

Unite the World with Technology. The Technical Journal of Rion, JAPAN

# Shake Hands

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Feature Story

## Speak

### INNER VIEW

Clara Bodin

MC, Narrator

## Speaking Is My Mission

~ As a Trilingual and as a Woman

### For More Intelligible Speech

~ What the Speaker's Side Can Do

### Playing an Active Role in Speech Analysis

~ Sound Spectrograph

### A Unique Approach from a Specialist's Vantage Point

Forty Years in Particle Counter History

Series Understanding Measuring Instruments Cleanrooms Management (Part1)

Hello From the Office Rion Metal Engineering Co., Ltd.

Science Column How Sound is Heard Underwater

Japanese scenery Monkeys Enjoying a Hot Spring

Shine View! Martial Arts Fitness Exercise

Clara Bodin MC, Narrator

## Speaking Is My Mission ~As a Trilingual and as a Woman

Text by Michinari Okazaki / Photo by Evan Will (i Style Japan)

At Studio C in Nakameguro, Tokyo, beyond the entrance of a seemingly normal condominium, one comes across an intriguing room decorated with Japanese-style ornaments, a space designed to allow people to engage in conversation in the French style: standing up.

### Pressure is the source of her energy

In 2016, at an event in Odaiba where Clara is to be the main MC, Clara's legs are shaking in front of an audience of more than 3,000.

"That was the first time in my life my legs felt like well-cooked asparagus. I couldn't stand straight. I was desperately searching the audience for the faces of my friends to calm myself. But you absolutely can't let your audience see that you're under so much stress. My heart felt like it would stop due to the pressure of not knowing what accidents might happen and knowing I was responsible for responding if they did. But that's the kind of pressure that gets my adrenaline pumping. And the interesting thing is that's what my body needs."

Ever since Clara was a child, she's been a model and appeared on TV. She's authentically French—born in Paris—with a younger twin sister. Her mother was a great fan of Japan and chose to raise her two children here.

"I could have chosen to become a Japanese national. But I wanted to be a bridge between France and Japan. Besides, what made me special was that I was a 100% French person who could speak fluent Japanese. A Japanese national speaking Japanese would simply be normal. That's why I chose to remain a French national [laughs]."

Although Clara was born in Paris, she was

raised mostly in Japan. Are there times she identifies more as French than Japanese?

"When I'm mad [laughs]. I feel the Latin blood in me. I can't be angry in Japanese. There aren't words to express my anger in Japanese. Japanese women typically don't swear using words like *'konoyarou* (you bastard)!' *'Mukatsuku* (I'm disgusted)' could be used, though it sounds a bit feeble. It's paradoxical, but it's the peaceful nature that makes me want to continue living in Japan."

Clara is a trilingual in Japanese, French, and English, and also works as a translator for the French ambassador, Diet members, VIPs of large corporations, and prestigious guests. She often assumes the role of both MC and translator at a single event. "There's great pressure when I'm working as a translator. Especially when translating in front of the media, since anything I say can appear in an article immediately. Since I'm acting as a translator for another person, it's important to choose the words more carefully than when I'm speaking for myself. My job as a translator is to relay the message of the person I'm working for as accurately as possible. But, again, that pressure is the source of my energy."

### Mission for the improvisation specialist MC

At just two months after birth, Clara's debuted as a model in a commercial for

baby products. She went on from there to work as a model in commercials, shows, and the like and remained in the limelight. When she turned 14 and began to be treated as an adult, she realized she'd entered a fiercely competitive world, where her figure came under close scrutiny. Even then, she courageously continued treading on the rough path all by herself.

"Up until I turned 14, my mother supported me. But after that, she told me, 'If you want to continue, you must continue from here on your own.' Since then, I've moved on alone. I was often rejected at the photo audition stage. Even when I did make it to the interview audition, I was lucky to get one job out of 50 trials. Once, I was rejected five times in a single day. Day after day, I kept on being told, 'Not quite, not quite.' In those days, to maintain my motivation, stay confident, and not become depressed, I asked myself, 'What could I have done to succeed?' I knew my shortcomings, but I chose to ignore them. Instead, I learned to focus on my strengths."

Trilingual is one of Clara's advantages, with an entirely foreign appearance. Since she doesn't need a translator, her clients can save on translation costs. One other advantage is her ability to improvise. On the TV variety talk program which aired until September 2016, she was in charge of the section where she introduced various regions in Japan.

"I loved the idea of having a foreigner

### Clara Bodin

Born in Paris, France, in 1984, Clara Bodin made her debut as a model in a commercial when she was just two months old. She's currently pursuing successful careers in both Paris and Tokyo. Her first experience as MC (master of ceremonies) came when she was 16. In 2010, she founded i Style Japan in Tokyo. While expanding her business in the beauty industry, she remains active in diverse fields: as a model, actress, and Japanese-French-and-English trilingual MC and narrator. Her dream is to build cultural bridges between her two mother countries, France and Japan.



Official site  
<https://clarabodin.com/>



i Style Japan  
<https://istylejapan.com/>



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introduce Japan to the Japanese and make them rediscover their country. There was a script when we started, but the producers seemed to like the unexpected questions I came up with, through the eyes of a foreigner. Eventually, they decided to 'let Clara improvise the whole section.' It felt like I was on a live show."

Clara enjoys doing live shows because the lack of a script means that she can draw out honest emotions and spontaneous reactions from people she meets. She's often improvised during her MC jobs, which she began doing at 16. Her conversations with the guests on a talk show she hosted gained popularity. Gradually, people began to trust her and say, "Let Clara handle it. She'll do fine." In the end, she was just told what she had to include in her talk. Everything else she improvised without a script.

"One of the things an audience enjoys learning about in an improvisation is what the guests have been doing backstage. I would introduce a rather solemn-looking guest and say, 'This is the conversation we had backstage.' What a person is like behind the scenes is something valuable I can offer to the audience."

Once, for a job overseas, Clara traveled abroad and returned the same day, after finishing four jobs on the previous day. The demand for her skills from so many people and in so many places comes from the mental toughness required to be an MC and her ability to respond flexibly in diverse situations not prescribed in the script.

"The people who're most nervous at events are the clients themselves. They're the ones who have to rely on an outsider like me to get their message across. I can always sense their stress. That's why I tell them, 'It's OK. Everything is fine, just fine,' even though I'm not sure how things will turn out myself [laughs]. My clients and guests are all very tense. I'm the one that can make them relax the tensed shoulders and exhale. That's my mission."

**For the clients:  
the things she discovered  
through the hardships she faced**

It might seem that Clara has grown into a successful person as she has paved her difficult path on her own, but one very

recent incident, in October of 2017, shook her confidence. In the preceding month, Clara had hired a manager for the first time since she was 14 and began to work as part of a team.

"My dog had died. It was the first time I'd lost a soul so dear to me. Until then, I really didn't comprehend how difficult it would be to lose something so close. I remember how, on that morning, my dog's body still felt warm but wouldn't move. My mind went blank. I couldn't accept its death. I somehow managed to get to my office, but as I approached my scheduled 8:00 a.m. stage, I didn't know what to do. Before that, I'd always been able to control myself. But I was helpless. It was the first time I thought I might fail. That MC job on that day was my first job with my new manager. When I went up on stage at the rehearsal, she told me, 'The clients are watching you. Keep a lid on your emotions.' That's when I realized: I'm not doing this job for myself. I wasn't doing it because I loved to do it. I was doing it to provide a service to my clients. When I changed how I looked at my work, I found I appreciated the work on a level I couldn't before. On that day, with this insight, I was able to give my best. I don't think I could have overcome it without my team. I was grateful to them. I believe



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that my dog's death had a special meaning for me."

