2008.12.17(Wed) 5th period 16:20-17:50
18 bldg hall at Komaba campus

Global Focus on Knowledge Series 2008 Winter Session

Special Lecture

"Scientific Gifts From Heaven –Why Do We Do Research?"

Akira Fujishima

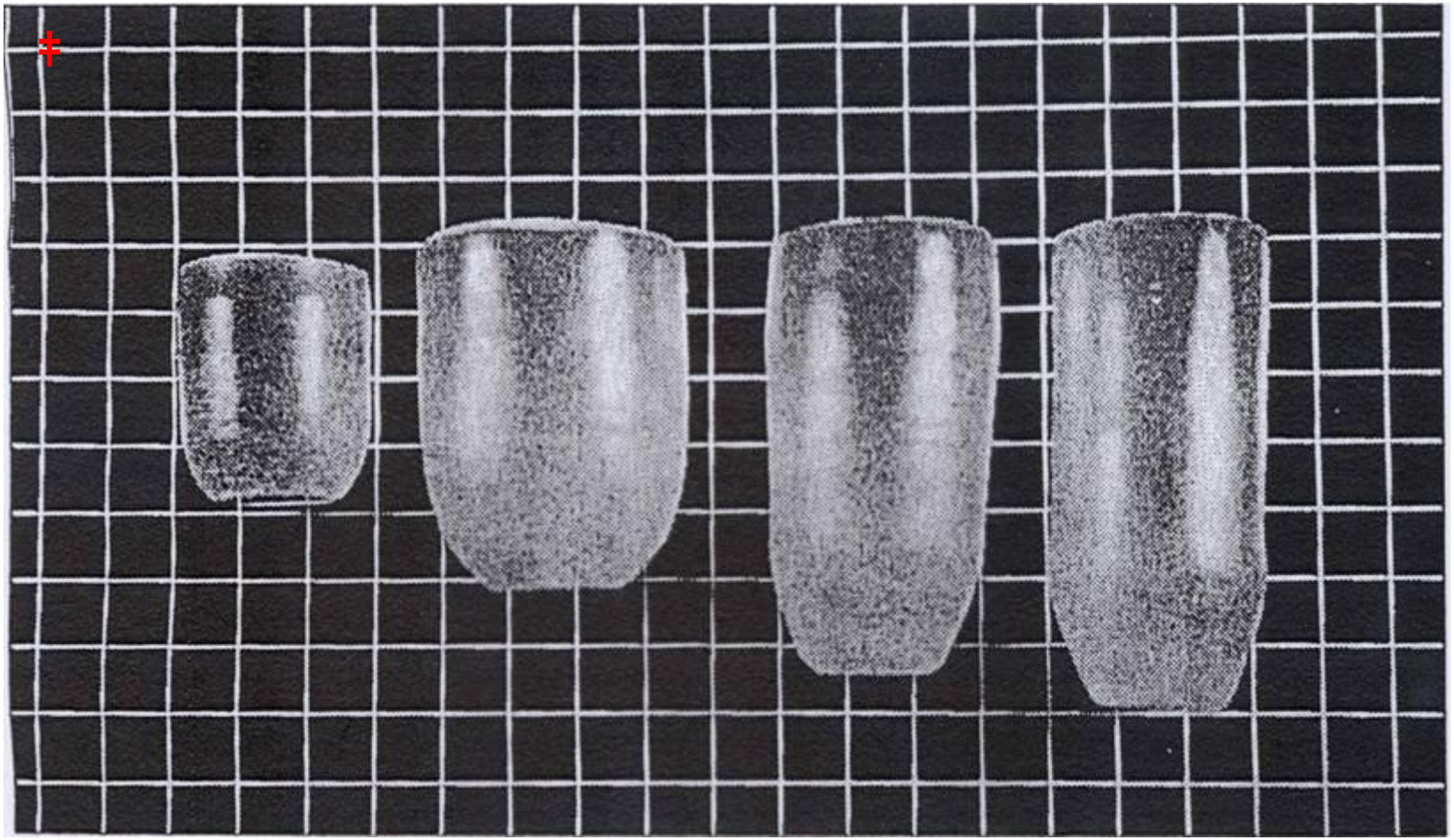
Applied Chemistry, the University of Tokyo, Prof. Emeritus.
President of Kanagawa Academy of Science and Technology
Member of Science Council of Japan

MM Towers at Yokohama Minatomirai

Courtesy of Japan Science and Technology Agency

Courtesy of Taiyo Kogyo Co., ltd.

Titanium Oxide Single Crystal

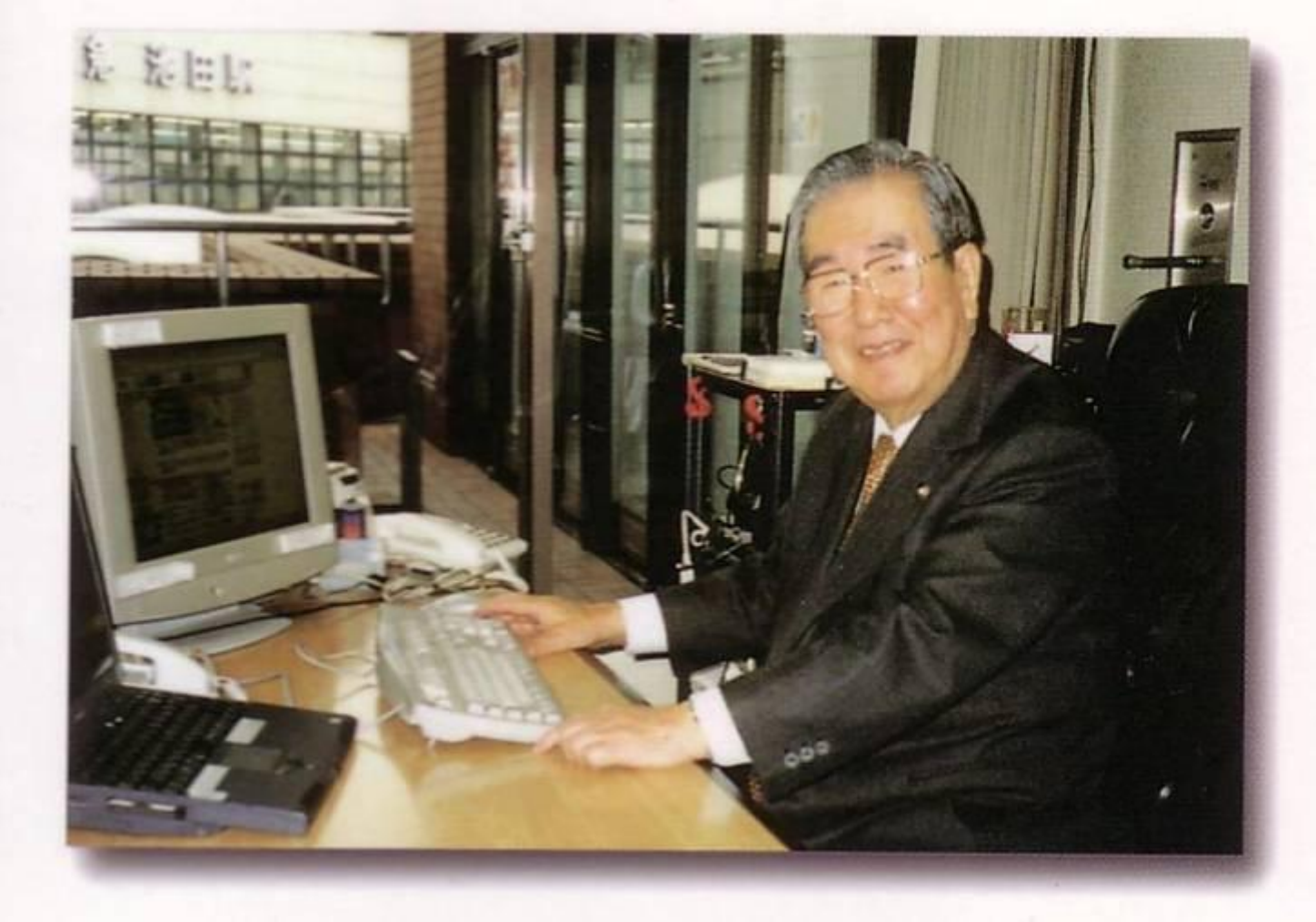


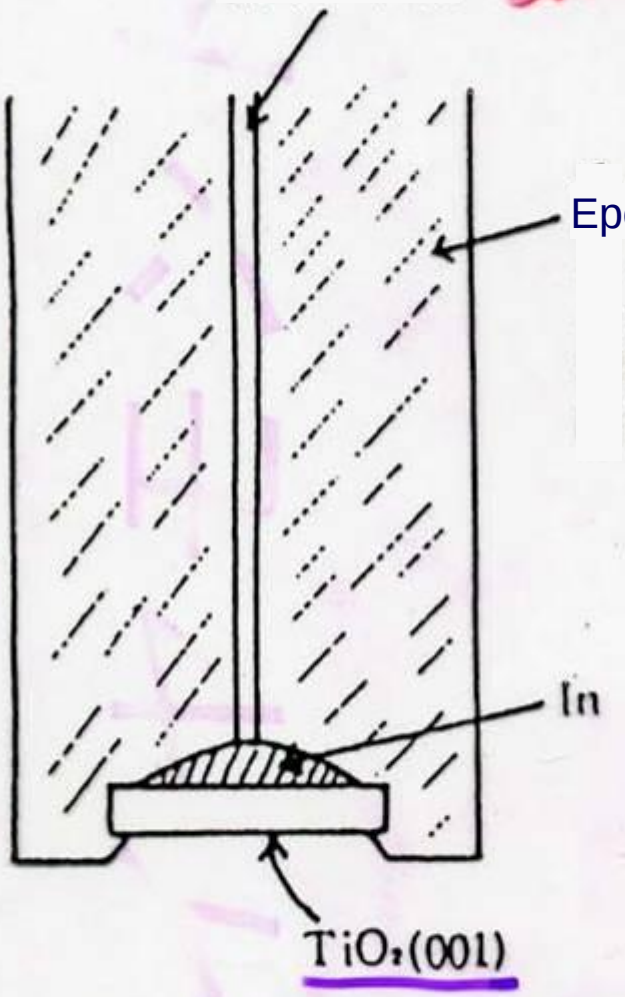
Reprinted from “Foster Sensitivity – A Suggestion to Educational Problem from Scientist”, Akira Fujishima, p7

Artificial Diamond

Reprinted from Wikipedia
Courtesy Gregory Phillips

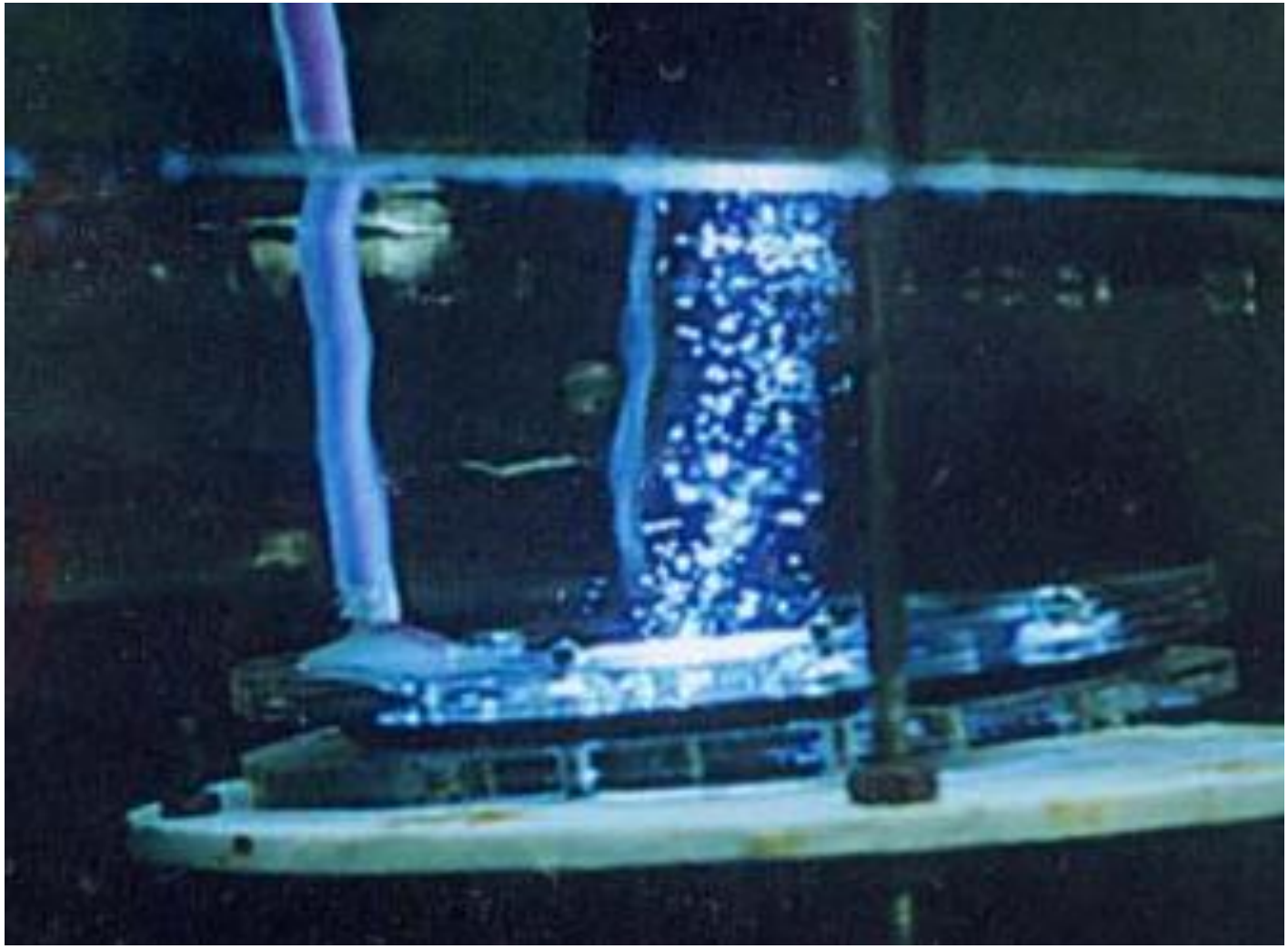
Recent Appearance of President Nakazumi





TiO_2 cross section of electrode

Experiment: Decomposition of Water



Being Impressed Is Important!

