JIRA

Radiology Japan

Japan Industries Association of Radiological Systems September 2004 No. 49

Review of the Japanese Market for Diagnostic Imaging and Therapeutic Systems in the Year 2003

Diagnostic Imaging and Therapeutic Systems (production, exports, imports, domestic market)

From January through December 2003 Unit: Millions of yen

Category / Item	Production		Exports		Imports		Domestic Market			
	Amount	% to Previous Year	Amount	% to Previous Year	Amount	% to Previous Year	Number of Units	% to Previous Year	Amount	% to Previous Year
1 X-ray	**111,141**	**117**	**34,330**	**132**	**19,848**	**94**	**–**	**–**	**96,659**	**107**
・General-purpose R/F	28,887	97	6,161	108	25	9	1,541	98	22,751	94
・Cardio & angio	12,045	133	5,968	143	11,315	79	258	82	17,393	91
・General-purpose radopgraphy	23,771	109	6,594	132	813	126	4,130	108	17,991	103
・Mobile	4,031	143	2,324	205	306	110	725	97	2,012	103
・Dental	6,504	102	1,525	147	0	–	4,655	91	4,979	94
・Others	35,903	139	11,758	131	7,389	131	–	–	31,534	141
2 CT	**81,992**	**107**	**40,075**	**99**	**14,369**	**178**	**1,198**	**114**	**56,286**	**128**
3 Nuclear medicine	**2,896**	**106**	**68**	**40**	**8,110**	**160**	**205**	**168**	**10,939**	**144**
4 MRI	**35,397**	**80**	**19,724**	**64**	**29,223**	**181**	**449**	**136**	**44,897**	**152**
5 Image processing systems	**12,189**	**149**	**1,596**	**215**	**3,561**	**385**	**–**	**–**	**14,153**	**170**
6 Related items & accessories	**27,888**	**111**	**9,811**	**103**	**2,943**	**171**	**–**	**–**	**21,020**	**122**
7 Diagnostic ultrasound	**73,772**	**108**	**48,636**	**105**	**8,214**	**178**	**5,842**	**122**	**33,349**	**126**
8 Therapeutic systems	**6,906**	**77**	**2,298**	**100**	**4,413**	**83**	**493**	**90**	**9,021**	**75**
Total	**352,180**	**107**	**156,538**	**100**	**90,682**	**144**	**–**	**–**	**286,324**	**121**

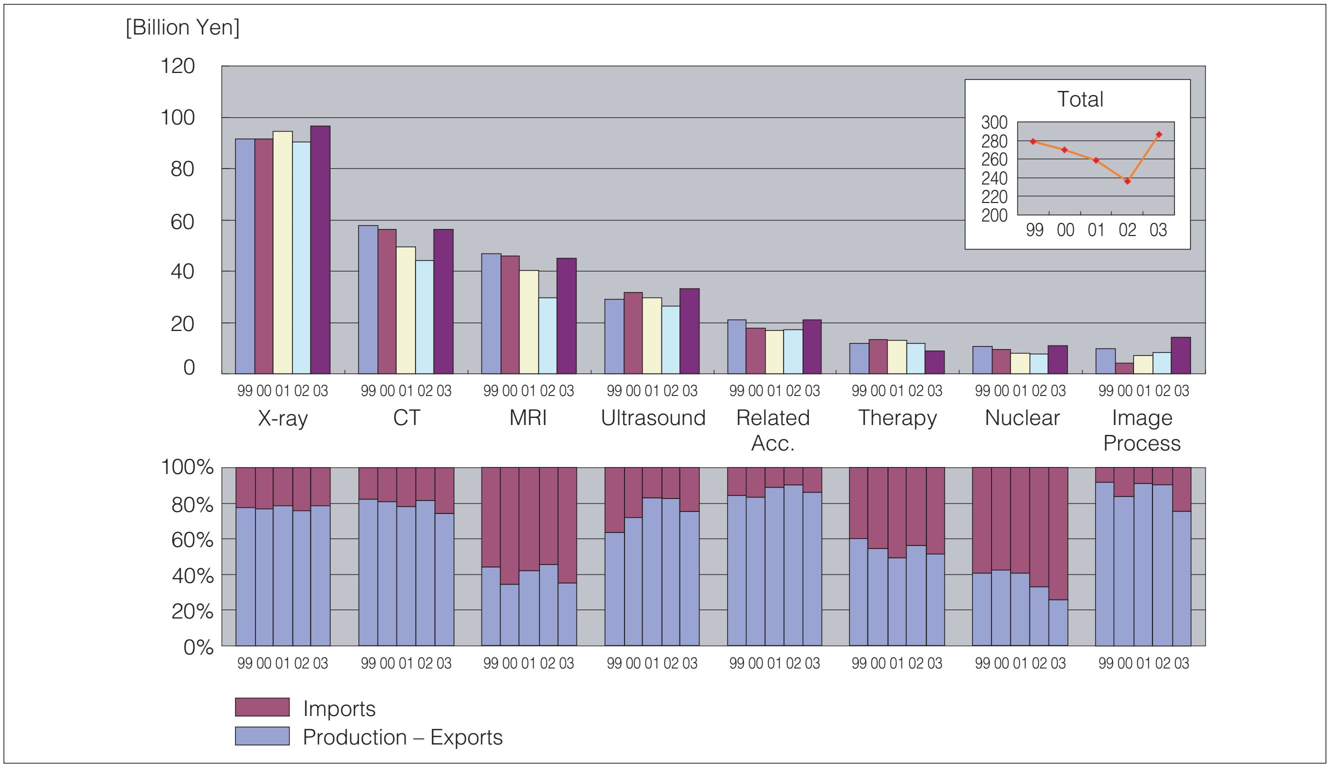
(Note 1) Domestic market: Calculated by the formula (Production – Exports + Imports).