Keeping a lid on her emotions and supported by her team, Clara fulfilled her responsibility as the MC. The experience, she says, opened her eyes to the role a coach might play in someone's life.

"How can I maximize my strengths in my performance, with confidence, in front of everyone?' I'd continuously asked myself that question, but I could never find the right answer. And I found it when I lost my beloved dog. I wanted to put to good use what I'd learned from my recent experience."

One sees this when she coaches others on how to be photographed. In a studio, she's giving advice to a man on posing, which, needless to say, includes facial expressions as well as angles of gaze and how the fingers and body are positioned. She does this repeatedly until she's satisfied. Her coaching brings out the best in people, because it's based on her own experience as a model. For example, she says to him "If you were to give a seminar tomorrow, what would it be like?" His face lights up. She watches attentively for that shining moment. "Good!" she says.

"My team and the people around me have helped me accomplish what I've accomplished. They've given me energy I didn't have. When I'm working as an MC, that energy would come from the smiles on the faces in the audience. I'm tense, and so are the people in the audience who are nervous about how to react. How do I connect to my audience and tap into their energy? The energy they provide is what lets me do my job. By talking about my experience, I hope I can influence as many people as I can to live confidently. You bring out the best in yourself by being open to the energy from those around you. I want people to realize that. That's what I hope to achieve by coaching."



**Succeeding to the role  
of her family's central figure**

The Bodin family has 23 members in all, from Clara to her grandparents. It's a family of strong bonds. Eight out of ten family members are female. We asked her how she feels about being a female member of such a family.

"Being a woman in Japan is a great challenge. I want women to be strong, or rather, be confident in themselves. The strength of women is what pulls a family forward."

A powerful reminder, says Clara, came when her grandmother was diagnosed with pancreatic cancer. It was her grandmother who made plans for the Christmas and family vacations. When her grandmother was hospitalized, it was as if the lights had gone out in their home.

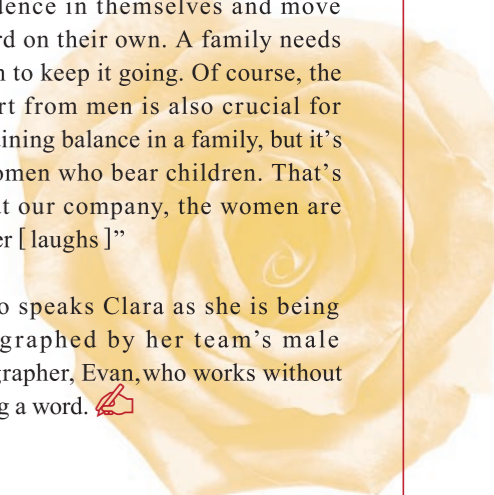
"I remember being amazed at that time by the power women have. Fortunately, my grandmother survived her two-year battle with cancer. After her return, the family bonds were stronger than ever before. In Japan, the *daikokubashira* (the main

pillar) of family is usually male. In a Latin family, it's a woman."

Clara has inherited her grandmother's personality, and now, she's assumed the role of the central familial figure from her grandmother. She's in charge of planning for Christmas. And she makes the following request to the men in our society, not the women.

"I'm not going to say to the women, 'Try harder!' They're already trying hard enough as it is. I want to ask the men to recognize how well their women are doing. That encourages women to have confidence in themselves and move forward on their own. A family needs women to keep it going. Of course, the support from men is also crucial for maintaining balance in a family, but it's the women who bear children. That's why, at our company, the women are stronger [laughs]"

And so speaks Clara as she is being photographed by her team's male photographer, Evan, who works without uttering a word. 🙌



Feature Story

# Speak

The sounds produced when people speak have both meaning and personality. The technology used differs completely, depending on which of the two aspects we focus on. Let's look at the various approaches taken in speech science.

01 Research

## For More Intelligible Speech —What the Speaker's Side Can Do

“Our research is based on our desire to help people who experience difficulties in perceiving speech, like the elderly, people with impaired hearing, and children who are particularly sensitive to sounds, as well as foreigners.” We interviewed Associate Professor Nao Hodoshima (PhD, Department of Information Media Technology, School of Information and Telecommunication Engineering, Tokai University). She's working to realize “barrier-free” listening environments.

Conventional research has targeted efforts to facilitate speech perception mainly by developing ways to improve the acoustic quality of the space involved—for example, controlling reverberation quality/time. In contrast, the main focus of this research is on producing highly intelligible speech.

### Processing voices

Dr. Hodoshima first came across the idea of producing highly intelligible speech in public spaces while working on her undergraduate thesis at the Faculty of Science and Technology, Sophia University. She'd always been fond of music and was part of a band in high

school. She'd once dreamed of being a PA operator at live events. As an ardent fan of classical music as well, she became interested in the differences in how the music sounded depending on the music hall. That's what prompted her to attend Sophia University to study acoustics and speech science. When she came across this theme of her undergraduate thesis, which still underlies her current research, she thought, “That's just perfect for me.” In 2001, while pursuing this idea, she discovered for the first time in the world that speech sounds in reverberant environment could be made more intelligible by cutting the steady-state portions of vowels (where the energy is constant). The principle behind this is as follows.

Take, for example the four-character word in Japanese, “O-ha-yo-u (good morning).” Each reverberant character affects the following letter; Reverberant “O” masks next letter “ha”, and reverberant “ha” masks “yo”, and so on. In the Japanese language, a vowel almost always precedes a consonant. Since the vowel has high acoustic energy, when the vowel is reverberant, the following consonant can be completely smeared. “On the other hand, it's been found that a vowel remains intelligible even after its steady-state portion is cut. If the lack of the steady-state portions of vowels doesn't affect their intelligibility, while its presence adversely affects the intelligibility of consonants, then we can save the consonants by suppressing the amplitude

of vowels. We conducted experiments by ‘backcalculating’ these effects, so to speak, to obtain results (Fig. 1).”

### Changing how we speak to improve intelligibility

This signal-processing technology has continued to advance, and research targeting real-time processing has started. Additionally, Dr. Hodoshima is also exploring methods for altering how we speak. The keyword for the latter research is the Lombard effect. “For example, imagine yourself having a conversation with a person standing at some distance in a crowded, noisy environment. You naturally speak in a louder voice, and the tones of what you say are also higher. In other words, in a noisy environment, a louder, high-pitched voice is easier to make out than a normal voice. That's known as the Lombard effect. Our research aims to apply this effect to improve speech intelligibility. Specifically, an announcement made over the loudspeaker in a public space becomes more intelligible if the speaker makes the

announcement while he or she monitors noise and vibration of the area intended for the announcement, even from a quiet booth (Fig. 2). We hope to educate people in charge of announcements by having them experience how much more intelligible their speech becomes.”