Water is decomposed using only light

‡

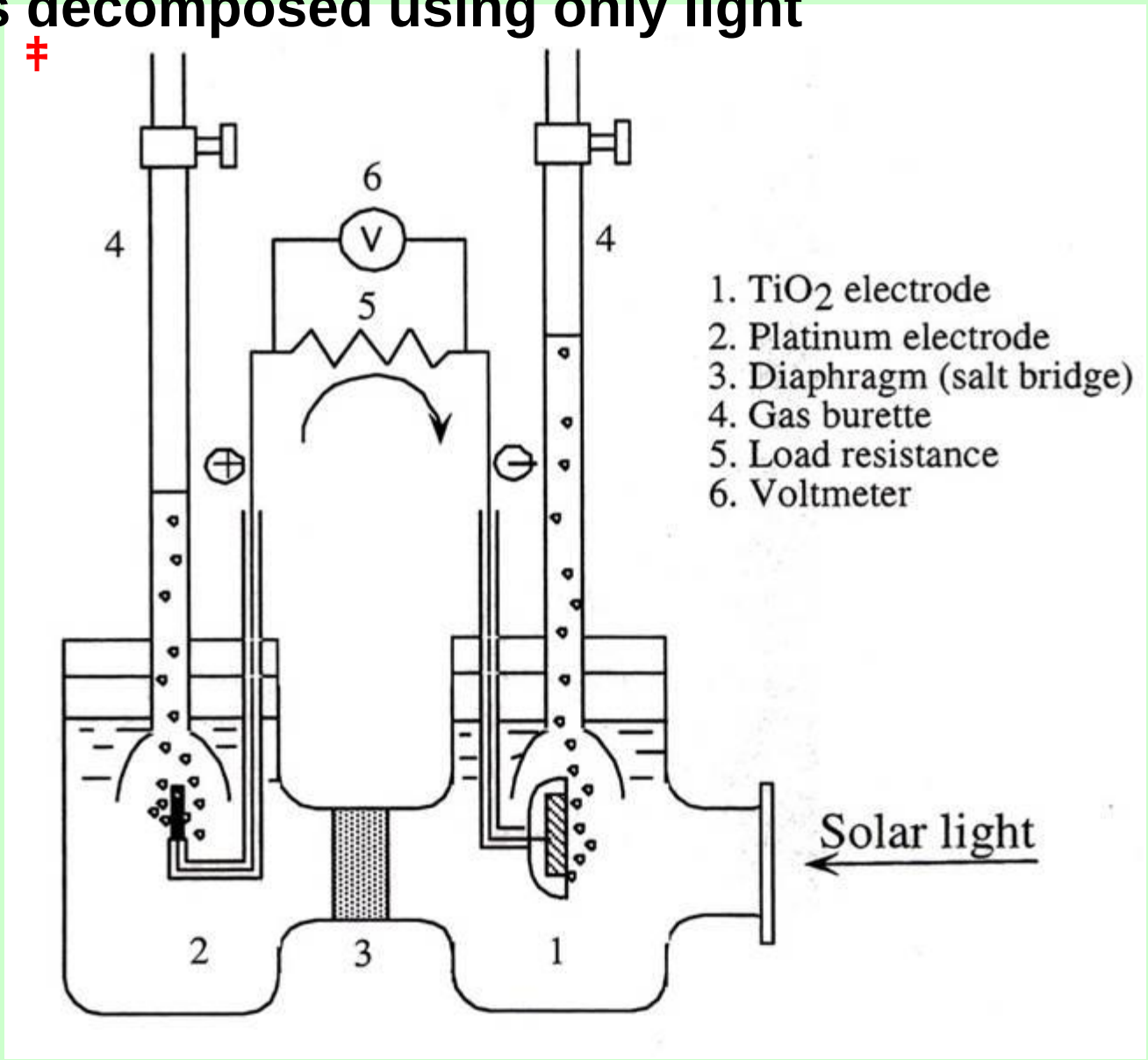
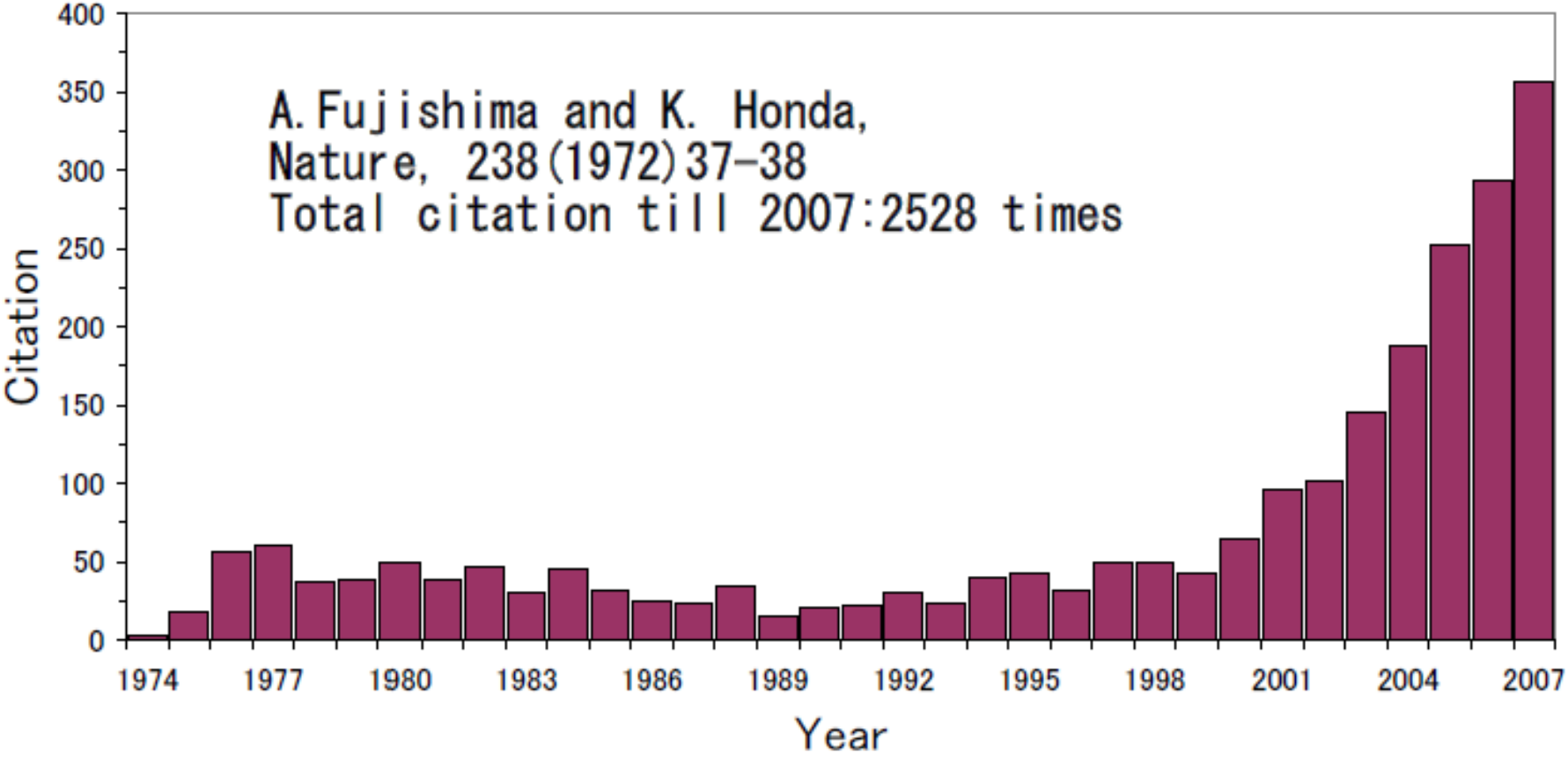


Figure reprinted from;

AKIRA FUJISHIMA, KENICHI HONDA *"Electrochemical Photolysis of Water at a Semiconductor Electrode"* *Nature* 238, 37-38 (1972)

Yearly Citation:



Degradation of Bacteria

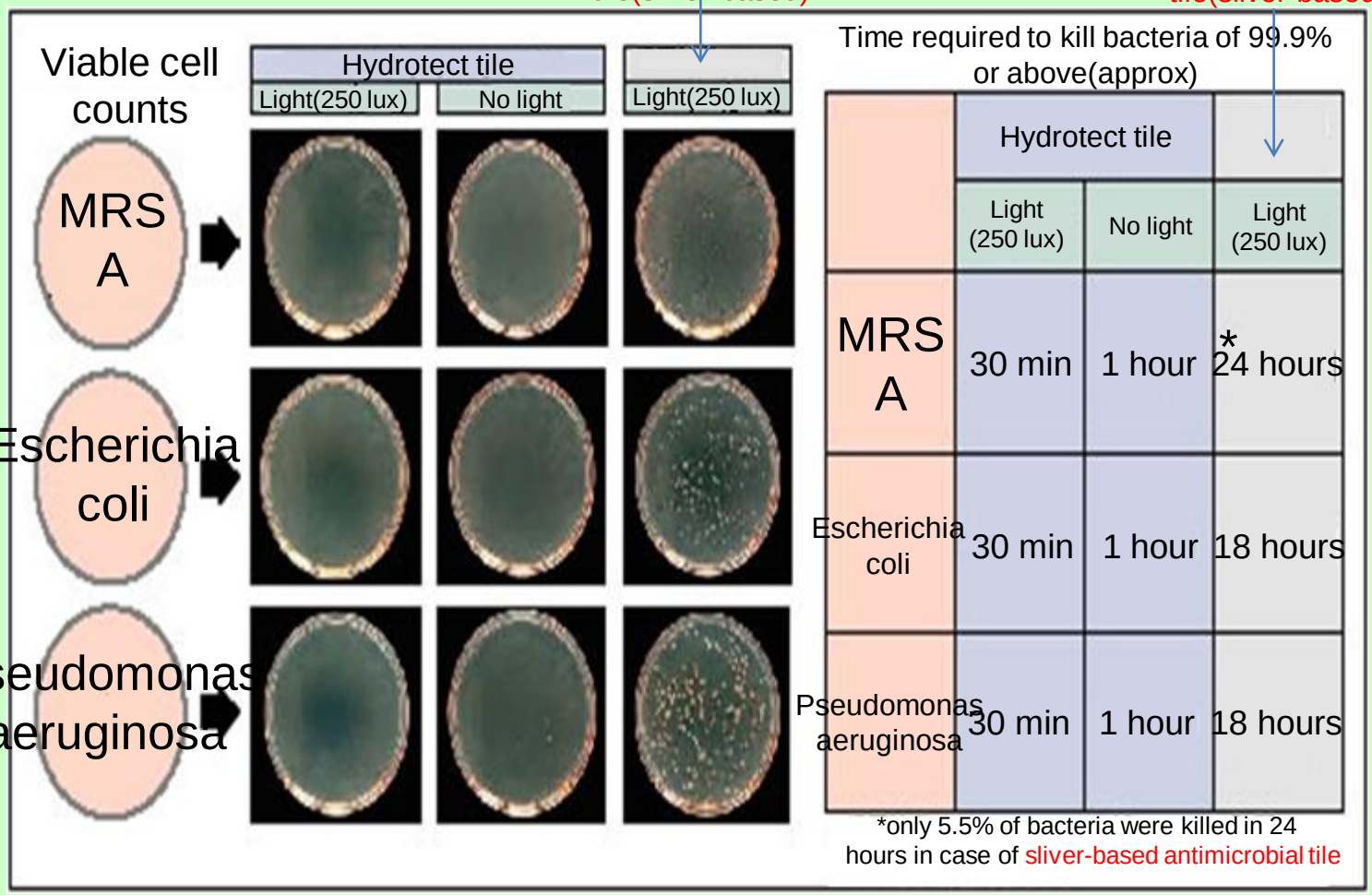
First result

Sterilization

Antimicrobial tile(sliver-based)

Antimicrobial tile(sliver-based)

‡



Time required to kill bacteria of 99.9% or above(approx)

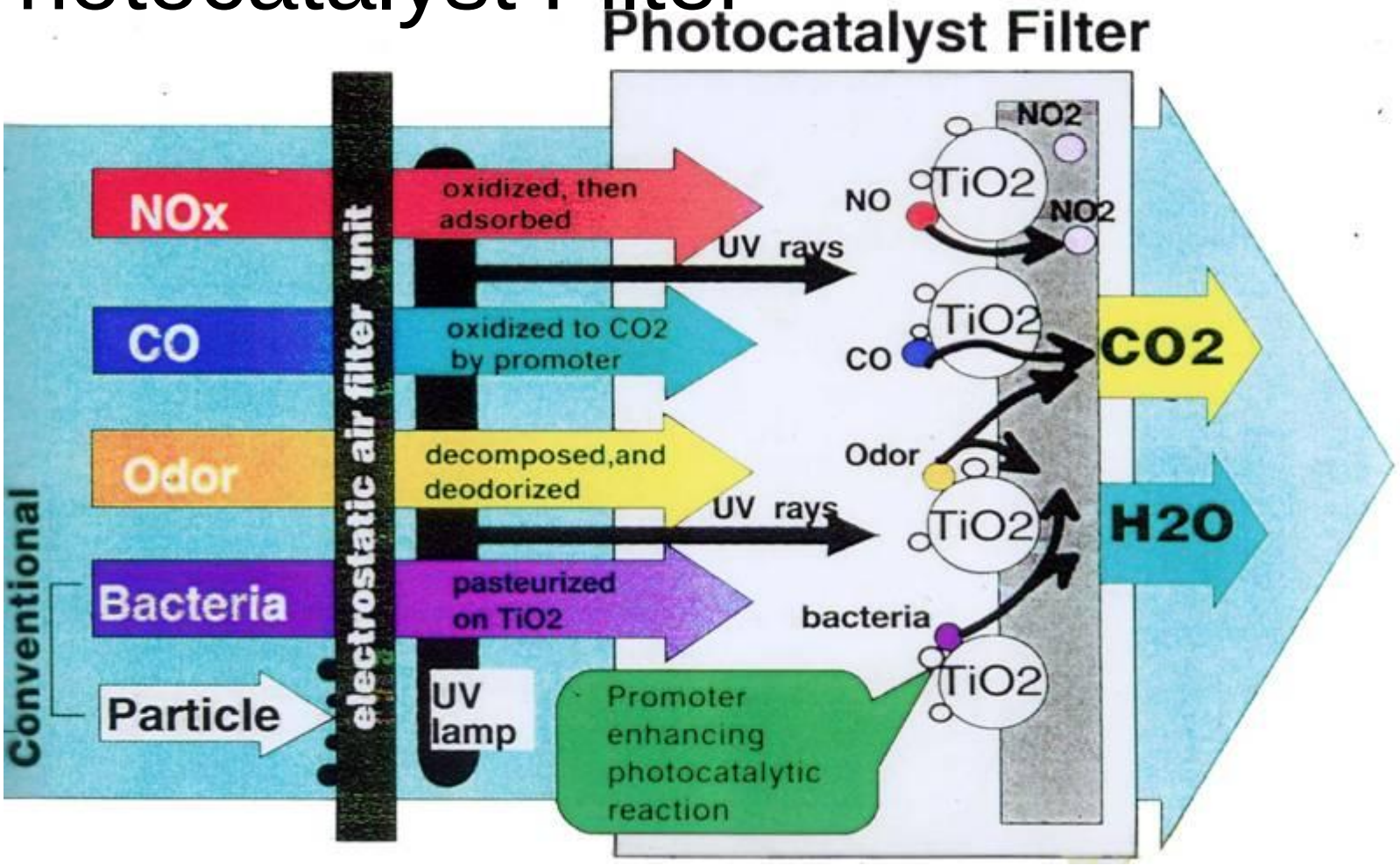
	Hydrotect tile		
	Light (250 lux)	No light	Light (250 lux)
MRS A	30 min	1 hour	* 24 hours
Escherichia coli	30 min	1 hour	18 hours
Pseudomonas aeruginosa	30 min	1 hour	18 hours

*only 5.5% of bacteria were killed in 24 hours in case of sliver-based antimicrobial tile

Courtesy of TOTO Ltd.

Figure removed due to copyright restrictions

Photocatalyst Filter



Deodorizing, Sterilization, Degradation

Reprinted from “Foster Sensitivity – A Suggestion to Educational Problem from Scientist”, Akira Fujishima p15

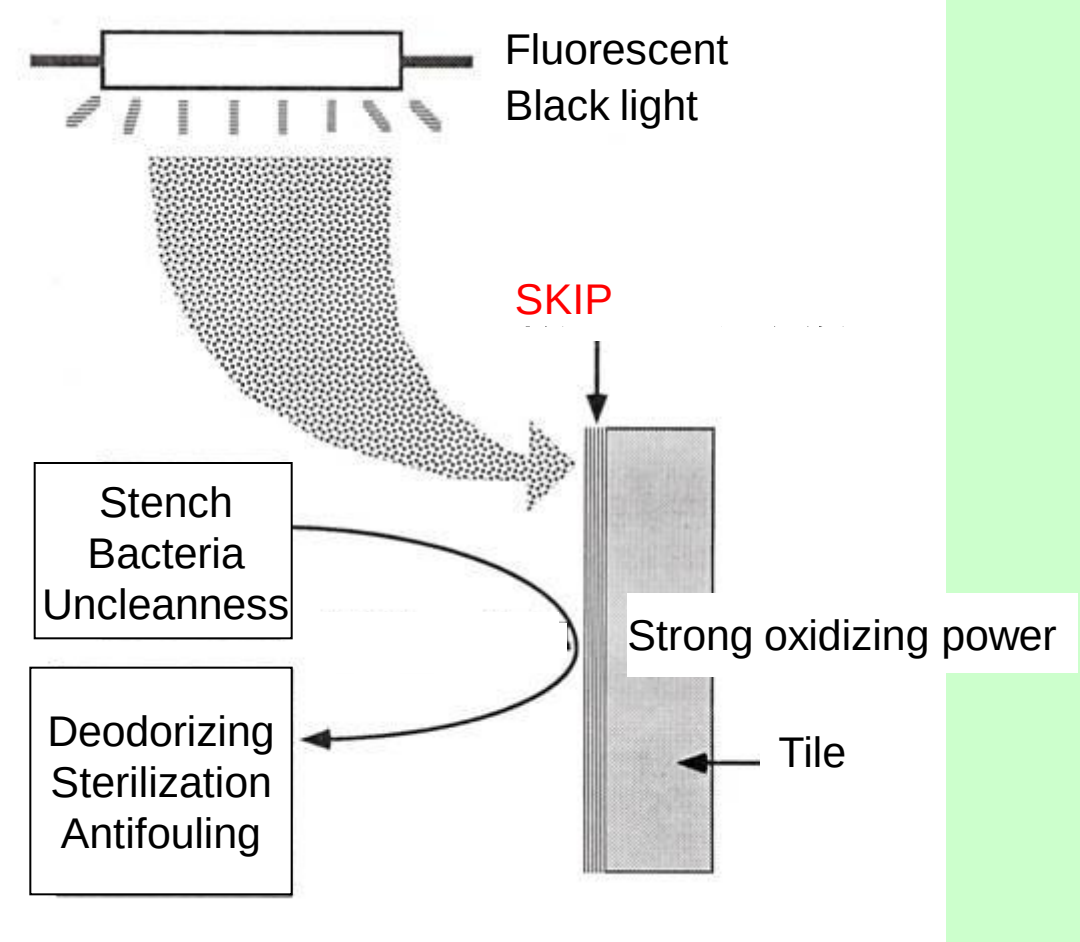
Photo courtesy of Central Japan Railway Company