Review of the results for 2003

1. The domestic medical imaging system market has reached 286.3 billion yen (121%), with 352.2 billion yen (107%) in production, 156.5 billion yen (100%) in exports, and 90.7 billion yen (144%) in imports.
2. The domestic market, by modality, is as follows. MRI: 44.9 billion yen (152%) or 449 units (136%), Nuclear medicine: 10.9 billion yen (144%) or 205 units (168%), CT: 56.3 billion yen (128%) or 1198 units (114%), Diagnostic ultrasound: 33.3 billion yen (126%), and diagnostic X-ray equipment: 96.7 billion yen (107%). The figures correspond to an overall increase in Diagnostic Imaging and Therapeutic Systems to 286.3 billion yen (121%).

   Along with the significant increase in all modalities, there was a substantial increase in the network-related segments of Image processing systems, leading to the strong increase of 14.2 billion yen (170%) in Image processing systems.
3. In 2002, Cutting in reimbursement point resulted in market contraction and a reduction in the market for highend imaging equipment, but in 2003 the market recovered to the level of 1999, immediately after the 1998 peak. This is thought to be due mainly to state-of-the-art MRI technology with high magnetic field strengths and high-speed data processing capabilities and to multislice CT in response to increasing advanced diagnostic demand, as well as to expansion in PET (responsible for 51% of diagnostic nuclear medicine equipment sales) and network-related equipment use in hospital IT infrastructure improvements. The level of imports for such equipment has also spurred the growth of the market.
4. As in 2003, increased demand for replacement of high-field MRI and multislice CT equipment is expected for 2004, and the PET and network-related equipment markets are also expected to expand. However, due to reimbursement adjustments (±0%) and the privatization of medical facilities such as national university hospitals and national hospitals, as well as the prevailing domestic efforts to reduce medical costs, overall expansion of demand is expected to remain flat.

Five-Year Overview of the Diagnostic Imaging and Therapeutics Systems Market in Japan by Modality



[Notes] Production and export figures for "Others in X-ray" and "Diagnostic ultrasound" have been revised since the publication of the 2002 report (Jan–Dec) (Radiology Japan, No. 47, August 2003), and these revised figures are used here.

Report on JRC 2004

JRC (Japan Radiology Congress) was held in Yokohama from April 8th to 11th. At JRC, JIRA held the International Technical Exhibition of Medical Imaging, ITEM 2004, in conjunction with the annual meetings of JRC and JSRT, from April 8th to 10th. This year's exhibition featured an increase in floor space of 160 m^2 (total 6,922 m^2), with 6 new companies bringing the total to 129, breaking last year's record.

This year, JRC organized an academic conference on the theme "Radiology: Standardization and Individualization", and ITEM 2004 continued with the theme "New Wave of Medical Imaging", displaying the most up-to-date equipment and services. Technologies on display included large-scale equipment such as CT, MRI, PET, and PET-CT systems as well workflow standardization and IT solution products such as peripheral devices and associated equipment. There was also a strong focus on the patient, with minimally invasive technologies and techniques for minimizing patient anxiety.

The number of attendees for the three days, compared to last year, are shown in the chart.

Next year's ITEM 2005 will be held from April 8th (Fri) to April 10th (Sun) in Yokohama.

Events / Participants	Registered congress members		Exhibition
	JRS	JSRT	ITEM 2004
Radiologist	3,883 (3,705)		5,184 (4,670)
Radio technologists		3,370 (3,464)	13,978 (13,467)
Co-medical personnel			1,542 (1,246)
Other			19,920 (15,871)
Total	3,883 (3,705)	3,370 (3,464)	40,624 (35,254)

Note 1) The numbers of visitors to the exhibition include repeat visitors.
Note 2) The numbers in parentheses are the corresponding figures for 2002.
Note 3) The number of registered exhibition staff was 4757 (4754) from 129 exhibitors.

ITEM 2004

JIRA Activity Reports

Study of Chinese Legislation system and meeting with Related Agencies

From November 11th to 14th, 2003, the JIRA International Division visited China to meet with related Chinese agencies.

1. State Food and Drug Administration (SFDA)

- Regarding Chinese medical equipment management ordinances, SFDA is requesting not Japanese Ministry of Health, Labor and Welfare "English certificates", but copies of production licenses (Japanese) and item certificates (Japanese).
  Copies of these documents, notarizations of those copies, and Chinese translations of these notarizations should be submitted.
- Interaction between JIRA and SFDA should be continued in the future. Information regarding Japan's revised Pharmaceutical Affairs Law was requested.
- Materials regarding March 2003's medical equipment registration overview (for imported and third-party medical equipment) were received.

with SFDA members

2. Chinese Quality Certification Center (CQC)

The CQC has 15 departments and 300 engineers. There are 12 branch offices.

A total of 100,000 licenses are issued to 26,000 companies, but 90% of these are handled by the CQC.

There are 100 research labs connected to the CQC, and 1000 total inspectors.

It would be beneficial for JIRA engineers and CQC engineers to meet once a year as well.

<Certification Cost>

(A) Application Fee: 600 yuan

(B) Document Inspection Fee: Free (however, for inspection of documents for equipment without need for inspection, 1000 yuan)

(C) Sample Test Fee
- X-ray Imaging Equipment:
  1) Approx. 49,000 yuan
  2) Approx. 59,000 yuan
  3) Approx. 68,000 yuan
  The above ranks depend on the contents of work performed by investigators.
- X-ray CT Equipment: Fixed rate of 63,000 yuan
  Additional costs are levied for reinspection or addition of equipment to be inspected.

