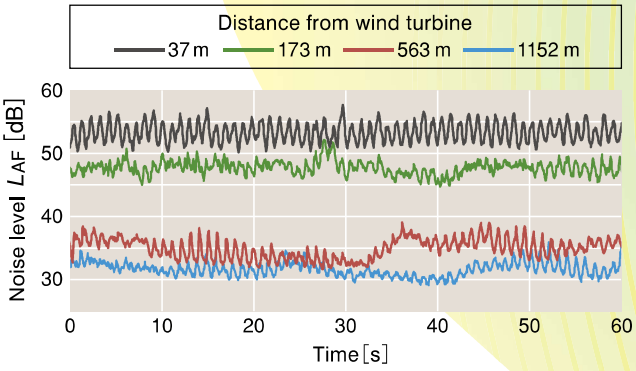


Fig.2. Example of measurement of wind turbine noise
The swishing sound with a frequency of approximately one second made by the rotating blades can be observed. Longer-period fluctuations in sound become evident with distance from the wind turbine.

created due to the effects of ambient weather conditions or background noise by the distance from the wind turbine (Fig.2).

What was interesting was that, while the level of wind turbine noise was high in the forward and the rear directions of the turbines and low to the sides, the fluctuations in noise level were larger to the sides and smaller in the forward and rear directions. The main source of noise generation is the tip of the blade, which moves at speeds comparable to a bullet train. This produces a Doppler effect, which makes the sound pressure higher as the tip approaches the measurement point and lower as it moves away. The distance from the tip of the blade remains basically constant in the front and rear directions, so noise levels also remain constant. But to the sides, the distance between the tip and measurement point changes, causing sound levels to fluctuate. In other words, wind turbine noise has different directivities for noise level, the volume of generated noise, and for fluctuations in noise.

——How is wind turbine noise evaluated?

The basic quantity of noise is the equivalent continuous A-weighted sound pressure level (L_{Aeq}). Several schemes have been proposed to represent fluctuations. We adopted the simple method of representing fluctuation by taking the differential of the noise level with time weighting S (slow) and F (fast) on the sound level meter. We found that people tend to complain more in cases with huge differences in noise levels between when the turbine is operating and when it's not. So the extent of the change (NE: noise emergence) is also an important factor. In coastal areas, the presence of wave sounds, as basic ambient noise, results in smaller NE. In quiet environments, as in valleys in mountainous regions, the NE is larger.

——Can you describe the architecture of your measurement system?

To measure low frequency sounds, we used a wideband sound pressure level meter that measures frequencies from 1 Hz to 20 kHz. When measuring sound in the lower frequency range, we can't disregard the effect of wind on the microphone. We therefore adopted a dual windscreen design to suppress this effect. The microphone is connected to the sound pressure level meter with a cable. The measurement point is set 20 cm above the ground (Fig.3).

——The external windscreen was constructed for the present measurement project, wasn't it?

Yes. It was developed mainly by Prof. Hideki Tachibana and Prof. Hiroo Yano at the Chiba Institute of Technology. The windscreen has a regular dodecahedron shape measuring 50 cm in diameter. The dual windscreen design really helped suppress the effects of wind noise. There's actually one part which was my idea —I placed a weight for colored traffic cones used at construction sites so that it wouldn't be blown away by the wind, although I have to admit that it has no effect whatsoever on the acoustic performance of the system (laughs).

——Thank you.

Mr.Akinori Fukushima (Representative director, NEWS Environmental Design)

"We have measured various noises, like those from roads, aircrafts, and wind turbines. We found that the various technologies developed for measuring each kind of noise were organically interconnected and would prove effective in completely unexpected situations. Perseverance matters, after all." (by Mr.Fukushima)

(References)

[1] FY 2010-2012 Research Project by the Ministry of the Environment "Research on the Evaluation of Human Impact of Low Frequency Noise from Wind Turbine Generators (S2-11)"
Principal Investigator: Hideki Tachibana, Chiba Institute of Technology

[2] A.Fukushima, "Field measurements of wind turbine noise in residential area around wind turbine," Journal of the Acoustical Society of Japan, issue 5, vol.74, 2018, pp.270–275.

[3] H.Tachibana *et al.*, "Nationwide field measurements of wind turbine noise in Japan," Noise Control Eng. J, 2014: 62(2), pp.99–101.