‡

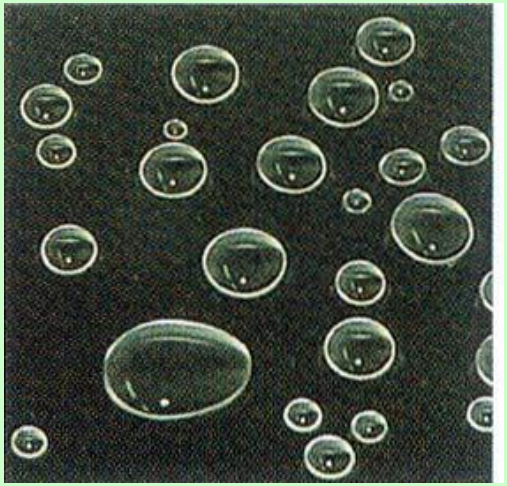
Photo courtesy of Central Japan Railway Company

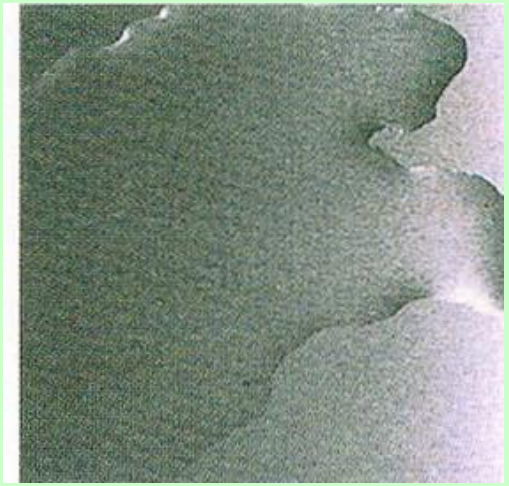
Dealing with Trace Amounts of Substance

‡



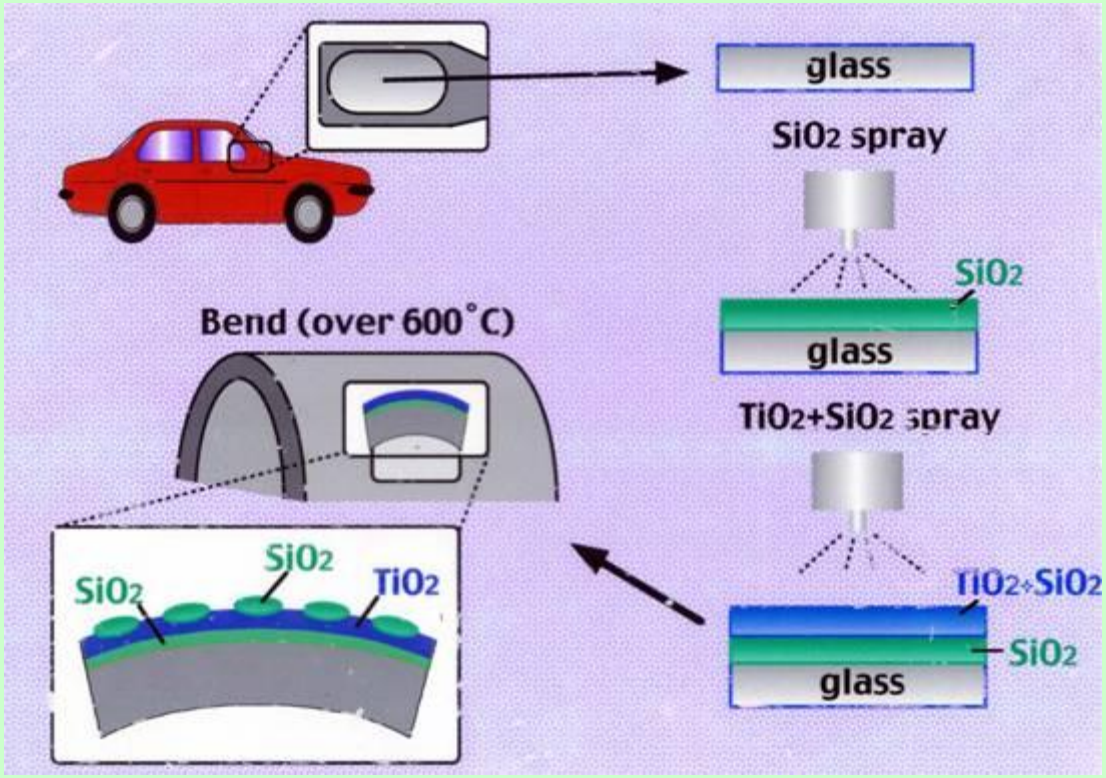
Reprinted from “Foster Sensitivity – A Suggestion to Educational Problem from Scientist”, Akira Fujishima p15





Coating on Side Mirror

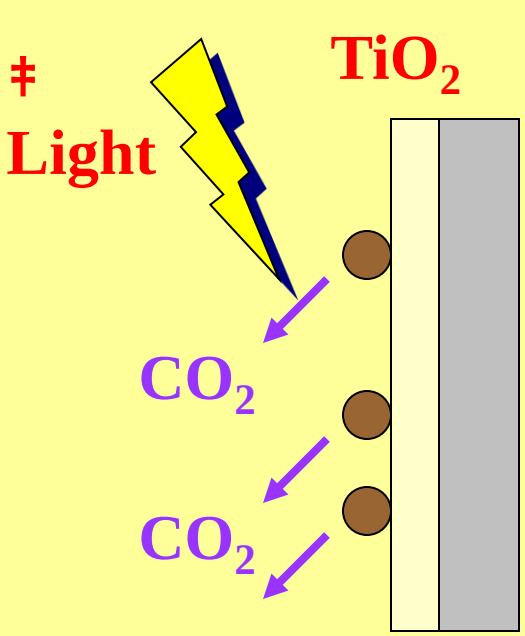
‡



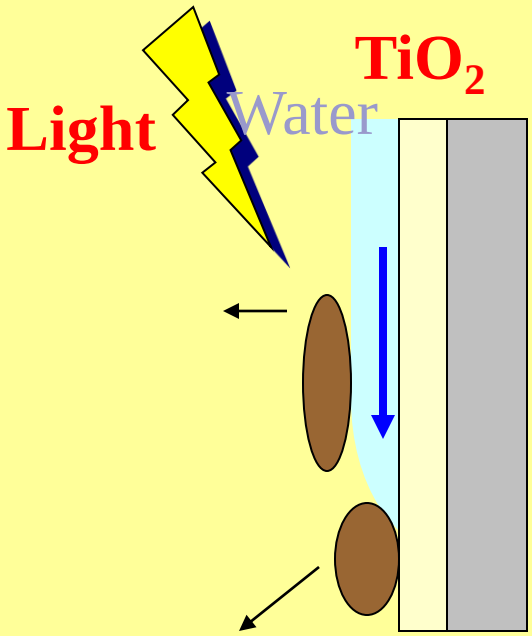
Side Mirror

Reprinted from “Foster Sensitivity – A Suggestion to Educational Problem from Scientist”, Akira Fujishima p17

Antifouling of Photocatalyst



(1) Oil spots are degraded by strong oxidization power.



(2) Heavy oil spots can be washed out by super hydrophilic effect.

Reprinted from “Foster Sensitivity – A Suggestion to Educational Problem from Scientist”, Akira Fujishima p19

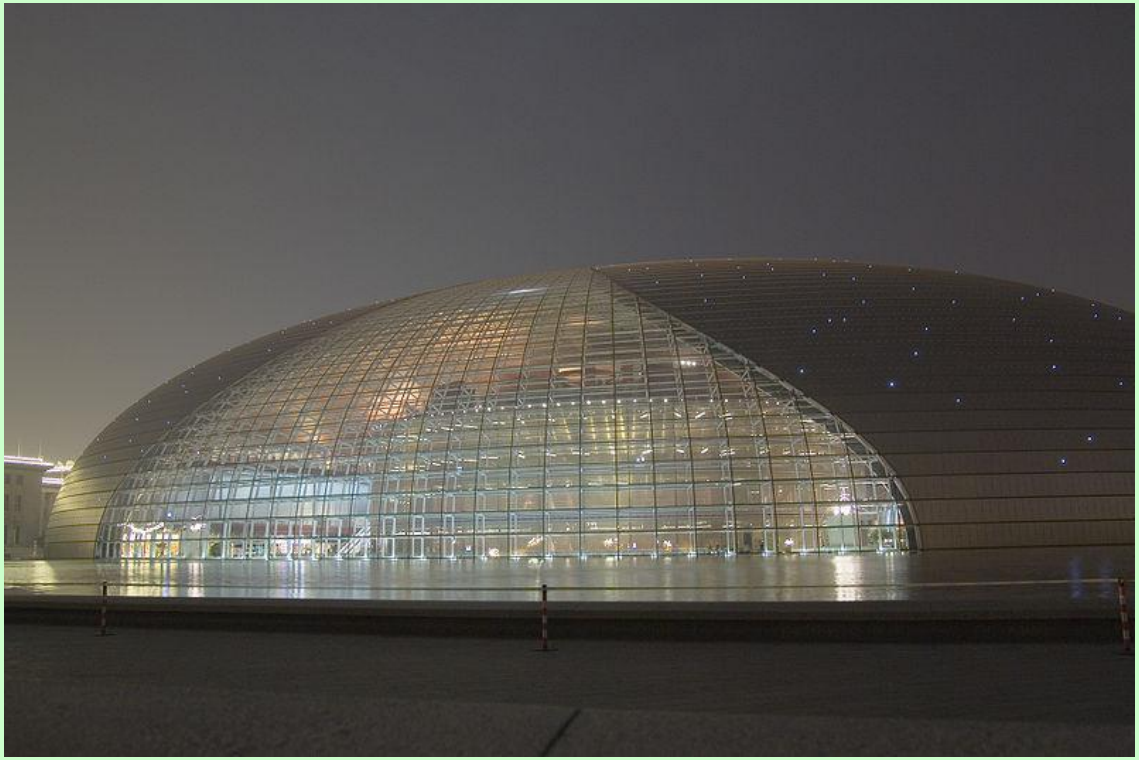
Panatown(Saitama Pref. Misatokoen)

The Louvre Pyramid

Reprinted from Wikipedia

Dives in Misericordia, Rome

Courtesy of Italcementi Group



Reprinted from Wikipedia

America

DallasCowboys Football Stadium
Surface area： 13,746㎡

Courtesy of Italcementi Group

‡Photocatalysis in urban areas

(1) CO, VOC (Benzene, Toluene, etc.), Methyl Mercaptan(gas), Organic chlorinated compounds, Polycondensed aromatic compounds, Acetaldehyde, Formaldehyde.
(2) NO_x, SO_x, NH_3 (gas)

Courtesy of Italcementi Group

‡

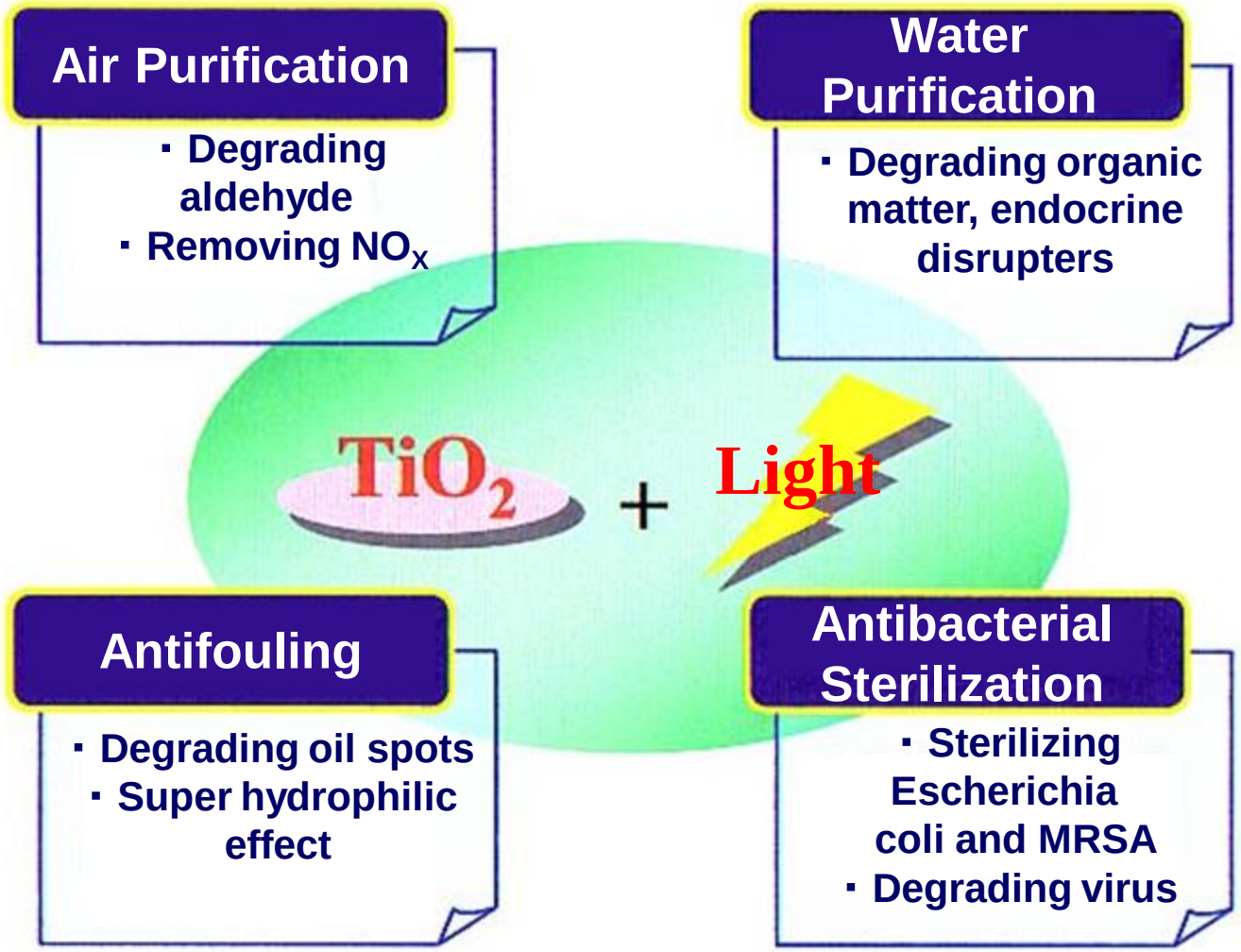


Fig.1 Area of Photocatalyst

Reprinted from “Foster Sensitivity – A Suggestion to Educational Problem from Scientist”, Akira Fujishima p19

Courtesy of Ohno Sekiyuten Co., ltd.