(D) Report Fee: For inspection costs of 10,000 yuan or less, 2.5% of the inspection costs. For inspection costs exceeding 10,000 yuan, no more than 300 yuan.

(E) Manual and Drawing English Translation: 1000 yuan/unit

(F) Factory Inspection Fee:
3500 yuan/person/day × 2 people × 2 days = 14,000 yuan (standard cost, travel expenses calculated separately)

(G) Follow-up Inspection: Based on the conditions above (the number of days may vary based on the conditions)

(H) Certification Document Fee:
- Certification Registration Fee 800 yuan
- Yearly Maintenance Fee 400 yuan

However, due to problems with samples clearing customs, a 6-month wait may occur. If there are problems with customs, CNCA (Certification accreditation administration of the people's republic of China) should be contacted. The CQC-designated customs agent is the Beijing Pacific Logistics Customs Broker Co., Ltd. In addition, equipment parts that require a CCC (China Compulsory Certification) mark will not be able to clear customs without the mark. Father information of the parts authorization list is available on the CNCA homepage (http://www.cnca.gov.cn/).

with CQC members

3. Ministry of Health (MOH) International Exchange Center

The following three Chinese health reform measures are being implemented.

(1) Yearly and regional medical system reform
(2) Pharmaceutical distribution reform
(3) Medical insurance system reform

China's government is a stable, legalist system, so even if the leadership changes, medical initiatives should be unaffected.

Public sanitation measures, highlighted by the SARS issue, are being strengthened.

– Purchasing and installation standards for costly medical equipment have not changed, but equipment purchases in coastal areas have slowed. Outlying agricultural areas receive governmental support. The 200 million US$ from Japan is being used for local infections disease prevention centers. In the 40,000 facilities in these areas, ultrasound systems are black-and-white units, analysis equipment is semi-automated, and X-ray equipment is available at 20% of sites.

with MOH members

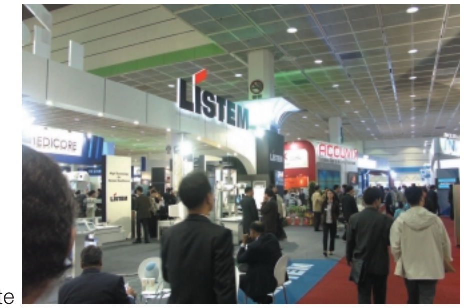
Visit to the 20th KIMES 2004 and Meeting with Korean Medical Equipment Associations

JIRA organized a visiting group tour to observe the 20th KIMES 2004 (Korea International Medical & Hospital Equipment Show) and to expand exchange with Korean medical equipment associations (the Korea Medical Instruments Industrial Cooperative [KMICA] and the Korea Medical Devices Industry Association [KMDIA]) and the Korea Testing Laboratory (KTL).

20th KIMES 2004 Out Line of Exhibition

Out Line of Exhibition

1. Organizers:
   (1) Korea E & Ex Inc.
   (2) Korea Medical Instruments Industrial Cooperative (KMICA)
   (3) Korea Medical Devices Industry Association (KMDIA)
2. Support:
   (1) Ministry of Commerce, Industry, and Energy
   (2) Ministry of Health and Welfare
   (3) Korea Food & Drug Administration (KFDA)
   (4) Korea Trade-Investment Promotion Agency (KOTRA)
   (5) Korea Health Industry Development Institute
   (6) Korean Medical Association
   (7) Korean Hospital Association
   (8) Medical Tribune
3. Exhibition Area: 25,101 m^2
4. Exhibition Site: COEX Convention and Exhibition Center
5. Attendees: 45,638 (Non korean: 921)
6. Exhibitors: 768 companies from 30 countries



Exhibition Site

Korea Medical Instruments Industrial Cooperative (KMICA)

The Korean medical equipment industry consists of 1446 production companies and 950 import companies (estimated).

KMICA was founded in 1979 and was granted authorization as an import company in July 1983.

There are currently 301 member companies (companies licensed by the Food & Drug Administration).

KMICA put forward a proposal for a joint Korean/Japanese/Chinese medical equipment industry conference. An overview of the proposal follows.

– Operation by Korean, Japanese, Chinese, Taiwanese, and Hong Kong members.
– Advice concerning production and import registration by the conference body.
– Sharing of year-end data.
– Release of Medical Imaging Market data in publications by each association.

JIRA is considering involvement with regard to medical imaging equipment.

Korea Medical Devices Industry Association (KMDIA)

KMDIA is a part of the KFDA. It contains 500 member companies. (Import-related companies: 178, production-related companies: 322)

During the visit, the KMDIA requested information from the JIRA regarding JIRA's administration and market information.

JIRA intends to continue cooperating with the KMDIA in the future.

with KMDIA members

Korea Testing Laboratory (KTL)

Currently, Korea is considering the possibility of establishing regulations and restrictions concerning medical equipment.

A draft of these regulations was submitted in the autumn of 2003 for initial comments, and the final version was published in April. Preparations for GMP (KGMP) announcement were also made and implemented on May 30th.

The regulations include standards for GMP and quality control for importers and service providers.

Korea is also establishing management regulations for MRI, CT, and other special purpose diagnostic equipment, e.g. mammography and is considering implementation of these regulations in the autumn of 2004 or later.