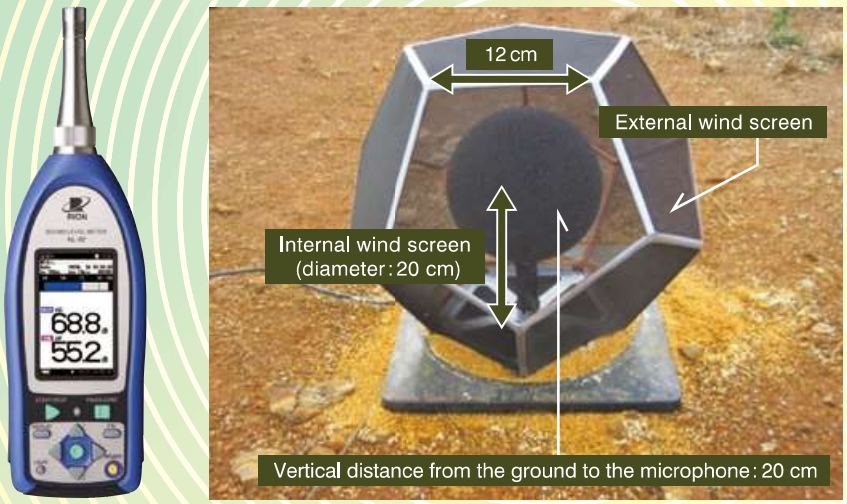


Fig.3. Measurement system
Left: RION High-Precision Sound Level Meter NL-62 capable of measuring low frequency sound. "The NL-62 can record waveforms, which significantly reduces the number of instruments needed." (by Mr. Fukushima)
Right: Dual windscreen design. Placing a weight at the base was Mr. Fukushima's idea.

03 Case Study

Long-Term Vibration Level Measurement
～Road Traffic Vibration Measurements Made in Accordance with the Manual of Vibration Measurement

Kodai Yamashita from our Technical Development Center will introduce the long-term vibration level measurements conducted by RION according to the Manual of Vibration Measurement.[1]

Kodai Yamashita
(S&V Measuring Instrument Development Group, Technical Development Center)

Manual of Vibration Measurement and Long-Term Continuous Measurement

In Japan, vibrations levels* at boundaries of premises are evaluated in accordance with the Vibration Regulation Act. Another evaluation method, the Manual of Vibration Measurement was developed by the Institute of Noise Control Engineering of Japan (INCE/J) in 2014. This manual describes methods for measuring and evaluating vibrations perceived by humans inside a building. This is because the vibrations that prompt most complaints are perceived inside buildings.
To investigate how vibration level changes over time, we've performed continuous road traffic vibration level measurements for approximately one month of every year since 2014, based on the methods specified in the manual. We accumulate this data for studies that require long-term continuous measurement.

*Vibration level refers to the quantity stipulated by the Measurement Act of Japan for evaluating vibration, and is represented by effective value levels for vibration acceleration. The baseline for vibration acceleration is 10^{-5} m/s^2.

Summary of The Measurement

The manual states that the basic steps in the investigation of the conditions of vibration exposure inside a building involve recording the waveform of vibration acceleration in the X/Y/Z directions and applying this data to calculate 1/3 octave band acceleration and vibration levels.
The road traffic vibration measurements presented here were made continuously from November to December every year. The measurement point is located on the floor inside Rion's experiment building (a wooden, single-story building) facing a two-lane road. The total traffic for the two lanes on this road is an average of 12.5 vehicles per minute on a weekday. The road is often used by bus services and cargo trucks. The number of passing buses hasn't changed from 2014 to 2019. Figure 1 presents the relative positions of the road, the building, and the point of measurement.
The vibration measuring instruments used initially in 2014 consisted of a vibration level meter (RION VM-53A), a vibration sensor, and a data recorder (RION DA-21).

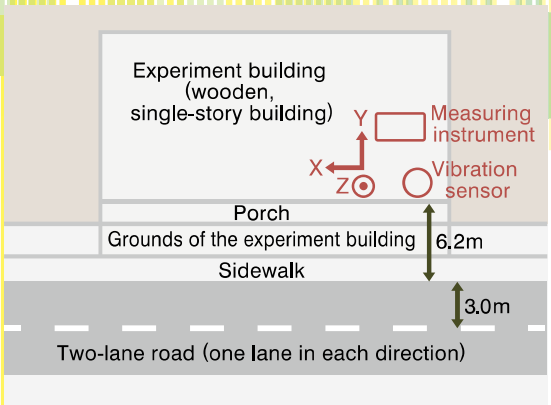


Fig.1. Relative positions of road, building, and point of measurement

A later model of the vibration level meter (RION VM-55) eliminated the need for a separate data recorder and simplified the measurement process (Fig. 2). In addition, a USB camera is used to make continuous recordings of the road to identify vibration sources.

After the measurements, vibration acceleration waveforms recorded are processed using software (RION AS-60VM) to calculate the daily equivalent power level of the vibration (L_{Veq}) and the upper end of the 80% range of the vibration percentile level (L_{V10}). For the vibration perception evaluations described in the next section, the upper 10 data points marking maximum vibration levels are extracted to calculate the arithmetic mean of the 1/3 octave band acceleration level.

Fig. 2. How the vibration level meter VM-55 (left) and vibration sensor (right) are set up
The VM-55 allows long-term recording and storing in SD memory cards of vibration levels on three axes (X/Y/Z), 1/3 octave band acceleration levels, and even vibration acceleration waveforms simultaneously.

Comparing Evaluation Results Before and After Pavement Repairs

The asphalt pavement on this road has been repaired several times during this period. As an example of the effect of these repairs, the results of vibration measurements made before and after the 2015 repairs (in which the whole road was repaved) are presented here.