### Shifting the focus from signal processing to people

A constant impression throughout our interview with Dr. Hodoshima is the sense of her long-held aspirations “to deliver higher-quality sound to the listener”—from her high school years, when she first got interested in live PA operators and resonance in music halls, to her current research. One interesting development is that her focus on sound has shifted from simply the physical aspect of sound—the physical phenomena and signal processing—to the people who speak. “For some speaker, the signal processing works very well. As I explored what accounted for these differences, I started to take an interest in the people. At first, I was just happy my signal-processing

experiments made speech more intelligible. Then I discovered the results couldn't be applied to all public spaces and that the results would be changed when we process the speech of a different speaker. I think this problem warrants careful study, so I've continued that research. The endpoint of my research would be to have the results actually applied in public spaces, both domestically and abroad, so no one is left behind during a disaster because they can't clearly hear an emergency announcement. That's what I see as the goal of my research.” Interview and photo by Yuichiro Fuse (music technical writer)



Associate Prof. Nao Hodoshima In front of the experimental device for the Lombard effect

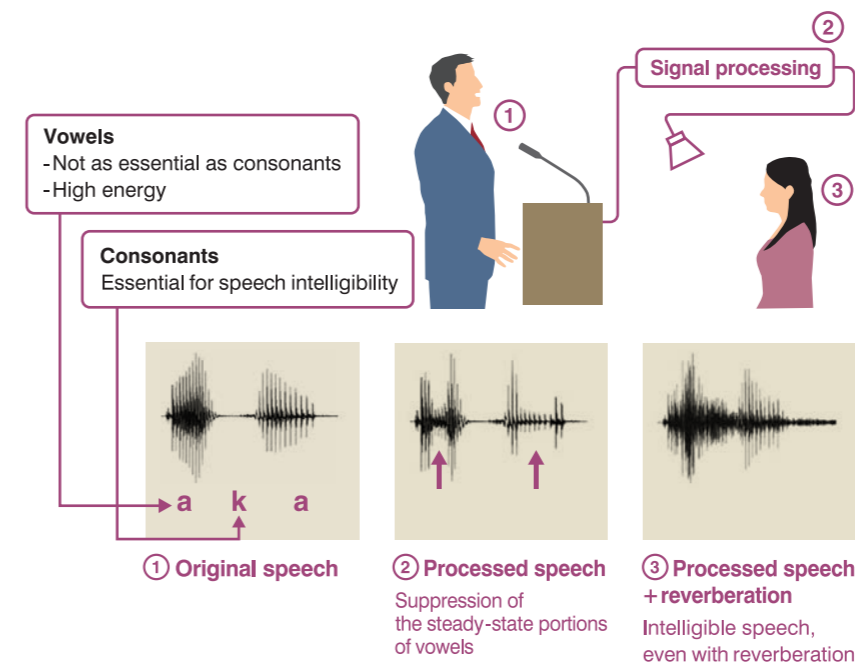


Fig.1. Steady-state suppression Suppressing the amplitude of the steady-state portions of vowels before delivering speech over loudspeakers reduces the reverberation masking on consonants, making speech easier to hear.

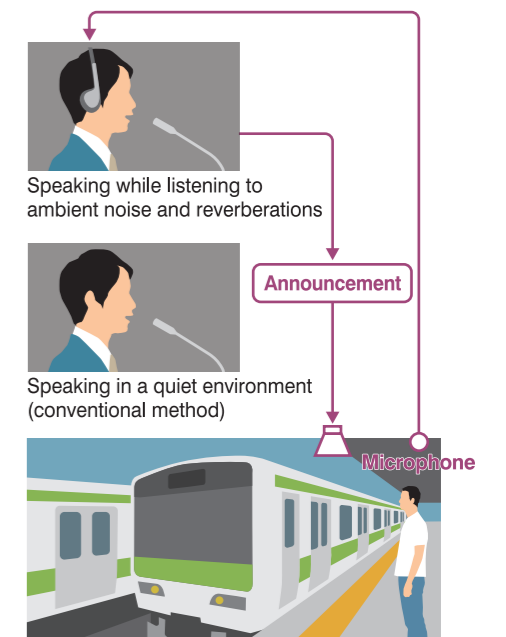


Fig.2. Speech announced over loudspeakers with the application of the Lombard effect Speaking while listening to noise and reverberations in a public space makes the speech more intelligible in the target environment.

02 LEARNING from our Past Instruments

# Playing an Active Role in Speech Analysis

## — the SG-07 Sound Spectrograph

The sound spectrograph frequency analyzer has been used by countless speech research and analysis institutions since the 1960s, dominating the market.

We spoke with Mr. Itsuo Ono,\* who played a role in its development.

\*Former Senior Executive Director, Senior Advisor. He was a member of Engineering Department Group 1 when he joined the company.

— Can you tell us about how you, Mr. Ono, were involved in the development of the sound spectrograph?

I joined the company in 1964, and I designed the filter for sound spectrograph SG-07, a model released after several models from the first sound spectrograph.

— What kind of analytical instrument is a sound spectrograph?

It's an analyzer for obtaining three parameters of a given sound: its amplitude, frequency distribution, and temporal change. They're viewed in a single plot of the result. The result of a voice analysis is a pattern referred to as a voiceprint.

— What's the mechanism underlying analysis?

First, we use a microphone to record sound. Then, we set a roll of paper for printing on the drum. While the recorded sound is played back repeatedly in fast-forward mode, the data output through a frequency filter is printed continuously. I think it may have taken two or three minutes for a single analytical run.

— So the center frequency of the frequency filter is changed continuously.

No, no. That might be possible with a single-frequency filter, but it's hard to change the center frequency of a band-pass filter without distorting the sound profile. That's why we'd adopted the heterodyne method, in which the filter remains fixed and the signal frequency changes. Mixed modulation, where you change the frequency of the local oscillator, which is then combined with the input signal, makes it possible to change the frequency being analyzed while keeping the filter fixed.

— How did you design the filters?

I took a different approach to the design strategy behind earlier models. I designed a steep, staggered (multistaged) filter. It used four resonance circuits and featured a flat passband. There were two types: one operated in a wide range of 300 Hz, the other in a narrow range of 45 Hz.

— Why did you design two types?

That was due to the difference in temporal and frequency resolution. When you analyze voice audio, the wide range filter

lets you determine the location of formants, and the narrow range filter lets you determine pitch. The instrument switches between the two filters for the analysis.

— How is the sound recorded?

Well, of course, the sound was recorded magnetically. We used a metal disk measuring 30 cm in diameter and 3 cm thick, coated with magnetic material. We adopted a metal disk for durability. The storage media remains in constant contact with the rec/play head at high speed, something magnetic tapes wouldn't withstand. I remember that the rec/play head would wear out faster than the disk.

— Could it be compared to a vinyl record?

No. For vinyl records, you use both the top and bottom surfaces. With our disk, the magnetic material was coated onto the outer rim of the disk. So, the surface used corresponded to disk thickness. The rec/play head was placed against the outer perimeter of the disk to record and playback sound. A single rotation of the disk was equal to 2.4 seconds of data. It was state-of-the-art technology at the time. We were the only ones in Japan to have it.

— Were these disks produced inside our company?

Yes. In order to coat the magnetic materials onto the perimeter, its surface had to be polished to be perfectly even. That was a challenge. Then, the coated surface had to be mirror-polished. That was another challenge. Only one technician at the factory could polish the disk to the levels needed, so we had him make several tens of disks before his retirement. We knew then we'd have to adopt semiconductor



Mr. Itsuo Ono

memory at some point.

— The SG-07 had a model with recording time of 7.2 seconds in addition to the 2.4-second model. How was that feature realized?

We just slowed the rotation speed to 1/3. That affected the frequency range, obviously, but the model was for analyzing low-frequency sounds like heartbeats, not for speech analysis.

— The SG series must have been expensive instruments.

Indeed, the materials were expensive. We used the best components available at the time, including motors. In those days, the

monthly pay of an employee in his first year was around 15,000 to 16,000 yen. The SG series were priced at 1.5 to 1.6 million yen. Adding the optional level line plotter boosted the cost of the entire set to above 2 million yen.

— I used one as a student. I remember a sharp, distinct smell.

That must have been from the paper used for the telegram. The printing requires an electrical discharge from the needle. That's where the smell comes from.

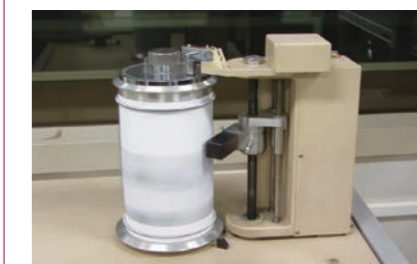
— Were there any episodes of users?