JIRA would like to continue in-depth exchanges with KTL in the future.

with KTL members

From the JIRA Activity Report (October 24, 2003)

1. Medical Imaging System division

The following were reported, focusing on Act for Protection of Computer-Processed Personal Data held by Administrative Organs compliance and IHE-J project trends.

– Act for Protection of Computer-Processed Personal Data held by Administrative Organs overview and individual medical laws
– Obligations of companies handling personal data
– Remote service security guide
– Handling of personal information included in medical equipment diagnostic data
– International collaborative efforts
– IHE-J's future, medical information integration project updates

2. International division

– Study of Korean and Chinese regulations; deliberations between Korea, China, and Japan based on JIRA activities
– DITTA conference participation, information exchange regarding market information and medical treatment fees
– Study of European WEEE and RoHS directive and provision of information to JIRA members

3. Survey and Research Committee

– JIRA statistics continued improvement with international conformance and reformed PAL
– Medical imaging equipment implementation results studies, addition and modification of equipment in accordance with modern medical conditions
– Economic evaluation structure establishment for diagnostic imaging equipment. At this time an economic evaluation of early cancer diagnosis was presented; in the future, the benefits of diagnostic imaging technology in the health of citizens and the country's economy will be presented.

4. Regulations and Economy division

– Regarding GCP (Good Clinical Practice)
  Revision and re-evaluation points for safety measures related to medical equipment
– Regarding reimbursement adjustments:
  Adjustment request overview and foundations; desirability of integration between JIRA, industry groups, and medical associations in future activities
– Regarding documentation for medical equipment and technical symposia:
  Role and uses of documentation, integration with technical institutes for safety purposes, establishment of a committee to achieve these goals
– High-energy radiological therapy equipment safety measure guidelines:
  Production goals, problems, overview, future plans
– Regarding ISO13485:
  ISO9000 conformance, differences, risk management, relationship with revised pharmaceutical law GMP
– Barcode committee activity report:
  Usage goals, information content, future issues

5. Japanese Society of Radiological Technology and Standardization Body

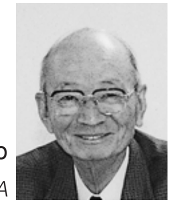
JIS summaries for the following 7 topics:

– JIS Z 4752-2-10: 200X Constancy Tests:
  Mammography X-ray Systems
– JIS Z 4753-2-7 (Proposal) Constancy Tests:
  Intraoral Imaging X-ray Equipment
– JIS Z 4752-2-8: 200X Constancy Tests:
  X-ray Protective Equipment
– JIS Z 4905 (Proposal) Photo:
  · Medical Imaging Cassettes
  · Intensifying Screens
  · Films
  · Dimensions and Specifications
– JIS Z 4752-3-4 Acceptance Testing:
  Intraoral X-ray Equipment Image Performance Acceptance Testing
– JIS Z 4751-2-43 Safety:
  Interventional Radiology X-ray Equipment
– JIS Z 4951 Safety:
  MRI Systems

Development of Japanese Radiological Equipment in the Post-World War II Period (14)

Radioactivity in Japan (Part 1): Beginning of the development of radiological measuring equipment

Sumio Makino
Advisor, JIRA



1. Dawn of radioactivity

It is very unfortunate and regrettable to have to begin the story of radioactivity in Japan with atomic bombs dropped in Hiroshima City on August 6, 1945 and then only three days later in Nagasaki City.

In five years after the war ended, the Korean War broke out in 1950, when the Japanese people became busy and shifting their topics of conversation from the "atomic bomb issue" to reconstruction of industries and stabilization of their daily lives. Then, an additional blow hit the only nation that had experienced atomic bombs. In March 1954, the Fifth Fukuryu Maru, a tuna fishing boat based at Yaizu Port was exposed in the experimental explosion of a hydrogen bomb at Bikini Atoll in the Central Pacific Ocean. One of the fishermen, Aikichi Kuboyama, died later of radiation disease. The tragedy shocked the whole nation and highlighted the relation of radioactivity with the Japanese people.

Under these circumstances, the author had been engaged in research and development of radiological measuring equipment since 1949. As one of those persons who experienced personally the development of atomic power, including the above-mentioned, so-called radioactivity and tuna accident, the author describes mainly his own experience and the history of research and development of related equipment, such as radiological measuring equipment, and radioisotope therapy equipment.

Part 1 summarizes the research and development of radiological measuring equipment.

2. The status of radiological measuring equipment in post-war Japan and the subsequent development

Japanese radiological measuring equipment in the pre-war and the early post-war periods

Around 1949, when the author was assigned to the research and development of radiological measuring equipment, apart from those in the possession of the U.S. Forces, R-meter (Fig. 1) was the only national equipment available in the market. R-meter has a long, protrudent arm, the tip of which is provided with an ionization chamber. The chamber is charged electrostatically. When the chamber is exposed to X-ray radiation, it loses its electrostatic charge proportionately. The decrease of charge is converted into Roentgen dose to measure X-ray dose. The tip is inserted into the X-ray beam emitted from the X-ray therapy equipment to directly measure the output Roentgen dose. Thus, R-meter was used to calibrate the radiation therapy equipment. It is a kind of electrostatic potentiometer. Every morning, X-ray technologists routinely calibrated the output of X-ray therapy equipment installed in hospitals. As far as the measuring equipment for radiation protection is concerned, no national products were available. Radiation was measured in Hiroshima and Nagasaki using exclusively the equipment brought over by the U.S. Forces.

Development of radiological measuring equipment by several companies

1. Toshiba as a pioneer

In order to explain how Toshiba started to develop and manufacture radiological measuring equipment, the author's experience in the involvement of the development of measuring equipment is described below.