The Present Sate and Prediction of Photocatalyst-related Market

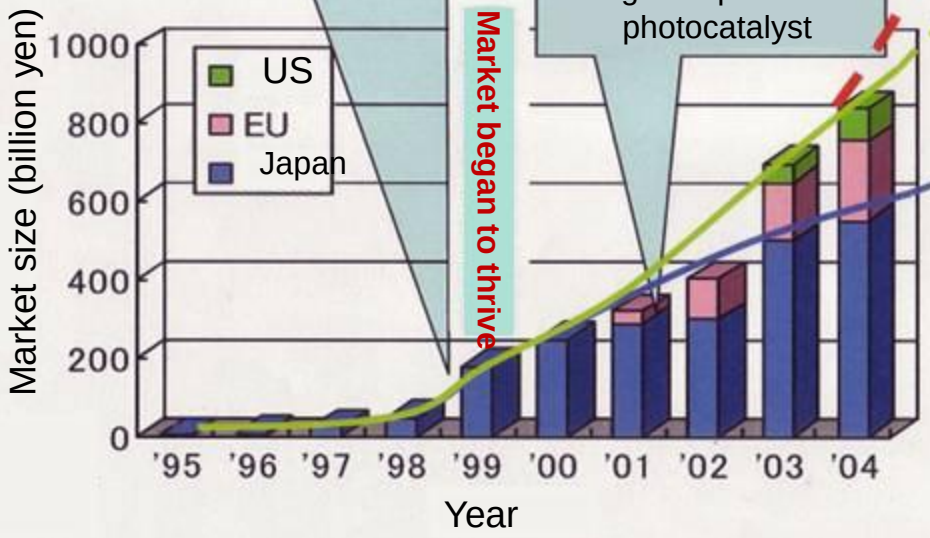
Photocatalystic technology developed in Japan

History of basic research on Photocatalyst
1972 Honda・Fujishima effect was announced in journal Nature
1990 Degrading organic matter and water (Sakata, Kawai)
1994 Putting antibacterial tile into use (TOTO)
1996 Super hydrophilic effect

Government should induce development

(Hashimoto, Fujishima, TOTO)

2001
Foundation of visible light responsive photocatalyst



Expand market size to 3 trillion (economical impact)

Break into new markets by cooperation involving science and market

Market abroad is growing rapidly (high growth rate)

Technology has been steadily advancing and markets have been growing. But market size in Japan will remain 100 billion. We can make it bigger.

Courtesy of Photocatalysts Industry Association of Japan

JIS

ファインセラミックス－
光触媒材料の空気浄化性能試験方法－
第２部：アセトアルデヒドの除去性能（案）

JIS R 1701-2 xxxx

JIS

ファインセラミックス－光触媒材料のセルフクリーニング性能試験方法－第１部：水接触角の測定

JIS X XXXX xxxx

JIS

ファインセラミックス－
光触媒材料の水質浄化性能試験方法
第１部：ジメチルスルホキシドによる活性酸素生成能力の測定

JIS R XXXX xxxx

JIS

ファインセラミックス－光照射下での光触媒抗菌加工製品の抗菌性試験方法・抗菌効果（案）

JIS R 17XX xxxx

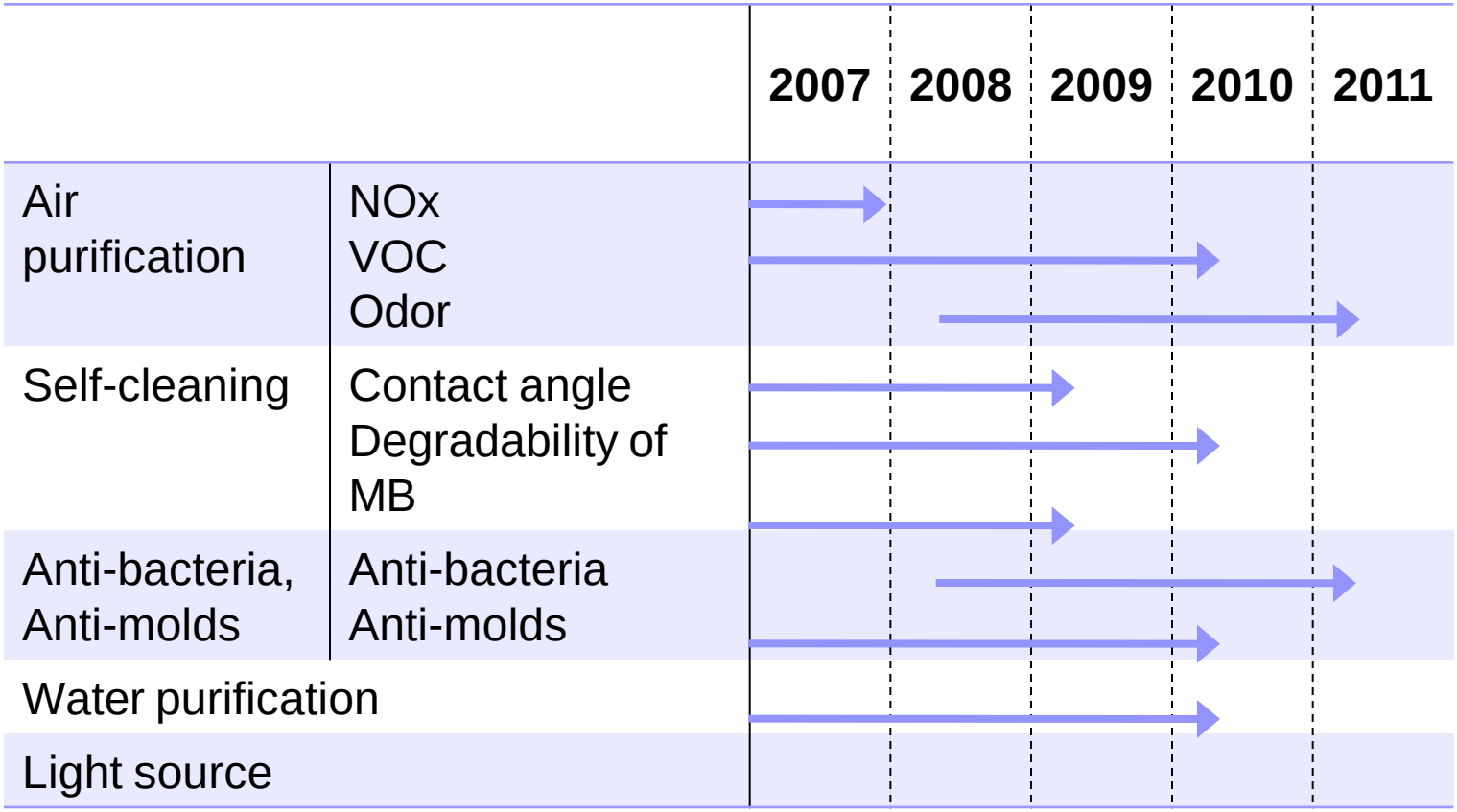
JIS

ファインセラミックス－光触媒試験用光源
第一部：紫外線励起型光触媒用光源

JIS R 17XX - 1 xxxx

ISO (International Organization for Standardization) for Evaluation of Photocatalyst Materials

Schedule for establishment of ISOs



‡

Editor: Kanagawa Academy of Science and Technology

Supervisor: Akira Fujishima, Taketoshi Murakami

Author: Shunsuke Nishimoto, Kazuya Nakata, Tomoo Nomura

“E de miru hikarishokubaibijinesu no shikumi(Mechanism of Photocatalystic Business)”

Japan Management Center Inc. 2008

Review Paper: Surface Science Reports
63(12)515-582(2008)

TiO_2 Photocatalysis and Related Surface Phenomena

Akira Fujishima, Xintong Zhang, and Donald A. Tryk

Pages: 68

Number of References: 637

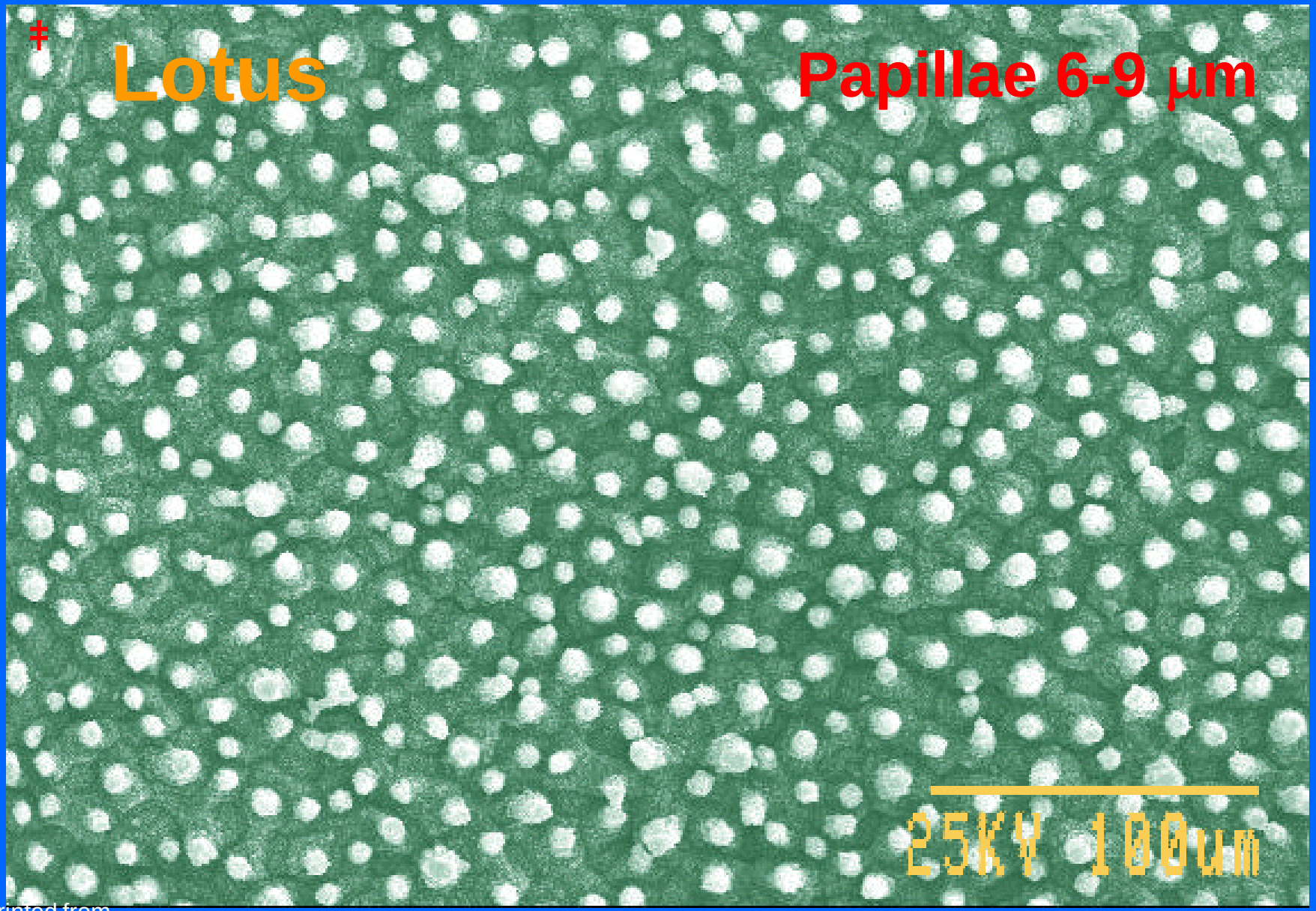
Number of Tables: 6

Number of Figures: 88

"There are so many interesting things around us!!"

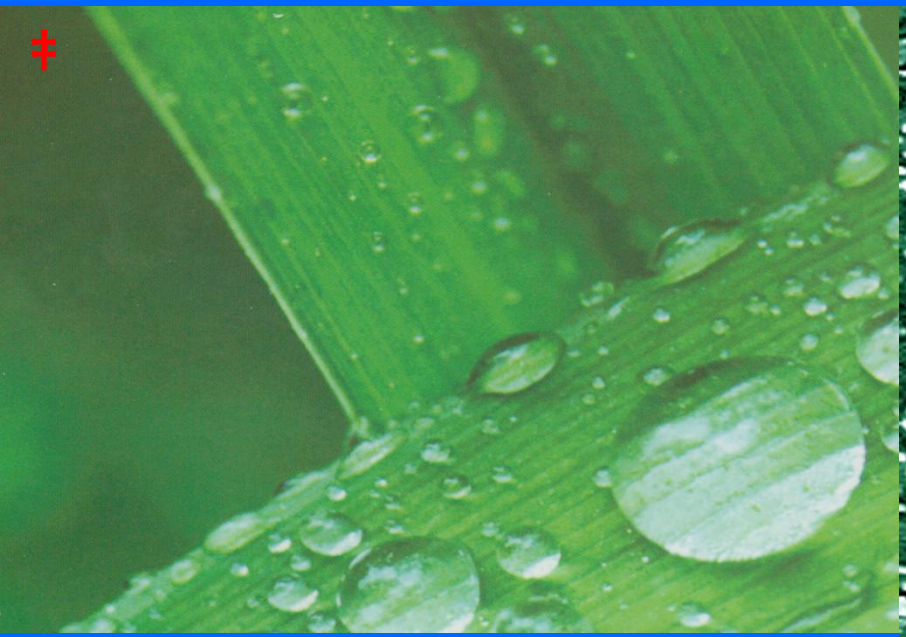
～Enjoy science with curiosity～

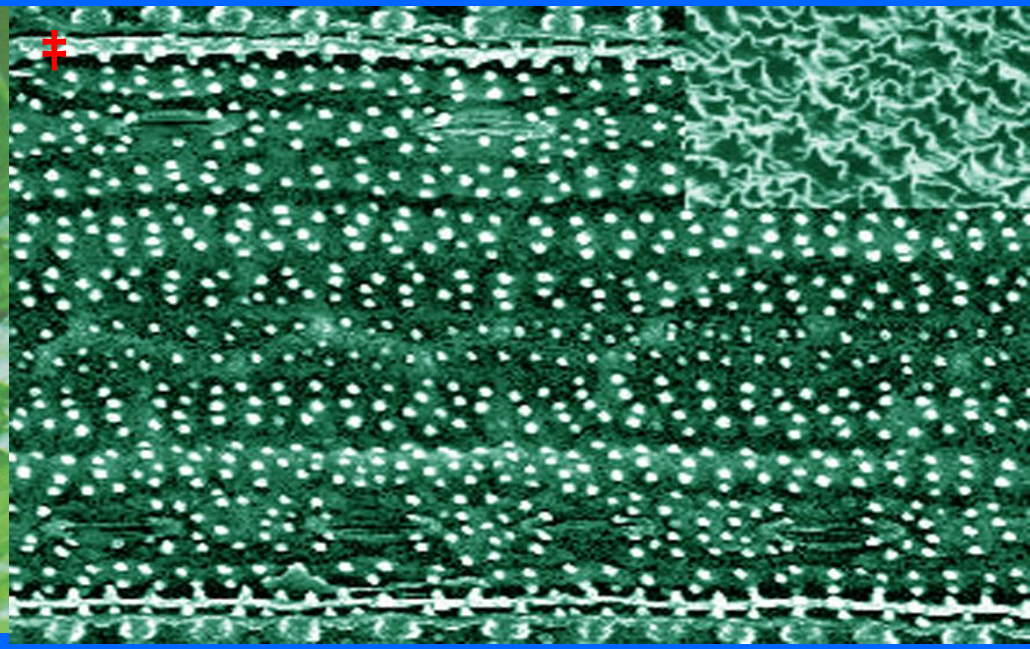
Surface Roughness in Micrometer Scale



Reprinted from
L. Feng, S. Li, Y. Li, H. Li, L. Zhang, J. Zhai, Y. Song, B. Liu, L. Jiang, D. Zhu(2002) "Super-Hydrophobic Surfaces: From Natural to Artificial " Advanced Materials, Volume 14, Issue 24 (p 1857-1860)

Anisotropic Super-hydrophobic Surface on Rice Leaf





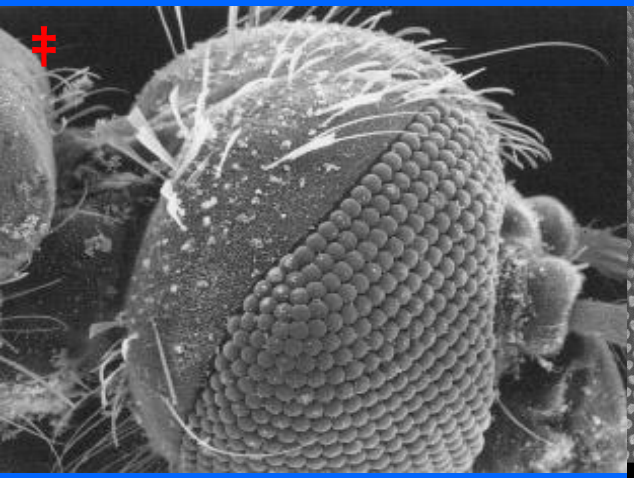
Reprinted from
L. Feng, S. Li, Y. Li, H. Li, L. Zhang, J. Zhai, Y. Song, B. Liu, L. Jiang, D. Zhu(2002) "Super-Hydrophobic Surfaces: From Natural to Artificial " Advanced Materials, Volume 14, Issue 24 (p 1857-1860)