The instrument did emit some odor, smoke, and soot from the electrical discharge during the printing process. But the uniqueness of the method was what attracted most of our users, so I don't think they were seriously perturbed. But I did once hear of a professor who would place the hose of a vacuum cleaner near the printer needle to suck soot away during his analyses. He had to print massive volumes of data.

— As an experienced engineer, do you have a message for our younger engineers?

I've created many devices during my career. What I've learned is that if you set a solid goal, it will give you the impetus you need to come up with various ways to achieve the goal and to go through the repeated trial-and-error process. A purpose and having the determination to reach some goal is what matters. 👍

Interviewer: Michinari Okazaki



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A video of SG-07 in action is available on YouTube. Produced by: Arai Laboratory, Sophia University <http://www.splab.net/APD/D710/>



SG-07 introduced in 1970

## All About the Sound Spectrograph !

We'll dig deeper into the sound spectrograph SG series, which was the first spectrograph made in Japan and had significant impact on the world.

### History of the SG series

The first model of Rion's SG series sound spectrograph was introduced in 1960 as the SSG-2201, followed by its successor, SSG-2202 (Fig.1). The development was extremely challenging; the developers had to find their footing in an unknown realm, starting from the selection of materials for the recording disk, research on magnetic

materials (with nickel-cobalt alloy ultimately being the material chosen), to the development of a metal coating and surface polishing techniques. The sound spectrograph was mainly comprised of five units: the mounting unit, power supply unit, mechanical unit, analyzer unit, and the frequency marker and amplitude plotting unit. Figure 2 is a block diagram of the analyzer unit.

The result of the analysis, printed on paper, was referred to as a sound spectrogram, with frequency and time plotted on the vertical and horizontal axes, respectively. Signal amplitude was represented by a gray scale (Fig.3). This "three-dimensional" visualization was innovative in that it made it possible for users to confirm various pieces of information at a glance. This unique feature was why a cumulative total

of about 450 units were purchased by research institutes, prefectural police departments, and universities around Japan during a nearly 30-year period, regardless of high cost.

With progress in computer technology in the years that followed, digital processing became the preferred method of frequency analysis, and the era of the SG series came to an end.

### Successful applications of sound spectrographs

Applications of the SG series weren't limited solely to acoustic analysis. Simply by connecting a vibration sensor in place of the microphone, the instrument could be used to analyze vibrations of machines. By connecting an antenna, the instrument could be used for radio wave analysis. Described below are some unique examples of applications for the SG series.

#### ◎Acoustic analysis of speech

The SG series instruments were used in

research on personal characteristics in speech, dialect, and foreign language. The sound spectrograph was used for the first time in a police investigation of the kidnap and murder of a young boy named Yoshinobu in 1963. It was used to compare the voice of the recorded ransom message over the phone from the kidnapper and a separately recorded voice of a suspect, and the characteristics of the voice patterns appeared to indicate a match.

#### ◎Studies of animal vocalizations

The spectrograph was used in studies of methods for estimating the health condition of livestock based on their vocal sounds and studies of the sound transmitted through water that could be used to attract specific species of fish in fish farms.

#### ◎Analyses of machine acoustic vibrations

The spectrograph was used in the quality control of cast products to identify defective products as it could be used to check the uniformity of material distribution and also to improve the combustion efficiency of engines by analyzing combustion sounds.


#### ◎Biological studies

Research was conducted to develop applications for the spectrograph to use sound for pathological diagnoses of the circulatory and respiratory systems.

#### ◎Aurora studies

The wintering team of the Japanese Antarctic Research Expedition carried a spectrograph to Antarctica as an instrument for analyzing the ionosphere in association with auroras.

#### ◎Study of timbre

The spectrograph was used to analyze the timbre of musical instruments and select the materials for the instruments. The analysis also looked at differences in the sound generated by a Stradivarius violin and other violins. 

Interview made with contributions from: Prof. Takayuki Arai (Sophia University) / Kobayasi Institute of Physical Research / Mr. Hideaki Marukawa (former employee of Rion) / Mr. Hisashi Kuno (former employee of Rion)

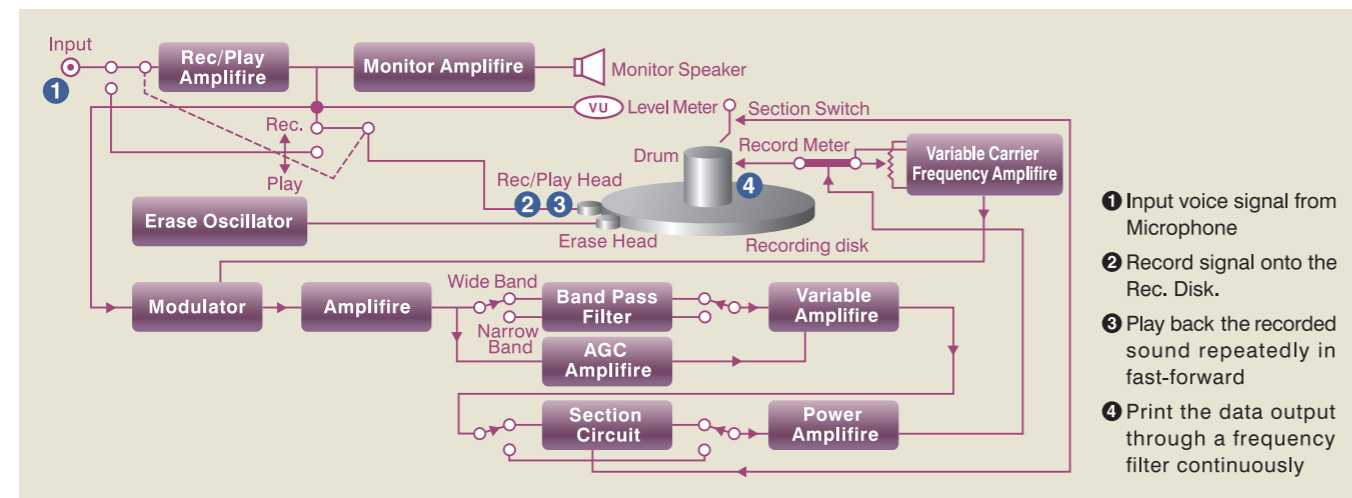
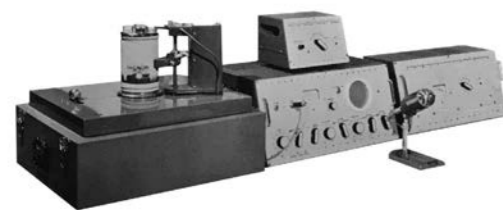


Fig. 1. Block diagram and mechanism of the analysis unit of the sound spectrograph (Reference: Catalogue for SSG-2202)



SSG-2202 introduced in 1960

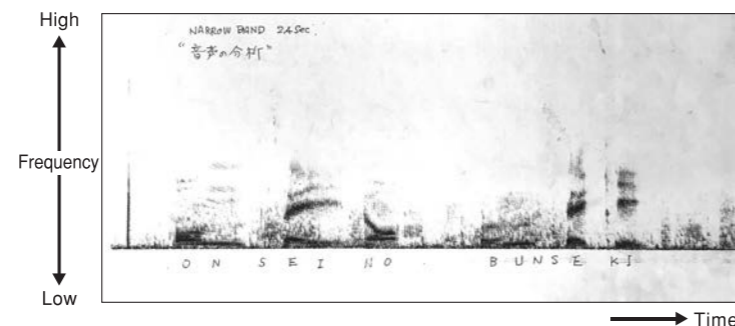


Fig. 2. Sound spectrogram: A pattern diagram of speech analysis "Onseino bunseki (speech analysis)"; duration of recording: 2.4 seconds; narrowband

## A Unique Approach from a Specialist's Vantage Point Japan Acoustic Laboratory

This is an interview with Mr. Suzuki, president of the Japan Acoustic Laboratory, a renowned institute that analyzes speech based on sound spectrograms.