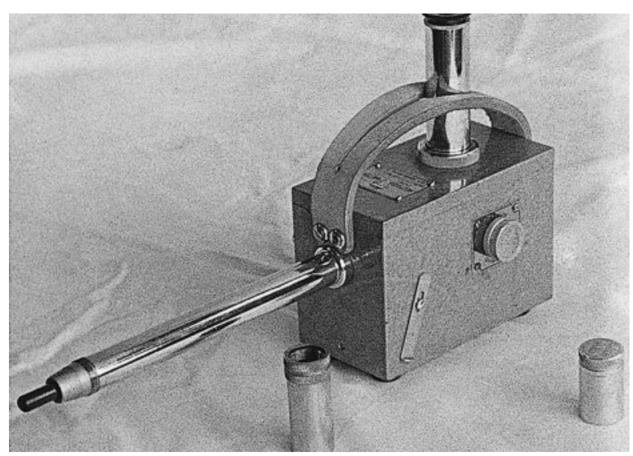


Figure 1. R-meter

After the war ended, I was discharged from military service and returned to my former place of employment, the Medical Division of Tokyo Shibaura Electric Co., Ltd., now Toshiba Corporation. I started my career as an employee at Fuji Works in Fuji City, which is now located near Shin-Fuji Station of the Shinkansen (bullet train).

Toshiba's medical division produced X-ray and other related equipment already in pre-war days. In order to expand the lines of products, a new unit was established there in August 1949. That was the Medical Equipment Engineering Section attached to Mazda Research Laboratory. The author was assigned to this new section to develop a new series of products related to medical equipment. This was the starting point of my subsequent career as a medical engineer. The theme was research and development of radiological measuring equipment.

This research theme was a part of radiation research which was addressed immediately after the war by the Physics Division of Mazda Laboratory (now Toshiba Research & Development Center) in Kawasaki City. My assignment was a researcher at the production factory which was closely associated to Mazda Laboratory.

The first theme was to manufacture a scaler (now a computer-like apparatus) by applying a flip-flop circuit basically designed by Mazda Laboratory, to combine it with a Geiger-Mueller counter soon available, and to produce a commercial model of Geiger counter.

2. Product development in several companies

A. Geiger counter

The author's experience in Toshiba:

Around 1949, vacuum tubes were used.

The assignment was to take over the basic design of the flip-flop circuit diagram (Fig. 2) from the Laboratory and to perform additional research for product design.

It was necessary to procure electronic parts to manufacture protocol for additional tests and experiments. Such parts were not available from any of the stores in Fuji City, which used to be a very rural area. It took three hours and a half by train to travel from Tokyo to Fuji City. The telephone communication with Tokyo was available only during lunchtime. Even in Tokyo, only specialized stores sold electronic parts such as highly accurate resistors and capacitors. Obviously there was no Akihabara area where such stores are concentrated today. In those days, all people could do was to earn money and support themselves and their families. Anyway, it was necessary to procure electronic parts, to go to Tokyo and buy them in cash. Cash payment was allowed under a special company rule. Toshiba-made vacuum tubes were available in large quantities, which were probably remaining products for military use during the war.

The first prototype used several eggplant-shaped vacuum tubes. To form the flip-flop circuit as shown in the diagram, a singe decimal circuit required eight tubes (four triodes and four diodes). The filaments of these tubes generated much heat like a heating appliance. Heat dissipation was a big problem to solve. Small GT tubes were developed later, contributing to reduce the number of tubes required. However, heat dissipation remained unsolved. If such a problem occurs today, a small ventilation fan would be useful. Two decimal units (Fig. 3A) were connected to form a centesimal circuit. Three decimal units were connected to a millesimal circuit (Figs. 3, B-1, -2 and -3).

The millesimal counter (Fig. 3) was delivered to Tohoku University and used by then Professor Yoshihiko Koga for research. It was a pioneering application in Japan. The author was allowed to join the medical staff of the radiation measurement study group under Professor Koga. It was very fortunate for the author to have started a relation with the medical community in this way.

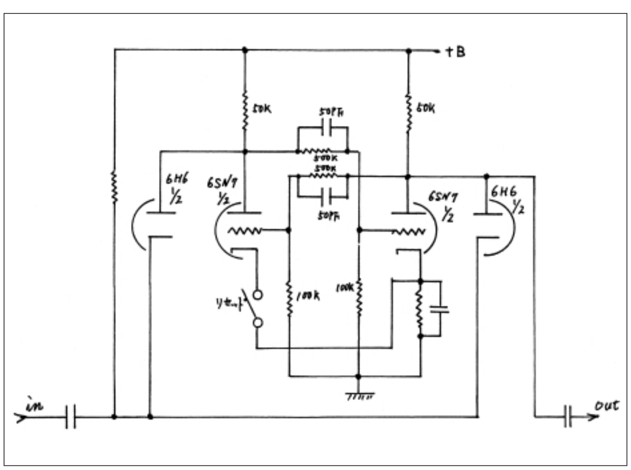
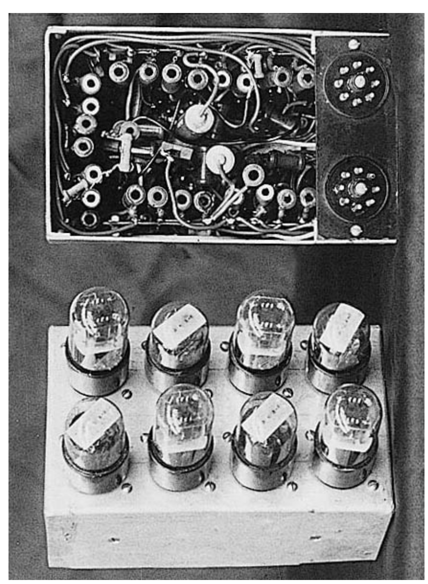
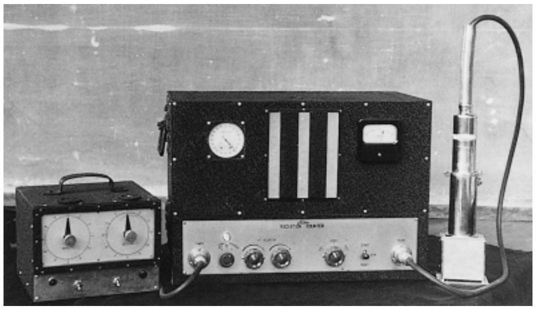