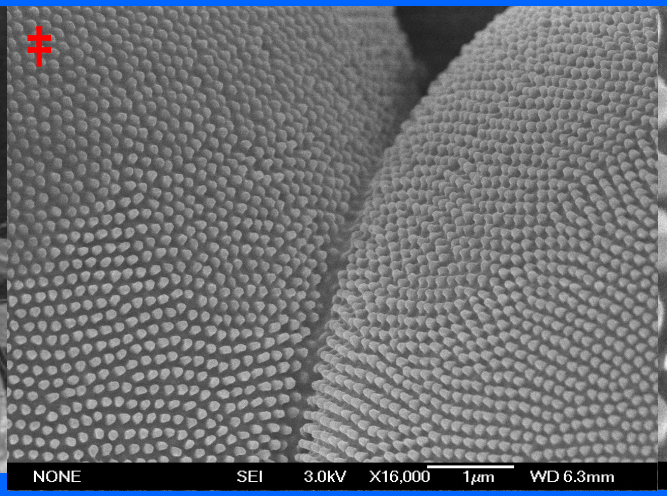
Micro/nano Structures of Water Strider Legs

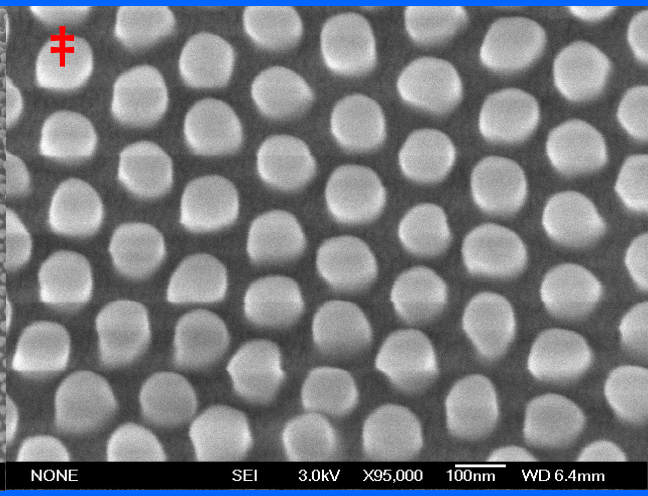
Figure removed due to copyright restrictions

L. Jiang Nature 2004, 432, 36

Micro/nano Structures of Mosquito Eyes

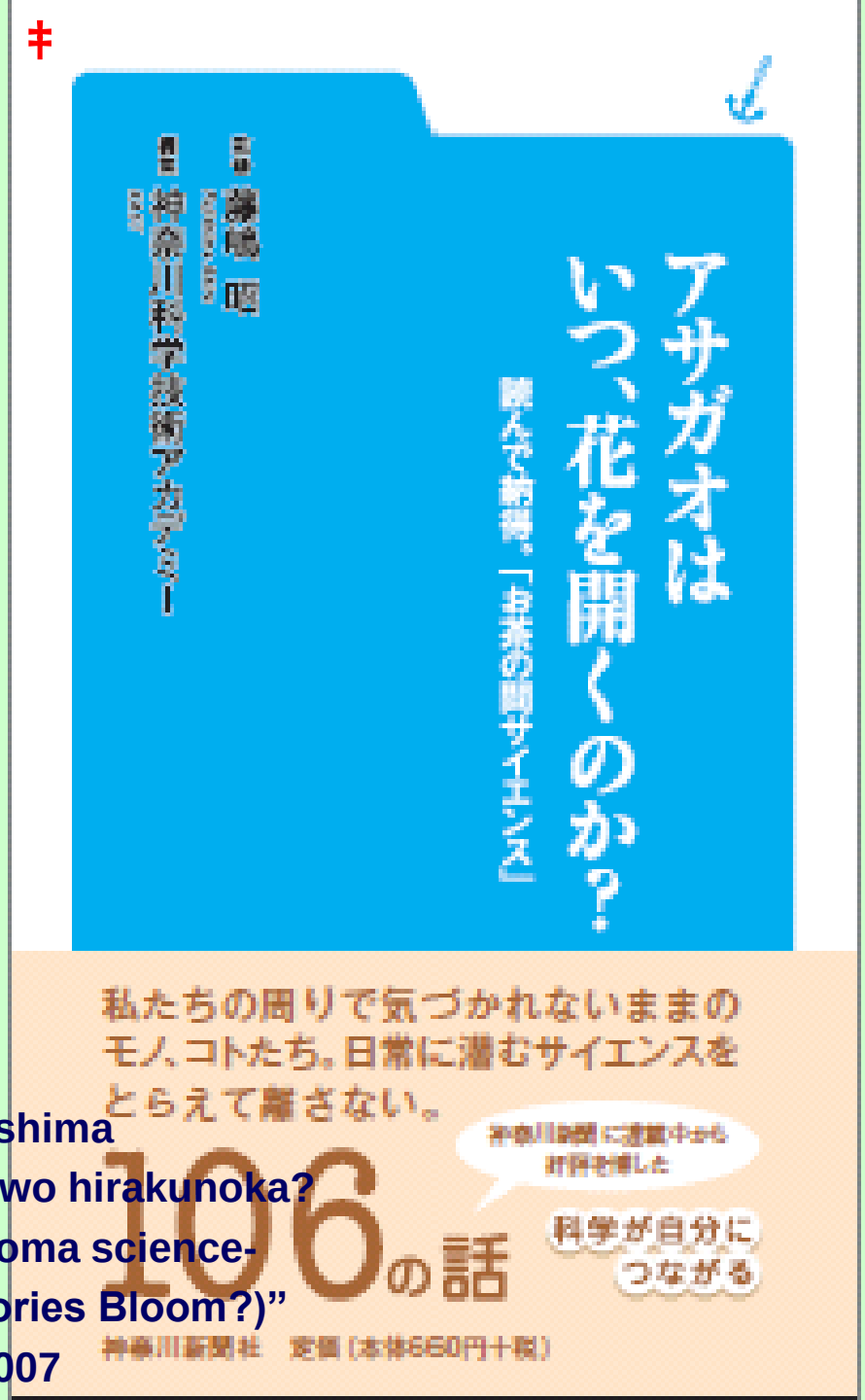






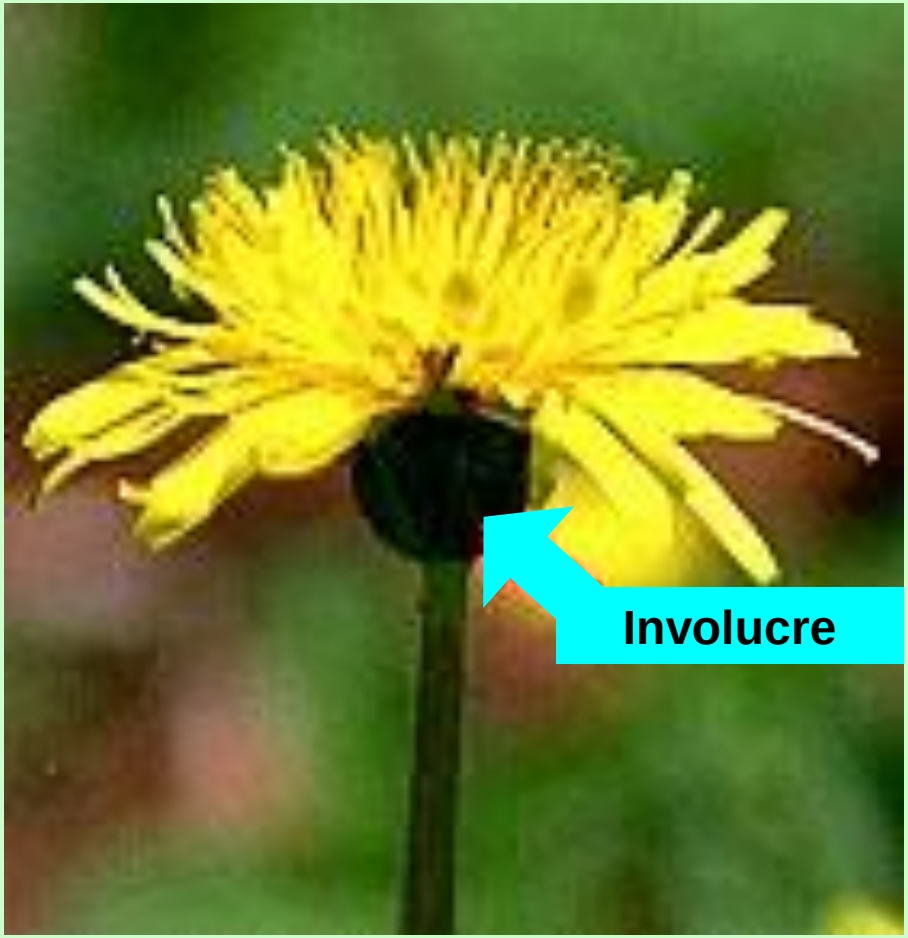
Reprinted from

X. Gao, X. Yan, X. Yao, L. Xu, K. Zhang, J. Zhang, B. Yang, L. Jiang (2007) " The Dry-Style Antifogging Properties of Mosquito Compound Eyes and Artificial Analogues Prepared by Soft Lithography " Advanced Materials, Volume 19, Issue 17 (p 2213-2217)



Supervisor: Akira Fujishima
“Asagao ha itsu hana wo hirakunoka?
-yonde nattoku ochanoma science-
(When Do Morning Glories Bloom?)”
Kanagawa Shimbun 2007

アサガオ
English：Japanese Morning Glory
Scientific name：Ipomoea Nil



ニホンタンポポ

English：Japanese Dandelion

Scientific name：Taraxacum Platycarpum

セイヨウタンポポ

English：Dandelion

Scientific name：Taraxacus Officinale

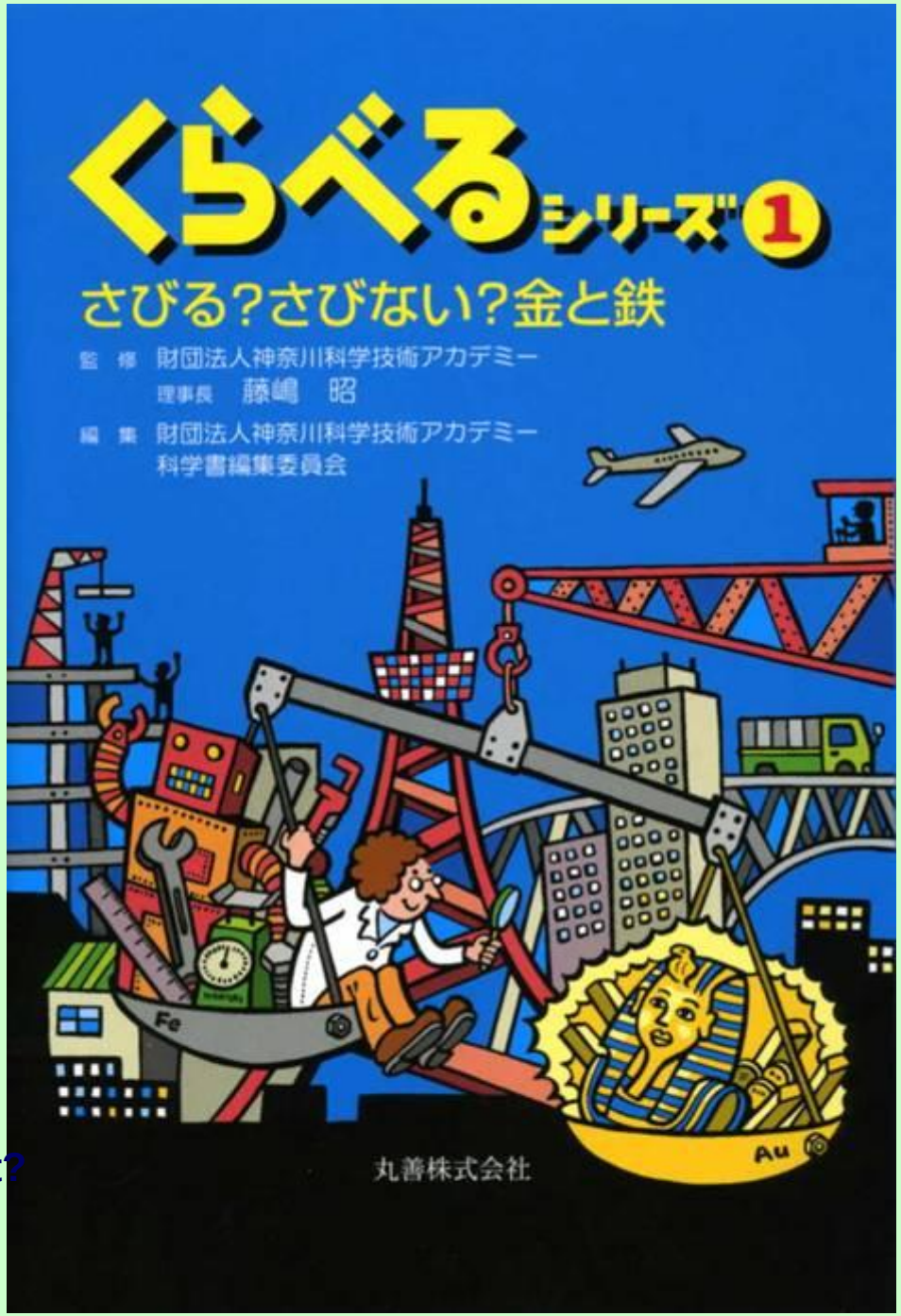
When do dandelions bloom?

It has been said that they are “clocks” for farmers(coming out when it gets light, closing when it gets dark).

Setaria

To discover new things by comparative thinking

‡



Supervisor: Akira Fujishima

“Kuraberu series I –sabiru?sabinai?kin to tetsu (A Series of Comparisons –Rust or Not? Gold and Iron)”

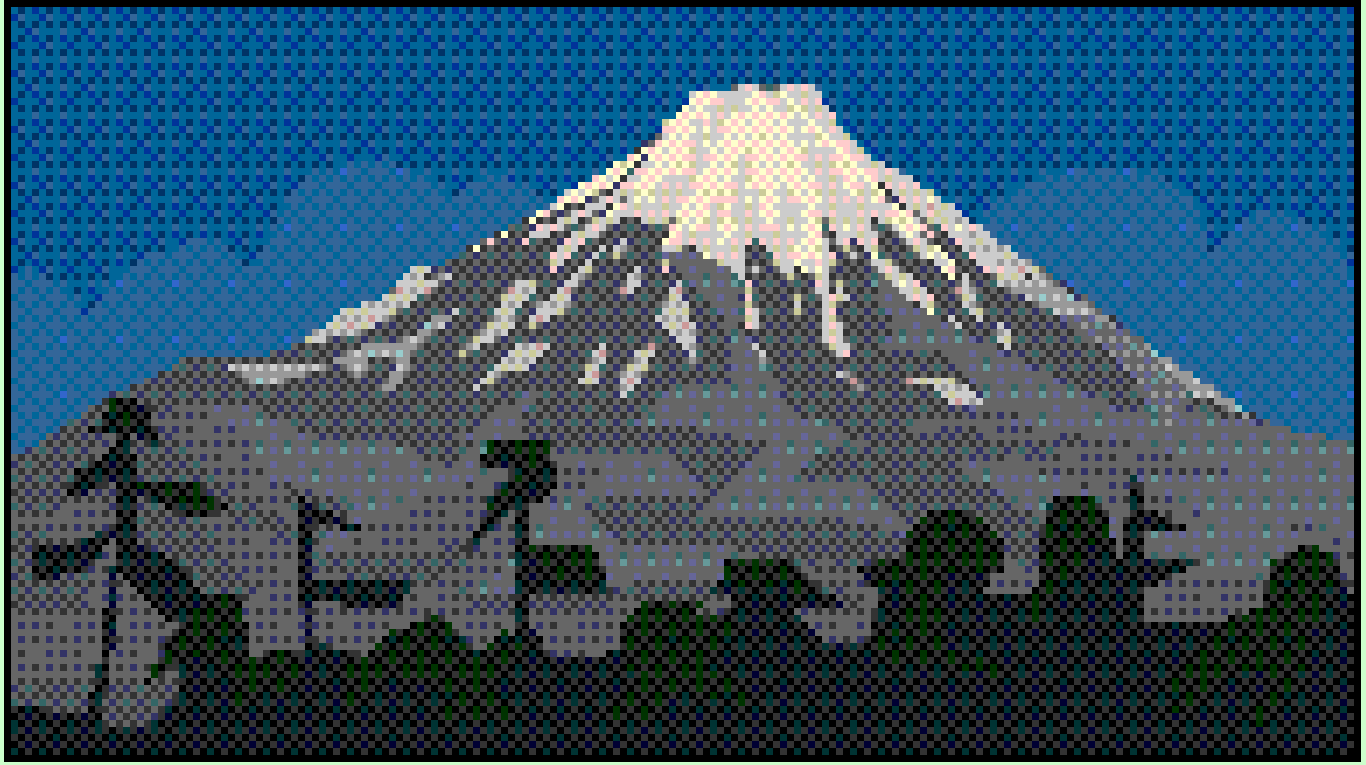
Maruzen 2004

‡

Reprinted from
“Kuraberu series I –sabiru?sabinai?
kin to tetsu (A Series of Comparisons –Rust or Not?
Gold and Iron)”
Maruzen 2004, p13