"When we answer the phone, we say, 'Hello?' and it probably sounds and means the same no matter who says it. But the volume of the oral cavity and the motions of the mouth differ depending on the person speaking, as well as the tone in which it's spoken. A typical voice recognition system will only identify the commonality in the words used. In contrast, our system distinguishes differences in tone—in other words, the individuality of the voice."


These words are spoken by Mr. Hajime Suzuki, who succeeded his father as the president of the institute his father founded. "Since childhood, I've been surrounded by acoustic instruments that would never be found in a normal home. I used to play with them and help my father dub recordings. I was in love with music and used to work as an assistant in a recording studio."

The sound spectrograph makes it possible to extract and analyze not just speech, but background noise as well. A forensic investigation to which Mr. Suzuki contributed involved a derailment on the JR Fukuchiyama Line in 2005. How were acoustics relevant to this case?

"In this accident, the derailed train overshot the correct stopping position at the previous station. The conductor had reported the incident to the command center by radio. The recording was found to contain background noise, something that sounded like 'ku-ruck, ku-ruck.' An analysis of these sounds concluded they were the sounds made by the train carriages passing over several points on the railroad. Based on the intervals between the sounds, we were able to calculate the speed at which the train was traveling. Combined with other available data, this helped us determine the speed of the train when it derailed."

Based on the name, one might imagine the research

institute is a highly specialized institute. In fact, it's also been active in developing unique commercial products based on its extensive experience, including the "BABY Sshh", which soothes crying infants; "Bow Lingual", which assesses the emotional state of a dog based on how it barks; and collaborative works with musicians. We asked Mr. Suzuki what comes to mind when he hears the keyword, "Speak."

"In a past project based on the theme—What type of voice makes people want to listen?—we analyzed the speech of charismatic corporate leaders like Steve Jobs and Masayoshi Son. We found a common factor. In their speeches, they all seemed aware of the importance of intervals of silence. Listeners need time to process what they've just heard. Spouting without a break not only makes the audience lose sight of the context, it diminishes any positive feelings the audience might have about the speaker. That's why it's so important to keep these intervals of silence in mind at all times, while raising your tone towards the essence of your theme. This, I believe, is how you captivate an audience." 

Interview and photo by Yuichiro Fuse (music technical writer)

Interview undertaken with the cooperation of:  
Japan Acoustics Laboratory  
<http://www.onkyo-lab.com/>



Mr. Hajime Suzuki, President



# Forty Years in Particle Counter History

It's been 40 years since Rion introduced its first particle counter to the domestic market in 1977. Here, we look back on how the use of particle counters evolved.



## Domestic production of airborne particle counters

Airborne particle counters are instruments that count the number of particles suspended in air based on how the particles scatter laser light. This technology was developed during World War II by the United States to protect workers from radioactive aerosols during the production of atomic bombs. In 1973, Rion began importing and distributing US-made instruments, becoming a pioneer in introducing this technology to Japan. In 1977, Rion introduced the first of its own products, the KC-01, becoming the first domestic manufacturer of particle counters. Since then, our company has contributed to the proliferation and use of particle counters in Japan as measuring instruments for addressing air pollution and indoor sanitary issues. Initially, the beam source was a halogen lamp, not a laser.

## The pharmaceutical industry is the first to launch efforts to manage cleanliness

In the early days, particle counters were primarily used in cleanrooms at pharmaceutical manufacturing plants. Accurate particle counts were essential to achieving the cleanliness stipulated by GMP (Good Manufacturing Practice), pharmaceutical quality control standards. The establishment of a JIS standard for clean rooms heightened awareness of issues related to managing air cleanliness. Other industries gradually adopted the practice, too.

## Shifting to clean rooms for the semiconductor industry

As cleanrooms became more common, the major target industry for particle counters shifted to semiconductors, a field that

made dramatic strides in the 1980s. Control of indoor air cleanliness at semiconductor manufacturing sites was critical, since the deposition of airborne particles onto silicon wafers would significantly reduce yields. With ever-shrinking semiconductor patterns, Rion reduced the size of particles the counters could measure. This culminated in the development of the KC-18, which was capable of measuring particles of 0.1  $\mu\text{m}$  in diameter. These counters featured a mechanism that automatically prevented soiling of the detection parts, reducing the work needed to clean the instruments. Over time, cleanrooms had to meet ever-higher cleanliness. We developed the KC-24, which is capable of measuring 0.1  $\mu\text{m}$  particles at a fast processing rate of 28.3 L/min. Airborne particle counters have continued to bolster manufacturing at Japanese companies by contributing to quality control for products ranging from TVs to home electric appliances in the early days to (more recently) LCDs, PC hard disks, and the latest smartphones.

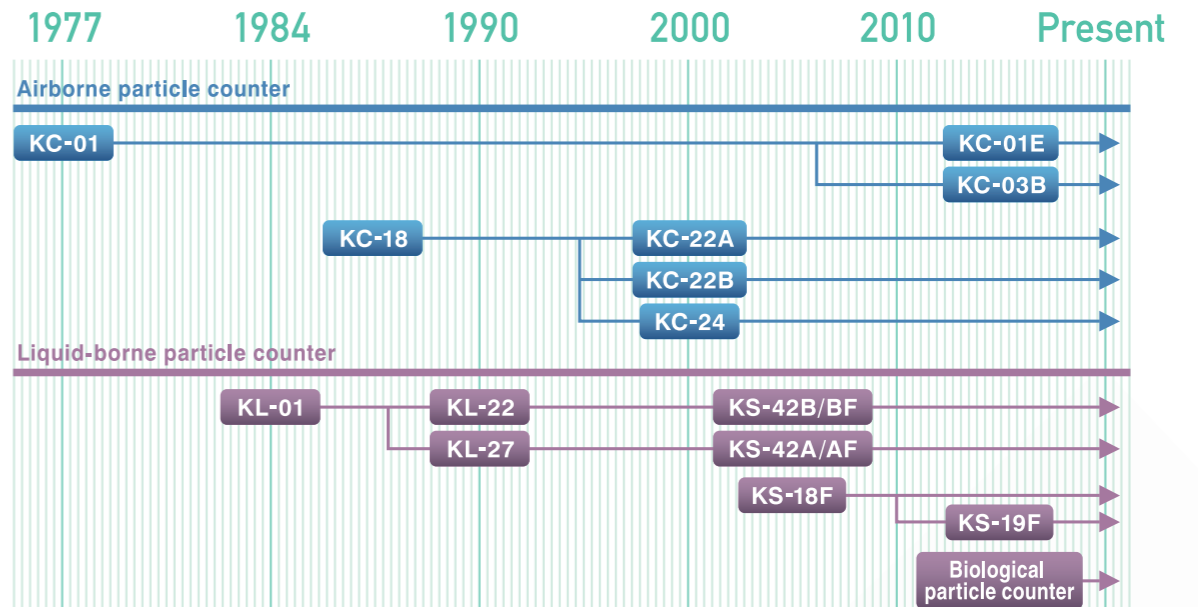
"Understanding Measuring Instruments," a three-part series of this magazine, starts focusing on cleanrooms in this issue.



This is the KC-24, which measures 0.1  $\mu\text{m}$  particles at 28.3 L/min (introduced in 2004).



This is the KL-22. It allowed measurement of hydrofluoric acid solutions (introduced in 1990).