Figure 2. Example of flip-flop circuit

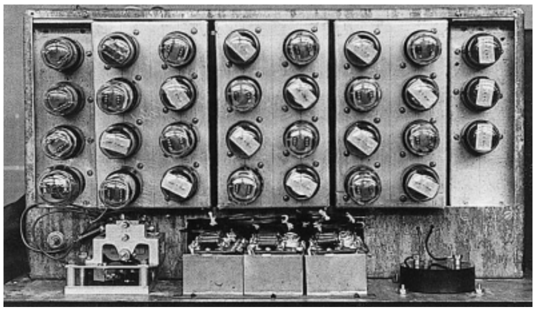


A

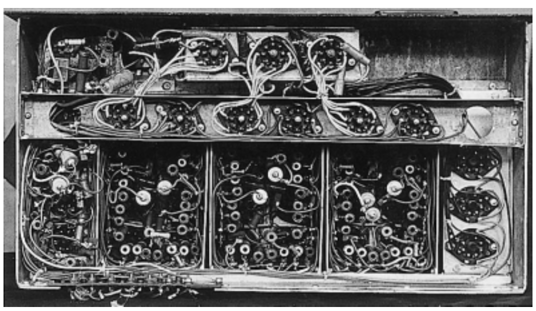
Figure 3.
A: Transformer circuit of decimal unit



B-1



B-2



B-3

Figure 3.
B-1: Millesimal counter
B-2: Vacuum tubes used in large numbers of millesimal counter
B-3: Inside the chassis of millesimal counter. The size of electronic parts is a problem.

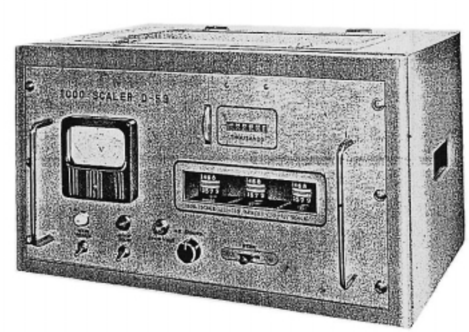


Figure 4. Millesimal scaler, type D-59

B. Example of Kobe Kogyo Co., Ltd.

Kobe Kogyo was one of national manufacturers of radiological measuring equipment. It was known to the author later. This company produced mainly industrial measuring equipment, such as radiation thickness meter. Later, they sold Geiger counters and survey meters. The detailed data were not available at the time of writing this article. They sold radiological measuring equipment actively under the brand name of "TEN", and were merged later with Fuji Denki Co., Ltd. Dr. Hirohide Miwa, an authority in this field, was an acquaintance of the author.

C. Products of Shimadzu Corporation

The data of millesimal counter are excerpted below.

This equipment is mainly a millesimal counter using high-speed and high-reliability decimal counter tubes E1T, with a mechanical counter attached.

Features

1. *It can be connected to any of GM tube detector, scintillation detector and 2π flow counter tube.*
2. *A built-in overvoltage prevention circuit eliminates possible damage of counter tubes caused by overvoltage.*
3. *Type D-55 incorporates the counting rate meter and provides the direct reading of counting rate. Moreover, the loudspeaker is built in and a click sound can be heard.*
4. *Short resolution time permits highly accurate measurement. Especially, the resolution time of type D-59 is 1 μs or less to ensure highly accurate, precise measurement over the entire range from low counts to high counts.*
5. *The counter tube E1T is easy to read and ensures operation with high speed and high reliability.*
   The millesimal scaler, type D-59 type, is shown in Fig. 4.

The author presumes that Shimadzu produced the above-mentioned scaler around 1955. The author also has the experience to use the E1T tube for design of circuits.

D. Geiger counter tube (=GM tube)

Figure 5 shows an example of the GM tube. The tip has a mica window to measure β-ray. The inner gas is neon with alcohol content. Electric discharge is quenched to generate pulses.

A voltage of about 1,000 V DC is applied to the central electrode. The output pulse is generated proportionately to the radiation dose to which the counter tube is exposed. The disadvantage of GM tube is that the output is not proportional at higher radiation (saturation effect). It was a very convenient tool for radiation measurement, but this problem remained unsolved for absolute measurement of radiation.

Then, a new measurement system was devised where the output pulse was counted by the above-mentioned scaler.