In 2014, before repairs, cracks and ruts were evident in the pavement, and vibrations could be felt inside the experiment building every time a bus passed. The L_{Veq} in the vertical axis on a weekday exceeded 40 dB. In 2015, after the repairs, vibrations were nearly imperceptible, even when buses passed. The LVeq in the vertical axis on a weekday was below 40 dB. The same trend was observed for L_{V10}.

We then compared the evaluation results obtained from measurements to the vibrations actually perceived. On a specific day in 2014 and 2015, we calculated the arithmetic mean of 1/3 octave band acceleration levels along the vertical axis by the method specified in the manual and compared them to the human vibration perception threshold [2] (Fig. 3). The zone in light blue corresponds to the vibration perception threshold. The vibration acceleration levels along the vertical axis in 2014 are approximately 63 dB at 12.5 Hz and 61 dB at 16 Hz—above the median vibration perception threshold value. In contrast, vibration acceleration levels in 2015 are approximately 55 dB at 12.5 Hz and 55 dB at 16 Hz, which plot near the lower limit of the vibration perception threshold. The results are consistent with the vibrations as perceived.

Thus, we conducted vibration measurements according to the manual, calculated evaluation results, and obtained data allowing comparisons of vibration characteristics and vibration perception thresholds.

Unlike studies of environmental noise, case studies involving long-term monitoring of vibration levels are rare. The accumulation of data as presented here will make it possible to investigate changes in road pavement conditions over time or study the relationship between vibrations and their sources, like vehicle types.

(References)
[1] "Manual of Vibration Measurement" , Technical Subcommittee on Environmental Vibration Evaluation of the Institute of Noise Control Engineering of Japan (INCE/J), 2014
[2] "Reference material for assessment of building vibration caused by external sources" , Technical Subcommittee on Environmental Vibration Evaluation of INCE/J, 2014

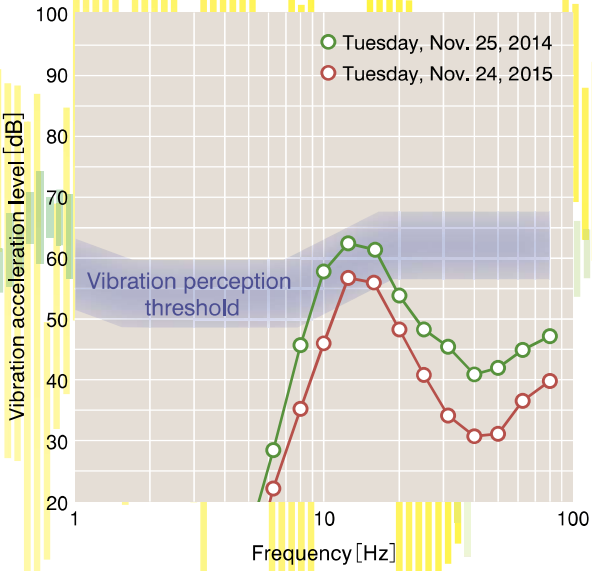


Fig. 3. Vibration threshold value evaluation before pavement repairs (on the vertical axis)

Rion's History of Technology

LEARNING from our Past Products

Liquid-Borne Particle Counter for pure water used in semiconductor production

KS-17

Various particle counters are used in the semiconductor industry,
KS-17 was the first developed by our company for use with pure water in semiconductor production.
We interviewed Mr. Tomonobu Matsuda, who oversaw its development.

＊Joined RION in 1986. At the time KS-17 was developed, he was a member of the Environment Technical Department. He currently works in the Technical Development Center.

——How did you become involved with particle counter development?

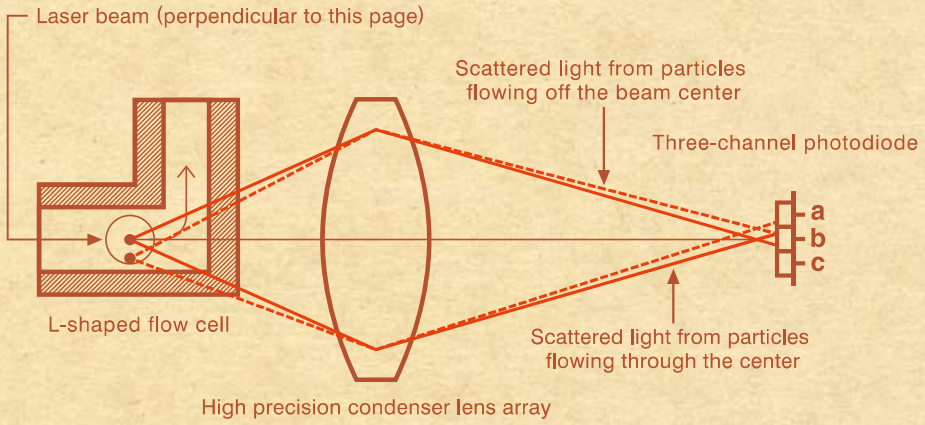
Since joining RION in 1986, I've worked only on particle counter development. At first, my job mostly involved modifying electrical circuits for custom order products. Later, I worked mainly on sensor development. I was in charge of developing the model preceding the KS-17 liquid-borne particle counter. When that was completed, I started working on development of the KS-17.