A history of particle counters

## Liquid-borne particle counters

Demand emerged in the pharmaceutical industry for liquid-borne particle counters designed for use with injectable solutions and other applications. In 1984, in response to this demand, Rion became the first domestic manufacturer to develop a liquid-borne particle counter. This product, the KL-01, also won wide acceptance throughout the semiconductor industry. It was used to control the cleanliness of the water and chemical agents used in wafer manufacturing processes. Models in the subsequent KL-22 and KL-27 series used sapphire as a sensor material, rendering

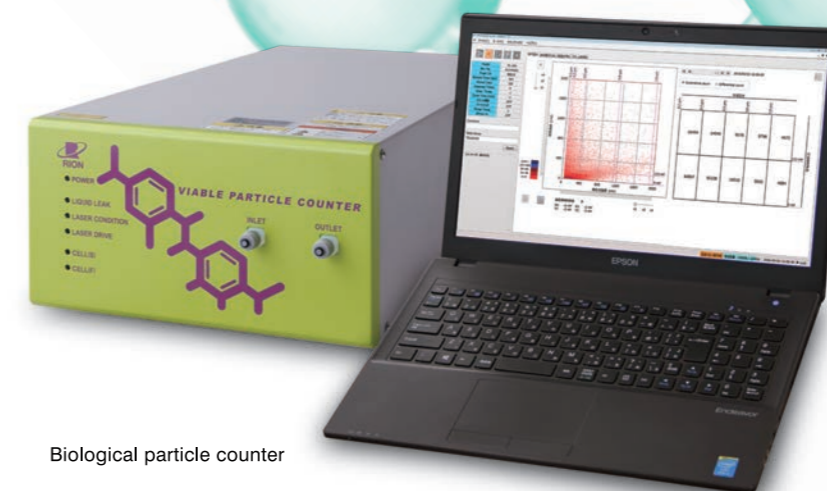
them highly resistant to corrosion and making it possible to measure even hydrofluoric acid solutions. When the products in these series were first released, the resulting interest generated massive crowds at Rion's exposition booths. The current lineup adds various other products, including the KS-19F, capable of measuring particles as small as 30 nm in diameter, as well as particle counters designed to measure specific types of solutions.

## New fields for biological particle counters

The importance of inspecting for bacterial

contamination of liquids has continued to grow in the pharmaceutical and food industries. Conventional methods, like cultivation, require time to return results. In response, Rion is focusing on developing a biological particle counter for liquid-borne particles. Taking advantage of the autofluorescence property of living organisms, this counter will make it easy to detect bacteria accurately and in real time. We're confident our biological particle counter will find successful applications in various fields.

Tsuyoshi Maeda,  
Particle Counter Sales Department



Biological particle counter

# Understanding Measuring Instruments

We will explain a measuring instrument from various angles in a three-part series

## Clean Room Standards and Monitoring (#1)

# Cleanrooms Management

Just as with surgical wards, the workspaces used for pharmaceutical development and medical research must meet high cleanliness standards. In a three-part series that starts in this issue, we'll explain pharmaceutical cleanrooms and how their cleanliness is monitored.

### Introduction

As Figure 1 shows, the need to count particles, whether airborne or liquid-borne, comes up in various fields. Clean indoor air matters in the semiconductor manufacturing industry because it has a direct impact on yields of extremely sophisticated products. In medicine and pharmaceuticals, research efforts associated with regenerative medicine have gathered momentum, as exemplified by the Nobel Prize granted in 2012 for iPS cell research. Research and experiments in these spheres require strictly

managed cleanroom environments. In this issue, we'll discuss management systems for these clean environments.

### Cleanroom classes and grades

First, let's review the standards for cleanliness. Cleanrooms are classified based on the number of airborne particles of a certain (particle) size per unit volume within the room. An international standard (ISO 14644-1:2015<sup>[1]</sup>) and a domestic standard (Japanese Industrial Standards; JIS B 9920<sup>[2]</sup>) stipulate cleanliness

standards for cleanrooms. The JIS is a standard consistent with the ISO, as it was based on the ISO with certain modifications. The standards define classification schemes and methods for evaluating various types of clean rooms—not just cleanrooms for the pharmaceutical and food manufacturing industries, but for semiconductor and LCD manufacturing plants.

The pharmaceutical field also applies the GMP guidelines from PIC/S<sup>[3]</sup>. This international convention stipulates the maximum number of particles permitted for a given cleanroom grade, both at rest and when operating.

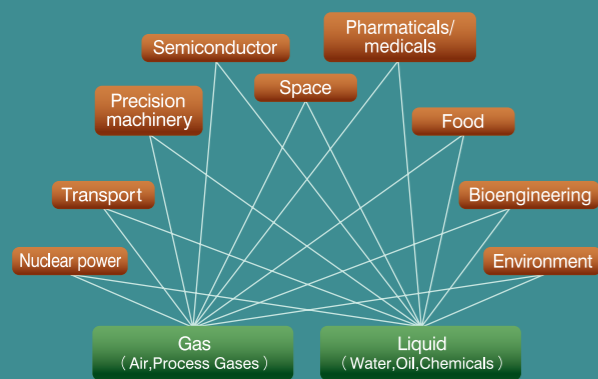


Fig.1. Fields requiring particle counts

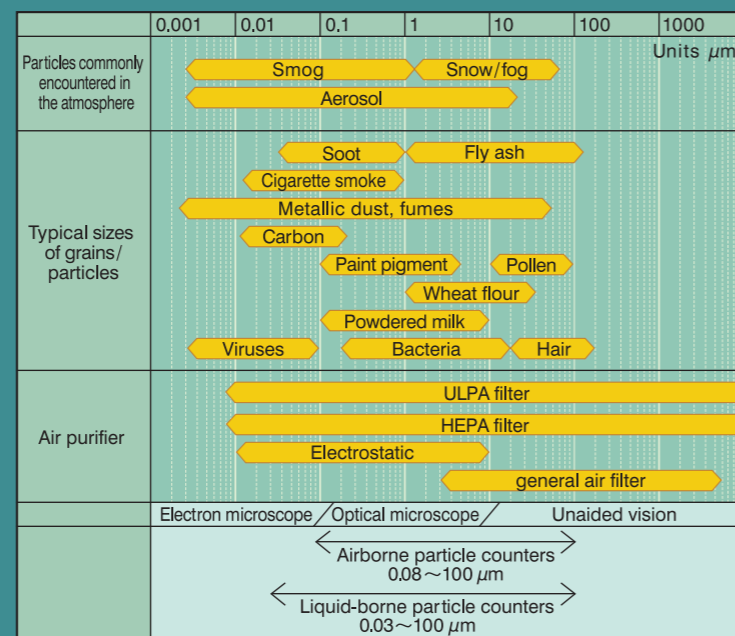


Fig. 2. Sizes of the particles in our surroundings (reference) and range of measurement of particle counters

Table 1 lists cleanliness classes from ISO 14644-1. Table 2 shows clean room grades for the GMP guidelines. For the most part, GMP grades and ISO classes in ISO 14644-1 correspond as follows:

Grade A ↔ Class 5

Grade B ↔ Class 7

Grade C ↔ Class 8

Since it's difficult to intuitively grasp cleanliness levels from tabulations of cleanroom standards, Figure 2 provides a schematic diagram of the particle sizes in our surroundings and the range measured by particle counters.