‡

Supervisor: Akira Fujishima
“Kuraberu series II –doko ga chigauno? hotaru no hikari to keikoutou (A Series of Comparisons –Rust or Not? Gold and Iron)”
Maruzen 2004



Measure the Amount of Petroleum on the Basis of Mt.Fuji

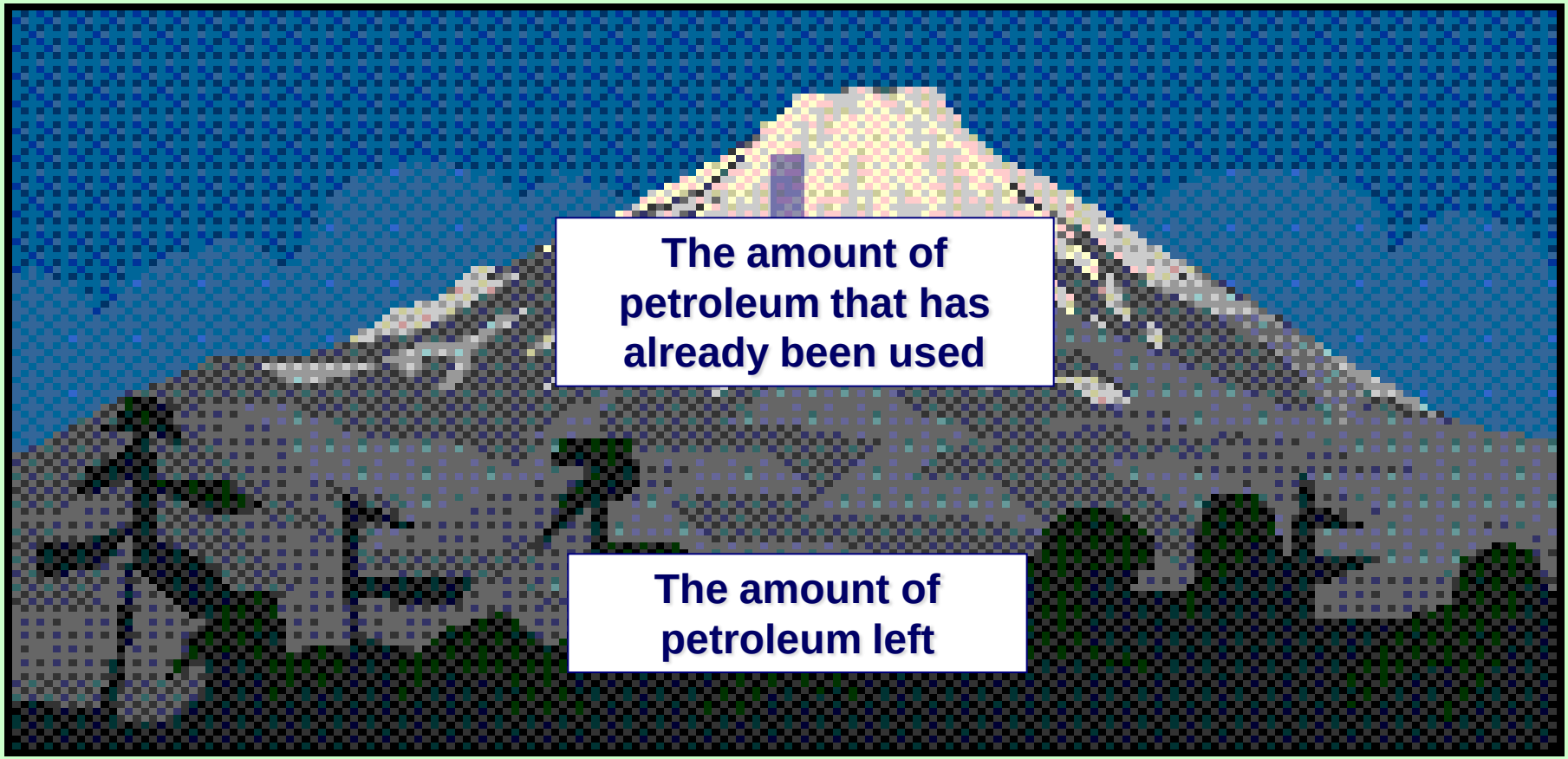


Figure removed due to copyright restrictions

＊Used petroleum ： 1 trillion barrels

＊Deposits： 1 trillion and 200 billion barrels

(Equal to seven times as much as Lake Biwa)

1 barrel :159liters

(equal to the volume of a bathtub）

Necessary Conditions to Make Research Successful

Research Costs

People
（researcher, advisor）

Atmosphere

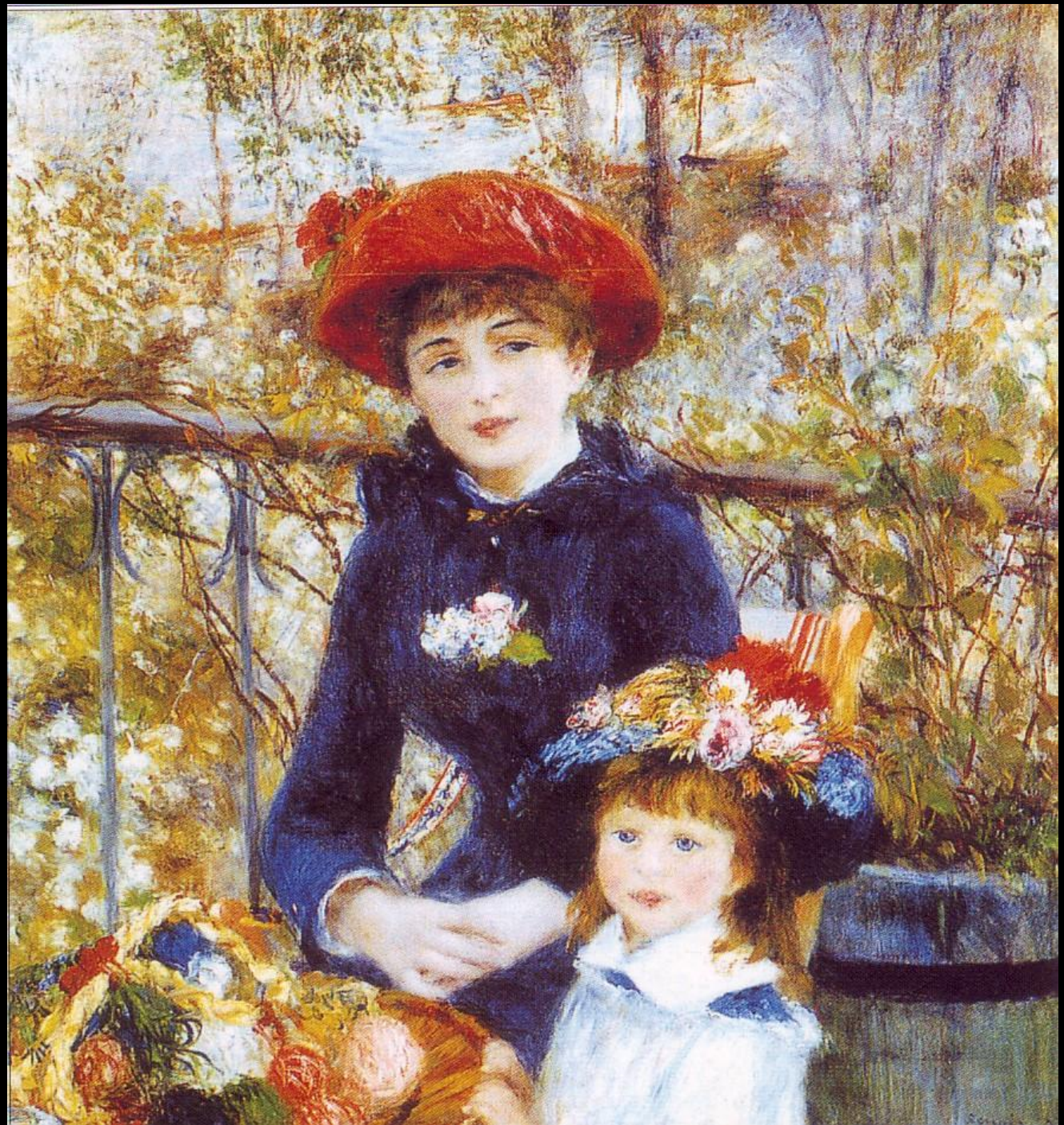
The painting is said to have been done when the Zen monk Dogen was 50 years old. This is the oldest portrait of Dogen and called “Kangetsu no miei”

“Kangetsu no miei”

Courtesy Houkeiji temple

“Walk in the mist, then the clothes get wet without notice”

The words of Dogen in “Shoubougenzou”
The founder of Soto Zen



An Innovative Atmosphere is Essential for Research

	Relevant topics to Brownian motion theory	Relevant topics to light quantum theory	Relevant topics to relativism
1905	Brownian motion（Einstein）	Light quantum hypothesis and photo-electric effect（Einstein）	Special relativity（Einstein）

The first Solvay Conferences on Physics. Jean Baptiste Perrin is on Madame Curie’s right and Jules-Henri Poincaré on her left. Ernest Rutherford stands behind her. The men on the left-side are Heike Kamerlingh Onnes, Albert Einstein, Paul Langevin. Solvay takes the head seat of honor.

Fame lasts

By 1927, in which the picture above was taken, Madame Curie became a member of the Solvay Conferences on Physics. It was held in Brussels and famous physicists gathered. Madame Curie is third from the left. Bohr, Bragg, Einstein, Heisenberg, Lorentz, Pauli, Planck and Schrödinger are also the member of the Conference.

Evaluation is necessary

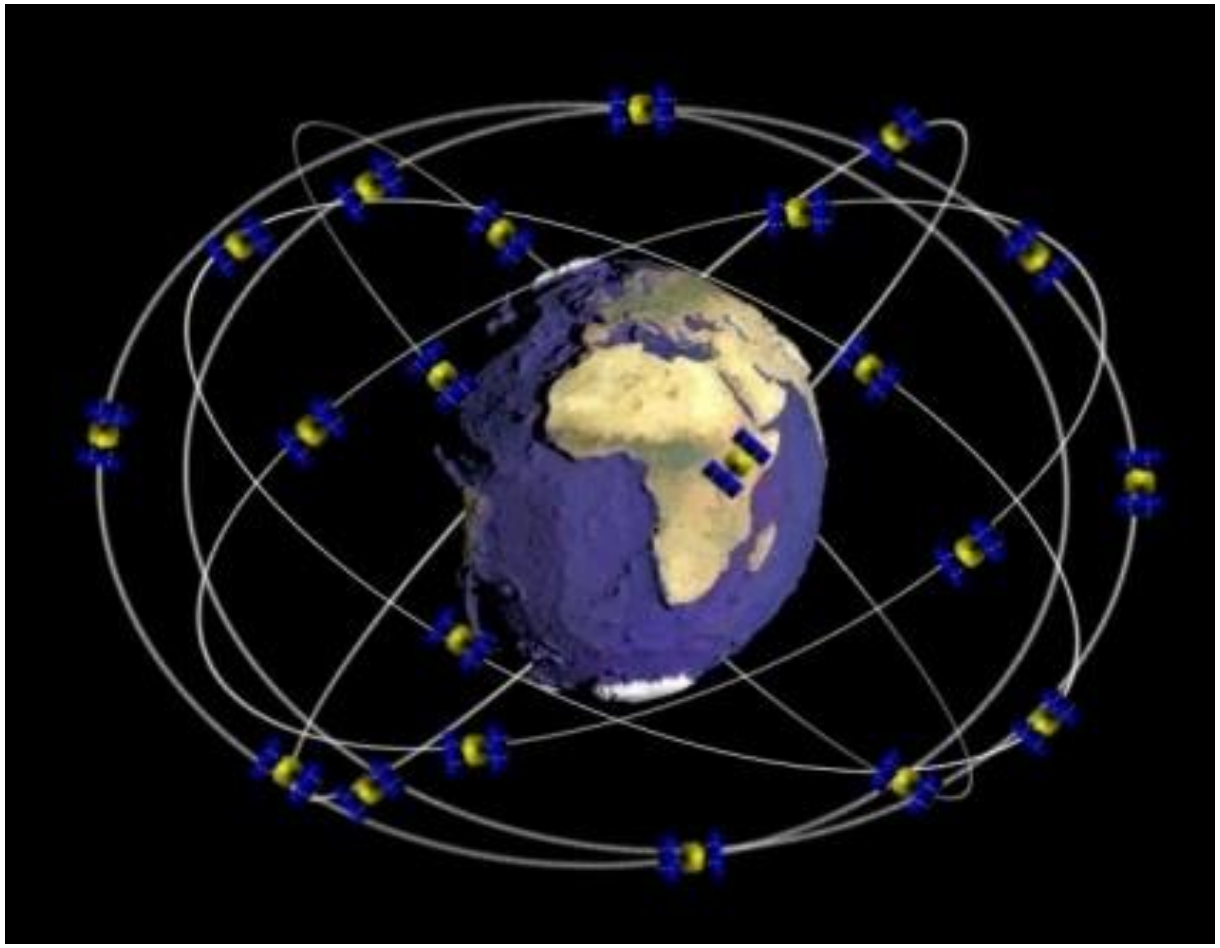
“Output” is important

(number of published theses, patents, etc.),

but we should take “Outcome” into account

(new concepts, products etc.)

Output → Outcome



GPS （Global Position System）

3 Satellites → 4 Satellites

Einstein’s General Theory of Relativity

Special Theory of Relativity

4km/sec t delay
Special Theory of
Relativity

2万km/sec t proceed
General Theory of
Relativity

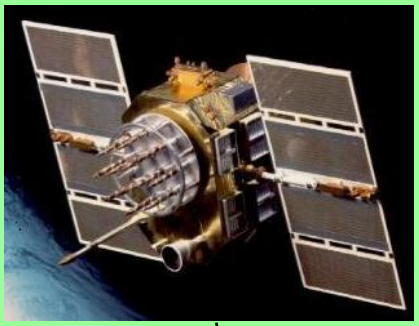
$$\frac{4.46}{10{,}000{,}000} \times 300 \text{ thousand km/sec}$$

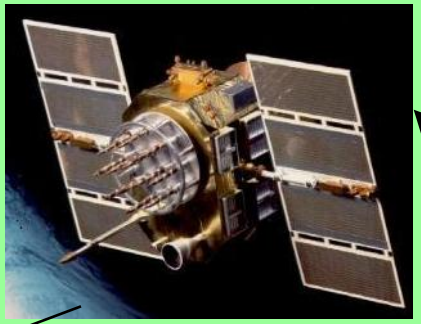
＝13cm/sec

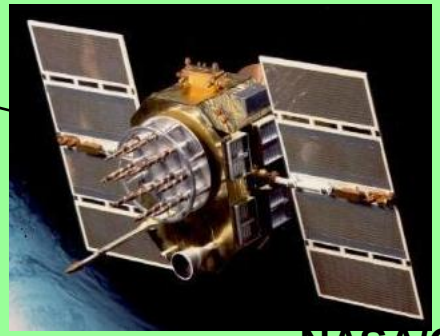
＝8m/min

Revolves the
earth in 12hr

Revise!







NASA/Goddard Space Flight Center
Scientific Visualization Studio.
Model courtesy of Tim Carnahan
(NASA/GSFC)

important things for Creative Research

(1) **To have a strong foundation**
(2) **To include a wide cultural background**
(3) **To be interested in your surroundings**
(4) **To discover new things by comparative thinking**

To have a Strong Foundation

Good Children's Stories for Children!

Children's stories are Interesting

Exhibition of million-seller children's stories was held at KAST photocatalyst museum

Exhibition of Million- seller Children's Stories

Exhibition of Satoshi Kako's Children's Stories

Karasu no panya san

Daruma-chan to tengu-chan

Otamajakushi no 101-chan

Piramiddo

Kako Satoshi Lecture

2008. 12. 20

13:30～15:30

Location : KAST

Include a Broad Cultural Background

Figure removed due to copyright restrictions

Figure removed due to copyright restrictions

Jawaharlal Nehru（1889～1964）

*Indira Priyadarshini Gandhi is a daughter of Jawaharlal Nehru.