——What kind of product is the KS-17?

It's a liquid borne particle counter based on the light-scattering method developed to detect particles with a minimum size of 0.05 μm in pure water. Development on KS-17 started in 1996. It was commercially introduced two years later, in 1998.

——Why the focus on pure water?

Pure water and reagents are used in semiconductor production. At first, we didn't intend to produce separate models for reagents and pure water. But we realized filtering technologies for pure water were more advanced than for reagents, and there was demand for detecting smaller particles. That's why



Schematic illustration of the KS-17 optical system

we decided to develop a model dedicated to monitoring particles in pure water.

——What technical issues did you encounter during development?

The minimum measurable particle size of liquid-borne particle counters in existence at the time was 0.1 µm. The KS-17 had to measure particle half that size, or 0.05 µm, so we had to increase the energy density of the laser beam used to irradiate the sample. Since the amount of light scattered by particles is proportional to the sixth power of the particle diameter, the amount of light scattered by particles measuring 1/2 in diameter is 1/64. That means detection would be really hard using laser beams of conventional energy density.

——How was this issue resolved?

We found that the light-gathering power of the typical lenses in use were inadequate, so we focused light using the high precision lenses used in microscopes. This increased energy density, but it also had the downside of producing inhomogeneous spatial energy distribution. The energy was high at the center and lower in the peripheral regions, which results in nonuniform sensitivity. The resulting sensitivity depended on the position of the measured particle, which didn't allow accurate determination of particle size. We tried a number of different approaches to solve this problem.

——Can you elaborate?

First, we adopted an L-shaped flow cell so we'd receive the scattered light head on from the direction of the sample flow. We used a three-channel photodiode as the light collector unit, which allowed us to measure by how much a particle is offset from the center of the beam. Knowing that makes it possible to calibrate for particle size in signal processing. These technologies were new to RION at that time.

——How was the new particle counter received?

We took prototypes to major domestic pure water manufacturers and demonstrated it was capable of measuring particles 0.05 µm in diameter. They were happy with the counter, but things got incredibly busy.

——Did you get requests for various improvements of the prototype?

A lot of requests. In the semiconductor manufacturing process, pure water is regarded as part of the infrastructure, like manufacturing equipment or the power supply. What they needed was a function that would issue warnings of anomalies, not particle identification. So we repeated the process of making modifications, then trying it out on site. The user interface—the display and how the data is output—ended up totally different from what we started with.

——What was the most decisive factor in finalizing the deal?

I think it was establishing rapport with a researcher there, engineer to engineer. I gave serious consideration to his requests and relayed information regarding the principles and features of the counter meticulously to give it a chance to be used effectively. My contact gained a deep understanding of our particle counter. He worked tirelessly with others in his company through in-house seminars for various divisions and in other efforts.

Mr.Tomonobu Matsuda
(Head of the Particle Counter Sensor Development Section, Technical Development Center)

——What do you find rewarding about your job?

Even now, 30 years later, I think it's the new challenge I face every time I meet a customer. I feel a sense of accomplishment at each step, however small, in responding to the needs of my customers as an engineer in the rather esoteric field of particle counters. The challenges to be overcome are endless.

(Comment from the interviewer)
I've learned a lot about particle counters from Mr. Matsuda. But this interview in particular was invaluable because it's the first time I've heard the story from the very beginning, from when development began.
(Tsuyoshi Maeda)

Providing Full Support for Customers and Responding to Questions and Issues

Measuring Instrument Technical Support Section

Our section belongs to the S&V Measuring Instrument Sales Department of the Environmental Instrument Division. Our role is to provide technical support, mainly to sales, for products in the sound and vibration fields. Our section consists of five people, relative veterans, with two in their 60s, two in their 40s, and one in his 30s. We have both members of engineering and sales backgrounds. Our duties can be quite diverse and include the following:

- Providing technical support associated with sales activities
- Holding technical seminars on sound and vibration
- Responding to customer requests and questions
- Preparing materials for sales expansion
- Providing support to seminars and study groups at distributors and trading companies
- Participating in various activities (incl.involving scientific societies, giving lectures, writing manuscripts and other activities)

Of the above, the most important duty is technical support. Our members accompany our salespeople when they demonstrate system products, provide measurement demonstrations and attend business meetings, thus helping them win and execute major deals.
With regard to responding to customer requests and questions, we receive lots of requests for technical consultations daily from both inside and outside our company —customers, salespeople in various company sections, and group businesses. We take pride in responding quickly, effectively, and attentively. We're often asked for advice by development and production engineering departments. I think we give off a friendly and accessible impression.
Our technical seminars for customers consist of lectures and practical training with actual sound and vibration measuring instruments.These events are held 10 to 20 times every year. They've been received well by participants, although, unfortunately, the coronavirus crisis has forced us to cancel plans for this year. We've launched online seminars (webinars) in their place. These have been available since July. It's a new endeavor for us.
Our members also attend most meetings associated with our products that take place within our company, looking for ways to improve our products and to offer opinions and suggestions from both sales and technical viewpoints.
If you need help with any of our products, we're here at your service!