Specifications

	D-55A type	D-59 type
Counting system	3-stage longitudinal connection of E1T for millesimal scaler with 6-digit mechanical counter	3-stage longitudinal connection of E1T for millesimal scaler with 6-digit mechanical counter using high-speed counting circuit
Resolution time	30 µsec or less	1 µsec or less
Input sensitivity	0.25 V (negative polarity)	0.25 V (negative polarity)
Counting rate meter	500 cpm × 1, × 10, × 100, 3-step changeover. Accuracy: ±10% (maximum scale)	
High-tension power supply	300 to 2000 V, stable power supply, continuously adjustable, with overvoltage prevention circuit	300 to 2000 V, stable power supply, continuously adjustable, with overvoltage prevention circuit
Connection system	GM tube detector, scintillation detector, 2π flow counter,	GM tube detector, scintillation detector, 2π flow counter,
	Preset timer	Preset timer
Power supply	90 to 110 V, 50 c/s, 60 c/s, 250 W	90 to 110 V, 50 c/s, 60 c/s, 250 W
Size	536 × 340 × 440 mm	530 × 380 × 316 mm
Weight	About 40 kg	About 40 kg

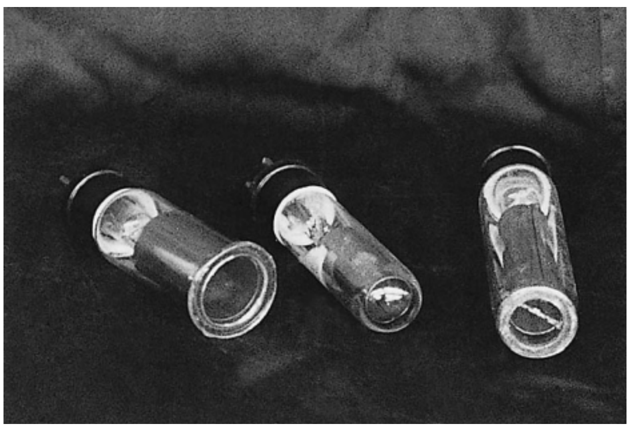


Figure 5. Geiger Mueller counter

Figure 6. Toshiba survey meter

The Geiger tube detects cosmic rays and excessive radiation. For example, when radioisotopes require a high level of measurement accuracy, they need to be shielded by lead, or measured in an underground room.

E. An example of survey meter using GM tube

Instead of using GM tube for counting, a pulse rate meter was devised. It generates DC current which is proportional to the number of input pulses per unit time, and the value of current is read by a meter. Figures 6 and 7 show examples of Toshiba and Shimadzu products, respectively.

These products were widely used for ordinary radiation protection, measurement of contamination, community radiation survey, and other purposes. Especially, the U.S. conducted experimental explosion of a hydrogen bomb at the Bikini Atoll in March 1954, and exposed a Japanese fishing boat to radiation. A lot of issues were raised, including the subsequent death of a fisherman Mr. Kuboyama, radiation contamination of tunas caught in the Pacific Ocean and banning of the landing of contaminated fish, disposal of contaminated fish, setting of disposal

Figure 7. Shimadzu GM survey meter

criteria, and measurement of contamination. The radiological measurement was almost forgotten even among experts in this field, but it became a big issue nationwide. At Misaki Port in Kanagawa Prefecture, unauthorized announcement declared disposal of tuna that had 100 counts of or higher. The announcement created an uproar among the persons concerned, who rushed to buy measuring equipment.

In addition, Kobe Kogyo and Shimadzu commercialized a lightweight, battery-operated rate meter. When the Bikini incident occurred, radiation measurement of tunas was planned and implemented at Misaki Port and Yaizu Port, causing much uproar in the fishery industry. Figure 8 shows the scene of a seminar for contamination measurement using a GM tube rate meter conducted by the author.