‡

ジャワーハルラール・ネルー

父が子に語る世界歴史

新たな戦争の地鳴り

大山 聰訳

GLIMPSES OF WORLD HISTORY

Being Further Letters to His Daughter Written in Prison, and Containing a Rambling Account of History for Young People

By

Jawaharlal Nehru

Author: Jawaharlal Nehru

Translator: Satoshi Ohyama

“Chichi ga ko ni kataru sekairekishi –aratana sensou no dinari-(World history father told his children –an outbreak of a new war-)” Misuzushobo 2003

Nobunaga Oda
（1534～1582）

Hideyoshi Toyotomi
（1537～1598）

Ieyasu Tokugawa（1543～1616）

‡

Author: Saburo Shiroyama

“Jinsei ni nido yomu hon(Books You Read Twice in Your Life)”

Kodansha Ltd. 2005

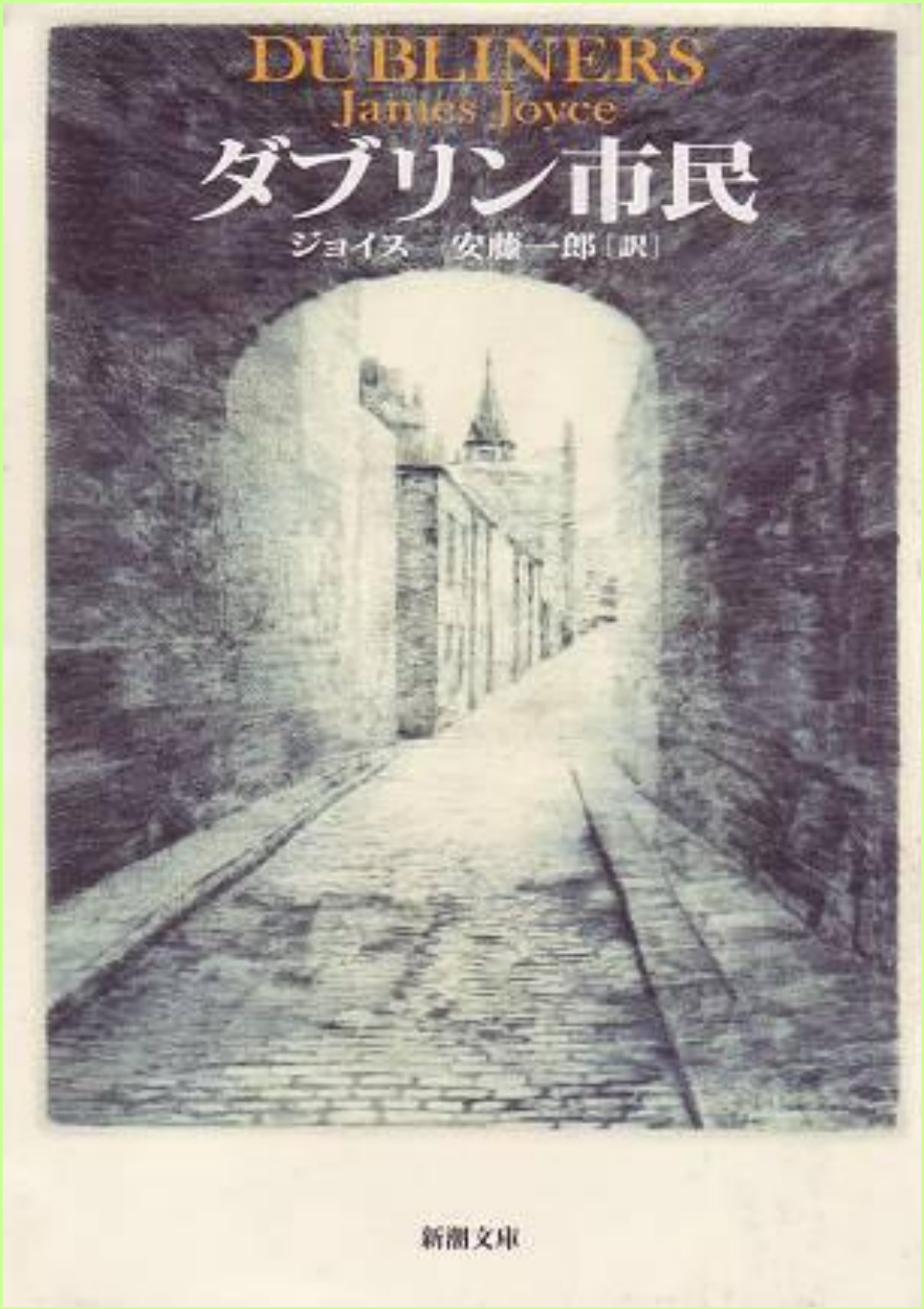
‡

Author: Soseki Natsume

“Kokoro”

Shinchosha publishing Co., Ltd. 1952

‡



Author: James Joyce

Translator: Ichiro Ando

“Daburin shimin(Dubliners)”

Shinchosha publishing Co., Ltd. 1971

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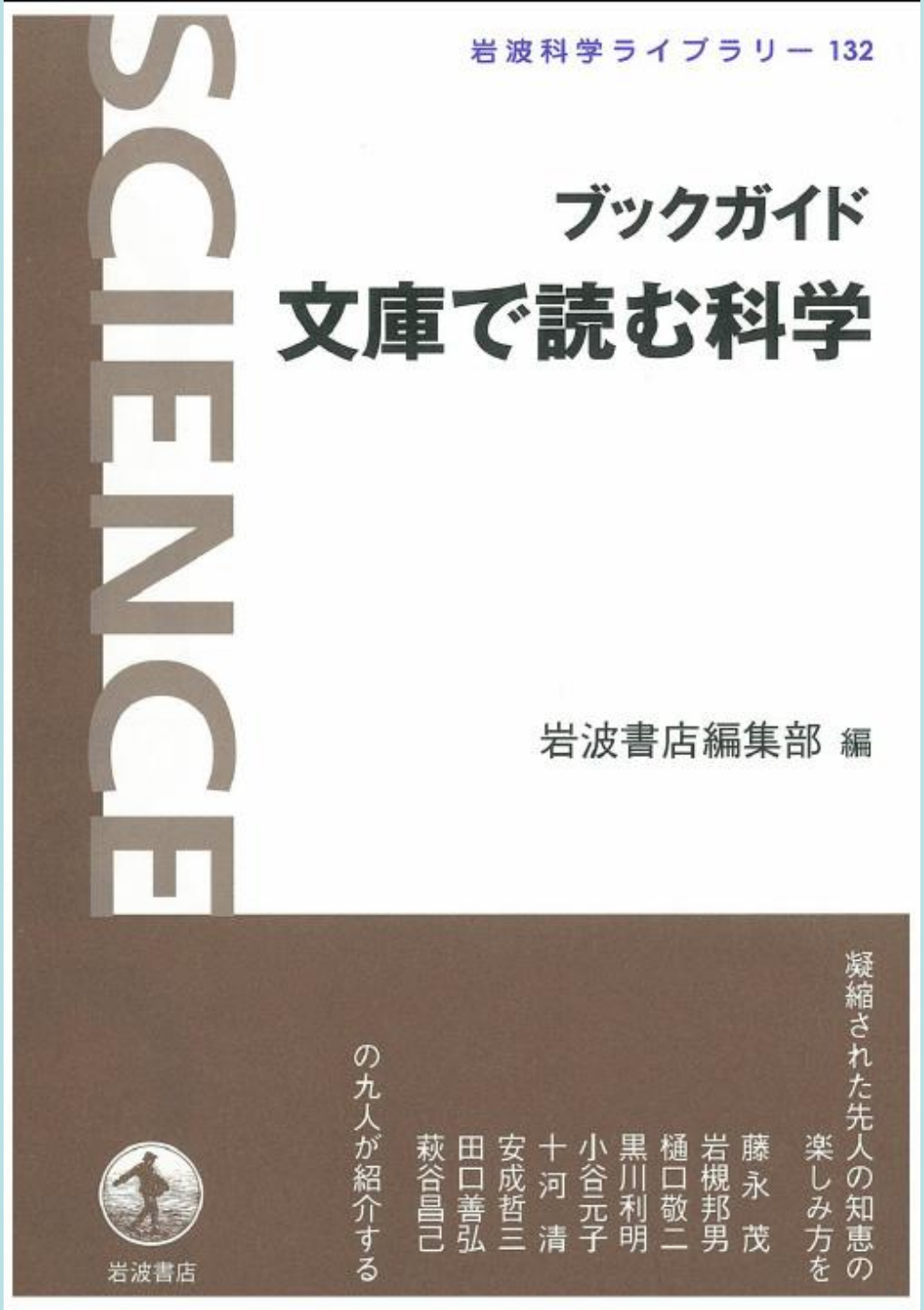


“Book guide Bunko de yomu kagaku (Paperbacks Dealing with Science)”

Iwanami shoten publishers 2007

Author: Faraday

Translator:

Iwao Mitsuishi

“Rousoku no kagaku(Science of Candles)”

Kadokawa Group publishing Co., Ltd.

1962

マイケル・ファラデー/Michael Faraday

English scientist. Born the second son of a poor blacksmith in London. He was interested in science from his childhood and did experiments, as well as working at a book binder. He began to research at the Royal Research Institute as an assistant from age 22, and later became the president. He archived much, such as discovering benzene, electromagnetic induction and creating Faraday's law

Author: Faraday

Translator:

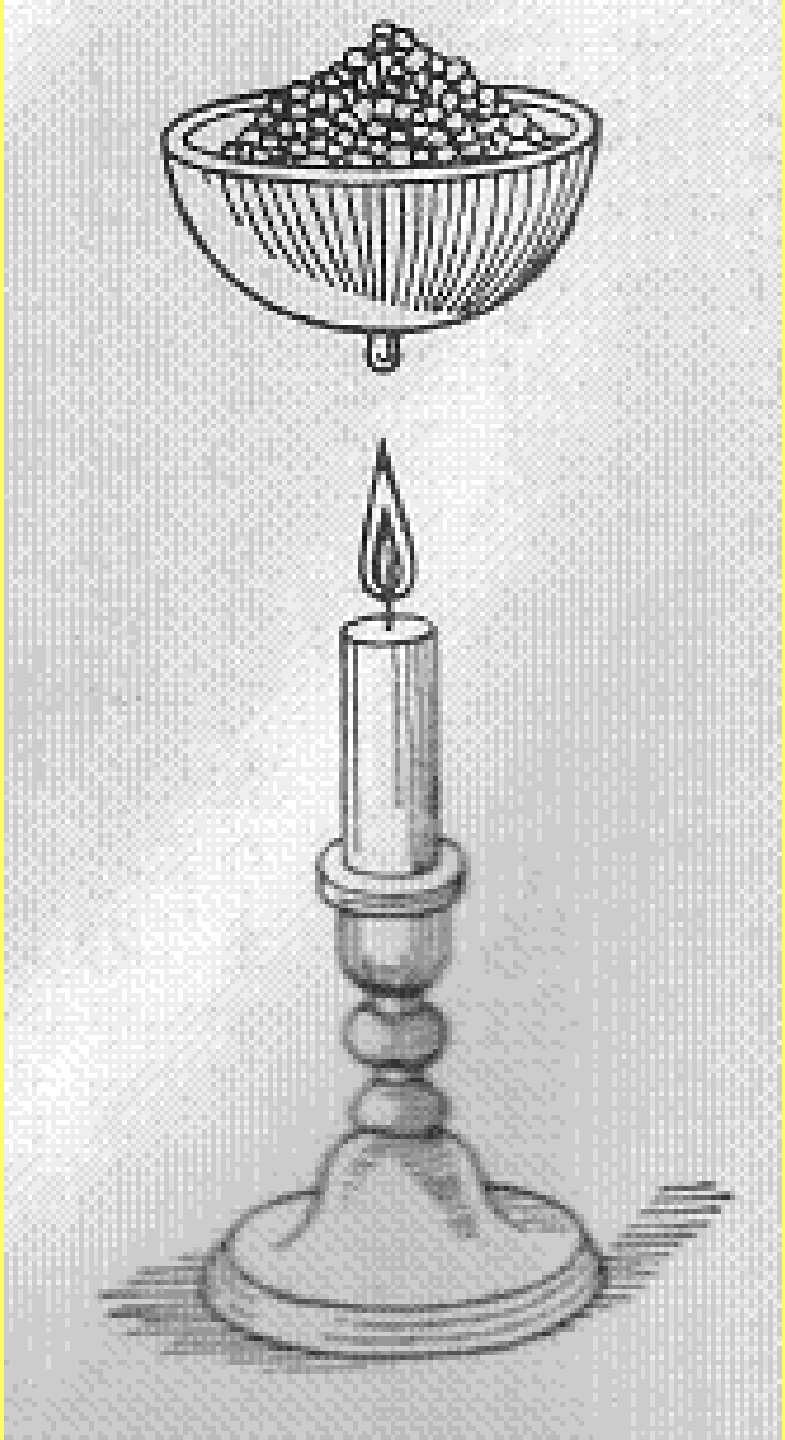
Iwao Mitsuishi

"Rousoku no kagaku(Science of Candles)"

Kadokawa Group publishing Co., Ltd.