Yukihito Iseki (Manager of the Measuring Instrument Technical Support Section)

Measuring instruments
for technical support ready to go

Members of the Measuring Instrument Technical Support Section
(author first from left)

SCIENCE COLUMN

Are Microphones the Only Way to Capture Sound?

Ever since the birth of telephones, various microphones have been devised to convert sound into electric signals. The first were carbon microphones, which have metal plates that vibrate and change the contact resistance of the carbon granules sandwiched between them. This was followed by condenser microphones, which could be used for measurements. The latter type uses changes in the capacitance of the condenser formed by a diaphragm and a backplate. Dynamic speakers that rely on electromagnetic principles had been used as receivers; the dynamic microphone reverses that principle. Other subsequent microphone types include the ribbon microphone, which is also dependent on electromagnetic forces, and the crystal microphone, which relies on the piezoelectric effect. Of these technologies, the condenser microphone is used as a measuring microphone for sound level meters or as the ultra-small microphone found in hearing aids. The materials and structure of these microphones have evolved to suit various applications, producing microphones now known as the electret microphone or MEMS microphone. The basic principle remains unchanged since the invention of condenser microphones more than a century ago. One could even say all microphones in current use have their roots in electroacoustic transducers and continue to rely on the same principles.

This state of affairs has prompted researchers in recent years to work on finding technologies that can detect sound waves using light instead of electricity. Since sound waves involve changes in air pressure, they're always accompanied with changes in the refractive index of air. Since changes in refractive index affect the velocity of light, we can observe sound pressure as phase changes in light waves passing through a light beam. We can detect phase changes by applying the principle of interferometers. This mechanism has been studied for quite some time in the field of underwater ultrasonic measurement because water enhances changes in refractive index. With recent advances in optical technologies, it's now possible to observe phase changes in light waves for airborne sound in the audible range. This technology is expected to prove useful in observations of sound in confined spaces, where microphones can't be deployed, or, conversely, for observing sound pressure distributions in large spaces without the need for multiple microphones.

Sojun Sato (Advisor, former head of the Acoustics and Vibration Metrology Section, NMIJ, AIST)

Rion's microphone
Left: Crystal microphone M-225 (1950)
Right : Electret microphone UC-59 (2006)

Japanese scenery

Photo taken at Suga Shrine
(Oyama-shi, Tochigi Prefecture)
Photo by Toru Yoshida
(S&V Engineering Section,
Environmental Instrument Division)

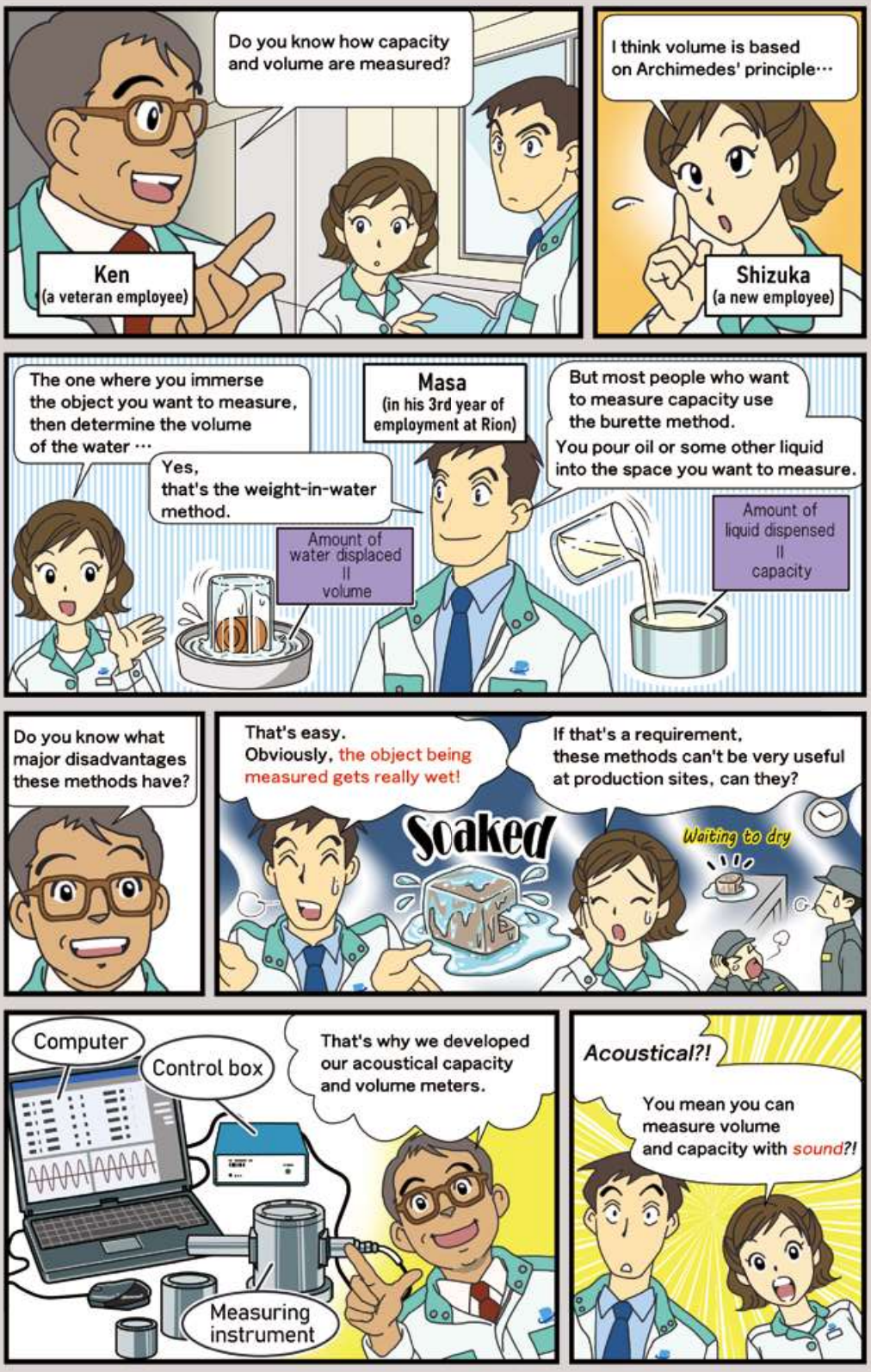
On New Year's Day in Japan, people visit shrines and temples to pay the year's first respects in a tradition known as *hatsumoude*. Its crowd of people was unlike any of those we're used to seeing this year in coronavirus crisis.