### PIC/S GMP guidelines and multipoint monitoring

Pharmaceuticals impact our health directly. For this reason, systems of validation have been established to ensure their quality. Validation involves a written certification assuring users that the management of hardware, such as manufacturing facilities, and the management of software, such as manufacturing procedures, have been carried out according to designated methods. This validation also addresses the cleanliness of the air and the particle counters used at pharmaceutical manufacturing facilities. All associated steps in the manufacturing process

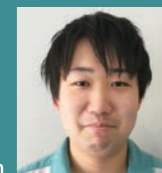
must be documented and stored as records of operations and execution. The GMP (the Ministerial Order for the Standards Concerning the Management of Manufacturing and Quality of Pharmaceuticals and Quasi-Pharmaceutical Products) constitutes the legal requirements of this validation. Originally, these requirements were set forth and implemented according to domestic laws specific to each country. In Japan, the applicable regulations were found in the Japanese Pharmacopoeia; in the United States, they were found in the cGMP; and in the European Union, they were found in the EU-GMP. The Pharmacopoeia is a standard document for pharmaceutical products, but it also includes standards for testing and purity. Later, a scheme for international cooperation, the PIC/S<sup>[3]</sup> (Pharmaceutical Inspection Convention and Pharmaceutical Inspection Co-operation Scheme) was established. Japan became a member of the convention in 2014.

The PIC/S GMP guidelines require daily monitoring of air cleanliness in the working environment. In Grade A cleanrooms in particular, the entire range of vital processes must be monitored, including the assembly of facilities. Continuously monitoring the

environment allows early detection of abnormal conditions and efficient response. Concentrated control of multiple monitoring points contributes to the efficient use of both time and human resources. If the grades required for the cleanrooms vary depending on the process, multipoint monitoring is especially useful in making comprehensive evaluations. Its applications include setting the size of the monitored particles and threshold value by grade of controlled environment to generate alerts whenever the particle count exceeds the threshold and installing warning lights at the monitoring points to notify workers of abnormal conditions. In the next issue, we'll focus on how multipoint monitoring works.

### References

- [1] ISO 14644-1:2015 Cleanrooms and associated controlled environments: Part 1: Classification of air cleanliness
- [2] JIS B 9920 (Classification of air cleanliness for cleanrooms)
- [3] PIC/S: Pharmaceutical Inspection Convention Pharmaceutical Inspection Co-operation Scheme



Wataru Osabe, Development Division

Table 1. ISO 14644-1 air cleanliness classes

ISO class number (N)	Maximum concentrations limits (particles/m <sup>3</sup> )					
	0.1 μm	0.2 μm	0.3 μm	0.5 μm	1 μm	5 μm
1	10					
2	100	24	10			
3	1,000	237	102	35		
4	10,000	2,370	1,020	352	83	
5	100,000	23,700	10,200	3,520	832	
6	1,000,000	237,000	102,000	35,200	8,320	293
7				352,000	83,200	2,930
8				3,520,000	832,000	29,300
9				35,200,000	8,320,000	293,000

Table 2. PIC/S GMP grades

Grade	Maximum permitted number (particles/m <sup>3</sup> )			
	At rest		In operation	
	0.5 μm	5 μm	0.5 μm	5 μm
A	3,520	20	3,520	20
B	3,520	29	352,000	2,900
C	352,000	2,900	3,520,000	29,000
D	3,520,000	29,000	N/A	N/A



Hello From  
the Office



## From hearing screening rooms to hearing instruments

~Half a century of supporting manufacturing at Rion

### Rion Metal Engineering Co., Ltd.

Rion Metal Engineering Co., Ltd., was founded in March of 1960. It's actually older than Rion itself, since it used the name "Rion" one month before the main company.\*

\*The company name was renamed in April 1960 from Kobayasi-Riken Co., Ltd., to Rion Co., Ltd.

In March 1998, Rion Metal Engineering relocated from Hachioji-shi to Mizuho-cho. The new building was completed in 2014, and the rich green surroundings create a great relaxing environment for research. The sound and vibration of the manufacturing machines, as well as the noise of the aircraft landing at and taking off from Yokota Base, are out of place in these surroundings, but the inconsistency is a feature of this town, too. The company's line of business is metal working—mostly, manufacturing and processing for Rion products. One major product is a hearing screening room. This includes a wide range of product types, from the standard types seen in medical check-up centers to custom, large-scale types used in university medical centers and general hospitals. Other work includes the production of chassis made

from metal sheets and the machining of metal parts to be placed in the chassis; assembly of parts for custom-made hearing aids; and various manufacturing processes associated with Rion products.

Rion Metal Engineering hopes to support Rion technology as an actual manufacturing center for the Rion group.

Akira Ogawa, President



New building completed in 2014



This is the turret punch press, the largest facility in the plant. Metal sheets are pressed (punched) and cut by laser. The design blueprints are converted into CAD format and programmed into the machine for manufacturing processes. The inner wall of the hearing screening room is near side.

Rion Metal Engineering Co., Ltd.  
1323-1 Hakonegasaki,  
Nishitama-gun Mizuho-cho, Tokyo  
Phone : +81-42-557-7386



## How Sound is Heard Underwater

I was talking once to a friend who was an experienced diver. He mentioned an interesting fact. Underwater, he said, you can't tell where a sound is coming from. Even if the sound source is directly in front of you, it can seem like it's coming from all directions or from above. "Is that because the speed of sound is different in water than in air?" If that's what occurred to you, you have one sharp mind.

We humans use two ears, one on the left and one on the right, to determine where a sound is coming from. Our brain relies on a range of information found in the sound our ears sense. The major parameters are differences in the arrival time of sound and the volume of the sound at the two ears.

The speed of sound in air is approximately 340 meters per second (at 15 °C). In water, the speed of sound is approximately 1,500 meters per second. Sound travels 4.4 times faster in water than in air. Therefore, in water, the time difference of sound arriving at the two ears is reduced. Faster speeds mean sound has longer wavelengths. Sounds of longer wavelengths are more likely to be diffracted—more likely to bend around and reach behind an obstacle. In other words, underwater, we are more likely to perceive sound originating from behind because the sound can reach our ears

by diffracting around the auricles. As illustrated above, since sound travels faster underwater, it reaches both ears at nearly the same time and nearly the same volume level. That's why our brain can't determine where the sound is coming from.

Dr. Sojun Sato

Advisor, Former Head of Acoustics and Vibration Metrology Division, NMIJ of the National Institute of Advanced Industrial Science and Technology



Photo by : Sae Nakayama



Photo taken at Jigokudani Yaen-Koen (Nagano Prefecture)  
Photo by: Nobuhiko Hiruma Hearing Instruments Development Section 3

The monkeys, who no doubt would normally be fighting for territory or food, are found here peacefully enjoying a hot spring side by side in a heartwarming scene for tourists.

# ShineView!

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

**Mr. Kiyotsune Inoue** Senior Advisor  
(Former President & CEO)

## Be victorious! Over my wife, kids and myself Martial arts fitness exercise



— I've heard you're a fan of martial arts. Do you practice a form of martial arts yourself?

I go to a gym every Sunday for a martial arts fitness exercise class. It's a pastime I share with my wife. I can retire anytime and spend the rest of my days with my wife [laughs].

— Was there something specific that motivated you to take up martial arts as exercise?

I have two sons who began learning Kyokushin karate when they were in high school. I watched them progress at a remarkable speed, and I was impressed by the moves they'd show me at home. As a father, I felt challenged by my sons. Eventually, I decided I wanted to apply my body to some form of rigorous physical exertion. That was what motivated me. And I've carried on for 20 or so years since then.

— What exactly do you do in class?

The class has "martial arts" in its name, but the activities involve performing martial arts moves like punches and kicks in time to the music. The class goes for an hour, including 10 minutes for warm-up and cool-down at the beginning and end of each class. So, it basically lasts 40 minutes. By the time I'm done, I'm

soaked with sweat. I feel refreshed and ready for the week's work on Monday.