1962

‡



Reprinted from

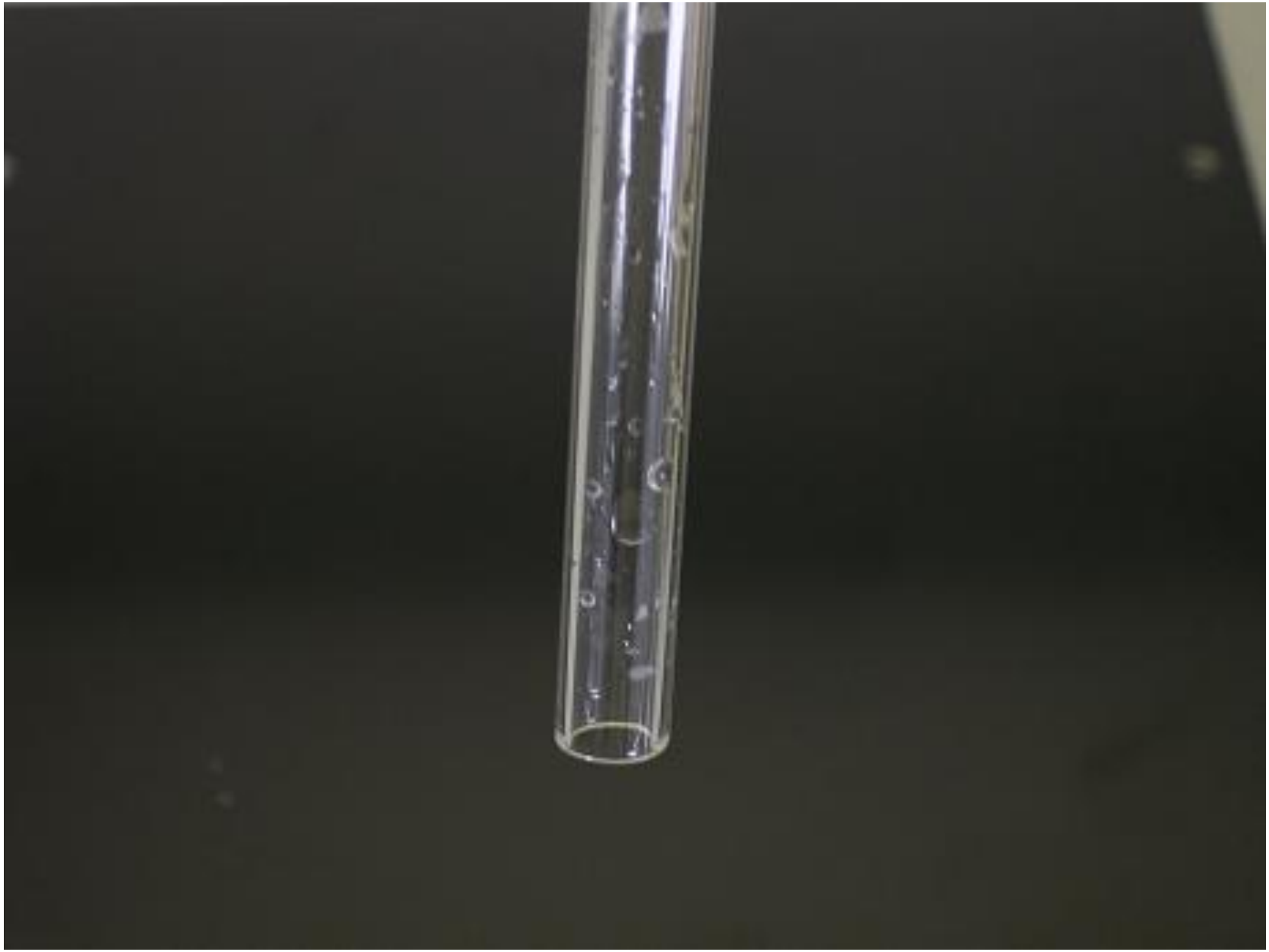
Author: Faraday

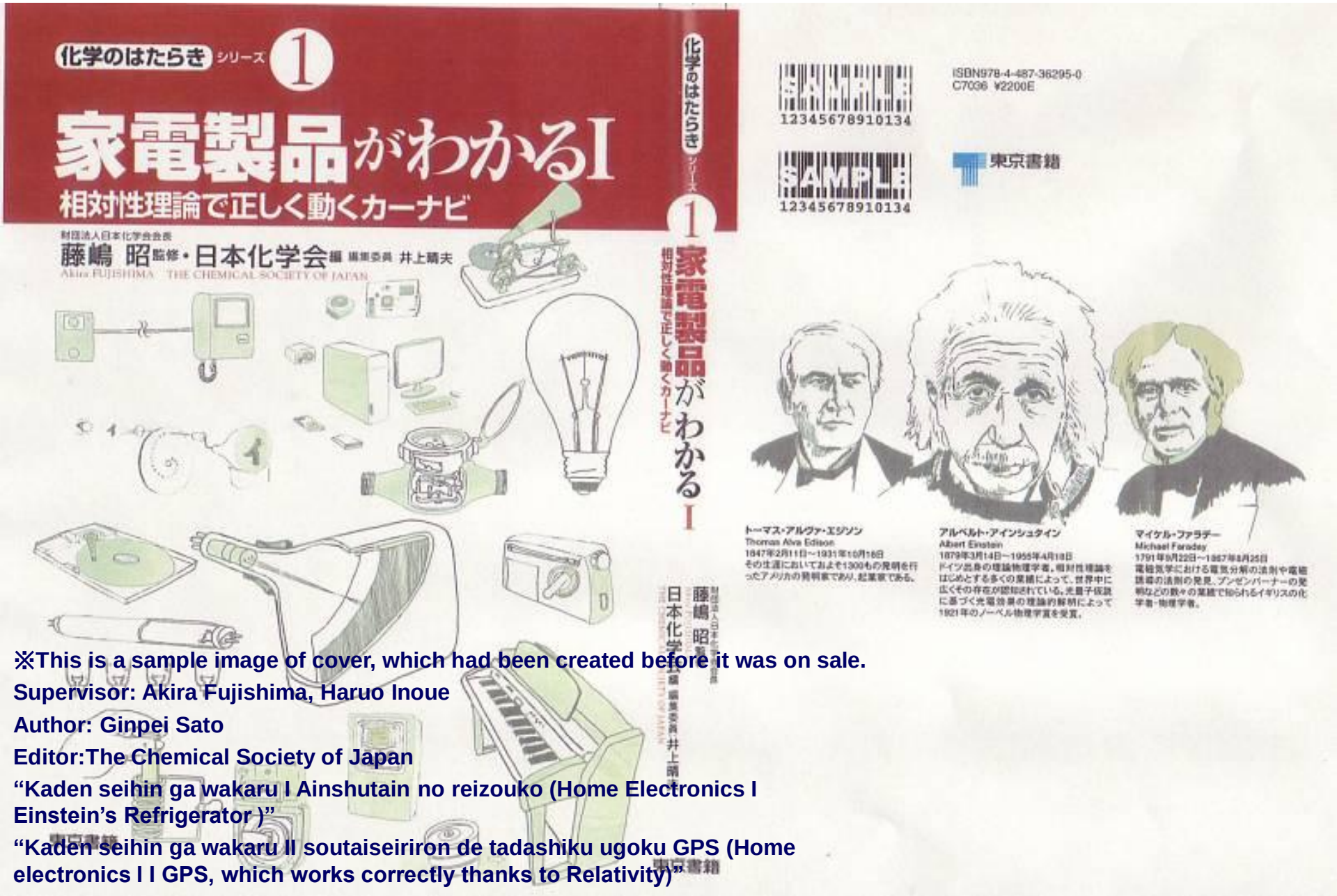
Translator:

Iwao Mitsuishi

“Rousoku no kagaku(Science of Candles)”

Kadokawa Group publishing Co., Ltd. 1962, p61, cover





※This is a sample image of cover, which had been created before it was on sale.

Supervisor: Akira Fujishima, Haruo Inoue

Author: Ginpei Sato

Editor:The Chemical Society of Japan

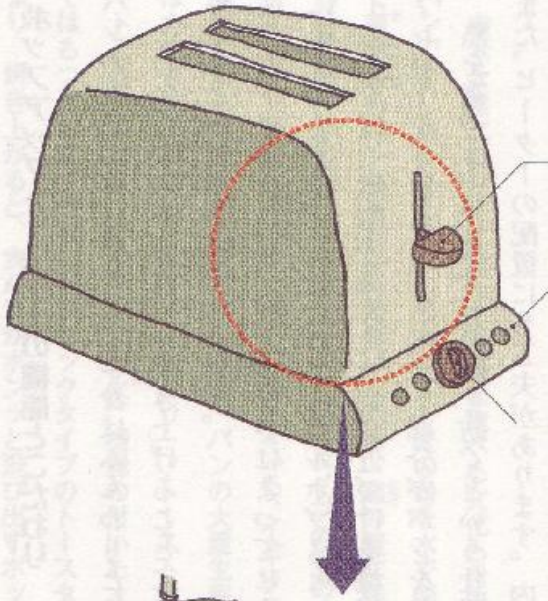
“Kaden seihin ga wakaru I Ainshutain no reizouko (Home Electronics I Einstein’s Refrigerator)”

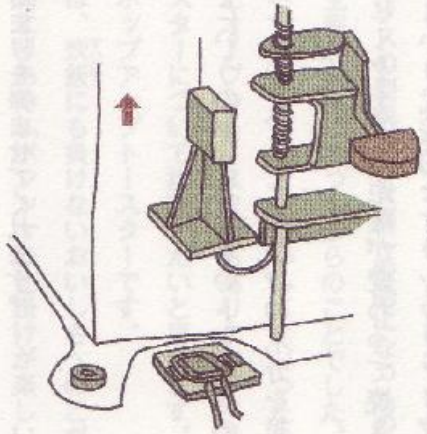
“Kaden seihin ga wakaru II soutaiseiriron de tadashiku ugoku GPS (Home electronics I I GPS, which works correctly thanks to Relativity)”

Tokyo Shoseki Co., Ltd. 2008

トースター

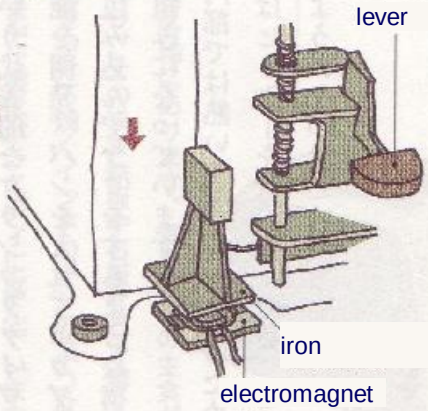
ⓐ The Outward Appearance of Toaster





ⓑ Mechanism of Pop Up lever

The current gets off into the electromagnet when the time come. Then the magnetic force goes out and the lever is pushed out(OFF). This is how breads jumps up.



ⓒ The Structure of the Inside of Toaster

The iron attached to the lever clings to the electromagnet(ON) when you set the timer and push the lever.

Fig. 1 Mechanism of Jumping Up of Breads

Reprinted from

Supervisor: Akira Fujishima

Editor:The Chemical Society of Japan

“Kaden seihin ga wakaru I soutaiseiriron de tadashiku ugoku GPS (Home electronics I GPS, which works correctly thanks to Relativity)”

Tokyo shoseki Co., Ltd. 2008, p61


KSP

Application to Color Printing

TiO_2 photocatalyst

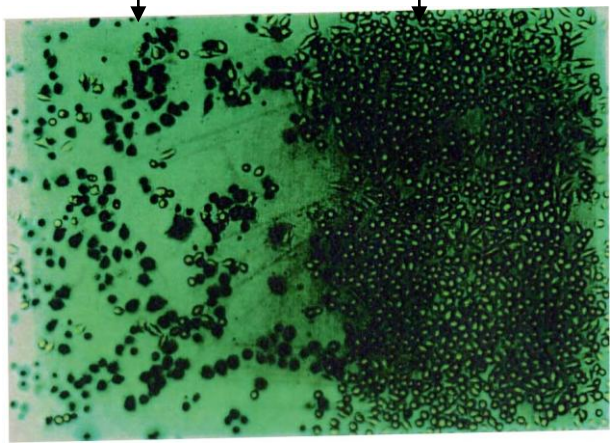
1)Strong oxidization power

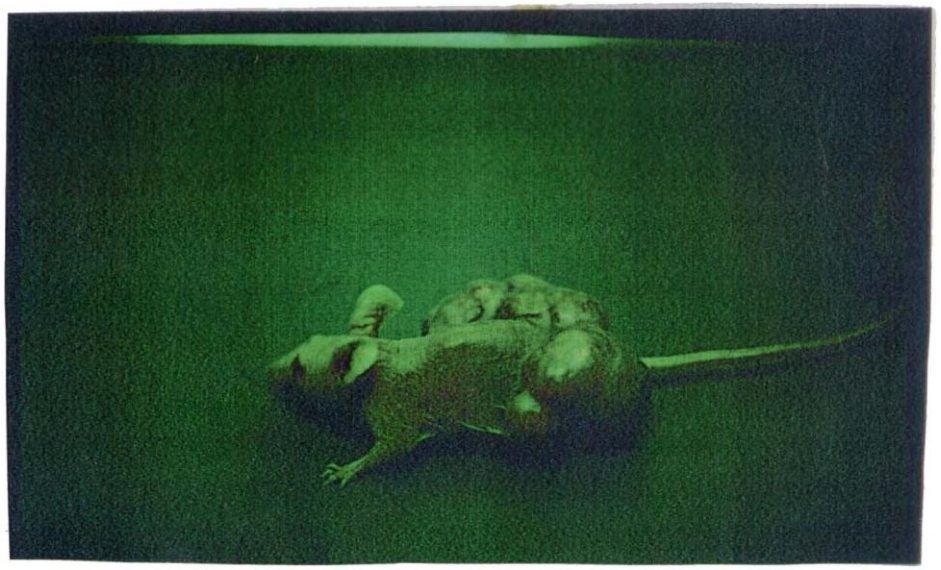
2)Super hydrophilic effect

Joint research of Tokyo Ohka Kogyo Co., Ltd. and KAST

Killing Tumors

UV treated Untreated

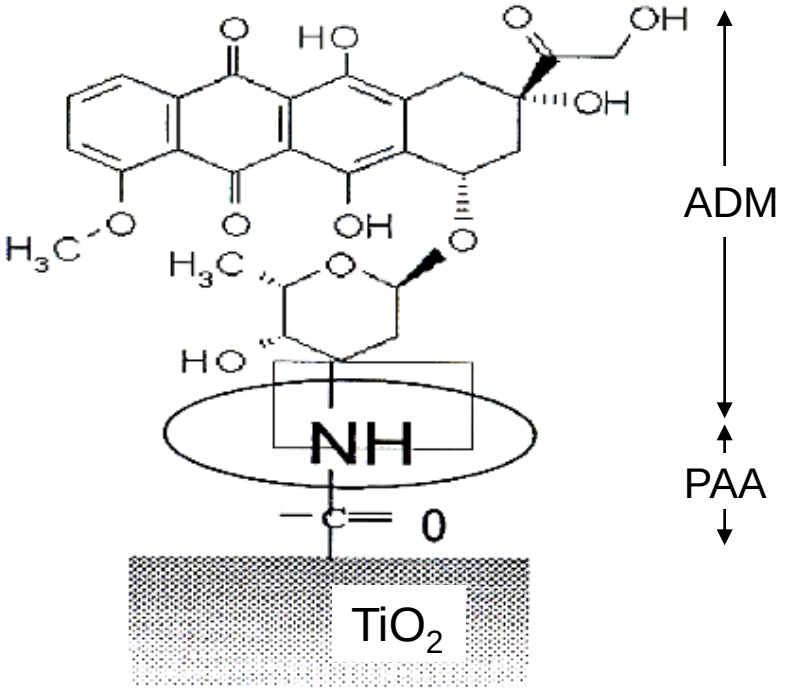


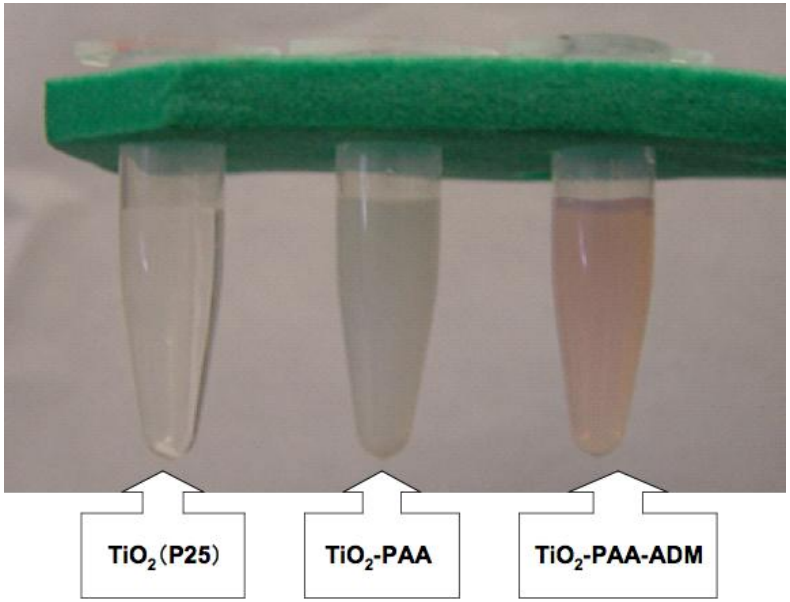


Cooperative work with Prof. Y. Kubota of University of Yokohama City

TiO_2-PAA-ADM hybrid nanoparticle

‡

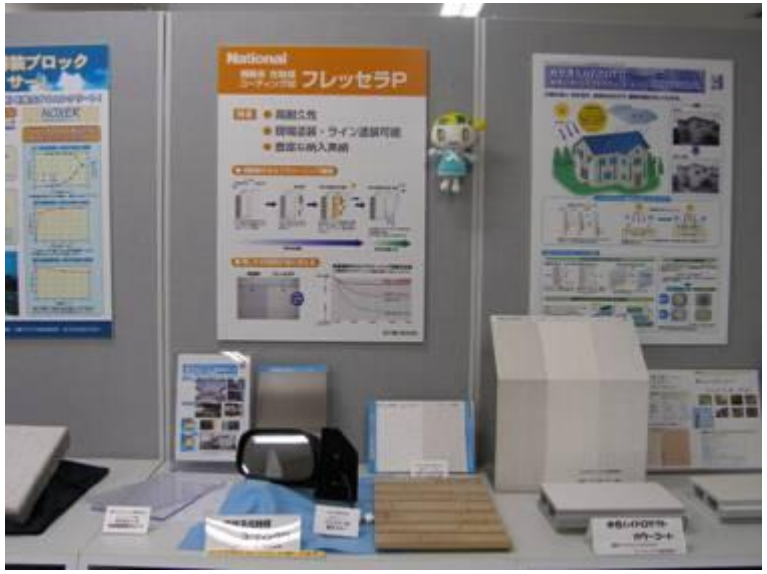




ADM is an anti-tumor agent

Cooperative work with Prof. Y. Kubota of University of Yokohama City

Photocatalyst Museum



Only

The Genuine

Can Survive!

Taking Notes

Thinking Calmly

Doing Good Secretly

Making a Scrapbook

- **Paste whatever interests you**

Order Books Immediately

Initiative

Touken mijikaku ba
ippo wo susumete
nagaku subeshi
by Munenori Yagyu

Even if a sword is short, do not budge an inch and go for it with strong will

Cited from

Author: Masaaki Arai

“Yasuoka Masahiro sensei ni mananda watashi no jinsei (Learning from Mr. Masahiro Yasuoka About Life)”

台上一分鍾

台下十年功

You have to train for ten years to act on the stage and be in limelight; the foundation is important

子曰く、

これを知る者は

これを好む者に如かず。

これを好む者は

これを楽しむ者に如かず。

論語（巻三第六雍也篇20）

The Master said, "Those who know the truth are not equal to those who love it, and those who love it are not equal to those who delight in it.“

Cited from “Rongo”

Thank you very much for your attention