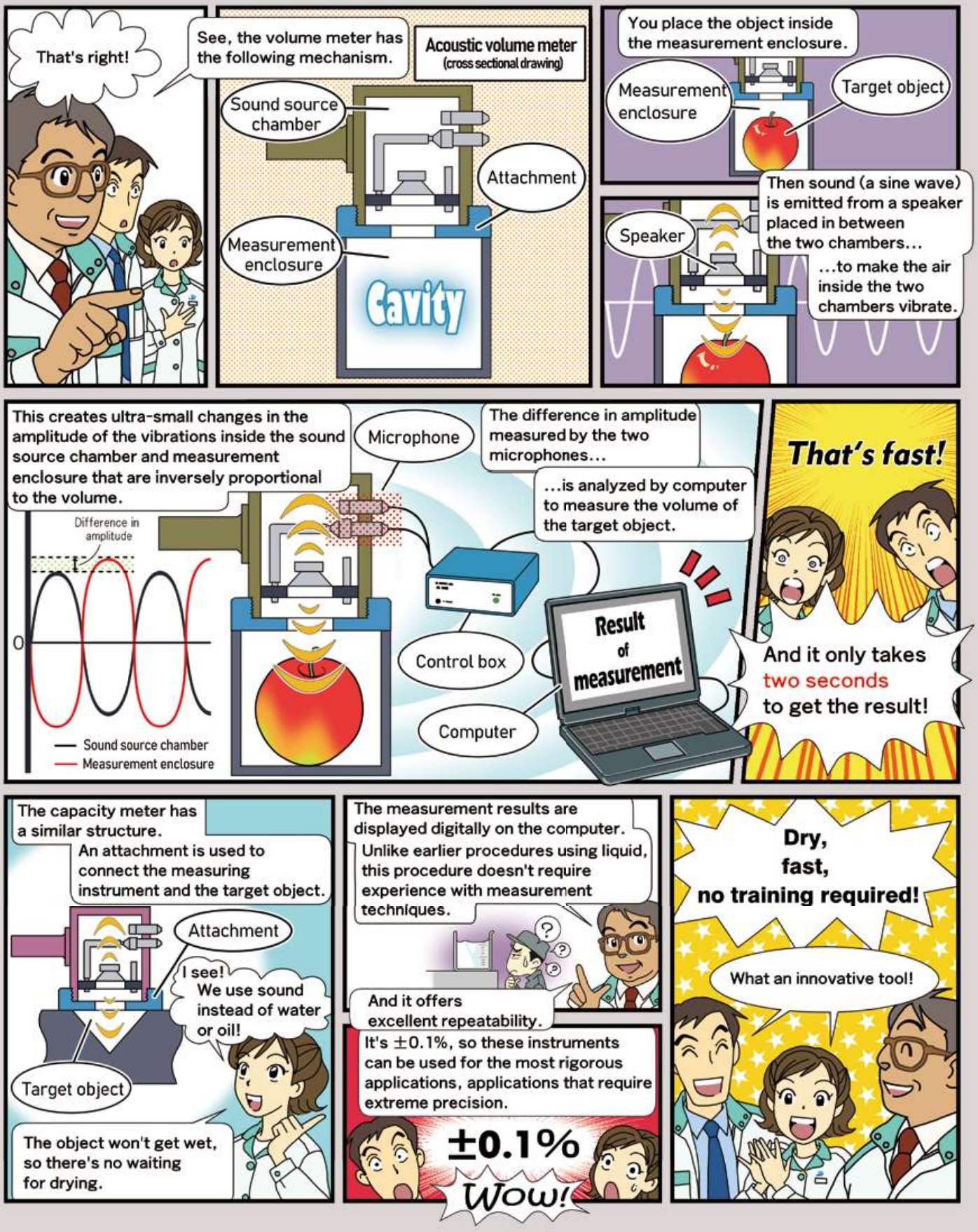
Manga series to help people understand our measuring instruments