— It sounds like a hard workout. Does your wife attend the class, too?

Yes. And of the 20 people in class, 15 are women.

— Is there something that makes you feel glad to have taken up the exercise?

It's quite strenuous. Sometimes, I feel like I'm overdoing it. There aren't many men in the class, so I want to stick with it. This exercise helps me nurture self-control to overcome my weaknesses and helps me stay positive in both my personal life and work.

— Have you ever thought about quitting?

No, never. I love it. I go even when I have a cold. After class, I take a shower and rest, then return to the gym to go through my personal strength training routine, which takes about 80 minutes. I take another shower before going home. I don't eat lunch that day, but I do drink lots of fluids.

— Sounds like it might lead to some sore muscles.

Yes, I do get sore muscles. I've heard it's actually better to work out twice a week, but I don't have the time. I need that time to spend with my grandchildren [laughs].



This is a Chinese poem, an acrostic, given to him by a business partner when he became company president.



The motto during his years as president: "No begin, no start."

From the interviewer:  
The secret to his vitality, youthfulness, and his family's happiness seems to lie in this shared interest that he and his wife have in common. (D. Sakau, Development Division)

Measurable particle size range 1.3  $\mu\text{m}$  to 100  $\mu\text{m}$   
Flow rate 25 mL/min (10 mL/min available as factory option)  
Up to 20 particle size ranges (freely selectable)

NEW

## Light Obscuration Particle Counter KL-05

- Designed for measurement of insoluble particles in injections, for example at pharmaceutical plants
- 21 CFR Part 11 compliant
- Conforms to Japanese Pharmacopeia (JP), United States Pharmacopeia (USP), European Pharmacopeia (EP), Korean Pharmacopeia (KP) and Chinese Pharmacopeia (ChP)



40<sup>th</sup>  
Anniversary  
-Since 1977-



NEW

## 50% less power consumption

Compact and lightweight

## Aircraft Noise Monitoring System NA-39A

- All required functions for aircraft noise measurement combined in a single system.
- 1/3 octave real-time analysis capability added to the noise arrival direction identification function results in higher accuracy of aircraft noise identification.
- Compact and lightweight design facilitates installation. Power consumption reduced by about fifty percent.

NEW

## High reliability / High quality

Compact and lightweight design ideal for use in the field

## Acoustic Calibrator NC-75

- Conforming with JIS C 1515: 2004 and IEC 60942: 2003 class 1.
- Each product comes standard with a JCSS Calibration Certificate, proof of high quality.

NEW

## Pocketable type

Compact vibration meter for easy on-site measurement

## Pocketable Vibration Meter VM-63C

- Highly compact vibration meter designed mainly for maintenance and inspection of industrial machinery, with particular emphasis on rotational machinery.
- Integrated accelerometer and digital display eliminate the need for extra cabling.
- Designed to fit snugly into the palm of one hand, for operation with a single button.

**[ Related to sound and vibration measuring instruments ]**

◎ Architectural Institute of Japan Annual Convention 2017 (August 31 - September 3 Hiroshima Institute of Technology)

- Mounting resonances of an accelerometer for measurements of environmental vibrations – Part 1 Shaking table test by sinusoidal wave – / D.Adachi, T.Kotani\*<sup>1</sup> (in Japanese)
- Mounting resonances of an accelerometer for measurements of environmental vibrations – Part 2 In case of stimulus source use – / T.Kotani\*<sup>1</sup>, D.Adachi (in Japanese)

◎ Acoustical Society of Japan 2017 Autumn Meeting (September 25-27 Ehime University)

- Investigation of very-high-frequency noise in our environment – part 3 psychological and physical effects of very-high-frequency noise – / M.Hiroe\*<sup>2</sup>, T.Ozaki, M.Ueda\*<sup>3</sup> (in Japanese)
- Distortion evaluation of silicon electret microphones / K.Yasuno\*<sup>2</sup>, M.Morikawa, T.Ito, N.Okubo (in Japanese)
- Hammering sound characteristics of tunnel by rotary hammer inspection equipment / Y.Nakajima, Y.Yonemoto, D.Kuwano\*<sup>4</sup>, T.Taniguchi\*<sup>5</sup> (in Japanese)
- DNN-based environmental sound recognition including exclusive processing / T.Ohshima, D.Naito, M.Sunago, Y.Nakajima (in Japanese)
- Study on methods for localization of the infrasound / T.Doï\*<sup>2</sup>, K.Iwanaga\*<sup>2</sup>, T.Kobayashi\*<sup>2</sup>, Y.Nakajima (in Japanese)

◎ The Institute of Noise Control Engineering of Japan 2017 Autumn Meeting (November 16-17 Tokyo Denki University)

- Timbre similarity evaluation on identifying sound sources of environmental noise / H.Suzuki\*<sup>2</sup>, Y.Nakajima (in Japanese)
- Proposal of acoustical propagation prediction method based on DNN weather estimation using school's time signal chime etc. / T.Ohshima, T.Naito (in Japanese)
- Automatic sound recognition and methods / Y.Nakajima (in Japanese)
- A comparison and evaluation of sound insulation with different sound sources / C.Fujita, T.Naito, N.Okamoto, T.Hasumi (in Japanese)

- Study on methods for localization of the infrasound. / T.Doï\*<sup>2</sup>, K.Iwanaga\*<sup>2</sup>, T.Kobayashi\*<sup>2</sup>, Y.Nakajima (in Japanese)

◎ JOURNAL OF INCE / J Vol.42No.1 2018.2

- An Application of IoT to Sound Level Meter and Multipoint Synchronous Measurement / R.Kazama, T.Yokota\*<sup>2</sup>, T.Matsumoto\*<sup>2</sup>, K.Anai\*<sup>6</sup> (in Japanese)

**[ Related to particle counters ]**

◎ Regenerative Medicine JAPAN 2017 (October 11-13 Pacifico Yokohama)

- Cleanliness and environmental monitoring of regenerative medical facilities / Y.Suzuki (in Japanese)

\*1 Fujita, \*2 Kobayashi Institute of Physical Research, \*3 Ghent University, \*4 Elwing, \*5 NEXCO Engineering Kyushu, \*6 Kyushu Institute of Technology

**Exhibitions**

- S** Related to sound and vibration measuring instruments
- P** Related to particle counters

- S** Acoustical Society of Japan 2018 Spring Meeting (March 13-15, Nippon Institute of Technology)
- S** The Japan Society of Mechanical Engineers Kanto Chapter 24th General Assembly • Lecture (March 17-18, Tokyo Institute of Technology)
- S** The Institute of Noise Control Engineering of Japan 2018 Spring Meeting (April 19 Fukagawa Edo Museum)
- S** Automotive Engineering Exposition 2018 Yokohama (May 23-25, Pacifico Yokohama)
- S** Automotive Engineering Exposition 2018 Nagoya (July 11-13, Portmesse Nagoya)
- S** ICSV25 (July 8-12, Grand Prince Hotel Hiroshima)
- P** SEMICON China 2018 (March 14-16, Shanghai, China)
- P** Interpex Japan 2018 (June 27-29, Tokyo Bigsight)
- P** SEMICON West 2018 (July 10-12, San Francisco, United States)

**About the Front Cover**

The Japanese explanations like “yellow voice” or “change the color of your voice” show a special sensitivity towards associating colors with voice. (Oana)



**Editorial Postscript**

A while back at a restaurant, I was a bit saddened to see that orders were to be made through an automated terminal. Today, I'll leave my office earlier than usual to talk more with my family. (Hasumi)

**This magazine can be downloaded from the *Shake Hands* website, where you can take part in a reader survey : <http://rion-sv.com/shakehands/>**



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