Figure 8. Seminar for measurement of contaminated tunas at Misaki Port

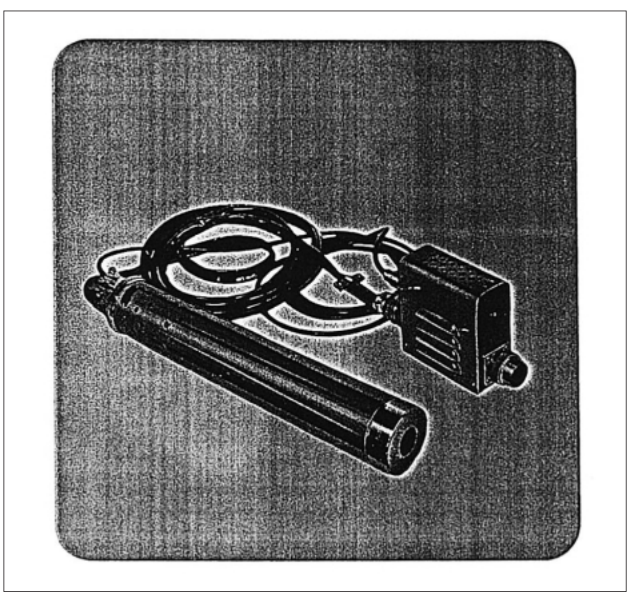


Figure 9. Shimadzu scintillation detector

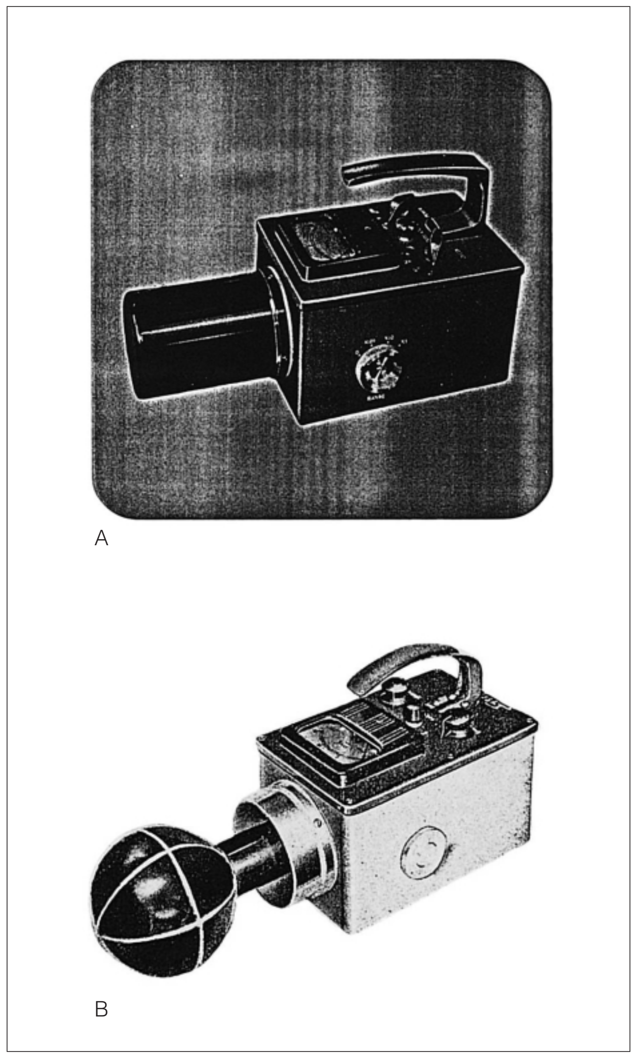
F. Measuring equipment using scintillation counter

Shimadzu manufactured scintillation measuring using scintillation counter. The company record is excerpted below.

A scintillation detector (Fig. 9) has high resolution and high counting efficiency for radiation, and is used widely to measure various types of radiation. The brightness of scintillator is proportional to the energy of incident rays, and it can be used also to analyze radiation energy.

The scintillation probe incorporates a photomultiplier tube and a cathode follower preamplifier. Sinctillators within diameter of 50.8 mm (2 inches) can be exchanged to measure α, β, γ or n-rays.

** This detector can be used in combination with various kinds of our scalers, rate meters or scintillation spectrometers. In this case, an external preamplifier is connected to increase input sensitivity. External preamplifiers are available in two kinds, such as PA-2 type for general counter.*



A

B

Figure 10.
A: Shimadzu ionization chamber type survey meter
B: Soft X-ray survey meter

G. Ionization chamber type measuring equipment

1. Survey meter

Before the war, ionization chamber type measuring equipment was used as R-meter. After the war, amore convenient ionization chamber type survey meter had been used. In this meter, electronic tubes detect any change of electric potential of ionization chamber and minute current, permitting direct reading of radiation dose. Figures 10A and B show the Shimadzu products. Figure 10B shows the meter developed exclusively for soft X-ray. The wall of the ionization chamber is surrounded by Mylar material. Furthermore, the spherical shape ensures non-directional characteristic. Figure 11 shows the Toshiba prototype and electronic tubes to amplify minute current.

2. Pocket chamber

The pocket chamber was developed for personal radiation protection to measure personal exposure dose (Fig. 12).

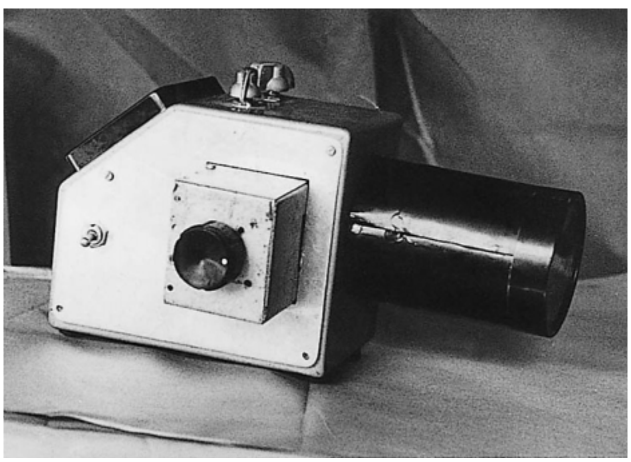


Figure 11. Toshiba prototype of ionization type survey meter

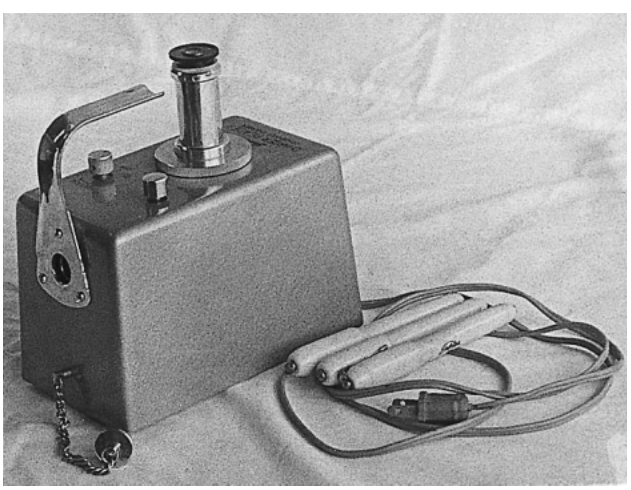


Figure 12. Pocket chamber

3. Summary of this article

The development and manufacture of radiological measuring equipment were started after the war, particularly in 1954 when the Bikini incident occurred and tunas were contaminated.

This article serves as a record for the beginning of development of measuring equipment.

Announcement of Discontinuation of Printed Version

Radiology Japan has been published over 27 years since its first issue in 1977. The present issue, Issue No. 49, will be the last printed version. The further articles and contents will be published in electronic media in the JIRA web site (URL http://www.jira-net.or.jp/e/)

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