MANGA Understanding Measuring Instruments

Manga by
Hisako Takagi

Acoustical capacity meter / volume meter




That's right!
See, the volume meter has the following mechanism.
Acoustic volume meter (cross sectional drawing)
Sound source chamber
Attachment
Measurement enclosure
Cavity
You place the object inside the measurement enclosure.
Measurement enclosure
Target object
Speaker
Then sound (a sine wave) is emitted from a speaker placed in between the two chambers...
...to make the air inside the two chambers vibrate.
This creates ultra-small changes in the amplitude of the vibrations inside the sound source chamber and measurement enclosure that are inversely proportional to the volume.
Difference in amplitude
0
Sound source chamber
Measurement enclosure
Microphone
The difference in amplitude measured by the two microphones...
...is analyzed by computer to measure the volume of the target object.
Control box
Computer
Result of measurement
That's fast!
And it only takes two seconds to get the result!
The capacity meter has a similar structure.
An attachment is used to connect the measuring instrument and the target object.
Attachment
I see! We use sound instead of water or oil!
Target object
The object won't get wet, so there's no waiting for drying.
The measurement results are displayed digitally on the computer.
Unlike earlier procedures using liquid, this procedure doesn't require experience with measurement techniques.
And it offers excellent repeatability.
It's ±0.1%, so these instruments can be used for the most rigorous applications, applications that require extreme precision.
±0.1%
Wow!
Dry, fast, no training required!
What an innovative tool!

Shine View!

Introducing one of Rion's shine workers, someone who shines, on and off duty.

Mr.Tsunetaka Tani

Material & Product Control Section, Materials Department

Marathon = Circle of Friendship

Mr.Tani has gained much by meeting and making friends with new people through running.
He's been motivated by the sheer dedication of his running mates as they train. That's helped keep him running.
[The marathon is a long-distance race with an official distance of 42.195 kilometers usually run as a road race.]

——How did you get started?

My friend invited me. He said, "Now that you' re past 40, you can enter the Ohme 10 km Road Race." So I ran my first race at 41 in the Ohme 10 km Road Race. I ran OK up to the 2 km point, but it was agony after that. A young female colleague of mine had finished the race, so it was a matter of pride to finish.
I entered a full marathon after my friend told me at a party he wanted to run in the Katsuta Marathon. It was a bit of an alcohol-fueled decision. I didn't know it was a full marathon until later. But as the saying goes, a samurai keeps his word – so do drunkards. Alas, so much for promises made over drinks. My first full marathon was a breeze until the 30 kilometer point. After that, I hit the wall. It was hell.

—— What's the appeal of marathons?

It's the sense of accomplishment when you complete a marathon. I tend to lose interest rather quickly. I don't think I would have continued running without a full marathon. There's always a certain drama in each marathon, and you always have to put up a struggle past the 30-kilometer point. But after each race, no matter what the outcome, you just want to tackle the challenge all over again. Plus, there' s the joy in sharing race stories with your friends who ran the same marathon over drinks and good food. It's a privilege granted only to those who participate.

—— What was your best moment?

It would have to be the Tokyo Marathon in 2008 when I set my personal best of 3 hours 10 minutes and 5 seconds. I was 47. Another good moment is when I ranked 69th in the results for full marathon ranking by age, which was an event held by the Runners magazine, when I was 58. This was after I ran the Beppu-Oita Mainichi Marathon in 3 hours 10 minutes and 59 seconds. I hadn't recorded a time in the 3 hour 10 minute range in 11 years, so I was really happy. Last year, I ranked 83rd at 59. If I keep up my training and maintain my record, I think I can keep my place in these rankings.

——Which was your most memorable marathon?

The Fuji Mountain Race was. The race starts in front of Fujiyoshida City Hall. Runners race to climb to the summit of Mt. Fuji (3,776 m) within four and half hours. I decided to take on the challenge when I was 50 years old. I qualified for the Summit Course for the first time when I was 52. After passing the 5th station, past the tree line, you have an unobstructed view of the landscape. I remember how the world of gravel and boulder gained a startling mystical aspect. It was the first time I'd climbed one of Japan's *reihos* (sacred peaks).

—— What are your future goals?

I want to continue fulfilling three goals: The first goal is to keep running in the Beppu-Oita Mainichi Marathon whose participation requires achieving the official time record of 3 hours and 30 minutes. The second is to keep my place among the top 100 in the full marathon rankings by age. And the last one is to qualify for the Summit Course challenge of the Fuji Mountain Race by clearing the cutoff time of 2 hours and 15 minutes at the 5th station. I want to do my best to achieve these goals before I'm 65.

Left:Jogging and chatting with a co-worker during lunch break
Right:With the Kenyan Olympic medalist Eric Wainaina at post-event party

KC-32 50.0L/min
KC-31 28.3L/min

Airborne Particle Counter

KC-32/KC-31

- Particle size range 0.3, 0.5, 1.0, 2.0, 5.0, 10.0 μm
- Approx. up to 5 000 measurement results can be stored in internal memory and can transfer to USB memory afterwards.
- Stainless steel chassis provides improved resistance against chemicals
- 21 CFR Part 11 compliant
- Light weight and battery powered operation are great for use anywhere

TOPICS Research presentations, articles, etc.

【Related to sound and vibration measuring instruments】

◎Acoustic Society of Japan 2020 Autumn Meeting (Sep.9-11, Online)

- Real-time measurements of tonal audibility by using multi-functional measuring system / A.Sugahara[*1], K.Ohkubo[*2], M.Yonemura[*2], H.Lee[*2], S.Sakamoto[*2], Y.Yonemoto, T.Ohshima[*3]
- Study on vibration acceleration estimation flow for floor structure under carpet / R.Tomita[*4], Y.Goto[*5], D.Adachi

◎The Japan Society of Mechanical Engineers Annual Meeting (Sep.13-16, Nagoya University)

- Study on methods for identification of low frequency sound / T.Doi[*6], K.Iwanaga[*6], T.Kobayashi[*6], T.Nakayama[*7], Y.Nakajima

◎The Institute of Noise Control Engineering of Japan 2020 Autumn Meeting (Nov.5-6, Online)

- The localization of the low frequency sounds using multiple microphones / T.Doi[*6], K.Iwanaga[*6], T.Kobayashi[*6], T.Nakayama[*7], S.Aoki, Y.Nakajima
- The localization of the low frequency sounds using multiple microphones / T.Nakayama[*7], T.Doi[*6], K.Iwanaga[*6], T.Kobayashi[*6], Y.Nakajima, S.Aoki
- Changes of aircraft noise annoyance with the times/I. Yamada
- Low-frequency sound from a fireball observed on July 2, 2020 / T.Doi[*6], T.Ueta, N.Arai[*11]
- Review of research studies on vibration sensation / K.Hayashi[*12] S.Yokoshima[*13], H.Umayahara, R.Tomita[*4]

◎Acoustic Society of Japan Noise and Vibration Association (Nov.18, Online)

- Consideration by vibration acceleration change of vertical vibration using a vibrator-Study on environmental vibration measurement method of tatami floor using vibration control rubber- / R.Tomita[*4], D.Adachi

◎Acoustic Society of Japan Architectual Acoustics (Nov.20, Online)

- Experimental study of horizontal vibration using a vibrator-Study on environmental vibration measurement method of tatami floor using vib ration control rubber- / R.Tomita[*4], D.Adachi

◎Journal of INCE / J Vol.44 No.6, Dec.2020

The Selection of Appropriate Noise and Vibration Measurement Instruments / A.Kikuchi

◎2020 METI Industrial Science and Technology Policy and Environment Bureau Director-General's Awards

Recognizing contributors to the operation of the metrology system / Masaharu Ohya

【Related to particle counters】

◎2020 METI Industrial Science and Technology Policy and Environment Bureau Director-General's Awards

Recognizing contributors to industrial standardization / Takashi Minakami

*1 Kindai Univ., *2 Inst.of Industrial Science, the Univ.of Tokyo,
*3 Aviation Environment Research Center,
*4 College of Science and Technology, Nihon Univ., *5 Takenaka Corporation,
*6 KIPR, *7 Gakushuin Univ., *8 Univ.of Toyama,
*9 Kanagawa Inst.of Technology, *10 Tokyo Inst. of Technology, *11 Nagoya Univ.,
*12 Benec Vibration and Sound Inst. Inc., *13 Kanagawa Pref.

Exhibitions

[S] Related to sound and vibration measuring instruments
[P] Related to particle counters

[S] Acoustical Society of Japan 2021 Spring Meeting (Mar.10-12, Online)
[P] SEMICON Korea 2021 (Feb.3-5, Seoul, Korea)
[P] INTERPHEX Week Osaka (Feb.24-26, INTEX Osaka)
[P] SEMICON China 2021 (Mar.17-19, Shanghai, China)

Editorial Postscript

While the coronavirus crisis is forcing changes in our society, we've made the bold decision to choose "keep" as the theme for this issue. Rion will keep our foundations strong while adapting to change —even driving the changes. Look forward to seeing such changes in future issues! (M.Okazaki)

About the Front Cover

According to Mr. Atsushi Kanemoto (p.2), some natural environments can only be sustained with human involvement. Of course, human activity is also blamed for certain natural disasters. Nature can change for the better or worse, depending on how we interact with it. Maybe we're standing at a critical juncture, a point where we need to decide how we should interact with nature. (M.Oana)

Corporate Philosophy

Contributing to people, society and the world through all our activities

Quality of Life　Barrier-Free Society　Eco-Management

Past issues of *Shake Hands* are available here : https://rion-sv.com/shakehands/

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